TOPIC AND FOCUS IN A FORMAL FRAMEWORK

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1. Introduction

The concepts of *topic* and *focus* have first begun to figure in linguistics in the middle of the nineteenth century. They have been recognized as interesting and they have received the casual attention of linguists of various proveniences, but they have never moved to the centre of interest.

One of the linguistic schools in which the problems of topic and focus have not been considered marginal was the school of Prague structuralists. It was especially Mathesius (1929; 1939) who pointed out the import of this range of problems. Firbas (1957; 1971) then continued the study of the phenomena under the heading of 'functional sentence perspective'; Daneš (1974) studied intonation and word order as a means of articulation of topic-focus structuring. The elaboration of the problem of topic-focus articulation within a formal framework of linguistic description has been carried out by Sgall and his collaborators (especially Sgall et al., 1973, and Sgall et al., 1986).

Besides Czech linguists there have also been also various other scholars who have displayed interest in this kind of phenomena (e.g. Kuno, 1972, Dahl, 1974); but the mainstream of the Chomskian movement, which has dominated the linguistic world since the sixties, has left them almost unnoticed. Now the situation seems to be changing: results such as those of Rochemont (1986), von Stechow (1989), Jacobs (1991), Krifka (1991), Partee (1991) or Rooth (1992) indicate that topic-focus articulation (hereafter *TFA*) is being increasingly recognized as a real challenge.

From this viewpoint the results of the long tradition of Czech linguistics might hold a renewed interest. To facilitate discussion about the various approaches to TFA and to related phenomena it may be worthwhile to summarize the possibilities of formal accommodation of TFA as developed in Prague. This is the aim of the present paper - not to offer

ready-made solutions, but rather to overview the problems and possible leads towards solving them.

2. Basic Concepts of the Prague Approach

The framework of the Prague research group of formal linguistics has been presented in detail by Sgall et al. (1986). Let us summarize the main points. The aim of the summarization is to facilitate the understanding of the main concepts independently of the particular framework in terms of which they might be articulated - hence the framework is to some extent oversimplified.

1. The framework, designed to capture grammar, is primarily based on dependency, not on constituency. The meaning of a sentence is considered in the form of a tree, called *tectogrammatical representation*, which contains no non-terminals and captures the dependential structuring. The items that are considered to depend on the main verb are classified according to their thematic roles (which are, however, more closely related to grammar than the Θ-roles common in American linguistics).

2. Each of the elements of the tectogrammatical structure (corresponding to autosemantic lexical elements of the sentence being represented) is either *contextually bound* or *contextually nonbound*. A prototypical example of a contextually bound item is one corresponding to an expression which appears also within the immediately preceding part of the discourse. However, contextually bound elements are not only those which are explicitly used before, they are also elements which are in an indirect way implied by the context, where context means not only verbal co-text, but also the situation of the discourse, including the common cultural background shared by the speaker and the hearer.

3. The default order of items depending on a verb (i.e. the order of thematic roles and adverbials) is considered to be fixed for a given language; it is called the *systemic ordering*. However, this order together with the order of other items not depending directly on the main verb is modified in a concrete utterance, so that the resulting order of the items of the tectogrammatical structure is that of the *communicative dynamism* (*CD*). The CD order of contextually bound items dependent on the same head is determined by the speaker's discourse strategy rather than by grammar; on the other hand, the CD of the unbound items dependent on the same head is in accordance with the systemic ordering. An item is less dynamic than its head iff the

dependent item is bound.
4. The least dynamic element of the sentence constitutes the *topic proper*.
5. All the contextually bound items depending on the main verb together with all that depends on them and together with the main verb if this is contextually bound, constitute the *topic* of the sentence; the rest of the sentence constitutes the *focus*. Hence the topic/focus classification is exhaustive: every element of the sentence belongs either to the topic or to the focus.

3. Formal means

There have been several attempts to account for the Prague notion of TFA in formal frameworks. One group of such attempts has been carried out within the framework of an intensional logic, namely of Tichý's *transparent intensional logic* (see Tichý, 1980). The basic issues of such kind of formalization have been discussed by Materna and Sgall (1980) and Materna et al. (1987); Vlk (1988) has outlined a procedure for the translation of surface forms into the logical representation. The attempts gave rise to an account of TFA in which the topic is taken roughly to be the specification of a class and the focus is taken as giving a kind of exhaustive listing of the elements of that class.

There has also been an attempt to account for TFA in a framework similar to DRT; this attempt is due to Peregrin and Sgall (1986). In this framework, each sentence is associated with a situation-like structure (the "content" of the sentence); the "meaning" of a sentence is then understood as the class of all the embeddings of its "content" into the model. A sentence articulated into a topic and a focus is considered as true if every embedding of the "content" of its topic is meaningfully extensible to an embedding of the "content" of the whole sentence.

Meanwhile, other approaches to semantic analysis which appear to be worthwhile from the point of view of capturing TFA have appeared as well. There are three impulses which we consider to be particularly promissing in this context: Rooth's *alternative semantics*, Groenendijk's and Stokhof's dynamization of logic, and Partee's elaboration of the notion of a tripartite structure.

4. Topic = Subject & Focus = Predicate?

The subject-predicate pattern has been considered as central to language since Antiquity. On the syntactic level this means that a typical sentence consists of a subject (nominal phrase) and a predicate (verbal phrase). On the semantic level it means that the content of a typical sentence can be considered as an assignment of a property to an object.

In the typical case the syntactic (grammatical) subject coincides with the semantic (logical) subject, and the syntactic predicate with the semantic one. Most linguists have restricted their attention to the syntactic side of the pattern; philosophers and logicians, who are intrinsically interested in the semantic pattern, have, on the other hand, usually tacitly considered it to coincide with the syntactic one. However, the identification of the syntactic subject-predicate pattern with the semantic one is unwarranted; and those who have really understood the nature of language have avoided it. Thus Frege, who sees the semantic subject-predicate pattern as constitutive of the object-concept opposition, remarks, that it need not be the grammatical subject which acts as the semantic or logical one: "Die Sprache hat Mittel, bald diesen, bald jenen Teil des Gedankens als Subjekt erscheinen zu lassen." (Frege, 1892, p.74). TFA can be considered as just this kind of means.

Let us consider a simple sentence (1) and its first-order formalization (1')

John walks (1)
Walk(**John**) (1')

The syntactic subject-predicate pattern of (1) is unequivocal: *John* is the subject and *walks* is the predicate. Sgall et al. (1986) suggested that due to the impact of TFA the pattern comes to be modified: if we say (2), then what we express seems to be not the property of walking assigned to the individual John, but rather the property of being John assigned to an anonymous walker.

JOHN walks (2)

One might here evoke the idea that the power of TFA is reminiscent of lambda abstraction: what we do when focusing *John* resembles what we do when making a predicate, λf.f(**John**), out of **John** and then applying it to

Walks. Hence (2) might seem to be appropriately formalizable by (2').

λf.f(**John**)(**Walks**) (2')

However, this idea, although based on a sound intuition, is not without its drawbacks. The point is that (2') lambda-converges to (1') and that it is hence equivalent to (1'). Thus if we consider a logical formula a mere means of presenting a proposition, then it makes no difference whether we analyze (1) as (1') or as (2'): in both cases we render (1) as expressing the same proposition.

This might seem to lead to the conclusion that what has been considered as the articulation of the subject-predicate pattern brought about by TFA is not a semantically relevant matter; and this would mean that it is a matter relevant in no way, since it is surely not relevant syntactically. The syntactic patterning is left unchanged in (2).

However, what really makes a sentence into a predication is the fact that one of its parts is "about" the other part. The (semantic) subject is what the sentence is about, predicate is what it says about the subject. What does this *"about"* mean? Well, it, first and foremost, means that the subject is taken for granted for the whole sentence, its existence is not being disputed. This is to say that the subject is connected with a presupposition. If I say about John that he walks, then the fact that there is no John (i.e. nobody known to the interlocutors under this name) makes the statement meaningless rather than false; in contrast to this, if there is a John, but he does not walk, then the statement is simply false. (Classical Russellian examples with the king of France are probably more perspicuous, but proper names are also subject to presuppositions).

Let us write ‖X‖ for the extension of an expression 'X' (hence ‖X‖ will be a truth value if 'X' is a sentence, an individual if 'X' is a term, and a class of individuals if 'X' is an unary predicate)[2]. Let us with every expression X associate a proposition whose extension we denote by |X| (to be understood as a presupposition associated with X) in the following way:

|X| = ‖X‖ if X is a sentence
= ‖∃y.y=X‖ if X is a term
= ‖∃y.X(y)‖ if X is an unary predicate

Now we can define the semantics of a formula P{S} (to be understood as the "real" predication of P of S) as follows:

$$\begin{aligned} \|P\{S\}\| &= T \text{ iff } |S| = T \;\&\; \|P(S)\| = T \\ &= F \text{ iff } |S| = T \;\&\; \|P(S)\| = F \\ &= 0 \text{ iff } |S| = F \end{aligned}$$

Appropriate formalizations of (1) and (2) now are (1") and (2"), respectively.

Walk{**John**}	(1")
λf.f(**John**){**Walk**}	(2")

If both (1") and (2") do have truth values, then these truth values coincide; however, it might be the case that (1") is false, while (2") lacks a truth value (in the case when ∃x.**Walk**(x) is false), as well as vice versa (in the case when ∃x(x=**John**) is false).

Let us consider a complex sentence, (3). If we accept the subject-predicate pattern articulated by means of {} as a standard pattern of a natural language sentence, then there seem to be the formalizations (3a)-(3d), and possibly also the two degenerated cases (3e) and (3f).

John loves Mary	(3)
λy.**love**(y,**Mary**){**John**}	(3a)
λx.**love**(**John**,x){**Mary**}	(3b)
λf.f(**Mary**){λy.**love**(**John**,y)}	(3c)
λf.f(**John**){λx.**love**(x,**Mary**)}	(3d)
λf.f(**love**(**John**,**Mary**)){}	(3e)
{λf.f(**love**(**John**,**Mary**))}	(3f)

From these, (3f) would seem to be ruled out by the fact that a sentence has to contain some nonpresupposed information; the 'thetic' reading (3e), however, would seem to be, possible[3].

And it is this 'thetic' reading, as well as the reading (3a) in which the semantic subject-predicate pattern coincides with the syntactic one, which may be considered the preferred reading of (3). (3c) is then the preferred reading of (3') and (3d) of (3"); but (3') may also be read as (3a). The reading of (3") as (3b) might also ge feasible, although not quite regular.

John loves MARY (3')
JOHN loves Mary (3")

5. Quantifier Scope

In the case of (1), or of (3), the difference between various TFA's is the difference in presuppositions, and hence can be considered as a matter of felicity conditions rather than of truth conditions in the strict sense. Not so, however, if we take into account sentences with two quantifiers. Let us consider (4): if we adhere to the Montagovian treatment of quantified noun phrases, then the analogues of (3a)-(3d) would be (4a)-(4d).

Every man loves a woman (4)
$\lambda M.M(\lambda x.\exists y.(\mathbf{woman}(y)\&\mathbf{love}(x,y)))\{\lambda Q.\forall x.(\mathbf{man}(x)\rightarrow Q(x))\}$ (4a)
$\lambda M.M(\lambda y.\forall x.(\mathbf{man}(x)\rightarrow\mathbf{love}(x,y)))\{\lambda Q.\exists y.(\mathbf{woman}(y)\&Q(y))\}$ (4b)
$\lambda Q.\exists y.(\mathbf{woman}(y)\&Q(y))\{\lambda y.\forall x.(\mathbf{man}(x)\rightarrow\mathbf{love}(x,y))\}$ (4c)
$\lambda Q.\forall x.(\mathbf{man}(x)\rightarrow Q(x))\{\lambda x.\exists y.(\mathbf{woman}(y)\&\mathbf{love}(x,y))\}$ (4d)

If we disregard felicity conditions, i.e if we replace {} by simple parentheses, then (4a) would reduce to (4a') and (4b) to (4b'), while (4c) in turn to (4c') and (4d) to (4d'). (4a') then further reduces to (4c') and (4b') to (4d'); but (4c') and (4d') are substantially different, hence different TFA's of (4) lead not only to different felicity conditions, but to quite different propositions.

$\lambda Q.\exists y.(\mathbf{woman}(y)\&Q(y))(\lambda y.\forall x.(\mathbf{man}(x)\rightarrow\mathbf{love}(x,y)))$ (4a')
$\lambda Q.\forall x.(\mathbf{man}(x)\rightarrow Q(x))(\lambda x.\exists y.(\mathbf{woman}(y)\&\mathbf{love}(x,y)))$ (4b')
$\exists y.(\mathbf{woman}(y)\&\forall x.(\mathbf{man}(x)\rightarrow\mathbf{love}(x,y)))$ (4c')
$\forall x.(\mathbf{man}(x)\rightarrow\exists y.(\mathbf{woman}(y)\&\mathbf{love}(x,y)))$ (4d')

This implies that in this case TFA is not just a matter of felicity conditions, it is something that results in different orders (and hence different scopes) of quantifiers. Hence (4a) and (4b) (or (4c) and (4d)) can have different truth values; and they will have different values in the case when every man will have a loved woman of his own, but there will be no single woman that would be loved by every man.

6. Focus = Exhaustive Listing?

Besides the subject-predicate character of the topic-focus pattern, there is another characteristic feature of the pattern, namely that focus in some sense has the character of exhaustive listing.

If we utter (2), then what we say is not only that there is a man who walks, but also that the walking man is the only entity that walks. The *only* is, of course, not quite determinate: the range of entities with respect to which it is meant may be in various senses determined by the context.

If we, following Rooth (1985) and Krifka (ms.), assume that for any expression X there is a class ALT(X) of its alternatives, then we can define the sentence P!(T) (to be understood as the "unique" predication of P of T) by the following prescription:

$$\|P!(S)\|=T \text{ iff } \|P(S)\|=T \,\&\, \forall P'[P'\in ALT(P)\&\|P'(S)\|=T\rightarrow\|P\|=\|P'\|]$$

However, it would seem to be more plausible to consider ALT as operating on the level of semantics rather than on that of syntax. If we write $\|X\|_I$ for the extension of X under the interpretation I, and if $I_{[P/p]}$ denotes the interpretation which is like I with the only possible exception that it assigns p to P, then we can write[4]

$$\|P!(S)\|_I=T \text{ iff}$$
$$\|P(S)\|_I=T \,\&\, \forall p.[p\in ALT(\|P\|_I)\&\|P(S)\|_{I[P/p]}=T\rightarrow\|P\|_I=p]$$

In this case ALT is a function mapping elements of the model structure on classes of such elements. It is reasonable to assume that if p is an element of a domain D, then $ALT(p)\subseteq D$. In the simplest case we may let ALT(p)=D, i.e. we may let the set of alternatives coincide with the whole domain. In such a case P!(S) says the same as $\lambda f.f(S)=\{P\}$ or $\iota f.f(S)=P$; i.e. it says that P is the only property instantiated by S. For nontrivial choices of ALT, P!(S) says that P is the only one of some restricted classes of properties that are instantiated by S.

Let us now forget (for the sake of simplicity) about presuppositions and let us consider (3) from the point of view of exhaustiveness of focus.

The four basic readings are

λy.**love**(**Mary**,y)!(**John**)	(3a')
λx.**love**(**John**,x)!(**Mary**)	(3b')
λf.f(**Mary**)!(λy.**love**(**John**,y))	(3c')
λf.f(**John**)!(λx.**love**(x,**Mary**))	(3d')

Let us first turn our attention to (3c') and (3d'). (3c') says that the class of all Mary's properties is instantiated by the property of being loved by John, and that none of its alternative is; (3c') says that the class of all John's properties is instantiated by the property of loving Mary, and that none of its alternative is. As any property surely belongs to more than one class of properties, we clearly need a nontrivial notion of an alternative. However, it seems to be clear what should count as such an alternative: any class of all the properties of an individual. If we conceive alternatives in this way, then (3c') says that Mary is the only individual loved by John and (3d') says that John is the only individual that loves Mary.

In the case of (3a') and (3b') the need of a nontrivial notion of an alternative is also quite evident (to love Mary is surely in no case the only property of John), but in this case no plausible notion seems to be at hand. The problem is that under the standard treatment of properties, *any* class including an individual (or any function from possible worlds to classes of individuals such that its value in the actual world includes the individual) is considered a property of the individual; so any individual is sure to instantiate a vast amount of properties. It seems that the trouble is grounded partly in the very nature of properties and partly in the way in which properties are approached within modern logic. (If we, contrary to the usual way, treated properties as primitives and individuals as classes of properties, then the problem might be with (3c') and (3d') rather than with (3a') and (3b').)

Hence it seems to be in general more appropriate to consider ALT nontrivial, to add it as a new element of the model structure that can be changed by the ongoing utterances. From such a notion there leads a direct path to both the concept of stock of shared knowledge as discussed by Sgall et al. (1986), and, on the other hand, to the dynamic notion of semantics to be discussed below.

7. Falsity vs. Inappropriateness

Combining {} and ! we come to the following definition

$$\begin{aligned}\|P!\{S\}\|_I = T \text{ iff } & |S|_I = T \;\&\; \|P(S)\|_I = T \;\&\\ & \forall p.[p \in ALT(\|P\|_I) \;\&\; \|P(S)\|_{I[P/p]} = T \rightarrow \|P\|_I = p]\\ = F \text{ iff } & |S|_I = T \;\&\; (\|P(S)\|_I = F \vee\\ & \exists p.[p \in ALT(\|P\|_I) \;\&\; \|P(S)\|_{I[P/p]} = T \;\&\; \|P\|_I \neq d])\\ = 0 \text{ iff } & |S|_I = F\end{aligned}$$

This seems to be an adequate expression of the way in which a sentence can be considered as articulated out of the topic and focus: it takes into account both the predicative character of the articulation, and the exhaustive character of the focus.

We may distinguish three cases of situations in which P!{S} comes to be false:

1. P!(S) is false, whereas P(S) is not. In this case we may speak about a *failure of exhaustiveness*. An example of a sentence which would not be true purely due to the failure of exhaustiveness is *German is spoken in AUSTRIA*. Disregarding TFA the sentence is surely true; however, with the indicated stress and the consequent TFA it is a sentence the utterance of which may cause a serious misguidance (suggesting that Austria is *the* country, or at least *the most representative* country in which German is spoken).
2. P{S} is not true, whereas P(S) is. This is the case of *failure of presupposition*. A case of presupposition failure is the sentence *François MITTERAND is the present king of France*. Disregarding TFA the sentence would not be true (notice, however, that in that case no presupposition would fail). With the indicated TFA (i.e. with *the present king of France* in the topic) it is not simply false, it makes the hearer wonder what the speaker is talking about.
3. P(S) is false. In this case we can speak simply about *failure of the subject matter*.

Hence we have three levels of falsity (or, better put in a weaker way, of a breakdown in communication). The extreme, straightforward level is the failure of the subject matter; with respect to the other two levels it is dubious whether it is appropriate to speak about falsity at all. In the case of the falsity of presupposition, the sentence is usually regarded not as false, but rather as lacking a truth value. In the case of the failure of exhaustiveness the falsity is even more subtle.

8. Negation

A positive sentence is usually considered as a means of asserting that its predicate holds about its subject; a negative sentence as that of asserting that this is not the case. If we use the classical predicate calculus, then a positive sentence is understood as P(S), whereas its negative as ¬P(S), as being true just in case P(S) is false. However, we have seen that the semantically relevant subject-predicate patterning of a sentence is a matter far from being this simple.

We have seen that TFA makes it possible to make almost any part of a sentence into a semantic subject, and that it is this part which is usually connected with a presupposition. There is a corresponding reading of its negative counterpart for every reading of a positive sentence, hence in the case of (5), the negation of (3), we have the following possibilities[5]

John does not love Mary	(5)
¬ λy.**love**(y,**Mary**)!{**John**}	(5a)
¬ λx.**love**(**John**,x)!{**Mary**}	(5b)
¬ λf.f(**Mary**)!{λy.**love**(**John**,y)}	(5c)
¬ λf.f(**John**)!{λx.**love**(x,**Mary**)}	(5d)
¬ λf.f(**love**(**John**,**Mary**))!{}	(5e)

However, these do not exhaust the readings of the negative sentence: there are, moreover, readings in which the negation is "internal", and which should thus be considered as cases of positive predication of a negative predicate. These additional readings are (5f) and (5g).

λf.f(**Mary**)!{λy.¬**love**(**John**,y)}	(5f)
λf.f(**John**)!{λx.¬**love**(x,**Mary**)}	(5g)

Note that the presupposition of (5f) is that there is someone whom John does not love, and that of (5g) is that there is someone who does not love Mary; hence these two readings are really different from all the previous ones. If no stress is on *John*, then (5b), (5d) and (5g) are ruled out, and thus, leaving the thetic reading (5e) aside, we have three basic readings of (5), namely (5a), (5c) and (5f) (cf. Hajièová, 1984).

What is beyond discussion is that the negation of a reading of a sentence is true if the reading of the sentence is false due to the fallacy of the subject matter. The cases of the other two fallacies are open to discussion: it seems to be commonly accepted that in the case of presupposition failure the relevant sentence lacks a truth value; hence its negation also lacks a truth value.

9. Dynamic Semantics

There is a background, an environment, of an utterance which is determined by the context of the utterance, especially by the utterances immediately preceding it. Any utterance changes this background. If we see the background as a kind of a stack (a *stock of shared knowledge*, as Sgall et al., 1986, put it), then we can say that an utterance may add new items and in so doing it may concurrently force the less salient items out of the stack. We may see these changes in the environment as a mere side-effect of discourse; it is, however, ever more clear that they should be rather seen as something quite essential.

One way to account for this dynamic aspect of language has been formulated within the framework of the dynamic logic due to Groenendijk and Stokhof (1989a; 1989b). This theory identifies the phenomenon of the environment's influencing of individual utterances (and then itself being changed by them) with an assignment of values (*discourse referents*) to special kind of terms (*discourse markers*). This engenders an essential perspectival change upon the meaning of a sentence: the meaning is now no longer considered as a truth value or a class of possible worlds, but as a medium of changing environment, hence a function from states of the environment into states of the environment. In this way the semantic account of natural language more nearly approaches that proposed earlier for programming languages - natural language becomes to be envisaged as an implicit *command* language instead of as a *declarative* language.

Each formula of the dynamic logic is associated with a set of ordered pairs of assignments (of objects to discourse markers); we shall denote the set of pairs of assignments associated by F as [F]. If $\langle g,g' \rangle \in [F]$ for a formula F, then this means that the evaluation of F with g as the "input environment" succeeds, and yields g' as the "output environment". If $\langle g,g' \rangle \in [\mathbf{man}(a)]$ (where *a* is a discourse marker), then g is an assignment which does not associate a non-man with *a* (i.e. that g(a) either is a man or it is undefined), and g' is like g with the single possible difference that it

associates a man with *a*. ‖F‖, the truth value of F, can be now considered as T if and only if [F] is nonempty.

The rule for dynamic conjunction is as follows: <g,g'>∈[F&G] iff there is an assignment h such that <g,h>∈[F] and <h,g'>∈[G]. This means that & no longer plays the role of the usual classical connective within dynamic logic, but has become instead an operator of concatenation. The evaluation of a formula F changes the environment E of its evaluation to a new environment E'; the meaning of F is the way in which it changes the environment. If the evaluation of F changes E to E' and that of G changes E' to E", then the evaluation of F&G changes E to E". This indicates that F&G need not be the same as G&F: if e.g. F changes E1 to E2 and fails in E3 and if G changes E2 to E4 and E1 to E3, then F&G changes E1 to E3, while G&F fails in E1. This brings about a new kind of sensitivity which may be utilized for capturing the linear order of items in an utterance. However, and here is where TFA may enter the scene, it is not the surface word order that is really relevant, it is rather the "deep" one, the one corresponding to the scale of communicative dynamism (with topic being always less dynamic than focus).

The dynamic framework seems to be well suited for the treatment of TFA; it seems that topic and focus can be treated as two ongoing utterances. If we interpret a sentence and fail during the evaluation of the topic, the sentence is meaningless or at least inappropriate; whereas when we succeed in evaluating the topic, but fail during the evaluation of focus, the sentence is simply false[6].

However, we have so far treated topic and focus as the subject and the predicate of a single sentence; to accommodate our treatment within the dynamic framework we would have to treat them as two sentences uttered subsequently. But this can in principle be done: it is enough to realize that to say that P(S) is true is to say that there exists an assignment of a value to x that satisfies P(x) & x=S. The two new modes of predication we have denoted by {} and !() can now be turned into two new modes of conjunction (or, better, concatenation): the idea is that F}&G (corresponding to G{F}) has a truth value iff F is true, and it is true iff F&G is; F&!G is true iff F&G is true and F&G' is true for no nontrivial alternative G' of G.

However, the embodiment of these ideas into the dynamic framework is far from being trivial. The embodiment of }& meets the complication that dynamic logic is essentially two-valued. We may

introduce }& by the rule below; however, this rule does not establish a real semantics for }&, since it does not specify the value [F}&G] and hence is not applicable recursively.

$$\begin{aligned}\|F\}\&G\| &= T \text{ iff } [F\&G] \neq \emptyset \\ &= F \text{ iff } [F] \neq \emptyset \text{ and } [F\&G] = \emptyset \\ &= 0 \text{ iff } [F] = \emptyset\end{aligned}$$

Far deeper problems concern the embodiment of &!. If we articulate the above mentioned idea, we have

$$\|F\&!G\| = T \text{ iff } \|F\&G\| = T \,\&\, \forall G'[G' \in ALT(G) \& \|F\&G'\| = T \rightarrow \|G\| = \|G'\|]$$

But if $\|G\|$ is, as so far, the truth value of G, then $\|G\| = \|G'\|$ is a condition far too weak to be satisfactory. We may try to substitute [G] for $\|G\|$ and so we can write

$$\langle g,g' \rangle \in [F\&!G] \text{ iff } \exists k \langle g,g' \rangle \in [F\&G] \,\&\, \forall G'[G' \in ALT(G) \& \langle g,g' \rangle \in [F\&G'] \rightarrow [G]=[G']]$$

but neither is this what we need; since for any two sentences G, G' containing no discourse markers [G]=[G'] trivially. Moreover, as Krifka(ms.) duly points out, the notion of alternative should depend on the environment of evaluation, so that the rule should look somewhat as follows:

$$\langle g,g' \rangle \in [F\&!G] \text{ iff } \exists k \langle g,k \rangle \in [F] \,\&\, \langle k,g' \rangle \in [G] \,\&\, \forall G' \forall h[G' \in ALT_k(G) \& \langle k,h \rangle \in [G] \rightarrow "G \approx G"']$$

Leaving technical problems aside, we can indicate the way in which (1) should be rendered in the dynamic framework by (1"), while (2) would be rendered by (2").

(a=**John**) }&! **walk**(a) (1")
walk(a) }&! (a=**John**) (2")

The first formula is to be true if there is someone who is John, if he walks, and if everyone who is John walks. Hence it is to be true just when **walk**!(**John**) is true. The second formula is to be true if there is someone

who walks, if it is John, and if everyone who walks is John; this means that it is to be true just when λf.f(**John**)!(**walk**) is true.

10. The Tripartite Structure

Partee (1991) has stressed the role of the notion of a tripartite structure as a universal pattern usable also for the analysis of TFA. A sentence of the shape *Det NP VP* can be considered as a tripartite structure consisting of an *operator* (determiner), a *restrictor* (noun phrase) and a *nuclear scope* (verb phrase). Such a sentence is true (w.r.t. a possible world) if the extension of the restrictor and that of the nuclear scope are in a relation determined by the operator.

Partee claims that the tripartite pattern is of greater generality than simply to cover the case of the basic grammatical structure of simple sentences; and she claims that the pattern is also useful for the analysis of the sentence considered not as a grammatical structure, but rather as a structure consisting of a topic and a focus. This is in accordance with what has been claimed above: that topic and focus are "in fact" subject and predicate. Moreover, what has been stated with respect to the exhaustive listing character of the focus means that the determiner that is to be implicitly present is of the kind of *only*[7].

The concept of a tripartite structure is closely connected with the theory of generalized quantifiers. If both the restrictor and the nuclear scope can be considered to stand for a class, then the determiner can be considered as a relation between sets or as a function assigning a set of sets to a set. The determiner *a* can be, for example, considered as a function that to every set s assigns the class S of sets such that s'∈ S holds just in case s and s' are not disjoint; *A man walks* is then true if this relation holds between the extension of *man* and that of *walks*.

However, the picture that a sentence of the structure *Det NP VP* is true iff the extension of its *NP* and that of its *VP* stand in the relation determined by its *Det* is plausible provided that we disregard TFA. Let us consider the sentence *A MAN walks*. Its grammatical structure leads to its analysis as the generalized quantifier *a* applied to *man* and *walk*, which renders the sentence true iff the set of men is not disjoint with the set of walkers. However, the TF-tripartite structure of the sentence leads rather to

its analysis as an implicit determiner *only* applied to *walks* and *a man*, rendering the sentence true iff the set of walkers is included in a set consisting of a single man. But to treat the combination of topic and focus as a tripartite structure based on the implicit generalized quantifier *only* we would have to interpret *a man* as a set, which seems to be implausible.

The general picture is that the operator of the "grammatical" tripartite structure somehow moves into the restrictor of the "topic-focus" tripartite structure making place for *only*. The problem is that while originally we have a determiner (e.g. *a*) of the type (in an extensionalized Montagovian notation) <<e,t>,<<e,t>,t> applied to two predicates (e.g. *man* and *walk*) of the type <e,t>, then we have the determiner *only* applied to a quantifier of the type <<e,t>,t> (*a man*) and a predicate (*walk*); and no plausible type-theoretical treatment seems to be at hand. We would need *a man* to be of the type <e,t>; but this would mean that we would have to consider *a* as of the type <<e,t>,<e,t>>.

One way to substantiate considering *a man* as an expression of the type <e,t> is to consider it as having "distributed reference", referring to a class of individuals, not, however, to one definite class, but rather to any element of a class of classes of individuals, namely to any one-element class of men. Such a view engenders a substantial change to the whole semantic framework: expressions come to be considered as having alternative references and a sentence is considered true if there exists at least one reference that renders it true. However, this change in the framework is not totally alien to the spirit of contemporary semantics: it is in fact quite close to the basic idea of DRT.

If we consider *man* as capable of referring to any class of men, then *a* can be considered as a filter retaining some of these interpretations (the one-element ones) for *a man* and filtering out the others. That this treatment is universally available for every monotone increasing quantifier follows from the following consideration.

If we denote the standard interpretation of Det, a function mapping sets on classes of sets, as $\|\mathrm{Det}\|$, then the truth value of the sentence will be $\|\mathrm{Det}\|(\|\mathrm{NP}\|)(\|\mathrm{VP}\|)$. $\|\textit{every}\|(X)$ will be $\{Y \mid X \subseteq Y\}$ for every set X; $\|a\|(X)$ will be $\{Y \mid X \cap Y \neq \emptyset\}$ for every set X.

The quantifier $\|\mathrm{Det}\|(X)$ is supposed to "live on" X for every Det and S; this means that $Y \in \|\mathrm{Det}\|(X)$ if and only if $Y \cap X \in \|\mathrm{Det}\|(X)$[8]. If we denote the class $\{Y \mid \exists Z.(Z \in \|\mathrm{Det}\|(X) \,\&\, Y = X \cap Z)\}$ as $\|\mathrm{Det}\|^*(X)$, then clearly $Y \in \|\mathrm{Det}\|(X)$ iff $Y \cap X = \|\mathrm{Det}\|^*(X)$, i.e. iff $\exists Z.(Z \in \|\mathrm{Det}\|^*(X) \,\&\, Z = Y \cap X)$. Moreover, if $\|\mathrm{Det}\|(X)$ is monotone increasing,

then $Y \in \|\text{Det}\|(X)$ iff $\exists Z.(Z \in \|\text{Det}\|^*(X) \& Z \subseteq Y \cap X)$; hence, as $Z \in \|\text{Det}\|^*(X)$ implies $Z \subseteq X$, iff $\exists Z.(Z \in \|\text{Det}\|^*(X) \& Z \subseteq Y)$[9].

Let us consider the sentence *Every man walks*. Let us consider $\|man\|$ the class of all men and $\|walk\|$ the class of all walkers. $\|every\|(X)$ is the class of all supersets of X; hence $\|every\|^*(X) = \{Y|\exists Z.(Z \in \|every\|(X) \& Y = X \cap Z)\} = \{Y|Y = X\} = \{X\}$. This means that the sentence is true iff there is an $X \in \|every\|^*(\|man\|)$ such that X is included in $\|walk\|$. Hence, as the only member of $\|every\|^*(\|man\|)$ is $\|man\|$, i.e. the set of all men, the sentence is true if and only if the set of all men is included in the set of all walkers. Similarly for *A man walks*: $\|a\|(X)$ is the class of all the sets not disjoint with X; hence $\|a\|^*(X) = \{Y|\exists Z.(Z \in \|a\|(X) \& Y = X \cap Z)\} = \{Y|Y \subseteq X \& Y \neq \emptyset\}$. Thus, the sentence is true iff there is an $X \in \|a\|^*(\|man\|)$ such that X is included in the set of all walkers; hence, iff there is a nonempty subset of the set of all men that is also a subset of the set of all of walkers.

These ideas have been in a somewhat more cumbersome way outlined by Peregrin and Sgall (1986) and also by Peregrin (1987). It has been shown that they can be useful for the purpose of accounting for TFA in a dynamic framework based on the DRT-like ideas (although DRT did not serve as its explicit foundation). Here we can see that they can illuminate the interplay between the "grammatical" tripartite pattern and that which results from TFA considerations.

11. Conclusion

The aim of the present paper has not been to develop a definite formal theory of TFA, its aim was rather to overview the different possibilities of the formal description of topic and focus holding the Prague notion of TFA particularly in regard.

From the logico-semantic point of view there are three aspects of TFA which are relevant. First, differences in TFA mean differences in the "deep word order" which may result in differences in the scopes of quantifiers. Second, topic is usually connected with a presupposition; hence different TFA's may lead to different felicity conditions (to different classes of possible worlds in which the sentence has a truth value). Third, at least

under some conditions, TFA purports the exhaustive listing readings with respect to focus, it causes a sentence to behave ina way as if it contained an overt *only*.

We have seen that some of these aspects can be accommodated as fairly straightforward extensions of the predicate calculus; but we have also indicated that dynamic logic might be a more suitable framework. We have, moreover, shown that picturing the TF-articulated sentence as a tripartite structure is fruitful, and we have floated the possibility of merging this view with that of dynamic semantics.

Notes

1 The author thanks Petr Sgall, Eva Hajièová, Barbara Partee and Mannfred Krifka for their willingness to share their views of the matters addressed here with him. Moreover, the exposition of the Praguian approach to topic-focus articulation presented here would hardly be adequate without the thorough help of Petr Sgall.

2 For the sake of simplicity we shall work with extensions where possible. However, the relativization to possible worlds is obvious.

3 The possibility of the thetic reading of (3) may be disputable due to the proper name in the subject position; in the case of a sentence such as *A man loves a woman* it would be quite regular.

4 Note that the formal difference between the "syntactic" variant of ALT and the "semantic" one is parallel to the difference between substitutional and objectual quantification. If there are no "nameless" entities, then these notions give the same results.

5 As was found with the thetic reading (3e) itself, its negation (5e) is also not quite regular.

6 This is indeed a simplification: the situation is more complicated due to the existence of presuppositions triggered by (parts of) the focus, e.g. by the object clauses of factive verbs.

7 The situation can be, indeed, more complicated when explicit focalizers other than *only* are involved.

8 See Barwise and Cooper(1981).

9 $\|\mathrm{Det}\|^{*}(S)$ is in fact the set of all the sets which Barwise and Cooper(1981) call witness sets for $\|\mathrm{Det}\|(S)$.

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