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Discourse Plan ⇒ Meaning

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Abstract - Resume

We outline in this paper the following view of linguistic meanings. Meanings are planned in the course of speech. The plans, we call them *discourse plans* (DP), combine referential structure, cognitive situation structure and communicative structure. If and when the DP is realizable, it is transformed into a meaning, which from a technical perspective, is a second order typed lambda term. As such, meanings turn out to be compositional.

Nous présentons dans cet article la vision suivante du sens linguistique. Le sens est planifié au cours de la parole. Les plans des sens, que nous appelons *plans du discours (DP)*, combinent la structure référentielle, la structure des situations cognitives et la structure communicative. Si un DP est réalisable, alors il est transformé en un sens. Sur le plan technique, les sens sont les Lambda-termes typés du deuxième ordre. Comme tels, ils s'avèrent compositionnels.

1 Introduction

There are two essentially different approaches to meaning representation: one *propositional*, another *cognitive*. The propositional approach, going back to Frege and developed and explicitly applied to natural language semantics by Montague, is characterized by the use of *sentential type* and of primitive semantic structures with values of this type (predicates, as a rule). It defines the meaning of a sentence through propositional attitude of its logical form towards conventional models. This approach is most consistently represented by type logical grammars (see collections (Gamut, 1991; van Benthem & ter Meulen, 1997)).

The cognitive approach treats the meaning as a structure (e.g. a graph) *encoding the content* of texts in the way sufficient for its representation at syntactic, morphological and phonological levels, independent of the propositional attitude. This is the way the linguistic meaning appears in the theory "Meaning ⇔ Text" (MTT) (Mel'čuk, 1997). The independence of propositionality has an effect on the primitive meaning structures used. The central part in these structures is played by semantic predicate-argument or function-argument dependencies. These dependencies are marked by specific markers: e.g. roles or argument names. If the logical form is more or less standard, the linguistic meaning appears in linguistic theories in different notations: graph-based, feature-structure, logical, mixed, and usually has no formal semantics.

Our aim in this paper is to reconstruct and formalize the cognitive linguistic meaning. We proceed from the idea that this must be exactly the kind of meaning structures developed by the young children of the age under four years, when they learn their mother tongue. Indeed, in this age the children cannot rely upon an ontological knowledge, on a systematic reasoning of any kind, nor on any meta-knowledge, such as meaning subsumption, presumptions, etc. So they must develop meaning structures more or less in the same way as they develop the system of phonemes, i.e. discovering salient factors in the speech addressed to them, relating these factors to the speech context, and then unifying and generalizing their observations. Relying on research of language cognitivists (see the synthesizing papers in the collection (Gleitman & Liberman, 1995)) and on the results of some convincing experiments, in particular, those expounded in the book (Hirsh-Pasek & Golinkoff, 1996), we conclude that one-word-speaking children develop a rudimentary role and type system, two-word-speakers develop the first asymmetric semantic relations (type - sub-type, semantic head - semantic dependent), three-four-word-utterance-producing children develop the first abstract function-argument meaning structure: the *abstract primitive situation*, and several months later the children start planning complex meanings as compositions of abstract primitive situations (we describe this inductive process in much detail in (Dikovsky, submitted)).

2 Semantic roles, types and situations

Roles. Semantic roles evolve from a few cognitive roles in the infants perceptual world (*agent*, *patient*, *location*, etc.) where they serve for projecting the speech on its context. They become universal semantic primitives. As we will see below, their semantic function is to mark situation arguments and, in this way, to serve for identification of situation diatheses in discourse plans. Besides this important part in the meaning definition, they definitely serve for a superficial speech/text understanding. In the examples below, we use some of the following cognitive roles: $\mathbf{AGT}$ *(agent)*, $\mathbf{CAG}$ *(counteragent)*, $\mathbf{PAT}$ *(patent)*, $\mathbf{PRO}$ *(proprietor)*, $\mathbf{ADR}$ *(addresser)*,

$\mathbf{ORG}$ *(origin),* $\mathbf{RCP}$ *(recipient),* $\mathbf{DST}$ *(destination),* $\mathbf{OBJ}$ *(object),* $\mathbf{ATR}$ *(attribute),* $\mathbf{QUA}$ *(qualia),* $\mathbf{DEF}$ *(definiendum),* $\mathbf{INS}$ *(instrument),* $\mathbf{MTR}$ *(material),* $\mathbf{EFF}$ *(effect),* $\mathbf{GL}$ *(goal),* $\mathbf{CSE}$ *(cause),* $\mathbf{RES}$ *(result),* $\mathbf{CLS}$ *(class),* $\mathbf{EL}$ *(element),* $\mathbf{LOC}$ *(location),* $\mathbf{TNS}$ *(tense),* $\mathbf{ACT}$ *(action),* $\mathbf{EVT}$ *(event),* $\mathbf{ST}$ *(state),* $\mathbf{CND}$ *(condition)* [1].

Types. Semantic types originate from a primitive archetype grammar developed by the children by the age of two years. They constrain meaning values. There are four initial *primitive types*:
– the type of *sententiator* $\mathbf{s}$ intuitively corresponding to "actions/processes/events";
– the type of *nominators* $\mathbf{n}$ intuitively corresponding to "things" in the most general sense;
– the type of *qualifiers* $\mathbf{q}$, intuitively corresponding to the meanings qualifying the nominators. Being combined with nominators, the qualifiers give new nominators;
– the type of *circumscriptors* $\mathbf{c}$, intuitively corresponding to the meanings, qualifying the qualifiers and the sententiators. Being combined with qualifiers, the circumscriptors form new qualifiers, and being combined with sententiators, they form new sententiators.

For instance, the meanings of common nouns are not nominators, but the values of their meanings have the type of nominators $\mathbf{n}$. The values of meanings of adjectives have the type $\mathbf{q}$. The meanings of adverbs have values of type $\mathbf{c}$. The meanings of sentences have values of type $\mathbf{s}$.

All other primitive types are *instances*, i.e. particular cases, of these four initial types. For example, the type of nominators $\mathbf{n}$ has the instances $\mathbf{n_a}, \mathbf{n_{\bar{a}}} \prec \mathbf{n}$ of *animated/inanimated nominators*, the instance $\mathbf{n_c} \prec \mathbf{n}$ of *countable nominators*, the instance $\mathbf{n_{pr}} \prec \mathbf{n}$ of *proper name nominators*, etc. The type $\mathbf{q}$ of qualifiers has the instance $\mathbf{q_{cp}} \prec \mathbf{q}$ of *comparison qualifiers* (e.g., '$BETTER\_THAN$', '$WORST$'), the instance $\mathbf{q_{qu}} \prec \mathbf{q}$ of *quantification qualifiers* (e.g., 'ALL', '$NEITHER$' '$FOUR$'), etc. The type $\mathbf{c}$ of circumscriptors has the instance $\mathbf{c_{dg}} \prec \mathbf{c}$ of *degree circumscriptors* (e.g., '$MORE$', '$ESPECIALLY$'), the instances of *tense circumscriptors* $\mathbf{t_{int}}$, $\mathbf{t_{pnt}}$, $\mathbf{t_{rpt}}$, $\mathbf{t_{prg}}$, $\mathbf{t_{prg}} \prec \mathbf{c}$ of *interval, pointwise, repetitive, progressive, neutral* tense circumscriptors etc. The type of sententiators $\mathbf{s}$ has the instance $\mathbf{s_{bf}} \prec \mathbf{s}$ of *belief sententiators* (that of meaning values of the belief verbs like '$THINK_2$', '$KNOW_2$'), of *oriented movement sententiators* (corresponding to the verbs like 'GO_1', '$MOUNT$'), etc.

The primitive types under the instance relation $\prec$ constitute a finite lattice. They serve for lexical semantic classifications and also for constraining correct meaning compositions.

Complex types. There are three kinds of complex semantic types: *iterated* types, *option* types, and *functional types*.

Iterated types are constructed by the iteration constructor $^{\omega}$ from primitive types. E.g. $\mathbf{c}^{(\omega)}$ is the type of iterated circumscriptors. This type is interpreted by enumerations (lists) of circumscriptor-valued meanings.

Option types are formed from primitive types by the option constructor ^{0} : $\mathbf{q^{(0)}}$, $\mathbf{c^{(0)}}$, $\mathbf{n^{(0)}}$ and $\mathbf{s^{(0)}}$. For instance, $\mathbf{q^{(0)}}$ is the type of qualifiers, which are optional in the position constrained by this type.

A *functional type* has the general form $(\mathbf{u}^{(\omega)}\mathbf{u}_1...\mathbf{u}_k \rightarrow \mathbf{v})$, where $\mathbf{u}_i$ are primitive or option types and $\mathbf{v}$ is a primitive type. $(\mathbf{u}_1...\mathbf{u}_k \rightarrow \mathbf{v})$ abbreviates $(\mathbf{u}_1 \rightarrow ...(\mathbf{u}_k \rightarrow \mathbf{v})...)$. It is the type of a functional meaning which, being applied to meanings with values of the corresponding types $\mathbf{u}_1...\mathbf{u}_k$, gives a meaning with the value of type $\mathbf{v}$. For instance, $(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{n^{(0)}}\mathbf{n_a^{(0)}} \rightarrow \mathbf{s})$ is the type of the meaning of a four-argument verb whose second and fourth arguments are animated nominators, third argument is a nominator, third and fourth arguments are optional,

[1] Of course, this list is far from being complete or minimal.

and first argument is an, eventually empty, list of circumscriptors. $‘PLAY’_1$ is an example of such verb.

A peculiarity of meanings of lexical units is that they all are represented by constants of a functional meaning type with an iterated sub-type. This sub-type is uniquely determined by the function value type: $\mathbf{q}^{(\omega)}$ for the value type $\mathbf{n}$ and $\mathbf{c}^{(\omega)}$ for the three other value types. For instance, common nouns have type $(\mathbf{q}^{(\omega)} \rightarrow \mathbf{n})$ (functions from lists of qualifier type meanings to nominator type meanings) and adjectives have type $(\mathbf{c}^{(\omega)} \rightarrow \mathbf{q})$ (functions from lists of circumscriptor type meanings to qualifier type meanings).

Many lexical units, among them all verbs, also have other sort of arguments, we refer to them as *actants*, which are marked by semantic roles and have non-iterated types. Such lexical units define the primitive meaning structures which we call *situations*.

Situations are determined (in the dictionary) by *situation profiles*. For instance, the profile

$$\mathbf{sit}(\mathbf{play}_1^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{n}^{(\mathbf{0})}\mathbf{n_a^{(0)}} \rightarrow \mathbf{s})}, ‘PLAY’_1(\mathbf{AGT}(1), \mathbf{PAT}(2), \mathbf{CAG}(3)))$$

determines the situation of type $(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{n}^{(\mathbf{0})}\mathbf{n_a^{(0)}} \rightarrow \mathbf{s})$ identified by the key $\mathbf{play}_1$ and having three actants: the first obligatory actant of type $\mathbf{n_a}$ has the role $\mathbf{AGT}$, the second optional actant of type $\mathbf{n_a^{(0)}}$ has the role $\mathbf{PAT}$, and the third optional actant of type $\mathbf{n}^{(\mathbf{0})}$ has the role $\mathbf{CAG}$. Besides them, $\mathbf{play}_1$ has a $\mathbf{c}^{(\omega)}$-type argument. This situation's meaning has $\mathbf{s}$-type values. There are other type value situations. For instance, the situation with profile

$$\mathbf{sit}(\mathbf{handle\_of}^{(\mathbf{q}^{(\omega)}\mathbf{n} \rightarrow \mathbf{n})}, ‘HANDLE_1’(\mathbf{ATR}(1)^{\mathbf{n}}))$$

represents a meaning with $\mathbf{n}$-type values.

The actual situation's meaning is the function resulting from the situation by abstracting its arguments. For instance (in Lambda-notation, abbreviating $\lambda X \lambda Y$ by λXY), the meaning of $\mathbf{play_1}$ is the function:

$$\lambda Y^{\mathbf{c}^{(\omega)}} X_1^{\mathbf{n_a}} X_2^{\mathbf{n}^{(\mathbf{0})}} X_3^{\mathbf{n_a^{(0)}}} .\ \mathbf{play}_1(Y, X_1, X_2, X_3).$$

Non-functional meanings are only two: $\emptyset^{\mathbf{u}^{(\mathbf{0})}}$ (*empty meaning* of optional type $\mathbf{u}^{(\mathbf{0})}$) and $\mathbf{nil}^{\mathbf{u}^{(\omega)}}$ (*empty list* of type $\mathbf{u}^{(\omega)}$).

3 Discourse plans and meanings

Abstract situations are developed by young children by the age of two, when they produce three-four-word utterances. Psycho-linguists evidence that in this age children's output seems to meet up with a bottleneck. Their two- and three-word utterances look like samples drawn from longer potential sentences (Pinker, 1995). We explain this by several serious problems which must be resolved before the child learns to compose complex meanings of abstract primitive situations.

Composition. As it is usual for Lambda terms (see (Barendregt, 1981)), their composition is interpreted by function application and is defined through substitution: to apply the term $\lambda X.\ T_1$ to the term t_2 means to substitute t_2 for X in t_1 (denoted $(\lambda X.\ T_1\ t_2) \rightarrow_\beta t_1[t_2/X]$). This is similar in the case of typed terms. The difference is that the abstract argument X must be of the same type as the actual argument t_2. The case of meanings is somewhat complicated by the instance/generic partial order on primitive types. The meaning composition is naturally adapted to this order using the following loose typing principle:

$$(T_0^{(\mathbf{v} \to \mathbf{u})}\ T_1^{\mathbf{v}_1}) \to_\beta T^{\mathbf{u}}\ \ if\ \ \mathbf{v}_1 \preceq \mathbf{v}$$

i.e. "applying a functional $(\mathbf{v} \ \to\ \mathbf{u})$-type meaning to a $\mathbf{v}_1$-type meaning, where $\mathbf{v}_1 \preceq \mathbf{v}$ is an instance of $\mathbf{v}$, gives a $\mathbf{u}$-type meaning". This revised application has the same good properties as the classical one: the corresponding transitive term reduction relation $\twoheadrightarrow$ always gives a unique resulting term in which no sub-term applies to another sub-term (the *normal form term*).

Necessity of planning. The obstacles preventing the children to compose abstract primitive situations are: *dynamicity of context*, in particular, extra-situation co-reference, and *type and situation profile conflicts*. The first problem needs reference scoping control: explicit in case of anaphora (as in well known examples of Geach: *If Peter has a donkey, he beats it*) and implicit in case of tense agreement (as in examples of Kamp: *John said that a child was born that will become ruler of the world*). Such sort of problems with meaning compositionality was the subject of long discussions (see (Janssen, 1997)) and lead to several propositions of compositional dynamic meaning formalization in logical terms, e.g. file change semantics (Heim, 1983) and DRT (Kamp, 1981). The type and situation profile conflicts are caused by the necessity to use in the place of dictionary situations their semantic derivatives. The dynamic context problems need composition planning because the short-term dynamic memory used for reference control is size-limited. The type-profile conflicts also call for planning because the actual derivative of a situation is specified through assigning new roles, types and precedence to its actants, depending on the choice of several factors (e.g., communicative structure, style, etc.) Such assignments are of the kind of the syntactic voice diatheses (see (Mel'čuk, 1994)), and we refer to them as to *semantic diatheses*. Let us illustrate these problems with two early utterances that reflect the problem being solved:

$(a)[28\ months]$ *See marching bear go?* $(b)[38\ months]$ *So it can't be cleaned?*

The corresponding composition plans are schematically represented by diagrams in Fig. 1. In these diagrams, the downward arrows correspond to planned primitive situation compositions. For instance, in the plan (a):

$[1]$ $\mathbf{hearer}^{\mathbf{n_a}}$ must develop the first actant of situation **see**, i.e.

$$\lambda X^{\mathbf{n_a}} Y^{\mathbf{n}}.\ \mathbf{see}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{n} \to \mathbf{s})}(\mathbf{nil}^{\mathbf{c}^{(\omega)}}, X, Y)$$

must be applied to $\mathbf{hearer}^{\mathbf{n_a}}$,

$[2]$ situation $\mathbf{go_1}$ with profile

$$\mathbf{sit}(\mathbf{go_1}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{c}^{(\mathbf{0})} \to \mathbf{s})}, \text{'}GO_1\text{'}(\mathbf{AGT}(1), \mathbf{LOC}(2)))$$

must develop the second actant of **see**, i.e.

$$\lambda Y^{\mathbf{n}}.\ \mathbf{see}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{n} \to \mathbf{s})}(\mathbf{nil}^{\mathbf{c}^{(\omega)}}, \mathbf{hearer}, Y)$$

must be applied to the meaning realizing the sub-plan for $\mathbf{go_1}$,

$[3]$ $\text{'}BEAR\text{'}^{(\mathbf{q}^{(\omega)} \to \mathbf{n_a})}$ must develop the first actant of $\mathbf{go_1}$,

$[4]$ $\mathbf{march}^{(\mathbf{c}^{(\omega)}\mathbf{n_a} \to \mathbf{s})}$ must develop the $\mathbf{q}^{(\omega)}$-type argument of '$BEAR$',

$[5]$ the reference to '$BEAR$' must develop the first actant of $\mathbf{march}$.

The problem with this plan is that in its points $[2]$ and $[4]$ the value types of the situations developing the corresponding arguments are in conflict with the types of the arguments to develop.

Discourse plans (DPs). A full definition of DPs may be found in (Dikovsky, submitted; Dikovsky, 2003). Here we illustrate some their elements with examples. A DP is a tree-like structure composed of primitives using development operators and aggregates. It uses references to global context Γ (never updated in DPs) and local context ρ of a bounded size. Let us see how the plan scheme (a) is implemented by a DP.

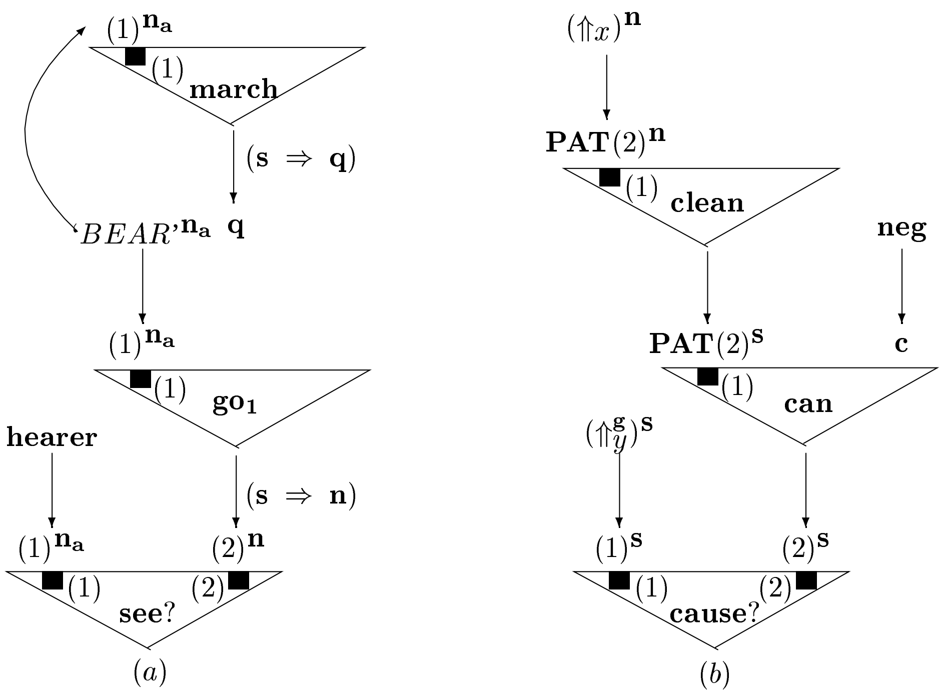

Figure 1: Early discourse plans

Utterance: *See marching bear go ?*

Situation profiles and diatheses:

$\mathbf{sit}(\mathbf{see_1}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{n} \to \mathbf{s})}, \text{'}SEE_1\text{'}(\mathbf{AGT}(1), \mathbf{PAT}(2)))$

$\mathbf{sit}(\mathbf{go_1}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{l^{(0)}} \to \mathbf{s})}, \text{'}GO_1\text{'}(\mathbf{AGT}(1), \mathbf{LOC}(2)))$

$\mathbf{dth_1}(\mathbf{go_1}) = (\mathbf{AGT}(1)^{\mathbf{n_a}}, \mathbf{LOC}(2)^{\mathbf{l^{(0)}}})^{\mathbf{n}}$

% semantic diathesis of infinitive; the corresponding derivative:

$\mathbf{der}(\mathbf{dth_1}, \mathbf{go_1}) = \mathbf{sit}(\mathbf{to\_go_1}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{l^{(0)}} \to \mathbf{n})}, \text{'}GO_1\text{'}(\mathbf{AGT}(1), \mathbf{LOC}(2)))$

$\mathbf{sit}(\mathbf{march}^{(\mathbf{c}^{(\omega)}\mathbf{n_a} \to \mathbf{s})}, \text{'}MARCH\text{'}(\mathbf{AGT}(1)))$

Discourse plan π_1:

[1] $\Downarrow^{\mathbf{s}}_{s_1}\ \mathbf{see_1}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{n} \to \mathbf{s})}\ ?\ \{$

[2] $\mathbf{t_{int}} \Leftarrow \Downarrow^{\mathbf{t_{int}}}_{t_1} \Uparrow s_1\ (\ )^{\mathbf{t_{int}}},$

[3] $\mathbf{t} \Leftarrow ((\Uparrow^{\mathbf{g}} \mathbf{now})\ \in\ \Uparrow t_1)^{\mathbf{t}},$

[4] $(1)^{\mathbf{n_a}} \Leftarrow (\Uparrow^{\mathbf{g}} \mathbf{hearer})^{\mathbf{n_a}},$

[5]$\odot$ $(2)^{\mathbf{n}} \Leftarrow \Downarrow^{\mathbf{n}}_{n_1}\ \mathbf{go_1}^{(\mathbf{c}^{(\omega)}\mathbf{n_a}\mathbf{l^{(0)}} \to \mathbf{s})}\ \mathbf{dth_1}\ \{$

[6] $(1)^{\mathbf{n_a}} \Leftarrow \Downarrow^{\mathbf{n_a}}_{n_2}\ \text{'}BEAR\text{'}^{(\mathbf{q}^{(\omega)} \to \mathbf{n_a})}\{$

[7] $\mathbf{q} \Leftarrow \Downarrow^{\mathbf{q}}_{q_1}\ \mathbf{march}^{(\mathbf{c}^{(\omega)}\mathbf{n_a} \to \mathbf{s})}\ \mathbf{abs}^{n_2}\ \{$

[8] $(1)^{\mathbf{n_a}} \Leftarrow \Uparrow n_2$

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At the point [1], the local reference s_1 to the sub-plan for $\mathbf{see_1}$ is added to ρ (using operator $\Downarrow^{\mathbf{s}}_{s_1}\ \mathbf{see_1}$). At the next point, the tense circumscriptor $\mathbf{t_{int}}$ of $\mathbf{see_1}$ is developed using operator $\mathbf{t_{int}} \Leftarrow \Downarrow^{\mathbf{t_{int}}}_{t_1} \Uparrow s_1\ ()^{\mathbf{t_{int}}}$, which accesses $\mathbf{see_1}$ by means of operator $\Uparrow s_1$, converts its type to $\mathbf{t_{int}}$ and adds to ρ the reference t_1 to the interval tense marker of s_1. The development operator at [3] adds to the list of circumscriptors of $\mathbf{see_1}$ the present tense condition. At [4], the first actant of $\mathbf{see_1}$ is developed by the reference to $\mathbf{hearer}$ in Γ_1. At the point [5] (which is in focus $\odot$), the second actant of $\mathbf{see_1}$ is developed by a semantic derivative of situation $\mathbf{go_1}$ specified by its diathesis $\mathbf{dth_1}$. This infinitive diathesis must convert the value type of $\mathbf{go_1}$ into $\mathbf{n}$ to fit the type of the second actant of $\mathbf{see_1}$. The $\mathbf{n}$-type reference n_1 to the sub-plan for $\mathbf{go_1}$ is added to ρ. At [6], the first actant of $\mathbf{go_1}$ is developed by the sub-plan for the lexical unit '$BEAR$' and the reference n_2 to this sub-plan is added to ρ. At [7], a qualifier of '$BEAR$' is developed by a sub-plan in which another converter $\mathbf{abs}^{n_2}$, called *abstractor*, is applied to the situation $\mathbf{march}$ to convert its value type into $\mathbf{q}$ and the reference q_1 to this sub-plan is added to ρ. $\mathbf{abs}^x$ has the approximate meaning "*such* x.. *that*". At the last point [8], the actant of $\mathbf{march}$ is developed by the reference n_2 to '$BEAR$'.

Adding a local reference may cause deletion of some other references. There are simple rules of local context control (Dikovsky, submitted). Their essence is that adding a reference x to ρ : (i) cannot cause deletion of a reference on which x "depends" in DP, (ii) causes deletion of all similar references on which x does not "depend". References are *similar* if they have the same types and are assigned in DP the same roles. So a DP may turn out to be *unrealizable* for one of two reasons: a reference is accessed which is not in the context (*invisible reference*), or a semantic derivative is planned, which is absent in the dictionary.

DPs induce a particular *communicative structure.* The first actant of a situation $\mathbf{key}$ in DP π represents its *theme*. The *rheme* of $\mathbf{key}$ in π is the set of all other *locally referenced* arguments of its semantic derivative $\mathbf{key}'$ determined by π. Intuitively, the rheme consists of those arguments related to the theme through $\mathbf{key}'$, which can be passed as parameters to situations introduced later in π. A DP has a unique point marked by the focus $\odot$. The DP element introduced at the focalized point must be locally referenced. For instance, in π_1 the focus is on $\mathbf{go_1}$.

The plan π_1 is realizable, because the derivative $\mathbf{der}(\mathbf{dth_1}, \mathbf{go_1})$ exists and all local references are visible. π_1 transforms the initially empty context ρ_1 into the context
$\rho_1 = \{s_1\ (see), t_1\ (time\ interval), n_1\ (to\_go), n_2\ (bear), q_1\ (marching)\}$.

Among other kinds of converters used in DPs, there are also *inverse diatheses* $\mathbf{dth_i^{-1}}$ serving for planning lexical functions, and $\mathbf{C}$-*relators* ($\mathbf{C} \in \{=, <, >\}$): $\mathbf{q}$–$\mathbf{rel}[\mathbf{C}]^y$, $\mathbf{c}$–$\mathbf{rel}[\mathbf{C}]^y$ with the approximate meaning "*as intensive as* y", or "*less intensive than* y", or "*more intensive than* y". Besides this, sub-plans can be grouped into *aggregates* to determine all kinds of coordination and parataxis. Let us see one more example.

Sentence: *Mike stared at me, at Kitty, and burst out laughing.*
Global context: $\Gamma_2 = \{\mathbf{speaker}^{\mathbf{n_a}}, Mike = gn_1^{\mathbf{n_a}}, Kitty = gn_2^{\mathbf{n_a}}, \mathbf{now}^{\mathbf{t_{pnt}}}\}$.

Situation profiles and diatheses:

$\mathbf{sit}(\mathbf{stare}^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \to \mathbf{s})}, \text{'}STARE\text{'}(\mathbf{AGT}(1), \mathbf{OBJ}(2)))$

$\mathbf{sit}(\mathbf{laugh_1}^{(\mathbf{c}^{(\omega)}\mathbf{n_a} \to \mathbf{s})}, \text{'}LAUGH_1\text{'}(\mathbf{AGT}(1)))$

$\mathbf{dth_1^{-1}}(\mathbf{laugh_1}) = (\mathbf{AGT}(1)^{\mathbf{n_a}}, \mathbf{ST}(0)^{\mathbf{n}})^{\mathbf{s}}$ % 0 stands for situation's standard nominator

$\mathbf{der}(\mathbf{dth_1^{-1}}, \mathbf{laugh_1}) = \mathbf{sit}(\mathbf{burst\_out}^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \to \mathbf{s})},$
$\text{'}LAUGH_1\text{'}(\mathbf{AGT}(1), \mathbf{ST}(0)))$ % $oper_1(laugh)$

Discourse plan π_2:

[1] $\mathbf{A}_\wedge\{$ % *and*-coordination: $\mathbf{A_{op}}$: aggregate with operator *op*
[2] $\Downarrow^{\mathbf{s}}_{s_1} \Downarrow^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \ \to \ \mathbf{s})}_{s_2} \mathbf{stare}^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \to \mathbf{s})} \{$
[3] $\mathbf{t_{pnt}} \Leftarrow \Downarrow^{\mathbf{t_{pnt}}}_{t_1} \Uparrow s_1 \ (\ )^{\mathbf{t_{pnt}}},$
[4] $(1)^{\mathbf{n_a}} \Leftarrow (\Uparrow^{\mathbf{g}} gn_1),$ % Mike
[5] $(2)^{\mathbf{n_a}} \Leftarrow (\Uparrow^{\mathbf{g}} \mathbf{speaker}^{\mathbf{n_a}}),$
},
[6] $\Downarrow^{\mathbf{s}}_{s_3} \Uparrow s_2{}^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \to \mathbf{s})} \{$ % stared
[7] $\mathbf{t_{pnt}} \Leftarrow \Downarrow^{\mathbf{t_{pnt}}}_{t_2} \Uparrow s_3 \ (\ )^{\mathbf{t_{pnt}}},$
[8] $\mathbf{t} \Leftarrow (\Uparrow t_1 \lhd_{\mathbf{x}} \Uparrow t_2)^{\mathbf{t}},$ % $\lhd_{\mathbf{x}}$: next discrete time moment
[9] $(1)^{\mathbf{n_a}} \Leftarrow (\Uparrow^{\mathbf{g}} gn_1),$ % Mike
[10] $(2)^{\mathbf{n_a}} \Leftarrow (\Uparrow^{\mathbf{g}} gn_2),$ % Kitty
},
[11]$\odot$ $\Downarrow^{\mathbf{s}}_{s_4} X \ \mathbf{dth_1^{-1}}(\mathbf{laugh}) \ \{$ % $oper_1(\mathbf{laugh})$
[12] $\mathbf{t_{pnt}} \Leftarrow \Downarrow^{\mathbf{t_{pnt}}}_{t_3} \Uparrow s_4 \ (\ )^{\mathbf{t_{pnt}}},$
[13] $\mathbf{t} \Leftarrow (\Uparrow t_2 \lhd_{\mathbf{x}} \Uparrow t_3)^{\mathbf{t}},$
[14] $\mathbf{t} \Leftarrow (\Uparrow t_3 \lhd (\Uparrow^{\mathbf{g}} \mathbf{now}))^{\mathbf{t}},$
[15] $(1)^{\mathbf{n_a}} \Leftarrow (\Uparrow^{\mathbf{g}} gn_1),$
[16] $(0)^{\mathbf{n}} \Leftarrow$ '$LAUGHING$', % $s_0(\mathbf{laugh})$
}
}

This DP is also realizable. It transforms the initially empty local context ρ_2 into ρ_2 = { s_1, s_2, s_3 $(stare)$, t_1, t_2, t_3 $(time\ points)$, s_4 $(burst\ out)$}.

Meanings. There is a translation τ of realizable DPs into meanings. It is defined by simple induction on sub-plans:
$\tau(S) = S$ if S is a primitive sub-plan.
$\tau(\odot S) = \odot\tau(S)$.
$\tau((S_1, S_2)) = (\tau(S_1), \tau(S_2))$.
$\tau(\mathbf{A_{op}}\{Components\}) = \mathbf{A_{op}}\{\tau(Components)\}$. % aggregate translation
Let S be a sub-plan introducing a new situation:

$[t_0]$ $\mathbf{key\ Converter\ Mode}$ {
$[t_1]$ $(j_1)^{\mathbf{v}_1} \Leftarrow S_1, \ ...$
$[t_k]$ $(j_k)^{\mathbf{v}_k} \Leftarrow S_k, \ ...$
$[t_m]$ $\mathbf{u}_1 \Leftarrow S_{k+1,1}, \ ...$
$[t_l]$ $\mathbf{u}_l \Leftarrow S_{k+1,l}, \ ...$
}

and $ader(\mathbf{key}, \mathbf{Converter}) = \lambda X_0^{\mathbf{u}^{(\omega)}} X_1^{\mathbf{v}_1} ... X_k^{\mathbf{v}_k}.\ \mathbf{key_{der}}(X_0, X_1, ..., X_k)$ be the abstract situation derived from the dictionary definition of $\mathbf{Converter}$ applied to $\mathbf{key}$. Then $\tau(S) =$

(t_0) $\mathbf{sit\ Mode}$ $(ader(\mathbf{key}, \mathbf{Converter})$
(t_p) $[\ \tau(S_{k+1,1}), ..., \tau(S_{k+1,l})\ ],$
(t_{m1}) $\mathbf{act}_1(\tau(S_1)), \ ...,$
(t_{mk}) $\mathbf{act}_k(\tau(S_k)))$
)

The *meaning derived* from π is the normal form term M to which reduces $\tau(\pi)$: $\tau(\pi) \twoheadrightarrow M$. For instance, from DP π_2 the following meaning is derived:

(1) $\mathbf{A}_{\wedge}\{$

(2) $\Downarrow^{\mathbf{s}}_{s_1} \Downarrow^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \rightarrow \mathbf{s})}_{s_2} \mathbf{sit}(\mathbf{stare}^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \rightarrow \mathbf{s})}$

(3) $[\Downarrow^{\mathbf{t_{pnt}}}_{t_1} \Uparrow s_1]^{\mathbf{c}^{(\omega)}}$,

(4) $\mathbf{act}_1((\Uparrow^{\mathbf{g}} gn_1))^{\mathbf{n_a}}$, % Mike

(5) $\mathbf{act}_2(\Uparrow^{\mathbf{g}} \mathbf{speaker})^{\mathbf{n_a}}$

),

(6) $\Downarrow^{\mathbf{s}}_{s_3} \mathbf{sit}(\Uparrow s_2^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \rightarrow \mathbf{s})}$ % stared

(7) $[(\Downarrow^{\mathbf{t_{pnt}}}_{t_2} \Uparrow s_3)^{\mathbf{t_{pnt}}}$,

(8) $(\Uparrow t_1 \lhd_{\mathbf{x}} \Uparrow t_2)^{\mathbf{t}}]^{\mathbf{c}^{(\omega)}}$,

(9) $\mathbf{act}_1((\Uparrow^{\mathbf{g}} gn_1))^{\mathbf{n_a}}$, % Mike

(10) $\mathbf{act}_2((\Uparrow^{\mathbf{g}} gn_2))^{\mathbf{n_a}}$ % Kitty

),

(11)⊙ $\Downarrow^{\mathbf{s}}_{s_4} \mathbf{sit}(\mathbf{burst\_out}^{(\mathbf{c}^{(\omega)}\mathbf{n_a n} \rightarrow \mathbf{s})}$

(12) $[(\Downarrow^{\mathbf{t_{pnt}}}_{t_3} \Uparrow s_4)^{\mathbf{t_{pnt}}}$,

(13) $(\Uparrow t_2 \lhd_{\mathbf{x}} \Uparrow t_3)^{\mathbf{t}}$,

(14) $(\Uparrow t_3 \lhd (\Uparrow^{\mathbf{g}} \mathbf{now}))^{\mathbf{t}}]^{\mathbf{c}^{(\omega)}}$,

(15) $\mathbf{act}_1((\Uparrow^{\mathbf{g}} gn_1))^{\mathbf{n_a}}$,

(16) $\mathbf{act}_2(\text{‘}LAUGHING\text{’})^{\mathbf{n}}$

)

)

Discussion

The main difference between the meaning graphs of MTT and the planned meanings in this paper is that the MTT graphs are neither compositional, nor typed. They are just relational structures. A non-structural modularity of MTT graphs due to periphrasis becomes completely structural in case of compositional planned meanings. The meaning - surface syntax interface in MTT is complicated by the absence of structural morphisms. For the planned meanings, this interface is transparent. Our type system supports functional semantic dependencies of actants and of **c**-type arguments, as well as dependencies of qualifiers on names. So these semantic dependencies never conflict with the surface syntactic dependencies. This is also the reason why the planned linguistic meanings are so different from those established on logical base. The fundamental difference between the two lies in the treatment of modifier phrases and of common nouns. Our interpretation is due exclusively to distribution and compositionality. This cannot be otherwise in young children learning their mother tongue. The logical meaning is founded on the basic concept of property, which leads to elegant meaning definitions in propositional terms going back to the seminal work of R. Montague (see (Montague, 1974)). In spite of theoretical problems (cf. (Janssen, 1997)), the logical approach to meaning provides sound theoretical foundations to linguistic semantics. On the other hand, direct application of the type logical semantics to language syntax creates problems of adequacy and/or feasibility. The linguistic meaning, as we define it, cannot play the role of linguistic semantics. It is not enough expressive for that. This concerns, in particular, its dynamic aspect: the DRT-like meanings progressively construct *models* of logical forms, whereas the planned meanings only transform the local co-reference context. The linguistic meaning is a formal and simple abstract code of grammatically correct texts, free from surface level details and at the same time related to these details by means of grammar rules. We argue that the type logical semantics should rather be defined on top of the linguistic meaning. This would let obviate linguistically problematic treatment in logical terms of surface syntax factors, such as word order, phrase movements and extraction, syntactic zeros, etc. and to apply logical means to propositional reference, presumption analysis, disambiguiation, lexical semantics, and other linguistic matters fitting propositional interpretations.

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