

## ON THE SEMANTICS OF FOCUS PHENOMENA IN EUROTRA

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### ABSTRACT

In this paper, we discuss issues connected to the phenomenon of linguistic FOCUS or INFORMATION DISTRIBUTION in the sentence in the context of the multi-lingual machine translation project EUROTRA. We shall present some of the arguments why a consideration of FOCUS phenomena is important for the determination of linear order and for semantic interpretation. We shall proceed, in sections 2 and 3 of the paper, to mention the main lines of development in the discussion of FOCUS phenomena in Computational Linguistics and in Linguistics respectively. Section 4 contains an illustration of a pilot implementation covering some aspects of FOCUS phenomena in EUROTRA-D.

#### 1. Problem description

##### 1.1. The determination of linear order in the clause

An initial, but faulty assumption, underlying a possible theory of language is that linear order of syntactic constituents in the clause is fully determined by a combination of the following types of information:

- basic type of language (SVO,SOV,etc)
- clause modus (indicative, interrogative,etc.)
- information on verbs in the lexicon (lexical forms).

This paper will present some of the arguments why this assumption is wrong for the clause, in how far this fact is relevant for EUROTRA, and initial suggestions towards a treatment within our framework. We shall not be able here, for reasons of time, to deal with linear order within NPs, ADJPs, or ADVPs (cf. for English on these questions Halliday.1985 : 158ff, and many others).

At least the following hierarchy of factors can be said to contribute to linear sequence (cf. Allen.1987 : 51):

- (1) The familiarity hierarchy
- (2) The topic < comment, given < new hierarchies
- (3) The universal sequencing conventions
- (4) The definiticity and referentiality hierarchies
- (5) The personal, social status, and role hierarchies
- (6) The dominant descriptor hierarchies
- (7) The formal hierarchies

Of these, this paper will deal with focus phenomena, covered in (2) above. Different aspects of this area are covered in the linguistic literature under the headings of "topic-comment", "focus-presupposition", "theme-rheme", and "given-new". The difficulty with these pairs of terms is

- that they reflect a difference in orientation (rhetorical vs. logical vs. psychological);

- that they cover the related, though different aspects of linear order and intonation.

Rather than go into an extended theoretical discussion at this point, we shall in 1.2. discuss a range of examples to show where exactly these phenomena would seem to be relevant for a multi-lingual MT-system like EUROTRA. The system within which the implementation of the ideas suggested here were implemented is the Eurotra-D system as described in Steiner.1986 and Steiner et al.forthcoming and in other places.

#### 1.2. The relevance of linear order for semantic interpretation

##### 1.2.1. The scope of negation

Cf. the following pair of sentences (capitals standing for stress):

- (1) The eec is not controversial, because it is a multi-national ORGANIZATION.
- (2) Because it is a multi-national organization the eec is not CONTROVERSAL

(1) and (2) are identical, except for the position of the Adverbial Clause, and the assignment of primary information focus realized by main stress and symbolized here by capitals. However, their semantic interpretation differs with respect to the scope of negation: (1) is ambiguous with respect to the question of whether or not the proposition expressed in the matrix clause is true, cf. (3):

- (3) The eec is not controversial, because it is a multi-national ORGANISATION. It is controversial because it is EXPENSIVE.

The second sentence in (3) is not possible with (1), whereas it is with (2). In (1), the scope of negation includes the Adverbial Clause, whereas in (2), it does not. In general, it seems to be the case that the scope of negation may include everything in the clause to the right of the negation particle and including the constituent which has a lexical item carrying focus. Therefore, the truth values of (1) and (2) are different, which implies that they are not acceptable translations of each other in a truth value oriented semantics, such as we are having it at the moment in EUROTRA. Yet, in the present framework, (1) and (2) would receive one representation at ERS, which means that ECS-ERS translations are not translationally equivalent. The implications for other pairs of levels of representation are obvious.

We shall not go into the question here of how marked intonation in such cases would influence truth values - as we are dealing with written texts exclusively, we shall assume unmarked intonation for each syntactic structure, which implies that in the case of thematizing constructions, we shall assume main stress in the constituent functioning as a marked theme, and stress within the rightmost clause constituent carrying a fully lexical item otherwise. All this, for the time being, applies to English.

##### 1.2.2. The scope of quantification

Cf. (4) and (5):

- (4) Everyone in this room speaks two languages.  
 (5) Two languages are spoken by everyone in this room.

This is a classical example which has been discussed in the literature again and again, so we shall merely re-state the problem:

In (4), it is not implied that everyone speaks the same two languages, whereas this does seem to be the implication in (5). The difficulty seems to be that type and scope of underlying quantifiers may change depending on linear order. This problem may be even more important in languages with a somewhat freer word order like German, cf. (21)-(24):

- (21) Einige von uns haben eine Sorge.  
 Some of us have a worry.  
 (22) Eine Sorge haben einige von uns.  
 A worry some of us have.  
 (23) Wir alle arbeiten an einer Lösung.  
 All of us a working towards a solution.  
 (24) An einer Lösung wird von allen von uns gearbeitet.  
 A solution is worked on by all of us.

In (21) and (23), the indefinite article in the object NP does not necessarily imply "one and the same for all of (Subject)", whereas the implication may be given in (22) and (24) (changes of syntactic constituents considered). Note that (24) includes passivization, whereas (22) includes thematization without passivization. This shows that what is at issue here is not VOICE, but, as we have been emphasizing all the time, FOCUS. However, it seems to be type, rather than scope of quantification which is at issue here. Furthermore, the judgements of native speakers here are influenced by intonation and other factors.

### 1.2.3. Acceptable question-answer pairs

For an illustration of this problem, cf. (6) to (11):

- (6) When did Parliament decide on the budget?  
 (7) Parliament decided on the budget last WEEK.  
 (8) It was last WEEK that Parliament decided on the budget.  
 (9) ?Last week Parliament decided on the BUDGET.  
 (10) ?It was on the BUDGET that Parliament decided last week.  
 (11) ?What Parliament DID last week was decide on the budget.

As it is well known from discussions in the literature, (7) and (8) are fine as answers to (6), yet (9)-(11) are at least questionable. Observe that thematizing devices like in (8)-(11) do not translate in simple syntactic transfer between different European languages. German, for example, can simply change linear order where English needs clefting, pseudo-clefting, extraposition, or similar devices. Observe furthermore that, as a first rule, focus goes with the thematized constituent in cases of marked theme assignment, whereas the remainder of the clause would seem to function as presupposition, which is important to observe in the case of written language, where we do not have any encoding of intonation directly. In the case of wh-questions,

focus usually goes with the wh-element. In cases of unmarked theme assignment, focus, in English, falls on the last fully lexical item in the clause.

Back now to the question of the translation of sentences with certain types of marked themes, cf. (12) to (15):

- (12) Zu einem großen UNGLÜCK wurde die Entscheidung erst durch die weitere ENTWICKLUNG (D)  
 (13) ?A big DESASTER the decision only became because of further DEVELOPMENTS  
 (14) It was only through further DEVELOPMENTS that the decision became a DESASTER.  
 (15) ?Es war nur durch die weitere Entwicklung, dass die Entscheidung zu einem Unglück wurde.

(13) is a questionable translation of (12), yet the present framework would either dictate so, or else produce the "canonical" form underlying (16) as a translation of (12):

- (16) The decision became a desaster because of further DEVELOPMENTS.

(16), however, misses the double focus of (12) and is thus problematic, also in view of what we have said in 2.2.1. On the other hand, (15) is a questionable translation of (14), because the syntactic device of "clefting" does not carry over from English into German in a non-complex way.

We shall not go into other areas where FOCUS is important at this point, such as, for example, the scope of certain classes of Adverbials like "only, just,..." in English (we would like to express our gratitude to Anand Syea, Manchester, for alerting us to this area.)

It should be obvious that:

a: These problems occur not just in isolated examples, but with thematizing devices in general.

b: The problems are magnified greatly between languages which are less closely related than English and German, such as, for example, Germanic and Romance languages etc.

As we hope to have indicated in this section, a disregard for questions of focus may lead to translations which are not truth value equivalent, or else to translations which are grammatically wrong or at least hardly acceptable. One could, of course, choose the approach of introducing complex syntactic transfer to handle such problems. It should be obvious that the complexities involved would be considerable. Even in a syntax based transfer, though, one would need a systematic account of focus phenomena.

The alternative would seem to be to include into EUROTRA Interface Structure semantic information about focus phenomena and let the rest be handled in target language generation. This seems to be a solution which is theoretically more desirable and practically far superior in view of the fact that with the number of languages involved in EUROTRA, introducing a major source of complex syntactic transfer is always extremely costly and should be avoided as far as possible.

The following two sections will give references to places in the literature where focus phenomena are discussed more extensively.

## 2. Issues in the discussion of focus phenomena: Computational Linguistics

The relevance of focus phenomena and topicalization for free word order languages is discussed in Karttunen/Kay.1985. A criticism of the general neglect of focus phenomena and topicalization can be found in Kay.1985 : 252, as well as in Winograd.1983 : 280ff.

McDonald.1985 discusses the relevance of such phenomena for the production of coherent text in MT.

Mann/Matthiessen.1985 emphasize the need for having a theory and implementation of topicalization in text generation, illustrating the particular strength of implementations of Systemic Functional Grammar in this area, just as do Winograd.1983 : 280ff, Patten.1984, and Houghton/Isard.forthcoming.

Recent contributions of Prague School representatives on the issues connected with our topic can be found in Hajicova/Sgall.1986 and in Sgall/Hajicova/Panevova. in press.

Within the field of Machine Translation, it would seem to be clearly the Prague School approach which has the strongest tradition with respect to our topic. Functional Unification Grammar and Systemic Functional Grammar both have a known history in this respect in Computational Linguistics, even if not in MT directly.

### 3. Issues in the discussion of focus phenomena: Linguistics

We shall only be able to give an indication of the main lines of thought, because the literature on issues of focus/presupposition, theme/rheme and topic/comment has become very extensive.

Within the paradigm of Generative Grammar and Government & Binding, we find, roughly from the early seventies onwards, a discussion of focus phenomena in so far as they contribute to a semantic structure of focus and presupposition (cf. Chomsky, 1970, Jackendoff, 1972, Jackendoff, 1983, Rochemont, 1986). The emphasis is on the implications for scope of negation, Adverbials, and quantification, as well as on rules for

generating acceptable sequences of sentences (cf. 1.2. of this paper).

The Prague School has perhaps the longest tradition of investigating focus phenomena under the heading of "Functional Sentence Perspective" organization of the clause (cf. Danes, F. ed. 1974.). The notions of "Theme" and "Rheme" are refined in order to overcome a purely binary division of the clause, using the notion of "Communicative Dynamism". Also, the notions of "Theme and Rheme" are extended to cover aspects of text-structure, rather than only sentence-structure.

Lexical Functional Grammar, to my knowledge, has not given a central place to consideration of focus phenomena, while not denying their importance (cf. Kaplan/Bresnan, 1982 : 255). However, in the area of LFG, my knowledge of the literature is far from comprehensive.

Systemic Functional Grammar has a long tradition of giving a central place in their theory for considerations of the "textual organization" of sentences into "Theme-Rheme" and "Given-New". These two aspects are conceived of as related, though distinct. The "Given-New" dimension expresses the assignment of "old vs new" information in the clause, whereas the "Theme-Rheme" dimension is assumed to account for "Point of departure"-assignment to constituents of syntactic structure (cf. Halliday, 1967-68./ Halliday, 1985 : 38ff/ Fawcett, 1980 : 157ff/ Steiner, 1983 : 228ff).

Outside of certain "Schools" of Linguistics, it is certainly worth mentioning Chafe, 1970:210ff, Prince, 1981 for an interesting treatment of focus phenomena within the perspective of Pragmatics, Sperber/Wilson, 1986 for a definition of "focus" with respect to hierarchies of ordered entailments between different syntactic and semantic constituents of sentences, and Jones, 1977, for a very useful treatment of the notion of "Theme" as it extends from the sentence to the text.

### 4. Towards a treatment of the semantics of focus phenomena in EUROTRA: some preliminary suggestions

In this section, we shall outline an implementation of a treatment which will at least begin to cover some of the translationally relevant phenomena which we have outlined in the previous sections. This implementation is entirely within the EUROTRA framework as described in Arnold et al. 1986.

For the time being, we shall assume that each clause constituent is assigned to either the focus or the presupposition of a clause. Later on, it may become important to distinguish more precisely between "clause" and "sentence", and between primary and secondary focus. Also, there are reasons to assume that focus is assigned to lexical categories in the first instance, and that upwards percolation to the phrase is not unrestricted. However, at present, we shall only try to account for movement of phrasal constituents as wholes, and therefore, we shall assume that focus is automatically percolated upwards from lexical categories to their phrasal mothers. Note that in the future this might create special problems as it is not necessarily the head element of a

phrase which is marked for focus.

For work in the immediate future, it seems important to investigate a somewhat more constrained interpretation of the percolation of the feature [+FOCUS]. We shall in the following use some of the insights to be found in Rochemont, 1986:84ff:

a. If some constituent A is [+focus] and A is  $X^0$ , then  $X^n$  is [+focus].

b. If A is [+focus] and A is an argument of  $X^0$  contained in  $X^n$ , then  $X^0$  is [+focus].

c. If  $X^0$  is [+focus] and A is an Adjunct of  $X^0$ , then A is [+focus].

From a.-c. above it follows that focus percolation operates differently on arguments and on modifiers: [focus] percolates upwards from arguments to heads (b.) and reverse (a.). However, [focus] percolates downwards from heads to modifiers (c.), yet not in the reverse direction. Now, while this is certainly an interesting hypothesis, it should be investigated before we base any implementations on it.

From a linguistic point of view, the semantics of focus and presupposition determines linear sequence at ECS in interaction with intonation (stress assignment). For an illustration of this fact, cf. (17) to (20) (Jackendoff, 1972:321):

(17) Did Maxwell kill the judge with a HAMMER?

(18) Was it with a HAMMER that Maxwell killed the judge?

(19) No, he killed him with a ZAPGUN.

(20) No, it was SAM who killed the judge.

Jackendoff's point here is that in a polar interrogative it is the focus rather than the presupposition which is questioned, and that therefore (20) is odd as a response to (17) or (18), both of which presuppose that Maxwell did the killing.

Our point here is that (17) to (20) exhibit unmarked stress assignment relative to their syntactic structures, and that marked assignments are possible, even if they are unlikely. As we shall argue shortly, the knowledge of unmarked stress assignments for the major syntactic patterns of a language is important in our context, because when dealing with written texts, stress itself is not accessible to us. Observe that "focus" and "stress assignment" are not the same phenomenon: in the case of wh-questions in English and German, for example, focus goes with the wh-element rather than with the element carrying primary stress.

For each of the EUROTRA languages, there would seem to be an unmarked stress assignment to ECS (Eurotra Constituent Structure) translations of one ERS (Eurotra Relational Structure) representation, e.g. in cases of fronting, dislocation, cleft sentences, pseudo-cleft sentences, extraposition, actives vs. passives etc. Assuming unmarked stress assignment, we could then predict the elements of sentences which carry focus. In the case of wh-questions, focus will always be assigned to the wh-element.

Within our framework, we can introduce an attribute-value pair "FOCUS=yes/no" which is included into the feature description

of syntactic constituents in the course of translating from ECS to ERS. Thus, we translate the information which we have available at ECS (linear sequence, whether we have a wh-question etc.) to ERS. The linguistic basis of this knowledge is the knowledge about unmarked stress assignments on ECS for each of the EUROTRA languages plus the assumption of unmarked intonation throughout, which is an assumption that we could modify in a controlled way at a later stage. From ERS to IS, our FOCUS feature and its value would simply be carried over, which is a natural consequence of the fact that information about focus and presupposition is semantic information based on information from the constituent structure level. Our sentence (1)

(1) The eec is not controversial, because it is a multi-national organization.

thus receives two representations both at ERS and at IS, whereas sentence number (2)

(2) Because it is a multi-national organization the eec is not controversial.

receives only one representation. In such cases, the difference is not only in the area of FOCUS assignment, but is also due to differences in scope assignment in the case of (1), which is dependent on the ECS position of the element carrying FOCUS.

So far, we have sketched an approach to the problems of FOCUS, yet not automatically to problems of scope of negation and quantification. The reason is that in our representations at ERS and at IS, each sister constituent of one level has to be either a predicate or an argument/modifier. A negative particle like English "not", however, does not seem to be one or the other at clause level. Semantically speaking, "not" corresponds to a logical operator rather than to a predicate or an argument. In other words, our IS or ERS representations do not correspond to a "logical form", which would represent problems of scope in the usual way, e.g. (roughly):

(NOT a(X)) AND b(Y) vs. NOT((a(X))AND(b(Y))).

Within our present framework, a possible approach would seem to be the following:

We define a feature SCOPEN=yes/no (Scope of negation) which is assigned to clause constituents in the translation ECS->ERS. As we assume that the scope of negation may include all the constituents right of the negative particle at ECS up to the constituent dominating the element carrying FOCUS, we could assign a SCOPEN value to constituents in the course of translation ECS->ERS and then simply carry it over to IS. The issue we have to decide on in this context is whether we want to introduce this additional source of creating ambiguities into the framework. Note that scope is said to extend "up to" the FOCUS constituents, yet this may or may not be the case, which exactly is the problem in (1) above. (2) is not ambiguous, because the adverbial clause is definitely out of the scope of negation. Ambiguities are created in all those cases where we have constituents between the negative particle and the FOCUS,

and in the case of longer clauses, this may cause a high number of readings which only differ in the scope of negation. It is not obvious at the moment whether the magnitude of the problem created by questions of scope is sufficient to warrant such a step. Our treatment of FOCUS, it should be said, does not create additional ambiguities at this stage, it merely adds to the feature descriptions in representations which we are generating anyway.

Our Appendix contains representations showing the operation of the FOCUS feature in ECS and ERS structures.

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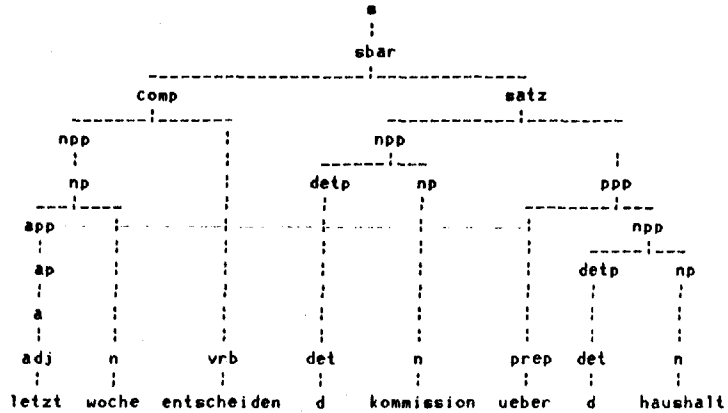
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APPENDIX

A.  
ECS-representations

1. Letzte Woche entschied die Kommission ueber den Haushalt  
(Last week the Commission decided on the budget.)

ecsd/1



(ppp, (cat = ppp  
focus = yes))

```

. [(ppp, (cat = ppp
  agr = (case = acc)
  prep = ueber))
  . [(prep, (lex = ueber
    lu = ueber
    cat = prep
    agr = (case = acc)))
    (npp, (cat = npp
      per = 3
      agr = (case = acc
        gend = mas
        nb = sg)
      inflec = def
      n_typ = sub))
      . [(detp, (cat = detp
        agr = (case = acc
          gend = mas
          nb = sg)
        inflec = def))
        . [(det, (lex = den
          lu = d

          det_typ = art
          cat = det
          inflec = def
          agr = (case = acc
            gend = mas
            nb = sg)))]
          (np, (cat = np
            inflec = def
            agr = (case = acc
              gend = mas
              nb = sg)
            n_typ = sub
            per = 3))
            . [(n, (lex = haushalt
              lu = haushalt
              n_typ = sub
              cat = n
              agr = (case = acc
                gend = mas
                nb = sg)
              per = 3))]]]]]]].

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