Abstract

A semantic analysis of topic and focus as two parts of tectogrammatical representation by means of transparent intensional logic (TIL) is presented. It is pointed out that two sentences (more precisely, their tectogrammatical representations) differing just in the topic/focus articulation (TFA) denote different propositions, i.e. that TFA has an effect upon the semantic content of the sentence. An informal short description of an algorithm handling the TFA in the translation of tectogrammatical representations into the constructions of TIL is added. The TFA algorithm divides a representation into two parts corresponding to the topic and focus; every part is analyzed (translated) in isolation and then the resulting construction is put together. The TIL construction discussed here reflects the scope of negation and some of the presuppositions observed.

1. Introduction: Transparent intensional logic

One of the current tasks of semantic studies consists in finding a procedure translating the disambiguated linguistic meanings of sentences (see Spall et al., 1986) into the constructions of intensional logic. The core of such procedure was developed (VLK, 1987), but a description of this procedure exceeds the scope of the present paper. The aim of this paper is rather to present some ideas used in the algorithm handling the topic/focus articulation within the translation.

Sufficient means for the semantic analysis of natural language are given by Tichy’s Transparent intensional logic (TIL). Referring to exact definitions to Tichy (1980) and Materna (1985), we reproduce here only a brief characterization of TIL.

Let $\sigma = \{T, F\}$ be a set of truth-values, let $\mathcal{L}$ be a set of individuals (the universe of discourse) and let $\omega$ be a set of possible worlds (the logical space). Then $B = \{\sigma, \mathcal{L}, \omega\}$ is an epistemic basis. Then

(i) any member of $B$ is a type over $B$,

(ii) if $\tau_1, \ldots, \tau_n$ are types over $B$, then $\langle \tau_1, \ldots, \tau_n \rangle$ is a type over $B$, where $\langle \tau_1, \ldots, \tau_n \rangle$ is the set of (total and partial) functions from $\tau_1 \times \ldots \times \tau_n$ to $\sigma$,

(iii) the types over $B$ are just those introduced in (i),(ii).

Any member of type $\tau$ is called an object of type $\tau$, or a $\tau$-object. An object is an $\tau$-object for any $\tau$.

For every type a denumerably infinite set of $\tau$-variables is at our disposal. The constructions are the ways in which objects can be given. They are defined inductively:

(i) any $\tau$-object, and also any $\tau$-variable, is an $\tau$-construction (called the atomic construction).

(ii) let $F$ be a $\langle \tau_1, \ldots, \tau_n \rangle$-construction, $x_1$ a $\tau_1$-construction for $i = 1, \ldots, n$. Then the application $F(x_1, x_2, \ldots, x_n)$ of $F$ to $x_1$, $x_2$, $\ldots, x_n$ is an $\tau$-construction.

(iii) let $Y$ be an $\tau$-construction and $x_1, x_2, \ldots, x_n$ distinct variables of types $\tau_1, \ldots, \tau_n$ respectively. Then the abstraction $\lambda x_1 x_2 \ldots x_n. Y$ of $Y$ on $x_1, x_2, \ldots, x_n$ is a $\langle \tau_1, \ldots, \tau_n \rangle$-construction.

(iv) there are no constructions except those defined in (i)-(iii).

Let us characterize some important objects of TIL. For every type $\tau$ we have objects $\tau^1$, $\tau^2$ of the type $\langle \tau \omega \tau \rangle$, such that (i) and (ii) hold:

(i) $[\tau^1 X] = \text{if } X \text{ is empty class then } T \text{ else } \tau$

(ii) $[\tau^2 X] = \sim [\tau^1 X] (X Y)$

For every type $\tau$ we have the $\tau$-singularizer $\iota$ of the type $\langle \tau \omega \rangle$, which is defined on single-element $\tau$-classes only and returns the single element of the respective class. Propositions are objects of the type $\langle \tau \omega \rangle$.

The following notation will be used throughout the paper. The outermost parentheses and brackets will be sometimes omitted. Furthermore, a dot will represent a left bracket whose corresponding right bracket is to be imagined as far to the right as is compatible with other pairs of brackets. The notation with an apostrophe will be used in the following meaning:

$X' = \{X \in X \mid \text{if } X \text{ is of type } \langle \tau \omega \rangle \text{ for any } \tau \}$

where $X$ is a construction and $v$ is a particular $\omega$-variable.

We write $\exists X. Y$ in place of $\tau^1 \lambda X. Y$ and $\Psi X. Y$ in place of $\tau^2 \lambda X. Y$, $\tau. X. Y$ in place of $\langle \tau \rangle \lambda X. Y$.

Logical connectives and identity will be written in the standard way, e.g. $\& b, a \equiv b$ in place of $\langle \tau \rangle \& \; b, \langle a \equiv b \rangle$ respectively.

2. The topic/focus articulation

The procedure is divided into two parts: into the Basic algorithm handling such phenomena as the scope of quantifiers, several kinds of reference, and so on, and the TFA algorithms handling the topic/focus articulation (TFA). The Basic algorithm is recursively applied to all subtrees of the dependency tree and returns the construction(s) corresponding to the subtree. The TFA algorithms divides the dependency tree into two parts corresponding to the topic and to the focus, respectively; either part is translated by the Basic algorithm, and then the resulting construction is put together.

The topic/focus articulation (TFA) plays a crucial role in analysis of the presupposition, of the scope of negation and also of the so called exhaustive listing (see Spall, Hajcova, Panenova, 1985, Hajcova 1974, 1984). First, its importance will be shown on an extremely simple 'toy' example; we will then discuss some problems in detail in connection with other examples.

Informally, the topic of a sentence is that the sentence talks about, and the focus is what the sentence says about the topic. A formal definition of topic and focus as two parts of the tectogrammatical
A. About Charles and Mary

Let us consider the examples:

(2a) Charles didn’t marry.

(b) Charles didn’t marry Mary.

(c) Charles didn’t marry Mary.

(d) Charles didn’t marry Mary.

Now (2) belong to the category according to the "contextual reading" or the reference. We can consider the constructions corresponding to the explicit mention.

Example 1: Construction

Want: "Look! Didn’t marry!"

Mary: Charles; Mary, if it’s incorrect.

Now we can eliminate the constructions they are associated only by direct knowledge the double individual;

(2'c) (a) Have (Focus2: Topical) "I’ve got! Charles y"

(b) Charles = Mary (Charles)

(c) I’ve got! (Focus2: Topical) "Charles = Mary (Charles)"

(d) Charles = Mary

Now (2'c) be corresponded have the work "Charles does not marry!" The construction (2'c) can be corresponded in the following way:

(2'c) (a) Don’t marry the Charles at

(2'c) Charles that Charles at

(2'c) Charles that Charles are not marry.

(2'c) Charles that Charles are not marry.

Now (2'c) be considered. Have the work "Charles does not marry!" The construction (2'c) can be corresponded in the following way:

Do these constructions reflect prepossession, negation and exclusive listing as observed in (2)? The "double-individual" is not defined on the empty class, i.e. the propositions (2'a,b) are undefined in those possible worlds where Charles met nobody, and (2'c) is undefined in those possible worlds where Charles met everybody. Also the two scopes of negation corresponding to the contextually bound and non-bound operator of negation are distinguished by (2'a) and (2'b). In (2'c) and (2'c) the equality says that Mary are the only one individual with the given property, i.e. the constructions reflect the exhaustive listing.

Nevertheless, at least two objections to these constructions can be raised:

1. In (2) Mary is not the single individual in the world that Charles met, but the single one in the given context, the single one from all currently present in the speaker’s view. The construction

Mary = Charles y

should be substituted by

Mary = Charles x & to x
where a is a given (not-variable) that is to be considered in every condition (statement) with a class of individuals admitted in the street of knowledge admitted by speaker and hearer. As may be inferred concerning the content and the street of admitted knowledge are not yet specified, we still neglect it in this paper.

The proposition of (2a-1) established by the left-operator in this theory. It requires that the choice under the left-operator has only one element. In case Charlie is not more than one individual (2'a) would be undetermined, but C(a) would be value in this situation. Of Charlie not for example Jane and two, containing C we would follow, because if was only the Charlie set. Exp Charlie and Jane, the statement (2'a) would be (2'a) almost purely, because the corner part of (2a) in not an unambiguous linking, it does not include Jane. Consider the sentence

(1) Charlie and Jane.

It is not possible to express (1) as conjunction of two sentences. Charlie and Jane and Charlie and Johny because the form of (1) is an unambiguous linking of individuals that Charlie not. The topic of (1) is to be the same as in (2a). Therefore, the propositions of both sentences in the same. The topic of both sentences determines a chain of individuals that Charlie not. The proposition of the two sentences in that Charlie not and Johny because the choice is non-empty. Sentence (2'a) says that the non-empty choice is equal to the single-element choice containing Jane and the sentence (2'a) says that is evident to the above considering both Charlie and Jane. To ensure the presence of the defined proposition we define the function

\[ f = \text{true} \text{ if } y \neq z \text{ and } y \neq w \]

\[ f = \text{true} \text{ if } f \mod 2 = 0 \]

The function $f$ is an identical function defined only on non-empty choices

In the following construction, "formally" corresponds to the form of (2a). "formally" corresponds to the form of (1) and "formal" corresponds to the topic of both sentences.

- $\text{true} \text{ if } x \neq y$  
- $\text{false} \text{ if } x = y$

(2') $\text{true}$ if $\text{formal}$  
  $\text{true}$ if $\text{formal}$  
  $\text{false}$ if $\text{formal}$

These constructions have the same proposition that the choice is topic is non-empty, they differ only in their root. The two propositions are not defined in those possible worlds where Charlie not nobody.

4. Dividing Edge

In this section we choose examples in which the dividing edge between topic and there are edges having relations to their structure (1'-edge). We restrict ourselves to this paper to continue having just one dividing edge.

(2) You see that a man.
(3) You see a man.
(4) You see it is a man.
In his discussion of the scope of negation, 

1. (a) the second proposition is negated, and 

(b) the second proposition is not negated.

We also note that the second proposition is not negated.

In the second proposition, the negation is not contained within the proposition.

The second proposition is negated.

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The following functions are used in the description:

- CB : DepTree -> Bool
- HB : DepTree -> Bool
- HBNeg : DepTree -> Bool
- Tree : Edge -> DepTree
- Fun : Edge -> Functor
- H : Functor -> Construction
- R : Construction -> Type
- A : Const -> Construction
- DivEdge : DepTree -> Edge
- DelEdge : DepTree Edge -> DepTree
- PutVar : DepTree Edge -> DepTree
- Translate : DepTree -> Construction
- GetTyp : Construction -> Type

The meanings of the functions are as follows:

- CB(dt) returns true if the root of dt is contextually bound. NB(dt) returns true if CB(dt) returns false (NB(dt) = ~CB(dt)). HBNeg(dt) returns true iff the contextually non-bound operator of negation is connected with the root of dt (contextually bound operator of negation is handled by the Basic algorithm).
- Tree(e) returns the dependency tree suspended on edge e. Fun(e) returns the functor of edge e. H(f) returns the object of TIL realizing relationship 'Causal', 'Aim'. R-Edge(e) returns true if e is an R-Edge. A-Edge(e) returns true if e is an A-Edge. DivEdge(dt) returns the dividing edge between the topic and the focus of dt.
- Functions DelEdge and PutVar realize dividing of the dependency tree. DelEdge(e) returns dependency tree dt without edge e (edge e is removed from dt). PutVar(dt,e) replaces the tree suspended on edge e in tr by a variable and returns the resulting dependency tree.
- Translate(dt) returns the construction of TIL corresponding to dt to which dt is translated by the Basic algorithms. GetTyp(c) returns the type of construction c.

Now we can describe the following procedures:

- TFA - the main procedure (function)
- FA - verb in the focus, dividing A-edge
- TA - verb in the topic, dividing A-edge
- FR - verb in the focus, dividing R-edge
- TR - verb in the topic, dividing R-edge

The procedure TFA is defined as follows:

\[ TFA(dt) = \begin{cases} \text{let } e = \text{DivEdge}(dt) \text{ in } \text{Tr} & \text{if } \text{DivEdge}(dt) = \text{DivEdge}(dt) \text{ in } \text{Tr} \\ \text{let } e = \text{DivEdge}(dt) \text{ in } \text{Tr} & \text{else } \text{Tr} \end{cases} \]

If the dividing edge is in an A-edge and the verb belongs to the focus the tree is handled by function FA. The tree suspended on the dividing edge is replaced by a variable, the topic and focus are translated separately and the resulting construction is put together. If the dividing edge is in an A-edge and the verb belongs to the focus the tree is handled by function FA. The tree suspended on the dividing edge is replaced by a variable, the topic and focus are translated separately and the resulting construction is put together.
Although many problems are open, it is seen that the topic/focus articulation has an effect on the semantic content of the sentence and, therefore, it can be analyzed by means of formal semantics.

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