On Speaker's Stance Meaning of Discourse

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Abstract

We outline a semantics for discourse from the speaker's stance. It's expressions, Discourse Plans, explicitly mark co-reference and present the verbal's predication in diverse diatheses. From the discourse plans, this semantics computes a relational structure representing verbals by unique canonical relations and interpreting nominals through their set extensions, taking into account plurality.

1 Introduction

Let us see the following text. *Currently, insurers can increase premiums by (levying surcharges if they determine (a driver)*$_{\Downarrow_{\mathsf{x}}}$ *is more than 50 percent to blame for a collision)*$_{\Downarrow_{\mathsf{e}}}$. *(Such penalties)*$_{\Downarrow_{\mathsf{p}}\ (\mathsf{e} \in \mathsf{p})}$ *often cost* $0_{\Uparrow_{\mathsf{x}}}$ *hundreds of dollars annually for up to six years. (About half of (the 50,000 cases disputed each year)*$_{\Downarrow_{\mathsf{c}}\ (\mathsf{c} \sim \mathsf{p})}$*)*$_{\Downarrow_{\mathsf{c_h}}\ \mathbf{part}^{\sim}_{0.5}(\mathsf{c_h}, \mathsf{c})}$ *are overturned by the appeals board. (Those drivers)*$_{\Downarrow_{\mathsf{d}}\ \mathbf{of-concern}(\mathsf{d}, \mathsf{c_h})}$ *are issued refunds.* [The Boston Globe, March 2, 2009].

Here are tagged the constituents describing entities and events related between them within this discourse. Suppose that $\Downarrow_{\mathsf{x}}$ in *(a driver)*$_{\Downarrow_{\mathsf{x}}}$ means something like: "a new semantical object x will identify the entity denoted by the selected occurrence of *a driver* in the discourse" and that $\Uparrow_{\mathsf{x}}$ is the object identified by x. Then e identifies the *levying* event, which is a kind of the *penalties* p that cost much to the *drivers* x (elided in the text). Further, c are the *disputed cases*, $\mathsf{c} \sim \mathsf{p}$ means that c identifies the same object as p and $\mathsf{c_h}$ identifies *about half of them..overturned...* Finally, d are the *drivers* concerned with the cases $\mathsf{c_h}$.

One can see that this tagging goes beyond the anaphora. Where does it come from? In contrast to the logical semantics of discourse, such as DRT (Kamp et al.,), it is not supposed to be *computed from the discourse*. On the contrary, we proceed from the assumption that *this tagging is given*: it represents elements of a *speaker's discourse plan* from which the discourse is to be *realized*. This is one of the roles to be played by a semantic representation of discourse in the context of the Meaning-Text Theory. In this role, the representation serves as a semantical notation.[1] But it should also provide relational structures, let us call them *contexts*, evolving in the discourse and suited for logical analysis. Only meaning representations playing these two roles may pretend to represent the *speaker's stance meaning of discourse*. Our example shows a specificity of the contexts. On the one hand, entities are treated as *sets evolving in the discourse*. On the other hand, *events may also behave as entities*, for instance, become elements of other entities-sets. The other specificity is less evident. It is implied, using Occam's Razor, by the speaker's stance itself. In contrast with the hearer's stance, the speaker's one needs not a reference analysis (the speaker disposes of complete knowledge of reference to express). Context consistency is also not required: the facts are postulated.[2]

[1] In (Dikovsky, 2007) is studied a formal system representing MTT in terms of finite tree transducers on discourse plans.
[2] This doesn't prevent from inclusion of the (extra-linguistic) consistency check in an implementation.

The speaker's stance semantics outlined in this paper is *object oriented* in the sense that entities and events are uniquely identified by invariable semantical objects characterized by values of *attributes* and by an *extension* which is an evolving set. In fact, we outline two semantics. The first is *static*: it defines objects' extensions in a fixed context. The other semantics is *dynamic*. It defines both, the evolution of the contexts, and the objects' extensions. This semantics is only outlined because of space limits and will be published elsewhere. The two semantics prove to be equivalent in every context.

2 Discourse Plans

Expressions of our semantics, called *discourse plans* (DP), are already published (see (Dikovsky, 2003; Dikovsky and Smilga, 2005; Dikovsky, 2007)). Below, a *discourse* is seen as a sequence of DP. Here we show and comment main features of DP using an example of a discourse consisting of DP of two sentences among which the first is a variant of "donkey sentences" borrowed from (Kamp et al.,) (see Fig. 1,2).

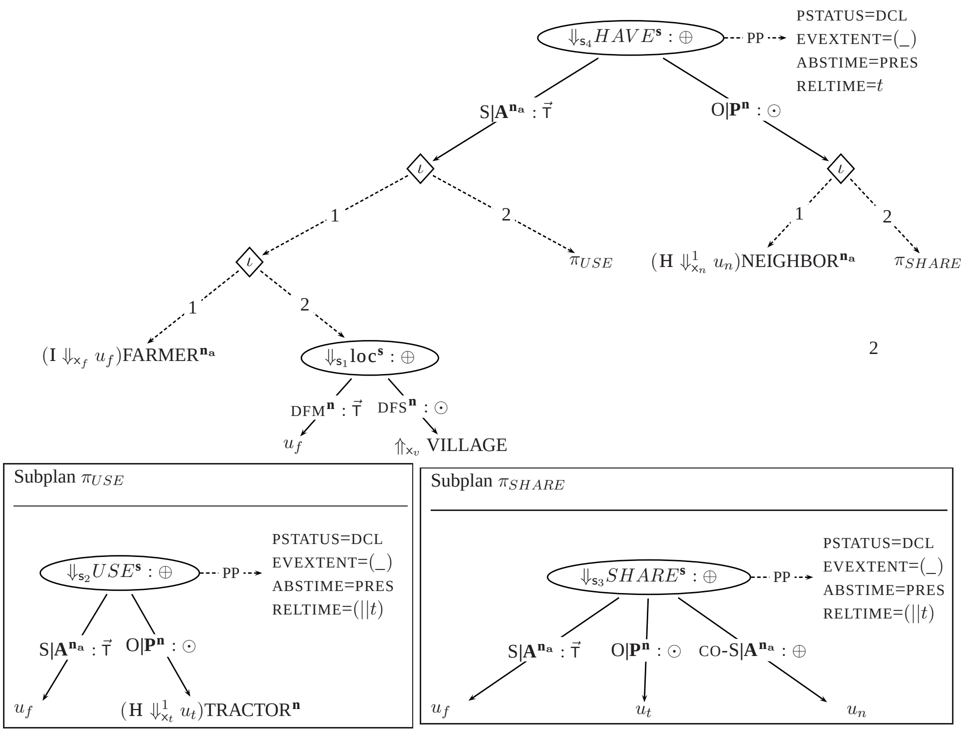

Figure 1. A DP of *Every farmer in the village, who uses a tractor, has a neighbor with whom he shares it.*

In DP, all semantemes have lexical types. Primitive types are partially ordered by a genericity order $\preceq$ ($\mathrm{u} \preceq \mathrm{v}$ means u is a case of v). In composite types $(\phi \rightarrow \mathrm{v})$, argument types are identified by sorts.

Example 1 Some nominal types and nominals. $\mathbf{n}$ *(*nominals*),* $\mathbf{n_a} \preceq \mathbf{n}$ *(*animated nominals*),* $\mathbf{n_{count}} \preceq \mathbf{n}$ *(*countable nominals*),* $\mathbf{n_{ncount}} \preceq \mathbf{n}$ *(*uncountable nominals*) are examples of nominal types.* $\mathbf{nct} = (\textsc{state}^{\mathbf{a_{grad}}} \rightarrow \mathbf{n_{ncount}})$ *(cf.* hot milk*),* $\mathbf{ves} = (\textsc{contents}^{\mathbf{n_{ncount}}}; \textsc{fullness}^{\mathbf{a_{grad}}} \textsc{quant}^{\mathbf{a_{card}}} \rightarrow \mathbf{n_{vessel}})$ *(cf.* two full glasses of beer*) are compound nominal types (*CONTENTS *is its core argument). MILK*$^{\mathbf{nct}}$*, SAND*$^{\mathbf{nct}}$ *are nominals of type* $\mathbf{nct}$*. GLASS*$^{\mathbf{ves}}$*, PACK*$^{\mathbf{ves}}$ *are nominals of type* $\mathbf{ves}$*.*
Some attributor types: $\mathbf{a}$ *(*attributors*),* $\mathbf{a_{grad}} \preceq \mathbf{a}$ *(*gradable attributors*, cf. RED*$^{\mathbf{a_{grad}}}$*, FAST*$^{\mathbf{a_{grad}}}$*),* $\mathbf{a_{degr}} \preceq \mathbf{a}$ *(*degree attributors*, cf. VERY*$^{\mathbf{a_{degr}}}$*, A_BIT*$^{\mathbf{a_{degr}}}$*),* $\mathbf{a_{ord}} \preceq \mathbf{a}$ *(*ordinal attributors*, cf. FIRST*$^{\mathbf{a_{ord}}}$*)* $\mathbf{a_{card}} \preceq \mathbf{a}$ *(*cardinal attributors*, cf. FIVE*$^{\mathbf{a_{card}}}$*, MANY*$^{\mathbf{a_{card}}}$*),* $\mathbf{a_{prec}} \preceq \mathbf{a}$ *(*precision attributors*, cf. ABOUT*$^{\mathbf{a_{prec}}}$*, NEARLY*$^{\mathbf{a_{prec}}}$*).*

Verbals have types $(\phi \rightarrow \mathrm{s}')$, where $\mathrm{s}' \preceq \mathrm{s}$ and s is the *sentential type*. Their argument structure is determined by diatheses and diathetic shifts. For that, the sorts are divided into *roles* R and *attributes* A. We use the most generic roles such as S|**A**(*subject-agent*), O|**P**(*object-patient*), etc. The roles identify the *core* arguments, the attributes identify circumstantials and *propositional parameters* (PP). In Fig. 1-3 DP are presented in a graphical form where solid lines labeled with roles link verbals to their core arguments and

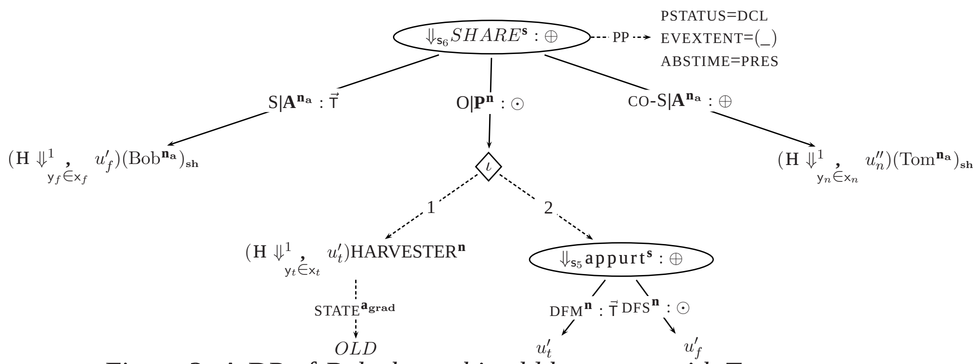

Figure 2. A DP of *Bob shares his old harvester with Tom.*

dashed lines labeled with attributes link semantemes to their circumstantials/qualifiers (e.g., $OLD^{\mathbf{a_{grad}}}$ represents the value of attribute STATE of HARVESTER in Fig. 2). The DP in Fig. 1,2 use several PP-attributes: PSTATUS (declarative in Fig. 1,2), SIGN (*positive/negative*), EVEXTENT, a generalized aspect (*continuous interval* in Fig. 1,2), time parameters ABSTIME (e.g., PRES) and RELTIME (*relative time*) etc.

The verbal SHARE has in Fig. 1,2 the type $((\mathrm{S}|\mathbf{A})^{\mathbf{n_a}}(\mathrm{O}|\mathbf{P})^{\mathbf{n}}(\text{CO-S}|\mathbf{A})^{\mathbf{n_a}} \to \mathbf{s})$. If a verbal V has several types: $types(V) = \{\mathbf{t_0}, \ldots, \mathbf{t_p}\}$, we call them *diatheses* of V. One of the diatheses, $\mathbf{t_0}$, is selected as *canonical*. E.g., the canonical diathesis of the verbal OPEN is $((\mathrm{S}|\mathbf{A})^{\mathbf{n_a}}(\mathrm{O}|\mathbf{P})^{\mathbf{n}}(\mathrm{INS})^{\mathbf{n}} \to \mathbf{s_e})$ (cf. *John opened the door with the key*), but in *The key opened the door* it has an object alternation diathesis $\mathbf{dalt} = ((\mathrm{S}|\mathbf{A})^{\mathbf{n}}(\mathrm{O}|\mathbf{P})^{\mathbf{n}} \to \mathbf{s_e})$. Non canonical diatheses are the result of transformations of $\mathbf{t_0}$, called *diathetic shifts*. The diathetic shifts correspond to core arguments' alternations/elimination caused at surface by change of mode, nominalization, conversion to infinitive, etc.

Definition 1 *Let* $\mathbf{t_0} = (\mathrm{R}_1^{\mathbf{u_1}} \ldots \mathrm{R}_n^{\mathbf{u_n}}; \mathrm{A}_1^{\mathbf{v_1}} \ldots \mathrm{A}_m^{\mathbf{v_m}} \to \mathbf{v})$ *be the canonical diathesis of* V *and* $\mathbf{t_i} = ((\mathrm{R}')_1^{\mathbf{u'_1}} \ldots (\mathrm{R}')_k^{\mathbf{u'_k}}; \mathrm{A}_1^{\mathbf{v_1}} \ldots \mathrm{A}_m^{\mathbf{v_m}} \to \mathbf{v}')$ *be some other its diathesis. Then* $D_i = (\mathbf{t_i}, \mathrm{d}_i)$ *is a* diathetic shift *of* $\mathbf{t_0}$ *if* $\mathrm{d}_i : \{1, \ldots, k\} \overset{1-1}{\to} \{i_1 \ldots, i_k\}$, *for* $1 \leq i_1 < \ldots < i_k \leq n$, *is a bijection preserving types:* $\mathbf{u'_j} = \mathbf{u_{i_j}}$, $1 \leq j \leq k$. *We call this bijection* argument shift *and denote it by* $\mathrm{d}_i : k \overset{1-1}{\mapsto} n$. *The non-canonical diathesis* $V^{\mathbf{t_i}}$ *resulting from* $V^{\mathbf{t_0}}$ *through diathetic shift* D_i *is denoted* $V[\mathrm{d}_i]^{\mathbf{t_i}}$ *and called a* derivative *of* $V^{\mathbf{t_0}}$.

Example 2 *For the verbal OPEN, the argument shift* $\{1 \mapsto 2, 2 \mapsto 1, 3 \mapsto 3\}$ *transforms its canonical diathesis into the diathesis of passive* $((\mathrm{SBJ})^{\mathbf{n}}(\mathrm{AGT})^{\mathbf{n_a}}(\mathrm{INS})^{\mathbf{n}} \to \mathbf{s_{eff}})$ *as in the sentence* The door was opened with the key by John's girl-friend *and* $\{3 \mapsto 1, 2 \mapsto 2\}$ *transforms it into the diathesis of alternation* $\mathbf{dalt}$ *shown above.*

In DP, the diathetic shifts are represented as assignments to core arguments of new roles and of *communicative ranks* ($\vec{\top}$: *topic*, $\odot$: *focus*, $\oplus$: *background*). Assignment of rank $\ominus$ (*periphery*) to an argument causes its elimination. E.g. SHARE has in Fig. 1,2 its canonical diathesis $((\mathrm{S}|\mathbf{A})^{\mathbf{n_a}}(\mathrm{O}|\mathbf{P})^{\mathbf{n}}(\text{CO-S}|\mathbf{A})^{\mathbf{n_a}} \to \mathbf{s})$ for which the canonical rank assignment is $\mathrm{S}|\mathbf{A} \longleftrightarrow \vec{\top}$, $\mathrm{O}|\mathbf{P} \longleftrightarrow \odot$, $\text{CO-S}|\mathbf{A} \longleftrightarrow \oplus$. A different role/rank assignment $\emptyset \longleftrightarrow \mathrm{S}|\mathbf{A}_{\ominus}$, $\mathrm{S}|\mathbf{A} \longleftrightarrow \mathrm{O}|\mathbf{P}_{\vec{\top}}$, $\text{CO-S}|\mathbf{A} \longleftrightarrow \text{CO-S}|\mathbf{A}_{\odot}$ would transform the canonical diathesis into a diathesis of passive: $((\mathrm{S}|\mathbf{A})^{\mathbf{n}}\ (\text{CO-S}|\mathbf{A})^{\mathbf{n_a}} \to \mathbf{s})$ (S|**A**-argument is eliminated by assignment of $\ominus$; assignment of $\vec{\top}$ to the O|**P**-argument promotes it to the S|**A**-position). This assignment corresponds to the *argument shift* $\{2 \mapsto 1, 3 \mapsto 2\}$.

The intuitive reading of operator ι is "*such object .. that ..*".

Expressions $\mathrm{D}_{x_f} = (\mathrm{H} \Downarrow_{x_f} u_f)$ in D_{x_f}FARMER and $\mathrm{D}_{y_f} = (\mathrm{H} \Downarrow^1_{y_f \in x_f} u'_f)$ in $\mathrm{D}_{y_f}(\mathrm{Bob}^{\mathbf{n_a}})_{\mathbf{sh}}$ are *determiners* creating and relating objects. Created objects may be referred by other determiners in subsequent discourse. E.g. the constructor $\Downarrow^1_{y_f \in x_f}$ "creates" a new object for the shifter name $(\mathrm{Bob}^{\mathbf{n_a}})_{\mathbf{sh}}$ and "refers" to the object which binds x_f. Constructor $\Uparrow_x$ just refers to x. E.g., $\Uparrow_{x_v}$ VILLAGE in Fig. 1 gives the object o_v previously created by $\Downarrow_{x_v}$ VILLAGE. Constructors H and I used in determiners define the way the referred objects are accessed. The former (*holistic*) provides access to the object itself, whereas the latter (*individual*) to the object's extension elements. The full DP syntax may be seen in the definition of the static semantics.

3 Fundamentals of DP Semantics

General notions. We define two DP semantics: one *dynamic*, the other *static*. Both are defined in a subset of the set theory extended with specific constants: $R_{\mathbf{g}}$ (*global object references*), $R_{\mathbf{l}}$ (*local object references*), $\mathsf{O}^{\mathbf{t}}$ (*object identities* of type t, O is the union of all $\mathsf{O}^{\mathbf{t}}$), *lexical class constants* in $LC = \{L_W \mid W \text{ is a semanteme}\}$, $\perp \notin \mathsf{O}$ (an *"uncertain value"*).

As show the examples in Fig. 1,2, DP do not use quantifiers and object variables. Instead they use determiners D_{x}, where x is a global reference in $R_{\mathbf{g}}$. The dynamic semantics is relativized to *dynamic contexts* (*d-contexts*). When the semantics of a DP $\pi = \mathsf{D}_{\mathsf{x}}\pi'$ is computed in a d-context Σ, it assigns to π a new object $o \in \mathsf{O}$ (a *realization* of π in the discourse), changes Σ to a new d-context Σ', binds x with o and assigns to o a set value $|o|^{\Sigma'}$, its *dynamic extension* (*d-extension*). In other words, the effect of the DP π in Σ may be seen as a *transition* $(\pi)_{\Sigma}^{\Sigma'}$ from Σ to Σ'. The d-extension of π is relativized to the initial d-context: $|\pi|_{\Sigma}^{\Sigma'} =_{df} |o|^{\Sigma'}$. The static semantics is insensitive to context transitions. It applies to a DP π in a *static context* (*s-context*) σ where it inductively computes a set value $\|\pi\|^{\sigma}$ called *static extension* (*s-extension*) of π. The two semantics are related through a tight correspondence between d- and s-contexts.

Definition 2 *A* d-context *is a finite structure $\Sigma = (D, I)$, where D is a finite collection of sets and I is a finite function from constants to sets in D with four particular restrictions: $\gamma_\Sigma = I\restriction R_{\mathbf{g}}$ (*global assignment*),* $\lambda_\Sigma = I\restriction R_{\mathbf{l}}$ *(*local assignment*), $\theta_\Sigma = I\restriction \mathsf{O}^{\mathbf{n}}$ (*nominal objects' evaluation*) and $\hbar_\Sigma = I\restriction LC$ (*horizon line *of* Σ). The finite structure $\sigma =< \gamma_\Sigma, \lambda_\Sigma, \theta_\Sigma, \hbar_\Sigma >$ is the* s-context corresponding to Σ.

$\gamma_\Sigma(\mathsf{x}) = o$ means that the global reference x is bound with the object o, $\lambda_\Sigma(u) = s$ means that the local reference u is bound with the set s, $\theta_\Sigma(o) = s$ means that the nominal type object o has d-extension $|o|^{\Sigma} = s$ and $\hbar_\Sigma(L_W) = s$ means that s is the part of the d-extension of lexical class L_W "accessible" in Σ. So the corresponding d-context and s-context share the four functions. Context transitions in the dynamic semantics correspond to updates of some of them.

Elements of lexical semantics. DP semantics rests upon a set of lexical axioms. The axioms introduce lexical class constants L_W for semantemes $W^{\mathbf{t}}$ of type t and relates with them a set of functions (*attributes*). For space reasons, we only cite some their consequences necessary to understand semantical definitions.

We suppose that every semanteme W has a unique set code $W^\star$. Let $LEX(\mathsf{u})$ denote the set of all DP semantemes of types $(\phi \to \mathsf{u})$ or u. First of all, we suppose that the lexical classes representing types consist of objects of these types: $L_{\mathbf{u}} \subseteq \mathsf{O}^{\mathbf{u}}$. Attributor type objects are particular: every attributor type object $o \in \mathsf{O}^{\mathbf{u}}$, $\mathsf{u} \preceq \mathsf{a}$, has an extension $\|o\|$ which is a semanteme code: $\|o\| \in \{W^\star \mid W \in LEX(\mathsf{u})\}$. E.g., for $o \in L_{\text{BRIGHT}}$, where BRIGHT $\in LEX(\mathsf{a}_{\mathbf{grad}})$, $\|o\| = \text{BRIGHT}^\star$.

Further, the hierarchy of lexical types induces a hierarchy of the corresponding lexical classes: $\mathsf{u} \preceq \mathsf{v}$ if and only if $L_{\mathbf{u}} \subseteq L_{\mathbf{v}}$ and $L_W \subseteq L_{\mathbf{u}}$ for $W \in LEX(\mathsf{u})$.

Then, all lexical classes L_W representing semantemes $W \in LEX(\mathsf{u})$ share the same attributes. The set of these attributes is denoted $Att(\mathsf{u})$. Every attribute A is characterized by the type v of its values (notation: $\mathrm{A}^{\mathbf{v}}$). E.g. $\text{DEGREE}^{\mathbf{a}_{\mathbf{degr}}}$ with values $(\text{VERY}^\star)^{\mathbf{a}_{\mathbf{degr}}}$, $(\text{SLIGHTLY}^\star)^{\mathbf{a}_{\mathbf{degr}}}$, etc., is an attribute of all classes L_W representing semantemes of type $\mathsf{a}_{\mathbf{grad}}$ ($W \in LEX(\mathsf{a}_{\mathbf{grad}})$), e.g., $\text{RED}^{\mathbf{a}_{\mathbf{grad}}}$, $\text{FAST}^{\mathbf{a}_{\mathbf{grad}}}$, etc. It is subsumed that $\mathsf{v} \preceq \mathsf{a}$ (v is an attributor type) for every attribute $\mathrm{A}^{\mathbf{v}}$. If $Att(\mathsf{u}) = \{\mathrm{A}_1^{\mathbf{v_1}}, \ldots, \mathrm{A}_m^{\mathbf{v_m}}\}$ are all attributes of objects of type u, the set of their value types is denoted $DT(\mathsf{u}) = \{\mathsf{v}_{\mathbf{1}}, \ldots, \mathsf{v}_{\mathbf{m}}\}$. We say that the types in $DT(\mathsf{u})$ are *lexically dependent* on u. It is presumed that the graph of this dependency *has no cycles*. The set of primitive types being finite, this means that there are *minimal* attribute types with no dependents: $DT(\mathsf{a}_0) = \emptyset$. One of minimal types is $\mathsf{a}_{\mathbf{degr}}$. Another example is the precision type: $\mathsf{a}_{\mathbf{prec}}$ with values $(\text{NEARLY}^\star)^{\mathbf{a}_{\mathbf{prec}}}$, $(\text{ABOUT}^\star)^{\mathbf{a}_{\mathbf{card}}}$, etc., which is the value type of the attribute QUANT of all classes L_W for semantemes of type $\mathsf{a}_{\mathbf{card}}$ ($W \in LEX(\mathsf{a}_{\mathbf{card}})$), e.g. $\text{TWO}^{\mathbf{a}_{\mathbf{card}}}$. We set $o.\mathrm{A} =_{df} \|\mathrm{A}(o)\|$.

In DP semantics, attribute values serve to constrain lexical classes. Here is an example.

Example 3 *The semanteme GLASS in the DP in Fig. 3 has one core* CONTENTS*-argument and two attributes:* $Att(\mathbf{n_{vessel}}) = \{\text{FULLNESS}^{\mathbf{a_{grad}}}, \text{QUANT}^{\mathbf{a_{card}}}\}$*. So the system of constraints for GLASS is defined as* $AC(\text{FULLNESS}^{\mathbf{a_{grad}}} = \pi_1, \text{QUANT}^{\mathbf{a_{card}}} = \pi_2) = AC(\text{FULLNESS}^{\mathbf{a_{grad}}} = \pi_1) \cup AC(\text{QUANT}^{\mathbf{a_{card}}} = \pi_2)$*, where* π_1 *and* π_2 *are the two attributor subplans (*FULLNESS*-branch and* QUANT*-branch) of this DP. Below, in semantics definition, the components are computed bottom-up recursively:* $AC(\text{DEGREE} = \textit{NEARLY}) = \{\text{DEGREE}(o_f) = NEARLY^{\star}, \|o_f\| = FULL^{\star}\}$ *for* $o_f = \gamma(\mathsf{z_f})$*,* $AC(\text{FULLNESS}^{\mathbf{a_{grad}}} = \pi_1) = \{\text{FULLNESS}(o) = o_f\} \cup AC(\text{DEGREE} = \textit{NEARLY})$ *for* $o = \gamma(\mathsf{x})$*. Similar for* $AC(\text{QUANT}^{\mathbf{a_{card}}} = \pi_2)$*.*

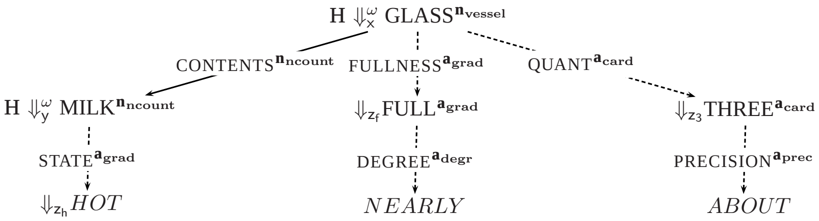

Figure 3. A DP of *about three nearly full glasses of hot milk*.

Finally, the lexical semantics of verbals reduces all verbals' derivatives $V[\mathbf{d}]$ to the canonical form V. For that is used a special product, called *shifted*, allowing to relate their arguments.

Definition 3 *Let* $n > 0$*,* $d : k \overset{1-1}{\mapsto} n$ *be an argument shift and* $s_1, \ldots, s_n$ *be a sequence of sets. The* shifted product *of this sequence (under shift* d*) is:*

$$\prod_{1 \leq i \leq k}^{d} s_i =_{df} M_1 \times \ldots \times M_n,$$

where $M_i = s_{d^{-1}(i)}$ *for* $i \in range(d)$ *and* $M_i = \{\bot\}$ *otherwise.*

4 Definition of Static Semantics

In this section we define in parallel the syntax[3] and the static semantics of DP. The correspondence between d- and s-contexts being inessential for this semantics, we fix an s-context $\sigma =< \Gamma, \Lambda, \Theta, H >$ in which, for every DP π, will be defined its *s-extension* $\|\pi\|^{\sigma}$. So Γ is a global assignment, Λ is a local assignment, Θ is a nominal objects' evaluation and H is a horizon line. As we shall see, every composite subplan π of a DP is uniquely identified by a global reference x introduced by a determiner: $\pi = \mathbf{D}_{\mathsf{x}}\pi'$. The static semantics $\|\pi\|^{\sigma}$ will be defined through the extension $\|\Gamma(\mathsf{x})\|^{\sigma}$ of the object $\Gamma(\mathsf{x})$.

I. Primitives.

I.1. Lexical classes. For a non-attributor semanteme W, $\|L_W\|^{\sigma} = H(L_W)$.

I.2. Null plans (intuitively, corresponding to existentially bound arguments).

For a null nominal plan $\pi = \Downarrow_{\mathsf{x}} 0^{\mathbf{n}}$ (**Ex:** *Testamentary succession*$_{\text{OBJ}:\Downarrow_{\mathsf{x}} 0^{\mathbf{n}}}$ *goes to Mary*),

$\|\pi\|^{\sigma} = \|\Gamma(\mathsf{x})\|^{\sigma}$, where $\|\Gamma(\mathsf{x})\|^{\sigma} = \{\bot\}$.

For a null attributor plan $\pi = \Downarrow_{\mathsf{x}} 0^{\mathbf{a}}$ (**Ex:** *happy*$_{\text{DEGREE}:0^{\mathbf{a_{degr}}}}$ *as goblin*),

$\|\pi\|^{\sigma} = \|\Gamma(\mathsf{x})\|^{\sigma}$, where $\|\Gamma(\mathsf{x})\|^{\sigma} = \bot$.

I.3. Shifter plans. Let $\pi = \Downarrow_{\mathsf{x}} (\mathrm{K}^{\mathbf{n}'})_{\mathbf{sh}}$, where $(\mathrm{K}^{\mathbf{n}'})_{\mathbf{sh}}$ is a nominal shifter constant of type $\mathbf{n}'$ (**Ex:** $(\textbf{speaker}^{\mathbf{n_a}})_{\mathbf{sh}}$, $(\text{John}^{\mathbf{n_a}})_{\mathbf{sh}}$). Then:

$\|\pi\|^{\sigma} = \|\Gamma(\mathsf{x})\|^{\sigma}$, where $\|\Gamma(\mathsf{x})\|^{\sigma} = \{((\mathrm{K})_{\mathbf{sh}})^{\star}\}$.

I.4. Reference plans.

$\|\pi\|^{\sigma} = \|\Lambda(u)\|^{\sigma}$ for $\pi = u^{\mathbf{t}}$, u being a local reference.

$\|\pi\|^{\sigma} = \|\Gamma(\mathsf{x})\|^{\sigma}$ for $\pi = \Uparrow_{\mathsf{x}^{\mathbf{t}}}$, x being a global reference.

I.5. Primitive attributor plans. $\pi = W$, where $W \in LEX(\mathbf{v})$ and $\mathbf{v} \preceq \mathsf{a}$ is a minimal attributor type (e.g. $\mathsf{a}_{\mathbf{degr}}$, $\mathsf{a}_{\mathbf{prec}}$), are the only nonreferenced DP. For such DP, $\|\pi\|^{\sigma} = W^{\star}$.

II. Compound DP.

Sentential plans.

[3] Because of space limits we omit the rules of visibility of references.

II.1. Unit sentential plans. Let $\pi = \Downarrow_{\mathsf{x}} V[\mathbf{d}](\mathrm{R}_1 : \pi_1, \ldots, \mathrm{R}_k : \pi_k, \mathrm{A}_1 : \pi'_1, \ldots, \mathrm{A}_m : \pi'_m)$ be a sentential DP in which $\pi'_i = \Downarrow_{\mathsf{x}_i} \pi''_i$, $1 \le i \le m$, are composite attributor DP. Then:
$\|\pi\|^\sigma = \|\Gamma(\mathsf{x})\|^\sigma$,
$\|\Gamma(\mathsf{x})\|^\sigma = \prod\limits_{1\le i\le k}^{\mathbf{d}} \|\pi_i\|^\sigma$.
$\Gamma(\mathsf{x}) \in \|(L_{\mathbf{V}})\|^\sigma$, $\mathrm{A}_i(\Gamma(\mathsf{x})) = \Gamma(\mathsf{x}_i)$ and $\Gamma(\mathsf{x}).\mathrm{A}_i = \|\pi'_i\|^\sigma$, $1 \le i \le m$.
II.2. Coordinated sentential plans. Let $\pi = \Downarrow_{\mathsf{x}} \mathcal{C}^{(n)}(\pi_1, \ldots, \pi_n)$, where $n > 1$ and $\pi_i = \Downarrow_{\mathsf{x}_i} \pi'_i$ are unit sentential DP of sentential types $\mathbf{s_i}$, $1 \le i \le n$. Then:
$\|\pi\|^\sigma = \|\Gamma(\mathsf{x})\|^\sigma$, where $\|\Gamma(\mathsf{x})\|^\sigma =< \Gamma(\mathsf{x}_1), \ldots, \Gamma(\mathsf{x}_n) >$,
$\|\Gamma(\mathsf{x}_i)\|^\sigma = \|\pi'_i\|^\sigma, 1 \le i \le n$.

Nominal plans.

II.3. Absolute unit determined nominal plans. Let $\pi = \mathrm{D}_{\mathsf{x}}\hat{\pi}$, where $\mathrm{D}_{\mathsf{x}} = (\mathrm{Q} \Downarrow^{\mathbf{k}}_{\mathsf{x}} u)$ is a determiner in which $\mathrm{Q} \in \{\mathrm{H}, \mathrm{I}\}$, $\mathsf{x}^{\mathbf{n}'}$ is a global reference, u is a local reference, k is a number or ω, $N^{\mathbf{t}}$ is a nominal of type $\mathrm{t} = (\mathrm{S}_1^{\mathbf{n_1}} \ldots \mathrm{S}_k^{\mathbf{n_k}} \mathrm{A}_1^{\mathbf{v_1}} \ldots \mathrm{A}_m^{\mathbf{v_m}} \to \mathrm{n}')$, $\hat{\pi} = N^{\mathbf{t}}(\mathrm{S}_1 : \pi_1, \ldots, \mathrm{S}_k : \pi_k, \mathrm{A}_1 : \pi'_1, \ldots, \mathrm{A}_m : \pi'_m)$ is a determinerless nominal DP, where $\mathrm{n}' \preceq \mathrm{n}$, $\pi_i = \mathrm{D}_{\mathsf{x}_i}\hat{\pi}_i$, $1 \le i \le k$, are core argument nominal DP and $\pi'_j = \Downarrow_{\mathsf{y}_j} \hat{\pi}'_j$, $1 \le j \le m$, are composite attributor DP (see the DP in Fig. 3 and Example 3). Then:
$\|\pi\|^\sigma = \{\Gamma(\mathsf{x})\}$, if $\mathrm{Q} = \mathrm{H}$, and $\|\pi\|^\sigma = \|\Gamma(\mathsf{x})\|^\sigma$, if $\mathrm{Q} = \mathrm{I}$,
$\|\Gamma(\mathsf{x})\|^\sigma = \Theta(\Gamma(\mathsf{x}))$ and $card(\|\Gamma(\mathsf{x})\|^\sigma) \le \mathrm{k}$,
$\Gamma(\mathsf{x}) \in \|(L_N)\|^\sigma$,
$\mathrm{S}_i(\Gamma(\mathsf{x})) = \Gamma(\mathsf{x}_i)$, $1 \le i \le k$.
$\mathrm{A}_j(\Gamma(\mathsf{x})) = \Gamma(\mathsf{y}_j)$ and $\Gamma(\mathsf{x}).\mathrm{A}_j = \|\pi'_j\|^\sigma$, $1 \le j \le m$.
II.4. Relativized unit determined nominal plans. Let $\pi = \mathrm{D}_{\mathsf{x}}\pi_1$, where $\mathrm{D}_{\mathsf{x}} = (\mathrm{Q} \Downarrow^{\mathbf{k}}_{\mathsf{x}\mathbf{r}\mathsf{y}} u)$ is a determiner in which $\mathrm{Q} \in \{\mathrm{H}, \mathrm{I}\}$, $\mathrm{r} \in \{\grave{\in}, \sim, \subset, /, \ldots\}$, π_1 is a determinerless nominal plan and y is a global object reference identifying in the preceding discourse a nominal plan $\mathrm{D}_{\mathsf{y}}\pi_0$ with determiner $\mathrm{D}_{\mathsf{y}} = (\mathrm{Q}_{\mathbf{0}} \Downarrow^{\mathbf{k_0}}_{\mathsf{y}} u_0)$ (see the DP in Fig. 2). Then $\|\pi\|^\sigma$ is defined as in the preceding case. Besides this, the following r-conditions also hold:
$\|\mathrm{r}\|^\sigma(\Gamma(\mathsf{x}), \Gamma(\mathsf{y}))$ if $\mathrm{r} \in \{\sim, \subset, /, \ldots\}$,
$\Gamma(\mathsf{x}) \in \|\Gamma(\mathsf{y})\|^\sigma$, $\Lambda(u) = \{\Gamma(\mathsf{x})\}$ and $card(\|\Gamma(\mathsf{y})\|^\sigma) \le \mathrm{k}_{\mathbf{0}}$ if $\mathrm{r} = \grave{\in}$.
II.5. Relative determined nominal plans. Let $\pi = \iota_{\mathrm{R}}(\pi_0 \mid \hat{\pi}_0)$, where $\pi_0 = \mathrm{D}_{\mathsf{x}}\pi'_0$ is a unit determined nominal plan, u is the local reference in D_{x}, R is a role and $\hat{\pi}_0 = \Downarrow_{\mathsf{y}} V[\mathbf{d}](\mathrm{R}_1 : \hat{\pi}_1, \ldots, \mathrm{R}_i : u, \ldots, \mathrm{R}_k : \hat{\pi}_k, \mathrm{A}_1 : \hat{\pi}'_1, \ldots, \mathrm{A}_m : \hat{\pi}'_m)$ is a sentential plan such that $\mathrm{R}_i = \mathrm{R}$. Let also $I^\sigma_{\mathrm{R}}(\hat{\pi}_0) = \{x \mid (\exists y_1, \ldots, y_n)(\langle y_1, \ldots, y_n\rangle \in \|\Gamma(\mathsf{y})\|^\sigma \;\&\; x = y_{d^{-1}(i)})\}$. Then:
$\|\Gamma(\mathsf{x})\|^\sigma = \|\pi_0\|^\sigma \cap I^\sigma_{\mathrm{R}}(\hat{\pi}_0)$ and
$\|\pi\|^\sigma = \{\Gamma(\mathsf{x})\}$, if $\mathrm{Q} = \mathrm{H}$, and $\|\pi\|^\sigma = \|\Gamma(\mathsf{x})\|^\sigma$, if $\mathrm{Q} = \mathrm{I}$.
If π_0 is a relativized unit determined nominal plan (i.e. $\mathrm{D}_{\mathsf{x}} = \mathrm{Q} \Downarrow^{\mathbf{k}}_{\mathsf{x}\mathbf{r}\mathsf{y}} u$), then the r-conditions also hold.
Ex: Relative and comparative clauses.
II.6. Aggregate nominal plans. Let $\pi = \mathrm{D}_{\mathsf{x}}\mathcal{A}(\pi_1, \ldots, \pi_n)$, where $\mathrm{D}_{\mathsf{x}} = \mathrm{Q} \Downarrow^{\mathbf{k}}_{\mathsf{x}} u$ and $\pi_i = \mathrm{D}_{\mathsf{x}_i}\pi'_i$, $1 \le i \le n$, are determined nominal DP. Then:
$\|\Gamma(\mathsf{x})\|^\sigma = \Theta(\Gamma(\mathsf{x}))$ and $\Gamma(\mathsf{x}_1), \ldots, \Gamma(\mathsf{x}_n) \in \|\Gamma(\mathsf{x})\|^\sigma$ if $\mathrm{k} = \omega$,
$\|\Gamma(\mathsf{x})\|^\sigma = \{\Gamma(\mathsf{x}_1), \ldots, \Gamma(\mathsf{x}_n)\}$ if $\mathrm{k} = n$,
$\|\pi\|^\sigma = \{\Gamma(\mathsf{x})\}$, if $\mathrm{Q} = \mathrm{H}$, and $\|\pi\|^\sigma = \|\Gamma(\mathsf{x})\|^\sigma$, if $\mathrm{Q} = \mathrm{I}$.
Ex: *(Students$_{\Downarrow_{\mathsf{x}_1}}$ and professors$_{\Downarrow_{\mathsf{x}_2}}$)$_{\Downarrow_{\mathsf{x}}}$ went on strike.*

Attributor plans.

II.7. Lexicalized attributor plans. Let $\pi = \Downarrow_{\mathsf{x}} W^{\mathbf{t}}(\mathrm{A}_1 : \pi_1, \ldots, \mathrm{A}_m : \pi_m)$ be a DP in which $\mathrm{t} = (\mathrm{A}_1^{\mathbf{v_1}} \ldots \mathrm{A}_m^{\mathbf{v_m}} \to \mathrm{u})$, $\mathrm{u} \preceq \mathrm{a}$, and π_i are attributor DP, $1 \le i \le m$. Then:
$\|\pi\|^\sigma = \|\Gamma(\mathsf{x})\|^\sigma = W^\star$,

$\text{A}_i(\Gamma(\mathsf{x})) = \Gamma(\mathsf{x}_i)$, if $\pi_i = \Downarrow_{\mathsf{x}_i} \pi_i'$, and $\text{A}_i(\Gamma(\mathsf{x})) = \|\pi_i\|^\sigma$ otherwise, $1 \leq i \leq m$,
$\Gamma(\mathsf{x}).\text{A}_i = \|\pi_i\|^\sigma$, $1 \leq i \leq m$.
Ex: See the DP in Fig. 3 and Example 3.
II.8. Relative attributor plans. Let $\pi = \iota\left(\Downarrow_{\mathsf{x}} 0^{\mathbf{t}} \,|\, \pi_1\right)$ be a relative attributor plan in which $\mathbf{u} \preceq \mathbf{a}$ is an attributor type, $\mathsf{x}^{\mathbf{u}}$ is a global reference and $\pi_1 = \Downarrow_{\mathsf{y}} \pi_1'$ is a sentential type DP. Then:
$\|\pi\|^\sigma = \|\Gamma(\mathsf{x})\|^\sigma = \bot$,
$\|\pi_1\|^\sigma = \|\Gamma(\mathsf{y})\|^\sigma$,
$\|\mathbf{rel}\|^\sigma(\Gamma(\mathsf{x}), \Gamma(\mathsf{y}))$ for a special relation $\mathbf{rel}$.
Ex: *He was so*$_{\Downarrow_{\mathsf{x}}(0^{\mathbf{a}_{\mathbf{degr}}})}$ *glad, that ...*

5 On Dynamic DP Semantics

The dynamic semantics is defined through translation $\lceil .. \rceil$: for a discourse $\delta = (\pi_1, \ldots, \pi_n)$, $\lceil \delta \rceil = \lceil \pi_1 \rceil \ldots \lceil \pi_n \rceil$ is a reaction-to-stimuli process which, when applied to a starting context Σ_0, executes transitions $(\pi_1)_{\Sigma_0}^{\Sigma_1}, (\pi_2)_{\Sigma_1}^{\Sigma_2}, \ldots, (\pi_n)_{\Sigma_{n-1}}^{\Sigma_n}$ and computes the corresponding d-extensions: $|\delta|_{\Sigma_0} = (|\pi_1|_{\Sigma_0}^{\Sigma_1}, |\pi_2|_{\Sigma_1}^{\Sigma_2}, \ldots, |\pi_n|_{\Sigma_{n-1}}^{\Sigma_n})$. The translation and the transition actions and rather technical and will be published elsewhere. Here we only illustrate it by the process corresponding to the discourse in Fig. 1,2.

Its intermediate data are shown in Tables 1,2 with columns: Context (current d-context), GRef (global object reference identifying a subplan), Oid (identity of the created object), d-Extension elements (elements added to the d-extension of the object), LRef (local object reference), LVal (current value of the local object reference), Attributes (attribute value extension) and Semanteme (the root semanteme of the subplan). This computation executes two processes: $\lceil \pi_1 \rceil = p_1$ (see Table 1) and $\lceil \pi_2 \rceil = p_2$ (see Table 2), where π_1 and π_2 are DP in Figures 1 and 2 respectively.

Context	GRef	Oid	d-Extension elements	LRef	LVal	Attributes	Semanteme
Σ_0	x_v	$o_v \in \mathsf{O}^{\mathbf{n}}$	$(\text{v})^\star_{\mathbf{sh}}$				VILLAGE
Σ_1	x_f	$o_f \in \mathsf{O}^{\mathbf{n_a}}$	$\bot$	u_f	$\{\bot\}$		FARMER
Σ_2	s_1	$o_{loc} \in \mathsf{O}^{\mathbf{s}}$	$< \text{DFM} : \bot, \text{DFS} : o_v >$				**loc**
Σ_3	x_t	$o_t \in \mathsf{O}^{\mathbf{n}}$	$\bot$	u_t	$\{\bot\}$		TRACTOR
Σ_4	s_2	$o_u \in \mathsf{O}^{\mathbf{s}}$	$< \text{S}\|\mathbf{A} : \bot, \text{O}\|\mathbf{P} : \bot >$			$o_u.\text{PSTATUS} = \text{DCL}^\star$, etc.	USE
Σ_5	x_n	$o_n \in \mathsf{O}^{\mathbf{n_a}}$	$\bot$	u_n	$\{\bot\}$		NEIGHBOR
Σ_6	s_3	$o_{sh} \in \mathsf{O}^{\mathbf{s}}$	$< \text{S}\|\mathbf{A} : \bot, \text{O}\|\mathbf{P} : \bot, \text{CO-S}\|\mathbf{A} : \bot >$			$o_u.\text{PSTATUS} = \text{DCL}^\star$, etc.	SHARE
Σ_7	s_4	$o_h \in \mathsf{O}^{\mathbf{s}}$	$< \text{S}\|\mathbf{A} : \bot, \text{O}\|\mathbf{P} : \bot >$			$o_h.\text{PSTATUS} = \text{DCL}^\star$, etc.	HAVE

Table 1. Computation for the first DP π_1.

Context	GRef	Oid	d-Extension elements	LRef	LVal	Attributes	Semanteme
Σ_8	y_f	$o_B \in \mathsf{O}^{\mathbf{n_a}}$	$(\text{Bob})^\star_{\mathbf{sh}}$	u_f'	$\{o_B\}$		$(\text{Bob})_{\mathbf{sh}}$
	x_f	o_f	$\bot, o_B$	u_f	$\{o_B\}$		
	s_2	o_u	$< \text{S}\|\mathbf{A} : o_B, \text{O}\|\mathbf{P} : \bot >$				USE
	s_4	o_h	$< \text{S}\|\mathbf{A} : o_B, \text{O}\|\mathbf{P} : o_n >$				HAVE
Σ_9	y_t	$o_{hv} \in \mathsf{O}^{\mathbf{n}}$	$\bot$	u_t'	$\{o_{hv}\}$	$o_{hv}.\text{STATE} = \text{OLD}^\star$	HARVESTER
	x_t	o_t	$\bot, o_{hv}$	u_t	$\{o_{hv}\}$		TRACTOR
	s_1	o_u	$< \text{S}\|\mathbf{A} : o_B, \text{O}\|\mathbf{P} : o_{hv} >$				USE
Σ_{10}	s_5	$o_{appurt} \in \mathsf{O}^{\mathbf{s}}$	$< \text{DFM} : o_{hv}, \text{DFS} : o_B >$				**appurt**
Σ_{11}	y_n	$o_T \in \mathsf{O}^{\mathbf{n_a}}$	$(\text{Tom})^\star_{\mathbf{sh}}$	u_n'	$\{o_T\}$		$(\text{Tom})_{\mathbf{sh}}$
	x_n	o_n	$\bot, o_T$	u_n	$\{o_T\}$		NEIGHBOR
	s_3	o_{sh}	$< \text{S}\|\mathbf{A} : o_B, \text{O}\|\mathbf{P} : o_{hv}, \text{CO-S}\|\mathbf{A} : o_T >$				SHARE
Σ_{12}	s_6	o_{sh}'	$< \text{S}\|\mathbf{A} : o_B, \text{O}\|\mathbf{P} : o_{hv}, \text{CO-S}\|\mathbf{A} : o_T >$			$o_{sh}'.\text{PSTATUS} = \text{DCL}^\star$, etc.	SHARE

Table 2. Computation corresponding to the second DP π_2.

This computation executes two processes: $\lceil \pi_1 \rceil = p_1$ and $\lceil \pi_2 \rceil = p_2$, where π_1 and π_2 are DP in Figures 1 and 2 respectively. The computation of p_1 (see Table 1) is started in context Σ_0 in which there is an object $o_v = \gamma_{\Sigma_0}(\mathsf{x}_v)$ referenced by $\Uparrow_{\mathsf{x}_v}$ (*the village*). Then, in the course of seven consecutive transitions, it creates a new object o for each subplan identified by its determiner D_{x}, binds the global reference x with o and adds the object to the accessible subset $\hbar_{\Sigma_1}(L_W)$ of the lexical class L_W corresponding to the head semanteme W of the subplan. In the case where W is a verbal, the process adds new facts to the shifted product related with L_W (the element of the column "Semanteme" identifies W and the corresponding subplan). For instance, the transition to Σ_1 is due to the determiner $(\mathrm{I} \Downarrow_{\mathsf{x}_f} u_f)$ applied to FARMER. The process creates a new object $o_f = \gamma_{\Sigma_1}(\mathsf{x}_f) \in \mathbf{O}^{\mathbf{n_a}}$ with *uncertain* extension $\{\perp\}$ which becomes in context Σ_1 the d-extension of the subplan with the head semanteme FARMER. The object o_f is added to $\hbar_{\Sigma_1}(L_{FARMER})$ and $\lambda_{\Sigma_1}(u_f)$ is set to $\{\perp\}$. In the next transition to Σ_2, due to the determiner $\Downarrow_{\mathsf{s}_1}$, the process creates a new object o_{loc} for the proper relation $\mathtt{loc}$, binds s_1 with o_{loc} and adds the fact $<$ DFM : $\perp$, DFS : $o_v >$ to the shifted product representing its extension. Importantly, in the next transition to Σ_3, the process, unlike the transition to Σ_1, creates an object $o_t \in \mathbf{O}^{\mathbf{n}}$ for TRACTOR with the *certain* extension $\{o_t\}$. This is explained by the difference of access constructors in the two determiners: *individual* I for FARMER and *holistic* H for TRACTOR. This difference manifests itself in the computation of p_2 (see Table 2). Viz., due to the determiner $(\mathrm{H} \Downarrow^1_{\mathsf{y}_f \grave{\in} \mathsf{x}_f} u'_f)$ applied to $(\mathrm{Bob}^{\mathbf{n_a}})_{\mathbf{sh}}$, this computation changes Σ_7 to Σ_8, creates $o_B = \gamma_{\Sigma_8}(\mathsf{y}_f) \in \mathbf{O}^{\mathbf{n_a}}$ with extension $\theta_{\Sigma_8}(o_B) = \{(\mathrm{Bob})^{\star}_{\mathbf{sh}}\}$, and, due to the relativized reference $\mathsf{y}_f \grave{\in} \mathsf{x}_f$, raises a stimulus to which reacts the object o_f binding the reference x_f. The reaction consists in reactivation of the process p_1 which adds o_B to the extension $|o_f|^{\Sigma_8}$ and to $\hbar_{\Sigma_8}(L_{FARMER})$, and binds the local reference u_f with $\{o_B\}$ ($\lambda_{\Sigma_8}(u_f) = \{o_B\}$), whereby the shifted products for USE and HAVE are recomputed: $<$ S|**A** : o_B, O|**P** : $\perp >$ is added to the former and $<$ S|**A** : o_B, O|**P** : $o_n >$ is added to the latter. A similar effect is seen later in the transitions to Σ_9 and to Σ_{11}.

This illustration explains the difference, in DP semantics, between the nominal DP $\pi_1 = (\mathrm{H} \Downarrow^{\mathbf{k}_1}_{\mathsf{x}\,\phi} u_1)N_1(\overline{\mathrm{A}:\pi})$ with holistic determiner and the nominal DP $\pi_2 = (\mathrm{I} \Downarrow^{\mathbf{k}_2}_{\mathsf{y}\,\psi} u_2)N_2(\overline{\mathrm{A}:\pi})$ with individual determiner. The former has *invariant* certain extension $|o_1|^{\Sigma} = \{o_1\}$ in which o_1 is the object which realizes π_1 in the discourse and binds the reference $\mathsf{x} : \gamma_\Sigma(\mathsf{x}) = o_1$ (cf. point **II.3.** of the definition of static DP semantics in the case of $\mathrm{Q} = \mathrm{H}$). The latter has a set extension $|o_2|^{\Sigma}$, where $\gamma_\Sigma(\mathsf{y}) = o_2$, evolving in the discourse. Viz., every time the DP π_2 is referred in the discourse by another DP, say π_1, through the relativized reference $\mathsf{x}\,\phi = \mathsf{x} \grave{\in} \mathsf{y}$, its extension $|o_2|^{\Sigma}$ is *updated*: $|o_2|^{\Sigma_1} = |o_2|^{\Sigma} \cup \{o_1\}$, as well as its local variable: $\lambda_{\Sigma_1}(u_2) = \{o_1\}$, the predications of the verbals for which π_2 is an argument, either directly (cf. point **II.3.** of the definition of static DP semantics in the case of $\mathrm{Q} = \mathrm{I}$), or relatively, through u_2 (cf. point **II.5.** of the definition of static DP semantics), are *recomputed*: the facts with the new witness o_1 are added to their shifted product. The determiner's parameter $\mathtt{k}$ stands for the intended cardinality of the nominal object extension. In particular, $\mathtt{k} = 1$ corresponds to the *singular* and ω imposes no constraints on the cardinality. In this way is expressed in dynamic DP semantics its specific *plurality-through-evidence*: only the entities mentioned in the discourse are added to nominal extensions and only the facts witnessed by such entities emerging in the discourse are added to verbal extensions.

In principle, DP-determiners may use rather complex relations constraining objects in the extension of nominals. For instance, the determiner $\mathrm{D}_c = \big(\mathrm{H} \Downarrow^{\omega}_{\mathsf{x}} \big(\mathrm{H} \Downarrow^{\omega}_{\mathsf{y}} \mathrm{ROSE}, \mathrm{H} \Downarrow^{\omega}_{\mathsf{z}} \mathrm{LILIES}\big)\, (\mathtt{card}(\mathsf{y}) > \mathtt{card}(\mathsf{z}))\big)$ will be used in the O|**P**-subplan $\mathrm{D}_c\mathcal{A}_{\cup}\{\Uparrow_{\mathsf{y}}, \Uparrow_{\mathsf{z}}\}$ of *At least three girls gave* (*more roses than lilies*)$_{\mathbf{D}_c}$ *to John*. Such determiners make them, in practice, comparable with so called cumulative quantifiers generally treated using generalized quantifiers (cf. (Keenan, 1996; Keenan and Westerståhl, 1997)). In our example, $\mathcal{A}_{\cup}\{\Uparrow_{\mathsf{y}}, \Uparrow_{\mathsf{z}}\}$ is a nominal aggregate with union extension: $\left|\mathcal{A}_{\cup}\{o_1, o_2\}\right|^{\Sigma} = |o_1|^{\Sigma} \cup |o_2|^{\Sigma}$. By the way, among the constraints imposed by the determiners, there is the *co-reference constraint* $\mathsf{x} \sim \mathsf{y}$ saying that the (different) objects $\gamma(\mathsf{x})$ and $\gamma(\mathsf{y})$ *represent the same entity*, as it is the case in the discourse:

$(Lincoln)_{(\mathbf{H}\Downarrow^1_{\mathsf{x}} u)(\mathrm{LINCOLN})_{\mathbf{sh}}}$ *was born in 1809.* $(This\ President)_{(\mathbf{H}\Downarrow^1_{\mathsf{y}\sim\mathsf{x}} v)PRESIDENT}$ *was a liberal.* These constraints directly correspond to the co-reference in the logical dynamic semantics such as DRT (Kamp et al.,). The difference is that in DP semantics the co-reference is not checked.

On the other hand, an object o_1 satisfying the determiners' constraints gets to the set-extension of a nominal object o_2 only through the reaction to the effective stimulus corresponding to a DP π_1 referring π_2 in the discourse. So from the point of view of extension constraints, the individual determiners are rather close to the universal quantifier in the first order logics. At the same time, they are very different from $\forall$ because of this plurality-through-evidence interpretation. As to the holistic determiners, they were always a problem to express in the traditional logical semantics. They allow to adequately express the meaning of noun phrases as in *John likes* $(books)_{(\mathbf{H}\Downarrow^\omega_{\mathsf{x}} u)BOOK}$ and provide a holistic interpretation for mass nominals as in *He needs more* $(water)_{\mathbf{H}\Downarrow^0_{\mathsf{x}} WATER}$.

Main property of DP semantics. We show that the dynamic and the static DP semantics coincide in the corresponding dynamic and static contexts.

Theorem 1 *Let* $\delta = (\pi_1, \ldots, \pi_n)$ *be a discourse,* Σ_0 *be an initial d-context,* $|\delta|_{\Sigma_0} = (|\pi_1|^{\Sigma_1}_{\Sigma_0}, |\pi_2|^{\Sigma_2}_{\Sigma_1}, \ldots, |\pi_n|^{\Sigma_n}_{\Sigma_{n-1}})$ *be the d-semantics of* δ *relative to* Σ_0 *and* $\sigma_i = < \gamma_{\Sigma_i}, \lambda_{\Sigma_i}, \theta_{\Sigma_i}, \hbar_{\Sigma_i} >$ *be the s-contexts corresponding to d-contexts* Σ_i*. Then* $|\pi_i|^{\Sigma_i}_{\Sigma_{i-1}} = \|\pi_i\|^{\sigma_i}$ *for all* $i, 0 < i \leq n$.

6 Conclusion

One can see that the speaker's stance discourse semantics outlined in this paper has not much to do with the Grice's implicatures (Grice, 1989). Nor has it something to do with processing of hearer's beliefs depending on an interpretation of speaker's discourse. It is also very different from all logical DRT-like semantics of discourse (cf. (Heim, 1983; Kamp and Reyle, 1993; Kamp et al., ; Muskens et al., 1997)). The anaphora resolution, the emblem of logical discourse representation theories, is not included into the DP semantics because the referential relations are explicitly marked in DP using its determiners. Some of these referential relations established by these determiners, such as co-reference $\sim$, and attribute value comparison relations $<, >, =$, as well as the signs $+, -$ of verbal objects may introduce conflicts in the contexts. Checking of probable inconsistencies in the contexts is not required in DP semantics. This makes possible to apply it to correctly constructed DP with contradictory meaning, which is impossible in all kinds of logical theories of discourse. By the way, these special features make the DP semantics efficiently implementable. It has a polynomial time complexity (the consistency check included).

Due to object-orientation, the DP semantics goes without quantifiers. At that, there are certain similarities between the conventional quantifiers and the DP determiners. Creation of an object ($\gamma(\mathsf{x}) = o$) is an analog of the existential quantifier. It is closer than the logical quantifier to the natural language "existence": *every entity mentioned in the discourse exists.* The object access connectors H and I correspond to two different concepts of universal quantification. The former, holistic, has no analogues in the traditional logics, the latter, individual, is rather close to $\forall$ from the point of view of extension constraining: the cumulative determiners $((\mathrm{H} \Downarrow_{\mathsf{x}_1})N_1, \ldots, (\mathrm{H} \Downarrow_{\mathsf{x}_n})N_n)_{\mathbf{r}(\mathsf{x}_1,\ldots,\mathsf{x}_n)}$ with unlimited relations r are not less expressive than the cumulative quantifiers used in the plurality constraints definitions in terms of generalized quantifiers. At the same time, the individual determiners express a specific plurality-through-evidence. In the end, it is due to this "quantifier-freeness" that the static DP semantics is fully compositional (DP-determiners are interpreted *in situ*, i.e. in verbals' argument positions).

The DP semantics is a kind of formal semantics fitting well the Meaning-Text Theory frame, because it applies to a meaning structure designed for discourse generation and does not require consistency of the meaning structures to which it applies. Verbals' diathetic shifts make DP very flexible and well adapted to the traditional linguistic semantical representations. In fact, they are very close to those introduced and studied by E. Paducheva (see (Padučeva, 2003; Padučeva, 2004)). The use of communicative ranks in definitions of argument shifts allows to express some aspects of communicative structure. To our knowledge, it is the first formal semantics taking in consideration diathetic shifts in predication.

Due to the interpretation of non-core arguments as representing constraints on the attribute values, the semantical function-argument dependencies in DP semantics do not conflict with the natural surface syntactic dependencies. For instance, in DP, attributor type semantemes are arguments of nominals, which reflects the surface dependency of modifiers on the modified nouns (to compare with the conventional logical semantics, in which, quite the contrary, a nominal object is the argument of the property expressing a noun's modifier). This structural conformity has an exact form: in (Dikovsky, 2007) we show how syntactic categorial dependency grammar types may be generated from DP by finite tree transducers. This transduction may be seen as a formal model for the Meaning-Text Theory.

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