

Focus Particles, Sentence Meaning, and Discourse Structure

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1. Introduction*

Theories of information structure assume a partition of the sentence into (at least) two informational units. These informational units do not depend on the syntactic structure of the sentence, they can even comprise expressions that do not belong to a (syntactic) constituent. Informational structure is reflected in intonational contours. It plays a crucial role in the interpretation of a sentence with respect to the felicity conditions of a sentence, to its presuppositional meaning and in the composition of the truth condition via the interaction with focus particles.

In this paper I argue that information structure is not to be defined as a partition of a sentence, but rather in terms of discourse representation and discourse linking of a sentence and its parts. I present my *foreground-background* semantics in which a sentence receives two discourse representations, the *foreground*-representation corresponding to the whole sentence, and the *background*-representation corresponding to the whole sentence minus focused expressions. These two representations differ with respect to their contributions and their interaction with the established discourse representation. Evidence for these two kinds of representation will be gained from an in-depth analysis of the interpretation of focus particles and adverbs of quantification.

In common descriptions of information structure, it is assumed that the sentence is divided into two components, the focus *F*, and the background *B*. The focus is often intonationally marked by a pitch accent and it is said to express the "new information". Following the usual convention, I set the expression with the pitch accent in small caps; the indexed feature *F* marks the syntactic constituent with the focus feature. The traditional test for informational focus is the constituent question in (1a) (cf. Paul 1880). Sentence (1b) can be understood as an answer to question (1a) since it relates to the question by its background *Sam talked* and its focus *Fred*. The expression *Fred* corresponds to the constituent that was questioned. The background is constructed by subtracting the focus from the full sentence and replacing the focus expression by a variable. The ordinary meaning of sentence (1b) is the combination of background and focus, while the presupposition is formed by existentially quantifying the variable of the background. Thus the presupposition is identical to the one of the corresponding question in (1a). The case of constituent questions is said to motivate the view

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that the background expresses given or presuppositional information, while the focus gives the new information.

- (1a) Who did Sam talk to?
 presupposition: Sam talked to someone
- (1b) Sam talked to FRED_F.
 Background: Sam talked _ / Sam talked to x
 Focus: Fred
 ordinary meaning: Sam talked to Fred = B+F
 presupposition: Sam talked to someone
 There is someone such that Sam talked to him or her

Example (2) is uttered without the corresponding constituent question. The focused expression is understood to express some contrast to other possible referents. This is an instance of contrastive focus which motivates a semantics of focus in terms of alternatives (see section 3). Here the function of the focus is invoking alternatives to the focused phrase. A sentence with a contrastive focus is uttered felicitously if there are alternatives to the focused expressions that could have replaced the focused expression in the given context, but did actually not:

- (2) Sam talked to FRED_F. (but not to Mary, John, Tim,)
 Background: Sam talked _ / Sam talked to x
 Focus: Fred
 felicity conditions The sentence is uttered felicitously if there are alternatives to Fred such that Sam might have talked to them

Focus particles like *only*, *even*, *also*, etc. are interpreted as operators that take two arguments: The focus *F* and the background *B*. In (3a) the focus particle *only* associates with the focus *Fred*. It is interpreted as an operation that is true if there is not alternative *x* of Fred such that Sam had talked to *x*. This can either be paraphrased as in (3a) or represented by the quasi-formalization in (3b), where " \approx " means "similar, but not identical":

- (3) Sam only talked to FRED_F.
 B: Sam talked to someone F: Fred
- (3a) *Nobody but Fred is such that* Sam talked to him or her.
- (3b) *only(F, B)* is translated to: For all $x \approx F$: $\neg B(x)$

Focus particles not only show truth conditional effects with different information structures (see next example or example (11) and (12) in section 3), but they also play an important role in the assumption that information structure is best understood in terms of a dichotomy of the sentence. The operator the focus particle is translated to takes two arguments that fit exactly with the informational units *F* and *B*. I challenge this view with two observations: First I show that adverbs of quantification take not the focus and the background as their arguments,

but the background and the whole sentence. Second I show that the assumption of a division of a sentence into two parts raises problems for the composition of the sentence meaning.

Adverbs of quantification are focus sensitive expressions, as can be seen from the difference between (4) and (5), where they show different behaviors with respect to their domain of quantification. Both sentences compare two sets of time points or intervals for which a certain restriction holds. In (4) the restriction concerns the places Sam invites Fred to, while in (5) it concerns the persons Sam invited to the movies. Sentence (5) can be paraphrased in (5a), where it becomes clearer that the main assertion is that the times Sam takes Fred to the movies constitutes more than half of all times at which Sam took someone to the movies. Again, we can construct the focus and the background out of the whole sentence. However, the operator *MOST* for the expression *usually* compares two sets of times *t*. The first set is characterized by the background information, while the second is characterized by the whole sentence or the conjunction of focus and background.

- (4) Sam usually invites Fred to the MOVIES_F.
- (5) Sam usually invites FRED_F to the movies.
B: Sam invites someone to the movies **F:** Fred
- (5a) For most times in which Sam invites someone to the movies, he invites Fred to the movies
- (5b) **MOST**(*t*: *t* holds in **B**) (*t*: *t* holds in **B**+**F**)

The second observation concerns the assumption that the focus sensitive operators always take the focus and the background as their arguments. This assumption runs into problems if the focused phrase is a modifier, as in (6). If we apply the semantics of *only* described in (3a) and (3b) to (6), we yield (6a) and (6b). But both interpretations exclude too many alternatives, namely all those artists that are not unique with respect to their nationality. Given the situation that Sam talked to the Swiss artist and one of the two German artists, the theory predicts the sentence to be true, since one German artist is not in the alternative set to *the* Swiss artist. Contrary to this prediction, we intuitively quantify over artists and assert that there is no artist but the Swiss artist such that Sam talked to him, as paraphrased in (7a) and represented in a quasi-formula in (7b)

- (6) Sam only talked to the SWISS_F artist.
B: Sam talked to the X artist **F:** Swiss
- (6a) *Nobody but Swiss is such that* Sam talked X artist.
- (6b) *only*(**F**, **B**) is translated to: For all $X \approx \text{Swiss}$: it is not the case that Sam talked to $\Box z[X(z) \ \& \ \text{artist}(z)]$
- (6c) Sam talked to the SWISS artist, but not to the GERMAN artist or to the AMERICAN artist...
- (7a) No artist but the Swiss artist is such that Sam talked to him
- (7b) for all $x \ \Box \ \text{artist}' \ \& \ \neg x = \Box z[\text{Swiss}'(z) \ \& \ \text{artist}'(z)]$: it is not the case that Sam talked to x

The discussion shows that the semantics of focus sensitive expressions like focus particles or adverbs of quantification plays an important role in the discussion of the nature (and size) of informational units. In particular, the discussion of the last two examples indicates that the informational units are the representations of the background and the representation of the whole sentence, rather than the division into focus and background.

To summarize this informal discussion, the commonly accepted view of information structure makes the following assumptions:

- (8) *Common assumptions of information structure*
 - (i) Information structure is to be defined with respect to the *sentence*
 - (ii) Information structure is the partition of the sentence into *focus* and *background*
 - (iii) Focus expresses new information, while the background refers to old or given information
 - (iv) The sentence meaning can be constructed from the meaning of the focus and the background ($||S|| = ||F|| + ||B||$)
 - (v) Focus sensitive particles are translated into operators that take the focus and the background as their arguments ($O(F, B)$)
 - (vi) Adverbs of quantification are translated into operators that take the background and the whole sentence meaning as their arguments: ($\text{Adverb}(B, B+F)$)

Contrary to these assumptions I assume the following:

- (9) *Assumptions of foreground-background semantics*
 - (i) Information structure is to be defined with respect to *discourse*
 - (ii) Information structure is realized as two representations: the *foreground* representation corresponding to the whole sentence, and the *background* representation
 - (iii) It is the whole sentence that expresses new information (rather than one word or one constituent); so the *foreground* representation expresses the new information; the *background* representation is discourse anchored, and therefore contains old or given information
 - (iv) Sentence meaning is compositionally formed from the meaning of its parts according to the syntactic structure (LF) and the compositional rules of semantics, rather than in terms of information structure.
 - (v) Focus sensitive particles are translated into operators that take the foreground and the background as their arguments ($O(\text{background}, \text{foreground})$)
 - (vi) Adverbs of quantification can be described in the same way:
($\text{Adverb}(\text{background}, \text{foreground})$)

I will present three arguments in favour of my view: First I show that the traditional dichotomy of the sentence into focus and background is not feasible for conceptual, methodological and epistemological reasons. Second I argue that the traditional view leads to

problems in the analysis of associations with focus, and third, I argue that the accepted analysis of adverbs of quantification already supports the new view.

The remainder of the article is organized as follows: In section 2, I present some traditional concepts of information structure and argue that they all are defective since they essentially refer to the concept of subject-predicate structure. It was the only available concept for sentence structure at the time when information structure was first discussed. However, this concept is itself not well defined. In section 3, I present the two most prominent semantic theories of focus. The Structured Meanings approach assumes a division of the sentence meaning in terms of Frege's functor-argument structure, while Alternative Semantics introduces a new denotation, the so called "alternative meaning". In section 4, I show that both approaches have problems with the compositionality of more complex instances of association with focus, e.g. with definite NPs. In section 5, I give a very short introduction into some of the ideas of discourse semantics (in terms of Discourse Representation Theory and segmented DRT). Discourse semantics provides us with a new conceptual framework that allows to describe information structure in a more adequate way. In section 6, I sketch my new approach of *foreground-background-semantics*, which is based on the discourse semantics developed thus far. In section 7, I give a summary of the argument in this paper.

2. The conceptual background of the information dichotomy

In the 18th century, linguists began to account for the traditional and purely descriptive subject-predicate structure of sentence in terms of syntax. The more this structure was syntactically reconstructed, the more aware the linguists became of the fact that there is a residuum that is not captured by the syntactic description. In particular the presentation of the content of a sentence did not always correspond to the syntactic categories. Therefore, an additional structure of the sentence was introduced, which subsequently received different terms, but has always been understood as being an additional subject-predicate structure. The theoretical basis for this additional structure varies according to the background theory of the researcher. E.g., von der Gabelentz (1869) introduces the pair *psychological subject* - *psychological predicate* according to his view that psychology is the ultimate base for language structure. Amman and following, the Prague School used the terms *theme* - *rheme* and later *topic* - *comment*, which are both borrowed from traditional rhetoric and philology. This was the move from a psychological base to a base in information or communication theory. Halliday learned about information structure from the Praguian School, and then brought this concept into the American Structuralism; Chomsky and Jackendoff rephrased the distinction in terms of *focus* - *presupposition*, stressing the semantic-pragmatic nature of the distinction:

(10) Terminology for the informational dichotomy

- | | | |
|-------|--|--|
| (i) | von der Gabelentz (1869),
Paul (1880) | <i>psychological subject</i> -
<i>psychological predicate</i> |
| (ii) | Amman (1929), Prague School: Firbas (1964) | |
| (iii) | Danes (1970), American structuralistic
Tradition: Halliday (1967) | <i>theme</i> - <i>rheme</i> |

- | | | |
|------|--|-------------------------------|
| (iv) | modern Prague School: Sgall & Hajicová & Benesová (1973) | <i>topic - focus</i> |
| (v) | Chomsky (1971), Jackendoff (1972) | <i>presupposition - focus</i> |

All these approaches have the following main assumptions in common: first the dichotomy of the sentence into two disjunctive parts with respect to their informational content; second the distinction between the parts in terms of their contribution to the sentence meaning; third the assumption that the two units can be reunited to the meaning of the whole sentence in a subject-predicate manner. None of these three claims seems well founded.

First, it is not clear what it means that one expression presents a new content (concepts, information, propositions, etc.) in a sentence. Only the whole sentence can provide new information, but not a particular constituent. Even in the answer (1b) to the constituent question (1a), the whole sentence gives the new information. It does not make sense to say that the expression *Fred* gives the new information since *Fred* only refers to some individual, but is unable to express any other information (without additional information from the context). Second, it seems questionable to restrict the information structure to the sentence and not to a larger discourse. Third, it is highly questionable that the informational units can be merged in a subject-predicate manner. It was already argued that it was the insufficiency of the traditional subject-predicate structure that caused the new informational dichotomy. Therefore, it is circular to explain the informational units in terms of subject-predicate structure, which itself has not received a semantic operation, except from Frege's functor-argument structure section (see von Heusinger 2001 for a detailed argument).

3. Semantic theories of association with focus

Information structure can cause truth conditional effects in collaboration with focus-sensitive operators such as *only*, *even*, *also* etc. This is illustrated by the two sentences (11) and (12) that differ only in the placement of the pitch-accent, which is marked by the focus feature *F*. In a situation where Mary introduced Sue to John and Ann to John and no other introductions are made, (11) is false, but (12) is true.

- (11) Mary only introduced SUE_F to John
 (12) Mary only introduced Sue to JOHN_F

This and other observations caused an interest of semantic theories in information structure. The semantics of focus-sensitive operators is generally assumed to require two kinds of additional information: the value of the focused expression, and the value of the linguistic environment of the focus, which is neutrally called the *background*. In (11), *Sue* is the focus, whereas *introduced to John* is the background. The focus-sensitive particle is translated into an operator that takes two arguments. Semantic theories differ in the way they compositionally construct the two arguments. The Structured Meanings approach assumes a partition of the meaning of the sentence, while Alternative Semantics composes alternative denotations parallel to the ordinary denotations.

3.1 Structured Meanings

Theories of Structured Meanings assume that the focus is moved to a position adjoined to the focus operator at the level of Logical Form. The focus leaves a trace in its original position which is interpreted as a variable. The LF can be translated into the categorial language of the *structured meaning* (Jacobs 1983, von Stechow 1982, Krifka 1991). In (11a), I give the representation (11a) for the VP-constituent of (11) that is headed by the focus sensitive operator. The focus *Sue* is moved out of its base position towards the operator and leaves a trace in the original position. The background $\lambda t_1 [\text{VP introduced } t_1 \text{ to John}]$ consists of the remainder of the VP with a lambda abstraction over the variable left by the focus. The lambda abstraction forms a relation between two individuals (in subject and direct object positions) out of the property of an individual (in subject position) to introduce Sue to John. Thus the information structure of the sentence is reconstructed by a different way of dividing the sentence in predicate and argument. *Only* is translated into an operator that takes the focus and the background as its arguments, as in (11c):

- (11a) only [_{VP} introduced SUE_F to John]
 F: Sue B: $\lambda t_1 [\text{VP introduced } t_1 \text{ to John}]$
 (11b) only (Sue₁, $\lambda t_1 [\text{VP introduced } t_1 \text{ to John}]$)
 (11c) $\| \text{only} \| (\| \text{Sue} \|, \| \lambda t_1 [\text{VP introduced } t_1 \text{ to John}] \|)$

The meaning of *only* combines with such a structured meaning consisting of the meaning of the focus and of the background. The semantic rule (13) of this operation asserts first the application of the meaning of the background to the meaning of the focus, and second that the background, applied to any other object than the meaning of the focus, yields a false statement.¹

$$(13) \quad \| \text{only} \| (F, B) = \lambda x [B(F)(x) \ \& \ \forall y \neq ALT(F) [B(y)(x) \rightarrow y = F]]$$

The domain of quantification of the operator is formed by a function *ALT* applied to the meaning of the focus *F*. The function *ALT* takes an object *d* and yields the set of elements that have the same type as *d*, as in (13a). We may also say that *d* generates the set of alternatives *ALT(d)*. The function *type* assigns a type to an object, e.g. (13b) where the denotation of a proper name like *Sue* is of type *e*. Hence, the alternatives generated from the denotation of *Sue* are all elements of type *e*, i.e., the domain of individuals:

- (13a) $ALT(d) = D_{type(d)}$
 (13b) $ALT(\| \text{Sue} \|) = D_{type(\| \text{Sue} \|)} = D_{type(s)} = D_e = \{b, j, m, s, \dots\}$

These rules can now be applied to example (11), repeated as (14). In the LF (14a) the focused expression *Sue* is moved to a position adjoined to *only*, and leaves the trace *t₁*. This translation is compositionally interpreted: Proper names and predicates denote constants, as given in

¹ This is a simplification since the first conjunct $B(F)(x)$ is the presupposition and the second is the assertion. In the remainder, both aspects of the meaning are merged for convenience.

(14b). The application of a predicate to its argument is defined as a functional application, as in (14c). In (14d), the semantics (13) of *only* combines with the meaning of the focus and background. This yields the property of introducing nobody but Sue to John. Finally in (14e), this property combines with the subject, giving the interpretation of the sentence. It correctly expresses that Mary introduces Sue to John and that she does not introduce anyone else to John.²

- (14) Mary [_{VP} only [_{VP} introduced SUE_F to John]]
 (14a) Mary [_{VP} only [Sue_I]_{Focus} [_{VP} introduced t_I to John]]_{Background}]
 (14b) ||Mary|| = **m** ||Sue|| = **s** ||John|| = **j** ||introduced|| = **introd'**
 (14c) ||_{VP} introduced t_I to John|| = λz [**introd'**(z)(j)]
 (14d) ||only|| (||[Sue]_{Focus} [_{VP} introduced t_I to John]]_{Background})||
 = λx [**introd'**(s)(j)(x) & $y \in \text{ALT}(s)$ [**introd'**(y)(j)(x) $\cap y = s$]]
 (14e) ||Mary only [Sue _{VP} introduced t_I to John]]||
 = **introd'**(s)(j)(m) & $y \in \text{ALT}(s)$ [**introd'**(y)(j)(m) $\cap y = s$]

One of the problems of this semantic approach to information structure is that even though the focus movement is understood as an instantiation of a more general principle of movement, it does not obey island restrictions that hold for quantifiers or wh-movement (cf. Jackendoff 1972, Rooth 1985, Kratzer 1991, von Stechow 1991). Another and more severe problem is that in certain cases, focus movement makes the wrong predictions (see section 4).

3.2 Alternative Semantics

Alternative Semantics (Rooth 1985; 1992) does not separate the meaning of the focus from the meaning of the background by extracting the focus out of the background. Rather it leaves the focus *in situ* and compositionally computes the alternatives that are generated by the focused expression on a new semantic level. Alternative Semantics distinguishes between two dimensions of meaning, the *ordinary meaning* ||_O and the *alternative meaning* ||_A. The alternatives are formed by the function *ALT* applied to the ordinary meaning of the focused expression. The alternative value of an expression is a set containing elements of the same type as its ordinary meaning. In this sense, the alternative meaning of a basic expression is derived from the corresponding ordinary value. The alternatives are projected parallel to the composition of the ordinary meaning.

Since there are two semantic dimensions, we have to define the interpretation rules for both dimensions. The ordinary interpretation (15a) does not see the focus feature *F* and, therefore, interprets a focused expression like the unfocused one. The alternative interpretation of a focused expression (15b) creates the set of alternatives. The alternative semantics of an unfocused expression (15c) is the singleton containing the ordinary semantic

² The formalism observes the following conventions: The lexical meaning of nouns, adjectives and verbs are represented in bold face with apostrophe. Proper names may be abbreviated by their first letter. A predicate takes first its subject argument, then its indirect object and then the direct object. The sentence *Mary introduces Sue to John* receives **introd'**(s)(j)(m) as its semantic translation.

value, which maintains the same type for the alternative values of all expressions – focused or unfocused.

- (15a) $\|\Box\|_O = \|\Box_F\|_O$
 (15b) $\|\Box_F\|_A = \text{ALT}(\|\Box\|_O) = D_{\text{type}(\|\Box\|_O)}$
 (15c) $\|\Box\|_A = \{\|\Box\|_O\}$

The interpretation of functional application must also be formulated in both ordinary and alternative semantics. The ordinary semantic function of functional application is simple set inclusion, as in (16). The alternative function of functional application (17) is more complex since it must warrant that the alternatives that are generated by a focused expression can be projected. It is a set formed by all possible expressions $X(Y)$ that are derived from the application of an element X of the first alternative set to an element Y of the second alternative set.

- (16) $\|\Box\Box\|_O = \|\Box\|_O(\|\Box\|_O)$
 (17) $\|\Box\Box\|_A = \{X(Y) \mid X \in \|\Box\|_A, Y \in \|\Box\|_A\}$

For instance, the application of a predicate to its focused argument is the functional application of its meaning to the meaning of the argument. The alternative set (18) generated by the VP *talk to FRED_F* includes the interpretations of all VPs of the form *talk to y*, where y is an alternative value to Sam. This is the set of individuals that have the property of talking to someone.

- (18) $\|\text{talk to FRED}_F\|_A = \{X(y) \mid X \in \|\text{talk}\|_A, y \in \|\text{FRED}_F\|_A\}$
 $= \{\text{talk}'(y) \mid y \in \text{ALT}(\text{fred}')\}$
 $= \{d \mid y \mid \text{talk}'(y)(d)\}$

The definition of the meaning (19) for the focus-sensitive operator *only* operates on both aspects of the meaning of an expression \Box . When applied to a VP, the ordinary meaning $\|\Box\|_O$ expresses the presupposition, whereas the alternative meaning $\|\Box\|_A$ determines the domain of quantification for the operator. There is no property in the set of alternatives that holds of x other than the property that is identical with the ordinary meaning. Here, the operator does not need two disjoint parts of the meaning of the expression as in the LF-movement account. It rather works with both dimensions of the meaning. Information structure is reconstructed as the denotation of the ordinary meaning and a set of alternative denotations. The focus-sensitive particle is translated into an operator that is defined with respect to the relation between the two kinds of denotations.

- (19) $\|\text{only VP}\|_O = \Box x [\|\Box\|_O(x) \ \& \ P \in \|\Box\|_A \ P(x) \supset P = \|\Box\|_O]$

We can now analyze sentence (11), repeated as (20). In (20a), the focused expression *SUE_F* generates a set of alternatives, whereas the alternative interpretations of *Mary*, *John* and *introduce* form singletons containing the ordinary meaning. The ordinary semantics of the

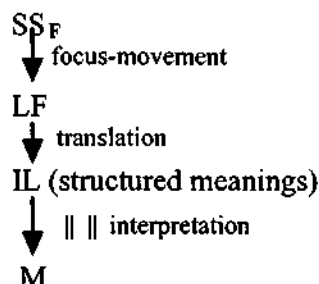
application of the predicate *introduce* to its arguments *Sue* and *John* yields the property **introd'(s)(j)**, as in (20c). The alternative value of this application is the set of properties consisting of introducing someone (i.e., an alternative value to Sue) to John. The semantics of *only* asserts in (20d) that there is only the one property, which consists of introducing Sue to John (and there is no other property of introducing someone else to John). This combines in (20e) with the subject and yields the correct semantic representation for the sentence, namely that Mary introduces Sue to John. Furthermore, all predicates formed by the description *introduce someone to John* and hold of Mary, are identical with the property of introducing Sue to John.

- (20) Mary ν_P [only ν_P [introduced Sue_F to John]]
- (20a) $\|Sue_F\|_O = s \|Sue_F\|_A = ALT(s) = D_e$
- (20b) $\|Mary\|_O = m \quad \|Mary\|_A = \{m\}$
 $\|John\|_O = j \quad \|John\|_A = \{j\}$
 $\|introduce\|_O = \mathbf{introd'} \quad \|introduce\|_A = \{\mathbf{introd'}\}$
- (20c) $\|introduced Sue_F to John\|_O = \mathbf{introd'(s)(j)}$
 $\|introduced Sue_F to John\|_A = \{\mathbf{introd'(x)(j)} \mid x \sqsubset ALT(s)\}$
e.g. $\{\mathbf{introd'(s)(j)}, \mathbf{introd'(s)(j)}, \mathbf{introd'(j)(j)}, \dots\}$
- (20d) $\|only introduced Sue_F to John\|_O = \sqsubset x [\mathbf{introd'(s)(j)(x)} \ \& \ P \sqsubset \{\mathbf{introd'(y)(j)} \mid y \sqsubset ALT(s)\} \ P(x) \sqsubset P = \mathbf{introd'(s)(j)}]$
- (20e) $\|Mary only introduced Sue_F to John\|_O = \mathbf{introd'(s)(j)(m)} \ \& \ P \sqsubset \{\mathbf{introd'(y)(j)} \mid y \sqsubset ALT(s)\} \ P(m) \sqsubset P = \mathbf{introd'(s)(j)}$

3.3 Comparing semantic theories of information structure

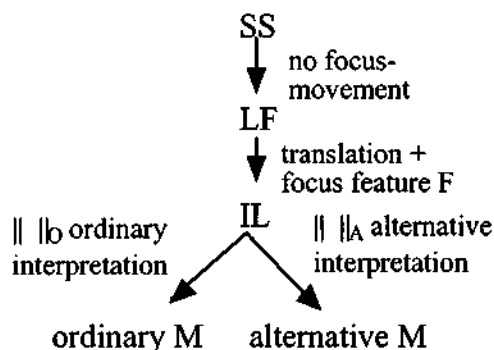
There is an ongoing debate as to whether the Structured Meanings or Alternative Semantics is more suitable to describe association with focus and focus-phenomena in general. I do not want to go into this discussion here (but cf. Rooth 1985, von Stechow 1991, Kratzer 1991, Krifka 1991 and others). However, I give a short summary of the two semantic theories with respect to their reconstruction of information structure. Theories of Structured Meanings assume that the focus feature on a constituent forces the constituent to move from its base position to a focus sensitive operator. The logical form is then translated into Structured Meanings, i.e. a representation of the meaning of the expression that describes the focus as the argument and the background as complex predicate (via lambda abstraction). The interpretation process can then proceed in the usual way. The focus sensitive particle is translated into an operator that takes the two parts of the structured proposition as its argument. Thus, this approach reflects the conception of information structure presented in section 2 in a semantically elaborated way – the problematic subject-predicate structure is reconstructed as the functor-argument relation of Frege, but independent of (and sometime orthogonal to) the functor-argument structure of the sentence that is induced by syntax and LF.

(21) Reconstruction of information structure in theories of Structured Meanings



Alternative Semantics does not assume focus movement. It leaves focused constituents in situ. The surface form is translated into a semantic representation (intensional logic) with the additional information of the focus feature F . There are two interpretation processes, one yielding the ordinary meaning, the other yielding the alternative meaning. The alternative meaning consists of alternatives generated by the focused expression and projected by compositional rules. Information structure is understood as relation between the ordinary and the alternative meaning of a sentence, and focus operators compare the ordinary and the alternative meaning.

(22) Reconstruction of information structure in Alternative Semantics



While Structured Meanings approaches still hold to a dichotomy of the sentence, Alternative Semantics assumes that we have to give two interpretations for a sentence that are computed in parallel. Thus information structure is not understood as a dichotomy of the sentence, but rather as the instruction to generate two meanings (denotations). In section 5, I modify this view in that I argue information structure is an instruction to generate two (discourse) representations, rather than two denotations as in Alternative Semantics. The argument is built on problems with the compositionality in cases of association with focus in definite NPs.

4. Association with focus in definite NPs

In the previous section, it was argued that association with focus reveals the complex interaction between different levels of semantic representation and interpretation. However both approaches have problems with cases of association with focus in definite NPs. Imagine

the following situation: At an international art exhibition, some critics, several German, Italian and American artists, but only one Swiss artist appeared. Sam talked to the Swiss artist and to one of the two German artists and nobody else. In this context, sentence (6), repeated as (23), is intuitively false. Yet in Structured Meanings as well as in Alternative Semantics the sentence is predicted to be true.

(23) Sam only talked to the SWISS_F artist

In the Structured Meanings account the focused adjective is moved to the operator as in (23a) with the paraphrase (23b). *Only* is translated into an operation on the focus and background as defined in (13). The definite article is represented with its classical semantics as iota-operator expressing the uniqueness condition (here: there is only one Swiss artist). A paraphrase for (23c) is: for all properties alternative to Swiss, if there exists a unique element *x* such that *x* has *X* and *x* is a artist and Sam talks to *x*, then *X* is Swiss.

(23a) Sam only (Swiss_I, $\Box X_I$ [talked to the X_I artist])

(23b) No nationality but Swiss is such that Sam talked to the artist of this nationality

(23c) $\Box X \Box \text{ALT}(\text{Swiss}') [\text{talk}'(s, \text{iz } [X(z) \ \& \ \text{art}'(z)]) \Box X = \text{Swiss}']$

The uniqueness condition of the definite article reduces the domain of quantification to exactly one element: the Swiss artist. All other expressions of the kind *the X artist* are not well-formed since they do not suffice the uniqueness condition of the definite article. Thus in a situation in which Sam talked to the Swiss artist and to one of the German artists, the sentence is counter-intuitively predicted to be true since no alternatives have survived the compositional process of the background part of the structured meanings.

Similar considerations hold for the analysis in Alternative Semantics, as it will be shown in detail on the example (23), repeated as (24). The adjective *Swiss* induces alternatives such as *German*, *American*, and *Italian*. But again, when these alternatives compositionally combine with the definite article, as in *the X artist* for $X \in \{\text{Swiss}, \text{German}, \text{American}, \text{Italian}\}$, only *the Swiss artist* survives the uniqueness condition of the definite article. In order to compose the alternative meaning of the definite NP, we have to account for the alternative meaning of the definite article. In a first approach we assume, according to the general rule (15c) above, that the alternative meaning of the article is the singleton of its ordinary meaning. If we take the iota operator as the ordinary meaning of the definite article, we then have the singleton containing the iota operator as the alternative meaning. Thus we get the ordinary meaning (24a) and the alternative meaning (24b) for the definite NP *the SWISS_F artist*. Here, the alternative set consists of unique artists with respect to nationality. Since there are more than one artist for all countries but Switzerland, all iota expressions are undefined except the one for the Swiss artist. Hence, the alternatives would include one single individual, namely the unique Swiss artist (cf. von Heusinger 1997 for a more detailed argument):

(24) [the SWISS_F artist]_{NP}.

(24a) $\| \text{the SWISS}_F \text{ artist} \|_O = \Box x [\text{Swiss}'(x) \ \& \ \text{art}'(x)]$

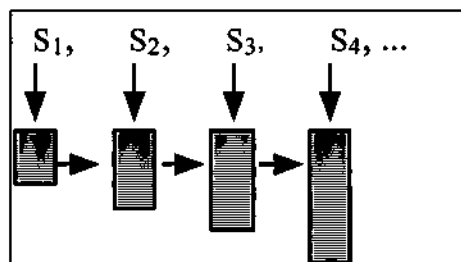
$$\begin{aligned}
(24b) \quad \llbracket \text{the SWISS}_F \text{ artist} \rrbracket_A &= \{X(Y) \mid X \sqsubseteq \{\square\}, Y \sqsubseteq \llbracket \text{SWISS}_F \text{ artist} \rrbracket_A\} \\
&= \{d \mid d = \square x \sqsubseteq R x \ \& \ \mathbf{art}'(x) \text{ for some } R \sqsubseteq \llbracket \text{SWISS}_F \rrbracket_A\} \\
&= \{\square x \mid [\mathbf{Swiss}'(x) \ \& \ \mathbf{art}'(x)]\}
\end{aligned}$$

Intuitively, the correct domain of quantification for the operator *only* consists of just the artists at that meeting. In other words, the focused expression does not contribute to the construction of the domain of quantification, it is rather "invisible" for that process. It seems, therefore, that approaches which rely on the distinction of focus and background are unable to analyse more complex cases. An alternative approach to information structure must be based on discourse structure, rather than on a dichotomy of a sentence. In the next section I introduce a simple discourse structure, which then is extended to the foreground-background theory of information structure.

5. Discourse structure

The initial problem that motivated discourse representation theories is the interpretation of nominal and temporal anaphora in discourse. The phenomenon of cross-sentential anaphora forces a semantics to extend its limits from the sentence to the discourse. The key idea in the approach to semantics of discourse, exemplified in (Heim 1982) and (Kamp 1981), is each new sentence or phrase is interpreted as an addition or 'update' of the context in which it is used. This update often involves connections between elements from the sentence or phrase with elements from the context. Informally described, a sequence of sentences S_1, S_2, S_3, S_4 is interpreted by incrementally constructing a discourse representation as in (25). Anaphoric relations and definite expressions are captured by links between objects in this representation. In order to derive the truth condition of the sentence, the representation is embedded into a model.

(25) Construction of a discourse representation structure (DRS) in classical DRT



The best way to get acquainted with DRSs is to look at an example (cf. Asher 1993, 66f). The DRS in (26a) graphically describes a discourse representation structure (in short DRS) with two parts. One part is called the *universe* of the DRS, the other its *condition set*. A DRS is an ordered pair consisting of its universe and condition set, written as $\langle U_K, \text{Con}_K \rangle$. The DRS in (26a) has as its universe one *discourse referent* x and as its condition a set of properties that are ascribed to the discourse referents in the universe. In (26a) the property of being a man and of walking is ascribed to the discourse referent x .

(26) A man walks.

(26a)

x
man(x) walk(x)

To give the truth conditions for (26), we need to define a *proper embedding* for the DRS. Informally, a proper embedding for a DRS in an (extensional) model $M = \langle D, \models \rangle$, consisting of a domain D and an interpretation function \models , is a function f that maps the discourse referents onto elements of the domain of M such that the elements are in the extension of the predicates that are ascribed to the discourse referents. For example, the DRS (26a) is true just in case that $f(x)$ is a man and $f(x)$ walks.

The sequence or conjunction of two sentences as in (27), receives a DRS incrementally. We start with the already established DRS for the first conjunct in (27a), then a new discourse referent for the pronoun *he* and a condition for the predicate *whistle* is added in (27b). The anaphoric link of the pronoun is graphically represented as $y=?$, indicating that the pronoun is still unresolved. The discourse referent which stands for an anaphoric expression must be identified with another *accessible* discourse referent in the universe, here the y is identified with the x , as in (27c). This mini-discourse is true if there is an embedding function f onto a model such that $f(x)$ is a man and walks and $f(y) = f(x)$ and $f(y)$ whistles.

(27) A man walks. He whistles

(27a)

x
man(x) walk(x)

(27b)

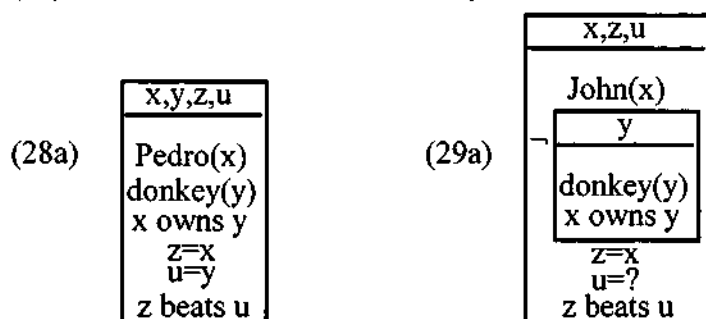
x, y
man(x) walk(x) $y=?$ whistle(y)

(27c)

x, y
man(x) walk(x) $y=x$ whistle(y)

The new discourse referent introduced by the pronoun must be linked or identified with an already established and accessible discourse referent. DRT defines accessibility in terms of structural relations, i.e., the discourse referent must be in the same (or a higher) universe. With this concept of accessibility, the contrast between (28) and (29) can be described by the difference in the set of discourse referents that are accessible for the discourse referent u of the pronoun *it*. The construction rule for the negation in (29) creates an embedded discourse universe with the discourse referent y and the conditions *donkey(y)* and x owns y . The anaphoric pronoun *it* in the second sentence cannot find a suitable discourse referent since it has no access to the embedded discourse universe with the only fitting discourse referent y .

- (28) Pedro owns a donkey. He beats it.
 (29) John does not own a donkey. *He beats it.

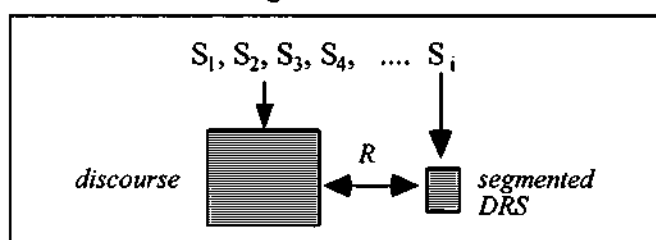


This program of investigating sentences and describing their informational properties with respect to the larger linguistic context has just begun. In the remainder of this section I present Asher's theory of *segmented DRT* (= SDRT) as one of the rare examples of a semantic account of discourse.

Asher (1993; 1997) develops the extension "segmented DRT" (=SDRT) that is not confined to the incremental composition of DRSs, but also captures discourse relations between the sentences in the discourse. He revises the classical DRT of Kamp (1981) and Kamp & Reyle (1993). The classical version describes the dynamic meaning of a discourse by processing sentence for sentence. Since the meaning of each sentence is construed as a function from truth conditions to truth conditions, the truth conditional content of the whole discourse is reconstructed by the sequential application of these functions. Asher (1993, 256) notes that "the notion of semantic updating in the original DRT fragment of Kamp (1981) (...) is extremely simple, except for the procedures for resolving pronouns and temporal elements, which the original theory did not spell out. To build a DRS for the discourse as a whole and thus to determine its truth conditions, one simply adds the DRS constructed for each constituent sentence to what one already had. (...) This procedure is hopelessly inadequate, if one wants to build a theory of discourse structure and discourse segmentation."

In SDRT, each sentence S_i is first represented as a particular SDRS for that sentence. The SDRS can then interact with the already established DRS reconstructing a discourse relations R , such as causation, explanation, coherence, elaboration, continuation, as informally sketched in (30). Only in a second step the representation is integrated into the already established representation.

- (30) Construction of a segmented DRS in SDRT



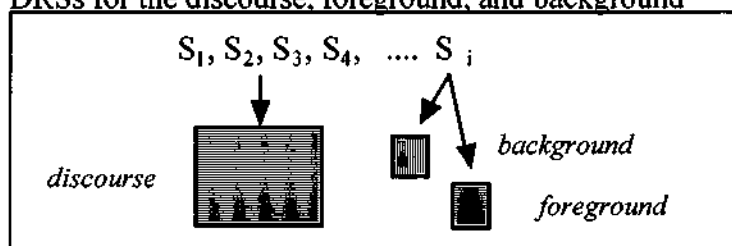
To summarize this very short presentation of DRT: The discourse structure of DRT provides not only a new structure but also introduces new semantic objects, the discourse referents, the conditions and the discourse domains ("boxes"). DRT explains semantic categories such as

definiteness and anaphora in terms of interaction between these representations. Furthermore, the extension to SDRT allows expressions of discourse relations between whole propositions as well. These new tools, objects, and representation form the basis for a new semantic analysis of information structure.

6. Foreground-background semantics

My approach is based on the assumption that a sentence makes (at least) two kinds of contributions to the context: the ordinary meaning and the background meaning. These two contributions are not provided by a dichotomy of the sentence surface in focus-background, but by two construction mechanisms that translate the sentence into two representations at the level of discourse representation. I assume a SDRT-like model sketched above with an extra set of construction rules for the background representations. The foreground representation is constructed from the material of the sentence in the common way a DRS is constructed. The background representation, however, is a DRS in which the focused expressions are not represented; they are merely represented by variables. Background and foreground are both DRSs or representational objects at the level of discourse representation. Thus there are (at least) three objects when analyzing a sentence: the DRS for the discourse, the DRS for the background and the DRS for the foreground:

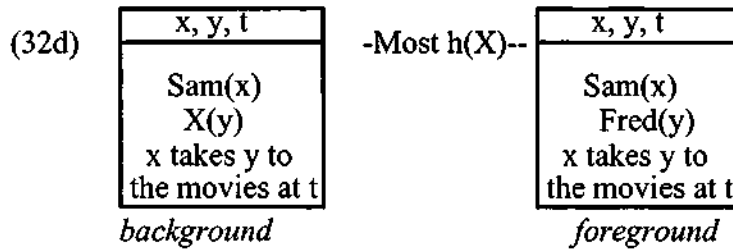
- (31) DRSs for the discourse, foreground, and background



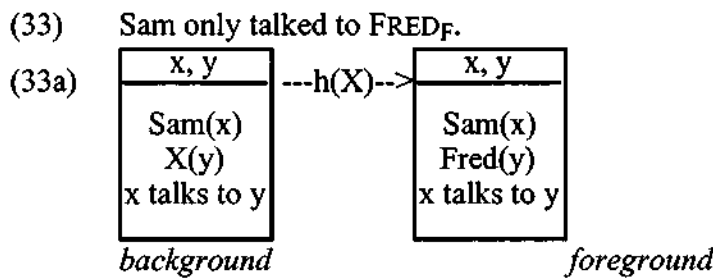
There are relations between each pair of DRSs: the relation between the discourse and the foreground concerns the discourse relation R mentioned above. The relation between the background and discourse is generally described in terms of givenness, and the relation between the background and the foreground serves as the domain over which discourse operators range. Thus the status of being part of the background or not, basically depends on the given discourse, rather than on something (mysterious) in the sentence property.

I will focus on the relation between the foreground and the background representation and illustrate this by the interaction of an adverb of quantification with a focused constituent, as in (6), repeated as (32). The operator ranges over sets that are constructed from the foreground and the background representation as in (32b).

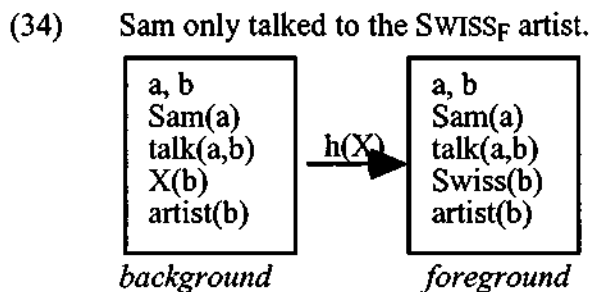
- (32) Sam usually takes FRED_F to the movies.
 (32a) For most times in which Sam takes someone to the movies, he invites Fred to the movies.
 (32b) Most { t | Sam takes someone to the movies at t }
 { t | Sam takes Fred to the movies at t }
 (32c) Most { t | background at t } { t | foreground at t }



The foreground representation in (33a) contains the two discourse referents x and y , the conditions which link the discourse referents to Sam and to Fred and the conditions that expresse the relation of talking between the two. The background representation in (33a) contains the same structure except for the condition $Fred(y)$, which is replaced by $X(y)$.



The focused adjective *Swiss* in (34) is replaced by a predicate variable X in the background. Note that the definite article does not appear in the representation. Focus semantics does not interact with the uniqueness condition of the definite article. One way to implement this is to assume with other discourse semantics (Heim 1982, Kamp 1981, Kamp & Reyle 1993) that the definiteness is a discourse pragmatic concept which is not expressed in the lexical meaning. It is operative while constructing the DRSs, for example, as an additional condition that there is only one Swiss artist. Such a condition could be understood as a locally accommodated representation (cf. Kamp & Reyle 1993, 297-299), which will be suppressed here:



7. Summary

The concept of foreground-background semantics posits a challenge for semantic theories of information structure because it tries to integrate a wide range of phenomena. It provides a

new view on information structure as being part of a larger discourse representation. Thus the following claims were defended:

- (i) Information structure is to be defined with respect to *discourse*
- (ii) Information structure is realized as two representations: the *foreground* representation corresponding to the whole sentence, and the *background* representation
- (iii) It is the whole sentence that expresses new information (rather than one word or one constituent); so the *foreground* representation expresses the new information; the *background* representation is discourse anchored, and therefore contains old or given information
- (iv) Sentence meaning is compositionally formed from the meaning of its parts according to the syntactic structure (LF) and the compositional rules of semantics, rather than in terms of information structure.
- (v) Focus sensitive particles are translated into operators that take the foreground and the background as their arguments ($O(\textit{background}, \textit{foreground})$)
- (vi) Adverbs of quantification can be described in the same way:
($\textit{Adverb}(\textit{background}, \textit{foreground})$)

These main assumptions of foreground-background semantics have led to a different view of information structure, which is understood as part of discourse semantics, and therefore, as part of semantics. Information structure certainly effects sentence processing, psychological models and computational questions of language, but as described here, it is a linguistic, i.e. discourse-semantic, level with linguistic objects. The particular view defended here might have raised more questions than it has solved. Certainly more research is necessary to elaborate this question. Furthermore, the theory presented has to be tested against a wide range of data.

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