Real Adjuncts in Instrumental in Russian*

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Abstract

An adjunct-DP in the free instrumental case occurs in a number of surface positions where the DP is syntactically optional, does not depend on any element in the sentence, and has a number of different interpretations. We introduce Bailyn's proposal which postulates a uniform syntactic environment for all the uses of *instr*. This calls for a uniform semantics of these DPs which can nevertheless accomodate the different interpretations. Starting with the hypothesis of Roman Jakobson about the semantics of the instrumental case we formulate a semantic interpretation theory based on abduction. We give a uniform semantics for three different adjunct uses of *instr* in this framework. In the concluding part of the paper we discuss some possible alternatives and ramifications as well as questions and objections raised with respect to the treatment proposed in this paper.

1. Explaining the problem: how are free DPs in instrumental interpreted in Russian?

Russian has six morphologically distinguishable cases[1]. DPs in the nominative or accusative are usually interpreted in the positions of verb arguments, where their interpretation can be easily described as basically that of a (generalised) quantifier which binds the occurrence of an argument variable of the verb. Instrumental case occurs in a number of surface positions where a DP is syntactically optional and does not depend on any element in the sentence. This use may be termed *free* (DPs in the) instrumental case. The syntactic role of a free DP in the instrumental is usually that of an adjunct.

We start by showing these uses, describing the problem of interpretation which these free DPs pose and our assumptions about the syntactic environment in which *instr* occurs in the uses we intend to examine. We choose a proposal which postulates a uniform environment for all the uses of *instr*, introduce the hypothesis of Roman Jakobson about the semantics of the instrumental case and formulate our technical semantic interpretation apparatus which is based on abduction. Then we formalise some selected uses of DPs in the instrumental and explain those properties of them which seem to be amenable to the treatment proposed. In the concluding part of the paper we discuss some possible alternatives and ramifications as well as questions and objections raised with respect to the treatment proposed in this paper.

The problem is how to characterise the semantics of such free DP adjuncts in the instrumental. The number of their rather different possible interpretations is great and we do not want to ascribe every such meaning to all possible DPs in *instr*, creating an unmotivated and extreme polysemy. The move to assign some kind of meaning to the instrumental case, similar to the meaning of a preposition, is slightly better, but it nevertheless simply shifts the problem of extreme polysemy to this case meaning.Wierzbicka (1980), for instance, argues that there are seventeen very general meanings of instrumental.

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1 Opinions differ. Some, like Jakobson, see 8 cases.

We see this problem as a part of the larger problem of how to construct meanings in context. Consequently, we will propose a treatment which constructs these meanings from different ingredients in the context of interpretation. We will use an abductive theory of interpretation in this treatment.

Some of the occurrences of the instrumental illustrating the difficulty will be reviewed now. We shall abbreviate the name of the morphological case-form to *instr* and the corresponding bunch of morpho-syntactic features as INSTR. The example is taken from Jakobson (1936) reprinted in Jakobson (1984). The translations of the DPs in the instrumental are in italics.[2] The brackets introduce the terminology.

(1) a. On el reb'onkom$_{instr}$ ikru
He ate childINSTR caviar
He ate caviar *as* a *child* (temporal 1)

b. On el pudami$_{instr}$ ikru
He ate pudINSTR caviar
He ate caviar *by* the *pood* (36lbs) (manner)

c. On el ložkoj$_{instr}$ ikru
He ate spoonINSTR caviar
He ate caviar *with* a *spoon* (instrument)

d. On el dorogoj$_{instr}$ ikru
He ate roadINSTR caviar
He ate caviar *on* the *way* (path)

e. On el utrom$_{instr}$ ikru
He ate morningINSTR caviar
He ate caviar *in* the *morning* (temporal 2)

f. On el grešnym$_{instr}$ delom$_{instr}$ ikru
He ate sinfulINSTR matterINSTR caviar
He ate caviar I am sorry to say (idiomatic)

The italicised prepositions clearly show that different relations between the DP in the instrumental and the rest of the sentence are involved. All these uses seem to be syntactic adjuncts.[3]

It is not obvious what the second term related to the DPs in *instr* should be, what the relations are and how they are associated with the syntax.

Jakobson proposed an interesting hypothesis to the effect that the meaning of the instrumental arises from its opposition to some other case forms in Russian on the one side, and from the interaction with the context on the other side:

> ... The instrumental itself denotes nothing more than peripheral status; it occupies the same position among the peripheral cases than the Nominative does among the full cases: that of the unmarked category. ... Everything other than peripheral status is given in individual uses of the I by the actual meaning of its referent and by the context, but not by the case form (Jakobson, 1936).

[2] The literal translation of the idiom would be *sinful matter*.

[3] We do not insist that they are DP-adjuncts, however. In fact, we will use a different syntactic adjunct structure of which the DP is a part.

While we do not seek to explain all the uses of instrumental by this hypothesis, we will investigate what one implementation of this hypothesis amounts to in cases where it seems to apply best, i.e. some of the uses which can be semantically treated as intersective modifiers. We will define the term in a moment[4].

The uses are Instrumental of transport (which was not listed in (1f)), Instrumental of path, and the two temporal uses in in (1f).

INSTRUMENTAL OF TRANSPORT.

(2) On exal poezdom
He drove train-instr
He was going by train

A SPATIAL PREDICATE (INSTRUMENTAL OF PATH).

(3) On šel dorogoj
He went road-instr
He was going on the road

A TEMPORAL ADVERBIAL (1 AND 2).

(4) Reb'onkom on bolel
Child-instr he ill-past
He was ill as a child

(5) Letom on bolel
Summer-instr he ill-past
He was ill as a child

Sometimes objections are raised to examples like (3) that they are ill acceptable. The impression vanishes, if a context is provided. In particular, a contrastive context which emphasises alternatives makes the example absolutely acceptable.

(6) Do reki on šel dorogoj. Tam ona končilas'.
He walked to the river on the road. There it ended

There also is a difference between our example with a verb of motion and Jakobson's example with the verb unrelated to motion. We will return to this effect in section 4.2. There we shall also discuss the restrictions on DP_{instr} in these constructions. A theory which ascribes case meanings to the instrumental must postulate at least three different meanings associated with INSTR, and provide some kind of meaning shift which maps people onto times when they were children in addition.

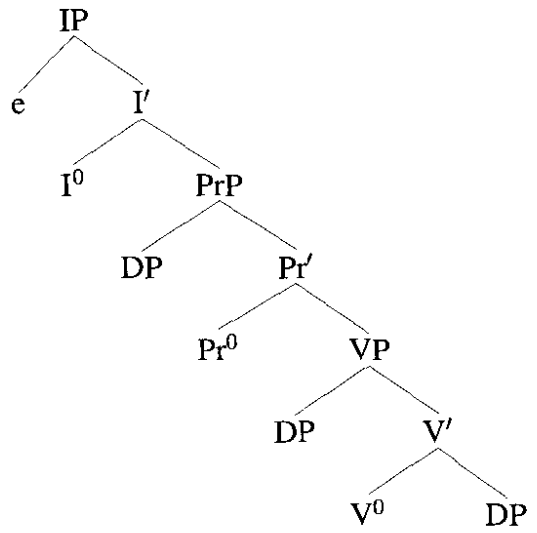
We will argue that an abductive theory of interpretation allows us to treat all these uses uniformly as instances of predication on different discourse referents denoting participants in the situation in a context. So the context-independent meaning of INSTR is very simple, but the role of context (including systematic world knowledge about types of situations) increases.

[4] Following Jakobson we assume that all grammatical cases of Russian are sorted into two groups, the central and the periferal cases. We wish to avoid formally reconstructing Jakobson's ideas on this issue here, but see Demjjanow and Strigin (1999b) for an partial attempt. The essence of Jakobson's ideas can be summed up by his quotation "... what is specific to the periferal cases is not that they indicate the presence of two points in the utterance, but only that they render one periferal with respect to the other.... [the periferal point] could be omitted without impairment to the central one, as is the effect of the periferal cases."

1.1. Where to assign the instrumental case? A syntactic unification.

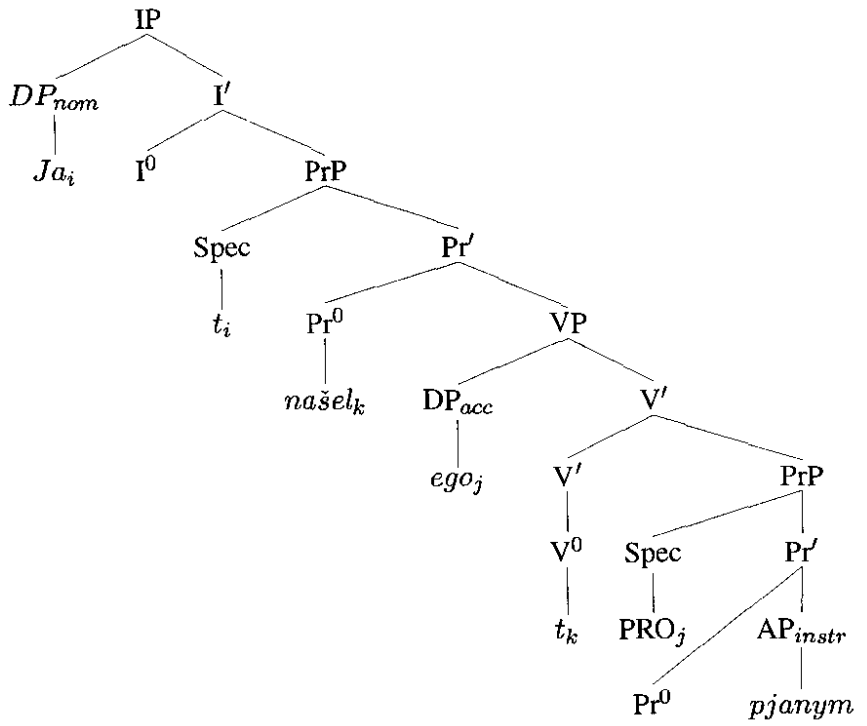
John Bowers (Bowers, 1993) argued that some interesting syntactic consequences follow, if we adopt a special functional projection which is responsible for the predication in the sentence. He calls this projection Pr for *Predicative element*, and assumes (7) as the structure for simple clauses of English. It is immaterial at this stage whether $I(nfl)$ is split into a number of separate phrases or not.

(7)



Here, the $SpecPr$ is the subject of the clause and $SpecV$ is the direct object of the clause. $SpecPr$ is the external argument wrt. the verb, $SpecV$ is its internal argument. Bailyn (1995) has applied this hypothesis to Russian to account for all non-idiosyncratic uses of instrumental. The net effect of this proposal is a syntactic unification under which INSTR is a structural case assigned by Pr^0, i.e. the case of predication. Bailyn applied his proposal to secondary predication structures. The typical case of an object oriented depictive has then the structure given in (8), with PrP being an V'-adjunct small clause.

(8)



I-NOM found him-ACC drunk-INSTR

We shall adopt this hypothesis. The proposal to introduce a new functional projection which marks predicational aspects did not seem to draw much attention, and we shall discuss the degree to which our proposal depends on it and whether the structure it postulates can be supplanted by a different one in the concluding part of the paper. It should be noted, however, that this is the only proposal known to us which provides a uniform syntactic environment for all the uses of the instrumental, which is an interesting hypothesis in its own right.

That we adopt this structure is not without difficulties, in particular considering the use we are going to put it to. Since PrP is the structure of predication we have to provide a uniform semantics to it[5]. We will explore the straightforward semantic proposition that all of the interesting uses of instrumental are basically predicative on some discourse referent in the situation described by the sentence. In which case we have to stipulate that Russian has a kind of semantically defined control of PRO[6]. Ordinarily, PRO is controlled either by the subject or by the object or has arbitrary interpretation with a kind of generic reading. We have to say how the semantic control works in Russian.

We intend to analyse these three uses of *instr* as adjunct small clauses PrP. For the moment we may also accept the assumption that these small clauses in the cases we want to analyse are adjuncts to IP in (8).

1.2. Interpretation

An interpretation of a sentence S with a DP_{instr} includes

[5] Bowers provides a predication semantics for his proposal in case of English. The predication relation is defined in the property theory. This semantics is clearly insufficient for Russian, since the predication Bowers is concerned with covers only cases of secondary predication with the subject or with the direct object as a controller.

[6] Already Nichols (1982) proposed that there is a control relation at work in secondary predication in Russian.

- the determination of the relation between the interpretation of $||DP_{instr}||$ and the interpretation of the rest of the sentence;
- the determination of the information status of this relation and of the $||DP_{instr}||$.

Broadly speaking, we are interested in the semantic and in some systematic pragmatic aspects of the interpretation of a sentence S with a DP in I. Since our conception of interpretation does not consider the difference between semantics and pragmatics be a difference of kind and rather emphasises the similarities, this attention to both aspects is explainable.

As far as the determination of the relation between the interpretation of $||DP_{instr}||$ and the interpretation of the rest of the sentence is concerned, we make a model case, as we already noted. We proposed that the uses of DP_{instr} in (2, 3, 4 5) to be well described in terms of introducing an intersective modifier on situations.

Situations are theoretical entities and will need justification. For the moment we may think of them as states of the world being described by sentences and consider the terms referring to them as explicit reference to models.

(9) A DP in *instr* in a sentence S is an intersective modifier on situations, if it is interpreted by $||DP_{instr}||$ in $(||DP_{instr}|| \,\&\, ||S'||)(s)$ where S' is S without the DP_{instr}.

An intersective modifier on situations is then simply a predicate on situations, like the sentence it which it occurs or the matrix sentence which is obtained by dropping the modifier. The modifier *by train* is a predicate on situations collecting those ones in which someone is going by train. The matrix sentence *Peter is going* is a predicate on situations in each of which Peter is going by some means somewhere. So the conjunction of the two makes the interpretation of the sentence with the intersective modifier. Thus, if Peter is going by train, then any situation making the sentence true would contain Peter who is going somewhere and is doing so by train. Obviously some kind of temporal indexing is involved in the notion of situation for this definition to make sense. We assume such an indexing implicitly for the moment.

The definition provides some semantic properties we should look for in the sentences in question. Thus, we should have $(||DP_{instr}|| \,\&\, ||S'||)(s) \models ||S'||(s)$, since each conjunct follows from a conjunction. That the modifier itself does not constitute a complete sentence is not detrimental. We may use some paraphrase, e.g. *it was by train* in *Peter was going to London. It was by train*. Note that we must stick to the same situation on both sides of the $\models$ sign.

On this understanding of situations as models their explicit mentioning is not essential, because explicit statements about models are made in the meta-language. In this case the situation argument could be dropped. As we shall see there is a use for a slightly different notion of situation, and therefore we shall retain the argument.

To begin with, (3) and (2) seem to satisfy our expectations about entailments. The example with the train was already discussed above. Example (3) also satisfies them: if someone is walking on a road, he is walking and he is on the road. Consider now (4). If someone was ill as a child, s/he was ill at some time. And she was a child. The latter entailment is somewhat tautological for people, but we may substitute *direktor* (director) for *reb'onok* (child), and obtain (10).

(10) Direktorom on bolel
Director-instr he ill-past
He was ill when he was the director

With this sentence, the entailment seems to be more readily obtained: he was a director at some time or other.

But now let us add a quantifying adverb, e. g. (11).

(11) Reb'onkom on často bolel
Child-instr he often ill-past
He was often ill as a child

We have a difficulty with the expected entailments: the sentence (11) without the DP_{instr} modifier does not follow from (11). It was different without the adverb: clearly, if someone was ill as a child in some circumstances, he was ill at some time under these circumstances. But if someone was often ill as a child under the circumstances, he need not have been often ill in general under these circumstances. The quantificational adverb needs a restrictor. We seem to implicitly change the situation which restricts the quantificational adverb *často* (often). The only observable change made was to drop the modifier. Therefore we must conclude that the temporal instrumental constrains the restrictor clause in the quantificational structure of the sentence. Dropping the restriction amounts to changing the reference of the situation term. Our entailment test is not applicable to this case, hence it is actually vacuously satisfied. But the problem of the place of *instr*-modifiers in the quantificational structure of the proposition remains, and we will return to it. This will lead us to determining the pragmatic status of the interpretation of intersective modifier DP_{instr}.

2. The theory

We understand the hypothesis put forward by Jakobson in the way which allows us to say that we infer the interpretation of DP_{instr} in the context (where the notion of interpretation is as discussed above). We consider interpretation to be an instance of inferential activity. The kind of activity we mean is hypothetic inference, often termed *abductive inference* or *abduction*. The context we mean includes the representational description of the situation the sentence characterises. Technically we shall provide such a description by giving a discourse representation associated with the sentence. We need to be very explicit, however, as far as our understanding of the terms *situation* and *abductive inference* are concerned, since they often give rise to misunderstanding and sometimes to a - in our opinions often misplaced - critique.

Our general position can be summed up in (12).

(12) **The hypothesis of interpretation.**

In all the cases under investigation we have an *abductive interpretation* of the predication relation introduced by the syntactic structure $[_{PrP}\ PRO\ [_{Pr'}Pr^0\ DP_{instr}]]$ which embeds a DP_{instr}.

We shall now explicate the hypothesis.

2.1. Abductive inference

For simplicity we will ignore here the contexts of interpretation which go beyond simple clause. The formalisation draws on Poole (1989) and Poole (1988). We consider P to be an explanation of ϕ according to (13).

(13) $\Gamma \cup P$ *explains* ϕ if the following holds:
(i) $P \cup \Gamma \models \phi$
(ii) $P \cup \Gamma$ is consistent

Consider Γ in (14). This is a set of background facts.

$$(14)\ \Gamma = \left\{ \begin{array}{l} rained{-}last{-}night \rightarrow grass{-}is{-}wet \\ sprinkler{-}was{-}on \rightarrow grass{-}is{-}wet \\ grass{-}is{-}wet \rightarrow shoes{-}are{-}wet \end{array} \right\}$$

If we observe $\phi = shoes{-}are{-}wet$ and want to explain it in this technical sense, we could have two explanations. The two hypotheses (the explanations) of $shoes{-}are{-}wet$ are $P_1 = \{rained{-}last{-}night\}$ and $P_2 = \{sprinkler{-}was{-}on\}$. We can choose one of them.

The hypotheses may include rules, i.e. implications. If we agree to use rules as hypotheses, whenever consistent, though subject to competition and choice, we have the concept of a default rule. Hypotheses in general are used when there is evidence for them, i.e. some observation which requires an explanation. Defaults are simply hypotheses which are used whenever possible.

Consider (15). The hypothesis can be treated as a default, and if we inquire what can be said about the flying abilities of *bob*, we have to use the default.

$$(15)\ A_{birds} = (\Gamma, \Pi)$$

$$\Pi = \left\{ bird(X) \rightarrow flies(X) \right\},$$

$$\Gamma = \left\{ \begin{array}{l} (\forall X)(emu(X) \rightarrow bird(X)), \\ (\forall X)(emu(X) \rightarrow \neg flies(X)), \\ emu(polly), \\ bird(tweety) \end{array} \right\}$$

Since we know nothing else about *bob*, we only get a conditional assertion. We know that *tweety* is a bird, so we can explain its flying. We cannot explain the flying of *polly*, since this would contradict the facts.

This simple sketch of the use of abduction suffices for the moment to draw a sketch of interpretation by abduction.

2.2. Interpretation by abduction

In general, what is interpreted by abduction is an underspecified semantic representation. We must determine where this representation comes from and how the syntactic structure enters the interpretation.

We assume the hypothesis of Logical Form being the contribution of grammar to semantics and use the term "the logical form of the sentence" accordingly. Logical Form is a level of syntactic representation which specifies the propositionally relevant aspects of syntactic structure. This representation is converted to representations of propositions. The latter are thus very abstract *semantic values* of logical forms which we may call semantic forms of sentences. The representational module can be called Semantic Form (SF), by analogy. We will not specify

the conversion algorithm LF - SF, but but we will assume that a grammatical relation of syntactic structure (i.e. a relation like *subject*) may be directly associated with a semantic value or with a special inference pattern. Moreover, we split this associated contribution into two parts reflecting both the syntactic and the semantic contribution of LF. Thus, we may transcribe the propositional impact of the subject relation between two nodes in a logical form by introducing the relation $gfsubject(i, j)$ whose terms are the discourse referents associated with the nodes. The associated semantic value may be specified as $argsubject(i, j)$, standing for something like *i is the argument of j which stands to it in the subject relation.*

This split has a special function. In interpreting syntactic structure semantic values are input to the abductive component of inference which further specialises them, depending on the context they are in, e.g. on the verb which provides the referent j. The grammatical context (things like $gfsubject(i, j)$) enters the interpretation as facts which may be used to constrain the interpretation, but not as observations. Our defaults which are involved in the interpretation should therefore be indexed by contexts, e.g. be bound to a lexical entry.

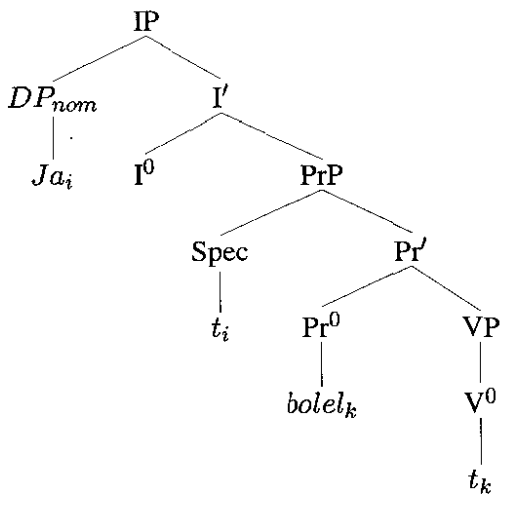
To write semantic values we use Discourse Representation Theory of Kamp and Reyle, DRT. The basic reference is Kamp and Reyle (1993), a more recent one is Kamp and Rossdeutscher (1994). We assume that the syntactic representations which serve as an input for constructing semantic representations are Logical Forms (Szabolcsi, 1997, has proposed this approach). LF has tree structures labelled with syntactic information. We shall also assume that subcategorising syntactic relations are registered in the lexical entries, so that syntactic structures of lexical entries are trees.

As far as the machinery of DRT is concerned, we will refrain as far as possible from introducing it formally and only provide illustrations in cases where semantic representations are necessary. Appendix A contains some basic definitions.

Under these assumptions (17) is the logical form of (16) and (18) is its semantic representation in the DRT format.

(16) Ja bolel
I was ill

(17)



I-NOM ill-was

(18)

s, t_s, now	u
$before(t_s, now)$	$myself(u)$
	$argsubject(u, s)$
	$ill(s)$
	$gfsubject(u, s)$

The semantic representation records that the situation is the one of being ill, $ill(s)$. The discourse referents (DR) s and t_s are introduced by *INFL*, together with the condition $before(t_s, now)$ (t_s is the time of the situation). The discourse referent u and the condition $myself(u)$ are introduced by *I*. The DR plays the role of the subject argument, which is expressed by $argsubject(u, s)$. Moreover, there is a record coming from the logical form of the sentence that the subject relation (grammatical function) holds between the two referents indicated, $gfsubject(u, s)$. We do not distinguish discourse referents in the syntactic relations from those in semantic relations. The underspecified interpretation which is the observation to be explained is $argsubject(u, s)$. The interpretation is done by abductive inference. We may specialise $argsubject(u, s)$ in the context of the situation s characterised as $ill(s)$ by hypothesising that this relation can be explained by myself being the theme of the situation of being ill, i.e. the person who is ill. This may be done using first order theories like (19) and (20).

(19) $A_{theme} = (\Pi)$

$$\Pi = \left\{ theme(E, X) \rightarrow argsubject(X, S) \right\}$$

(20) $A_{ill} = (\Gamma)$

$$\Gamma = \left\{ \begin{array}{l} ill(S) \rightarrow is - ill(X, E) \\ is - ill(X, E) \rightarrow theme(E, X) \end{array} \right\}$$

The theory in (19) contains a default to the effect that themes are subject arguments. Being a default, this rule can be overridden by the fact that whenever an agent is present in a situation , it will be realized as subject. Then another realisation of theme must be codified as a default, but one which is weaker[7]. The theory in (20) says that a situation s labelled $ill(s)$ is built up around an eventuality (i.e. process or state) in which someone is is ill, and this individual X plays a role classifiable as theme, $theme(E, X)$. The latter condition may also be rendered by $theme(E) = X$, if the relation is considered to be functional. The explanation of $argsubject(u, s)$ is given by (21), on the assumption that $ill(s)$ holds, i. e. that this is the situation we have.

(21) $\{is - ill(u, E),\ theme(E, u) \rightarrow argsubject(u, s)\} \models argsubject(u, s)$

Since we are indeed in the situation $ill(s)$, $is - ill(u, E)$ helps to explain $argsubject(u, s)$. Which is to say the sentence is interpreted as *I am ill.*

The theory of interpretation sketched here is presented in more detail in Strigin (1999).

[7] Strigin (1999) has a more complete treatment of such a thematic role theory in an abductive framework.

3. Interpreting *instr* abductively

Given the abductive framework we sketched, there are two possibilities to proceed with the interpretation of the PrP.

3.1. Interpreting INSTR: First version

We could postulate default rules which interpret some underspecified semantic relation R_{instr} which is associated with this case as its interpretation. Suppose (22) is such a rule where $msoftransport(S, E, X)$ is the predicate which is true of a means of transport X in situation S which contains some movement event E. Then (23) is a partial representation of (2). The referents ls, lg denote the implicit source and goal in S (Kamp and Rossdeutscher, 1994).

(22) $A_{instr} = (\Gamma, \Pi)$

$\Pi = \{\ msoftransport(S, E, X) \rightarrow R_{instr}(S, E, X)\ \}$

(23)

s, t_s, now	u, e, z, ls, lg
$before(t_s, now)$	$he(u)$
	$move(e, u, ls, lg)$
	$theme(e) = u$
	$msoftransport(s, e, z)\ train(z)$

Under this approach we must explicitely register all the interpretation possibilities of R_{instr} along the lines of (22). The particular hypothesis is always available, but it can only provide the $msoftransport(S, E, X)$ part of the representation as an interpretation of R_{instr}, if $msoftransport(S, E, X)$ is already contained in the situation! What new contribution the rule provides is relating $train(Y)$ to $msoftransport(S, E, X)$. The approach predicts that this particular reading is obtainable in situations which can accommodate it by actually having a referent for the means of transport.

A technical point is to specify which structure is interpreted by the relation R_{instr}. It can be the (abstract) case itself, or the predication structure.

3.2. Interpreting INSTR: Second version via predication relation

We do think that the first approach does not fully exploit the possibilities of abduction. We would rather take R_{instr} to be more specific and postulate that it is basically the relation of predication which allows to hypothetically identify the subject of predication, cf. (24). The expression $||DP_{instr}||$ stands for the interpretation of DP_{instr}, big X may be identified with any DR in the domain of the representation of situation s.

(24) $A_{instr} = (\Gamma, \Pi)$

$\Pi = \{\ s : X = x\ \&\ ||DP_{instr}||(x)\ \}$

This is a sweeping claim, since it provides an interpretation schema for all referents $u \in U$ of the discourse structure with the universe U interpreted in the domain Dom_s of situation s.

We shall see where it will get us. The colon : delimits the conjunctive condition on situations here. The condition can be taken as the interpretation of the small clause containing DP_{instr}. Therefore we must specify its mode of composition. We resort to abduction here, too, by using (25).

$$(25)\ \frac{p\ \&\ q \qquad (p\ \&\ q) \rightarrow q}{q}$$

We can conceive q as an indication that $p\&q$ is the case. If we have no evidence that p and q are somehow related, the assumption $p\ \&\ q$ seems to be unwarranted. But if a number of observations established that q is often accompanied by p, then the reverse use of this instance of modus ponens amounts to assuming that in the case under observation the situation is the same, though we have no observed data on p. The point here is context-dependence of the criteria of what is a good assumption. Since $(p\ \&\ q) \rightarrow q$ is a tautology, we can always use modus ponens to make the assumption that $p\ \&\ q$, given q, but in some contexts it is a good hypothesis, in some a less good one. If I see an unknown dog carrying a newspaper in the maw, I am inclined to think that the owner must be around, too. If it were just an unknown dog without any embellishments, the hypothesis seems to be ill justified.

From a somewhat different point of view, we can take $(p\ \&\ q)$ to be a hypothesis about the relation between p and q, given that we have to explain q on the assumption that p. There is a linguistic sense to this move: if q occurs in the presence of p, then they probably must be conjoined. An adjunct can therefore be always conjoined, by default. Hence, this default is an least one possible interpretation of the syntactic adjunct relation. The conjoined hypothesis is a predicate on some discourse referent in the universe of the situation. Since we interpret conjunction within the one and the same situation, the situation argument is left implicit.

We shall adopt this course of investigation and apply it to the three uses of *instr*.

4. The three cases of *instr*

4.1. *Instr* of transport

This is probably the easiest case. Conjoining a predicate with a DRS amounts to simply importing this predicate into it. If a situation characterised by the DRS contains the referent for the means of transport, this referent can be hypothetically taken to be the value of X in (24).

(26) On exal poezdom
He drove train-instr
He was going by train

(27)

s, t_s, now	u, e, z, ls, lg, w
$before(t_s, now)$	$he(u)$
	$move(e, u, ls, lg)$
	$theme(e) = u$
	$msoftransport(e, z)$
	$z = w\ train(w)$

The proposal also predicts that the reading is only possible with situations which already have the appropriate referent. We can check this prediction in (28).

(28) *On spal poezdom
He slept train-instr
He slept while being transported by train

The sentence is unacceptable. It is of course quite possible to characterise the situation with the help of a locative PP.

(29) On spal v poezde
He slept in train
He slept on the train

The reason for the difference under our theory is the difference in the interpreting relations: locatives relate events within the situation to a location, whereas the instrumental of transport merely identifies two referents one of which is a means of transport.

There is another curious fact which can probably be explained under the predication interpretation of *instr*. If a quantified distributing DP is put into predicational *instr*, the result is unacceptable, cf. (30). If we manage to indicate that there is a need for the wide scope of *každym poezdom*, as in (31), the sentence becomes acceptable.

(30) *On exal každym poezdom
He went every train-instr
He drove on every train

(31) On exal každym poezdom dva časa
He went every train-instr for two hours
He drove two hours on every train

Similar effects are known for copula structures in English where quantifying-in gives some sentences an acceptable interpretation[8].

4.2. *Instr* of path

The treatment is essentially the same. Some new points of interest arise, however. We have (34) as a partial representation of (33).

(33) On šel dorogoj
He went road-instr
He was going on the road

[8] Partee (1987) proposed a number of type-shifting operations to account for the semantic NP-type ambiguities. None of them would allow a distributive generalised quantifier like *every* to be a predicate. Examples like (32) seem to contradict it.

(32) This house has been every colour

They motivated Partee to propose that nouns like *colour* are predicates of those properties which are among the entities of the domain of type *e* of individuals and (32) are cases of quantifying-in into contexts forming predicates out of properties.

(34)

s, t_s, now	u, e, z, ls, lg, w
$before(t_s, now)$	$he(u)$
	$move(e, u, ls, lg)$
	$theme(e) = u$
	$path(e, z)$
	$z = w\ road(w)$

The availability of the path discourse referent in the representation of the situation is a necessary prerequisite, as the pair (35) and (36) shows.

(35) On šel asfaltovoj dorogoj
He went asphalt road-instr
He was going on the asphalt road

(36) ??On spal asfaltovoj dorogoj
He slept asphalt road-instr
He was sleeping on the asphalt road

The example (37)and the fourth example in (1f) seem to contradict this generalisation.

(37) On spal dorogoj
He slept road-instr
He was sleeping on the road/way

It can be argued, however, that *dorogoj* (way-$_{instr}$) is an adverb. The semantics of this adverb is a generalisation of the part of any situation of movement which contains the referent for the path.[9] The accommodation of such an adverb in case of (37) can proceed by extending the representation of any situation which allows some participant to undergo movement simultaneously with the main eventuality of the situation. The extension is with that part of the movement situation which is associated with the adverb.

There are some restrictions on what can be a path in this use of instrumental, but they are difficult to state. Paths in instrumental should be more or less natural. Thus, if the movement is within a city, the city provides a natural path. If, as in case of perfective verbs, we are interested in the state at the end of the path, a city is no longer a good path, whereas a road still is one, cf. (38), (39) and (40).

(38) On šel Parižem
He went Paris-instr
He was going/walking through Paris

(39) *On prišel Parižem
He arrived on foot Paris-instr
He arrived through Paris

[9] Traditional Russian grammar theory often describes e. g. temporal uses of nouns in the instrumental case like in (4) as adverbs and speaks of adverbial derivation. However, Isačenko (1962) noted that this kind of derivation does not really allow to form new adverbs. He proposed to characterise the process of forming occasional adverbs as *entstehung* (coming into being, emergence) rather than derivation. Some uses of DP_{instr} gradually become adverbialized. Such development is a separate topic of investigation, however.

(40) On prišel dorogoj
He arrived on foot road-instr
He arrived via a road

Similarly for *voda* (water) in (41). There is nothing wrong about water being the surface on which the transportation takes place, as (42) shows.

(41) ??Oni dobralis do goroda vodoj
They reached to town water-instr
They reached the town by water

(42) Oni dobralis do goroda po vode
They reached to town on water-prep
They reached the town by/through water

The restrictions become explainable, if considerations of conceptual characterisations are involved in deciding whether to choose the referent as a good hypothesis. Thus, Paris probably ceases to be a good hypothesis in the context of a telic verb, because it cannot be portioned in pieces with a declared end. Similarly for water, but not for roads.

Quite in parallel to the use of instrumental to mark means of transportation, distributive quantification with narrow scope is bad with the instrumental of path, but not in general for paths, as (43) and (44) show.

(43) ??On projexal každym gorodom
He went through every town-instr
He went through every town

(44) On projexal po každomu gorodu
He went through upon every town-dat
He went through every town

4.3. Temporal *instr* 1

The temporal use of instrumental presents more difficulties. We assumed at the start that the default mode of combination of a $PredP$ with the matrix sentence is that of simple conjunction. The temporal use is difficult, as (45) shows, for although the predication is of the subject, the sentence does not assert merely the simple conjunction of the matrix sentence and the predicate expressed by the DP_{instr}. Thus, (45) does not simply mean that at some time in the past he was a child and was ill.

(45) Reb'onkom on bolel
Child-instr he ill-past
He was ill as a child

The correct interpretation seems to be derived by constructing a temporal characteristics for any modell which is relevant to the evaluation of the sentence on the basis of the direct predication. To construct the temporal characteristics we restrict our attention to the time at which the $||DP_{instr}||$ is true, i. e. restrict the situation (the model) to that time, and then assert the

matrix sentence relative to this restricted situation. This assertion relative to a time cannot be adequately rendered by the simple truth-functional conjunction, as it seems. The point needs some elaboration.

One way to represent the temporal reading of the instrumental is to postulate a regular lexical process forming temporal predicates from temporally dependent nouns. The derived predicates should then be used like temporal adverbs, e.g. *yesterday* or *on May, 21.* The interpretation would also be similar e.g. *the time which is May, 21* vs. *the time when x was a child.* The conjunction of the matrix sentence and the adverb would yield an interpretation like *there is a time satisfying the temporal predicate at which the matrix sentence is true.* It is immaterial here, that we resort to lexical processes, since we could mimic this lexical process via an inference in the context. The point is this would not be adequate.

First, we noted that (11) violates our expectations about the entailments, and suggested that DP_{instr} provided a condition for the restrictor of the adverb of quantification *často* (often). What we now suggest is that there is a certain quantificational structure of the proposition even if there is no adverb of quantification. The structure of a proposition is always a restrictor and a nuclear scope, i. e. a predication. Moreover, we suggest that relativisation is not always a conjunct formally speaking.

Suppose we use a different temporally dependent noun which does not imply that there is a single homogeneous time period associated with every member of the extension of the noun[10], e. g. (10).

(46) Direktorom on bolel
Director-instr he ill-past
He was ill as a director/whenever he was a director

The time period of being a child associated with somebody is homogenous. Not so the period of being a director associated with a person. There may be several periods when the *he* of (46) was a director which are separated by times when he was not. Now, what (10) may mean is that at least some times when he was a director he was ill, but may also mean that each time he was a director he was ill. The second reading is no longer a conjunction, but rather a conditional. We seem to relativise the assertion that he was ill to either some or to all relevant periods. The accompanying change seems to be from the conjunction to the conditional. This change is easily explainable, if we note that we have a distribution of $||DP_{instr}||$. In other words, if the restriction of the situation can distribute, we get a conditional, if not, a conjunction. Such effects are well-known with definite plural DPs. The interesting thing is that we do not have a plural here.

Second, there is a certain pragmatic implicature in case of (45). This sentence is perfectly OK *only when* the person referred to by *he* is not a child at the time of utterance! Otherwise it is infelicitous. This implicature is unexpectable, if we have to do with a simple conjunction. But it can be explained by pragmatic factors, if we assume that the temporal interval provided by the predicate in the instrumental should play a role different from the one played by time of the utterance or the time of the situation which sets the index of the model, and should restrict

[10] A set S with the join operation $\sqcap$ is homogenous, iff for any two objects

$$(i)\ if\ e_1 \in S,\ e_2 \in S,\ then\ e_1 \sqcap e_2 \in S\ (cumulativity),$$

$$(ii)\ if\ e \in S,\ and\ e = e_1 \sqcap e_2,\ then\ e_1 \in S,\ e_2 \in S\ (distributivity).$$

As usual, *join* is a binary commutative and associative operation.

the situation.

To render these intuitions about restrictions formal we need the possibility of referring to separate temporal stages of the same individual plus the *reference time* of the situation, t_s, and not simply the time of the situation. The difference is this: whereas we took the time of situation to be simply the temporal index of a model, the reference time of a situation is a restriction of this index for the purpose of making some part of predication in the situation only with respect to the restricted index. We will retain the notation t_s for the reference time, and will not bother to explicitely specify the time of situation any longer, since reference times of situations seem to be sufficient. We shall comment on our use of the term *situation* in a moment, and suggest a first approximation to the semantic representation of (45).

We must restrict the situation in which there exists a person referred to by *he* to the time specified by the DP_{instr} *reb'onok* (child), and then evaluate the rest of the sentence with respect to the restricted temporal interval. But to be able to accommodate the implicature that the person is no longer a child, we separate the universe of the discourse structure into two universes. The one is the general universe of the situation, the other is the universe of the restrictor. This gives us a quantifier-like representation, in which the overall situation of utterance is not represented by a discourse referent, whereas the restricted situation is represented. The restrictor is the left sub-box, the predication is the right sub-box.

(47)

u *now*	
s t_s	e
$before(t_s, now)$	$he(u)$
$t_s = t$	$be\text{–}ill(e, u)$
$child_t(x)$	$theme(e) = u$ $x = u$

Here t in the abbreviation $child_t(x)$ denotes the time when $child(x)$ is true. Evidently, the additional predication $t_s = t$ is a new hypothesis. The interpretation of the whole structure is like this: the sentence is true in a model if the DR embeddable. It is embeddable, if

(i) the restrictor is embeddable, and
(ii) the embedding of the restrictor may be extended to that of the predication

What happens is the following: we hypothesise that the subject is the referent of the predication associated with the instrumental. Presumably because there is already one predication structure for the subject (built on the main verb), and the addition of a new parallel predication structure is achieved via a conjunction, a different hypothesis is put forward. This hypothesis is to take temporally dependent DPs as restrictors of the situation. It yields a quasi-quantificational structure of the situation. Note that this cannot be simply a conjunction, because this is a different hypothesis. In fact, as we shall discuss at the end of next section, the restrictor is a kind of presupposed information.

The relation between the reference time of the situation and the time of the event associated with the verb is indirect. *On* (he) in (45) need not be ill all through the time he was a child. Therefore we need an additional event referent. The identification of the two discourse referents for the individuals is possible on some additional assumptions, e. g. that a child grows up to become an adult, but remains the same person.

Now the use of the situation becomes a deviation from the standard DRT-apparatus, and we will try to clarify our use of the term.

4.4. Situation

There are different traditions of the use of situations in semantics. The most widespread one is to conceive of them as total models and relativise all the pertinent semantic relations to a model, if necessary, and not refer to situations explicitely (Chierchia and McConnell-Ginet, 1990). This is the classical Fregean approach. Situation theory with its staring point in Barwise and Perry (1983) is a radical departure from the bulk of assumptions of Fregean-type natural language semantics. Situations are conceived here as information objects. Yet another way of using situations is to take them to be a kind of object in itself, a kind of individual in the sorted domain of different kinds of individuals. This use is found in Kratzer (1989) and Berman (1987). If semantic interpretations of situations are used at all, this is the closest to our demands.

But we need somewhat different aspects of situations. Situations should serve as reference points which specify the information available in them, but we would not like to identify them with that information. We therefore divorce situations from information and make them entities in the domain on the one hand. But on the other hand we will treat them as contexts which guide interpretation and provide useful information for that purpose.

Consider (48). The date provides a temporal anchor for the event of Peter's sleeping.

(48) On March, 21, 1990, Peter slept.

As is well-known, if some such anchors are not available, they are obtained by inference. If the information which can be inferred is not enough, the sentence sounds strange or infelicitous. Thus (49) is hardly interpretable as an assertion at all out of the context, because the temporal anchors are very weak and we cannot resolve the temporal ambiguity.

(49) Peter slept.

The date in (48) is not necessarily predicated of the time of sleep. The exact nature of the relation between the temporal anchor and the time of sleep is not definitely specified. His sleep need not take place during the whole time characterised as March, 21, 1990, and the relation may be more like that of inclusion. So we may resort to the concept of situation and say that the time of this situation was on March, 21, 1990, and Peter slept at some time during the situation. We thus temporally specified a context of inferential behaviour.

It might seem that this move is representationally superfluous, but actually this indexing by a context has interesting consequences. Further discourse may shift the context by extending the situation with material from common ground or in other ways which involve temporal indexing. Therefore, inferences about temporal indexes could become dependent on the situation.

Let (50) be the continuation of the story of Peter.

(50) This was a good thing to do, because March, 21, 1999, was a bleak and cold day

We would like to infer that Peter slept at some time during the day and that day was a part of March, 21, 1999. We cannot consider the inference about Peter's sleeping during the day as generally given. It depends on the assumption that the causative relation should connect relevant statements, and bleak days are the reason for the characteristics *good* for sleeping only if it takes part during them. So we treat the situation description as a kind of context and limit our inference that Peter slept during the day to this context.

We would not speculate here on what information from the sentence can serve as an anchor, except the temporal and the existential. But we would like to be able to collect all relevant anchors from a sentence separately. The rest of the representation of the sentence is then taken relative to these anchors. To give an example, (51) is the first attempt at a partitioning into the anchors and the assertion part the representation for (48). Here, s is the discourse referent (DR for short) of situation, *now* is the time of now, p is the DR for Peter.

(51)

	$now\ p$
$s\ t_s$	e
$before(t_s, now)\ peter(p)$ $March_{21}(t_s)$	$sleep(e,p)$

We have two kinds of anchors here: the temporal information and the condition introduced by the proper noun. We also implicitely index the predicate $sleep(e,p)$ to the time of situation t_s, i.e. we put it into a context. Putting things into contexts is what situations are for.

The notion of situation is thus dependent on the notion of context, which is just as rubbery and needs a theory. The theory of context we would like to have should be modelled after McCarthy (1993) and McCarthy and Buvač (1997)[11]. For theoretical reasons these two papers make a distinction between contexts and situations, but make it possible to assign a context to any situation. We see no need to follow them in this paper.

Collecting some information about a situation separately as anchors gives this information a kind of presuppositional status: whether we assurt something about the situation anchored in a particular way or deny something about it, it should remain the same situation due to the anchoring. We may now identify the anchors with the restrictor on situations which we needed to account for the temporal 1 use of the instumental. This move has some explanatory power, because in the case of the temporal1 use of *instr* this presuppositional status can indeed be observed. The temporal restriction by a DP_{instr} is like a kind of presupposition. A denial of the assertion still refers to the period when the person was a child (52).

(52) On reb'onkom ne bolel
He child-instr not ill was
He was not ill as a child

This fact is reminiscent of Frege's argument about existential presuppositions of proper names. Frege argued that if the names were not presupposing their bearers, but rather asserting their existence, the denial of

(53) Kepler discovered Neptun

would have been equivalent to

(54) Kepler did not discover Neptun, or there was no Kepler.

which is usually not the intended meaning. Similarly with (52) or (55).

(55) On diektorom ne bolel
He director-instr not ill was
He was not ill as a director

[11] See Strigin (1999) for an attempt to integrate their theory into a linguistic description.

The normal interpetation is the one which denies that he was ill when he was a director, and not the disjunction of the negations.

4.5. Temporal *instr* 2

There are some interesting problems with the temporal use of the instrumental case. The most interesting one is that of temporal nouns in instrumental. We call these nouns distributive temporal predicates, for reasons which will immediately become obvious.

A noun like *leto* (summer) is predicated of a temporal discourse referent, and not of the subject. We consider this referent to be the reference time of the situation, i.e. a temporal anchor of the situation.

(56) Letom on bolel
Summer-instr he ill
He was ill this summer/in summer

The representation is straightforward.

(57)

now	*u e z*
$s\ t_s$	
$before(t_s, now)$	$he(u)$
$t_s = t$	$be-ill(e,u)$
$summer(t)$	$th(e) = u$

The curious thing about this use is that some rather similar temporal uses of nouns denoting temporal measure units are impossible.

(58) *Časom on čital
Hour-instr he read
He was reading for an hour/this hour

If the unit is used in the accusative, the sentence is OK with the durative reading of the DP_{acc}.

(59) Čas on čital
Hour-acc he read
He was reading for an hour

Distributive temporal predicates e. g. *den'* (day), can be used in both ways. But only in the use requiring the instrumental such words cannot be modified by *celyj* (whole).

(60) on čital (*celym) dnem
He read (*whole-instr) day-instr
He was reading the whole day

(61) on čital (celyj) den
He read (whole-acc) day-acc
He was reading (the whole)/for a day

We proposed that DP_{instr} in such use are situation restrictors, i. e. anchors. We may therefore provisionally conclude, that temporal measure units are probably bad anchors. The accusative is then the case which is reserved for duratives.

If so, there must be some characteristics distinguishing good temporal anchors from durative use. Indeed, there is a substantial difference between the two kinds of temporal predicates. The ones we call distributive predicates are really distributive. Any part of summer is summer. Units are not: no part of a week is a week. The modifier *celyj* (whole) disallows ditribution. Distribution correlates with quantificational structures. So, if we assume that the anchoring function of temporal predicates (i. e.their functioning as restrictors) requires the preservation of the potential for distributivity, temporal units are excluded.

However, one may think that if temporal units are pluralized, they should acquire the ability to distribute, if the theory of plural in Krifka (1989) is assumed. This seems to be born out at first, because temporal unit nouns in plural can be used in free instrumental.

(62) Časami on čital
Hour-instr he read
He was reading for hours on end

However, there is still a difference with distributive predicates. A plural temporal unit is probably best regarded as predicated of the event or state of the situation, and not of its reference time.

This can be easily shown. Perfectivizing the verb immediately blocks the interpretation with the plural unit, but not with distributive temporal predicates in singular.

(63) *Časami on pročital knigu
Hour-instr he read the book
He read the book in hours

(64) Večerom on pročital knigu
Evening-instr he read the book
He read the book (to the end) in the evening

The complex *event : state after it* which is characteristic of Russian perfectivisation is not distributive. It should be, however, because of the homomorphic requirement associated with the distribnutive nature of the temporal referent of *časami* (hours-instr). This homomorphism is the cornerstone of the theory in Krifka (1992). No homomorphism is requred from temporal noun anchors, which are singular and distribute on demand, and not maximally. Thus, (65) is OK, (66) is out, but if we let *dvaždy* (twice) have scope over *nedel'asami* (weeks-instr), the sentence becomes OK with the durative reading for *nedel'ami*,(67) .

(65) Letom on dvaždy bolel
Summer-instr he twice ill
He was twice ill this summer/in summer

(66) *Nedel'ami on dvaždy bolel
Weeks-instr he twice ill-past
For weeks he was twice ill

(67) On dvaždy bolel nedel'ami
He twice ill-past weeks-instr
He was twice ill for weeks.

The same operation can be done on (65). The interpretation is that he was twice ill in summer (different summers), but not that he was twice ill during the whole summer (different or same).

We may cautiously conclude that the additional hypothesis which interprets the DP_{instr} which is temporally dependent or a ditributive temporal predicate is that it characterises the reference time of the situation, and that this time is not indentical with the time of the event of the situation. What we still did not explain is the strange requirement on such DP_{instr} of ditributivity on demand, which seems to be associated with this hypothesis. We do not have a good explanation at present.

5. Discussion and conclusions

We would now like to sum the developments of the paper up.

We proposed that the three adjunct uses of DP_{instr} should be treated as having a uniform structure. This is the structure of predication within a small clause. The choice forced us to postulate a uniform interpretation for DP_{instr} in such structures. This presented a problem of accounting for the polysemy in the three free DP_{instr}-adjuncts.

We proposed an abductive theory of interpretation which can handle this problem without assigning these three different meanings to each DP_{instr}. It is based on inferring the referent of predication within the description of the situation, and possibly making additional hypotheses. The theory seems to work, but there are some questions to be answered yet.

Is there a better alternative using another syntactic structure? Sentences like (68) show that some syntactic constraints are operative[12], so the structure is important. There is no reading on which the advice was given when Peter was a child. Under the syntax of PrP the dative object is the complement to V^0, and not the specifier of PrP, and cannot control PRO.

(68) *On uže reb'onkom$_i$ sovetoval Petru$_i$ begat
He already child-instr advised Peter to run/jog
He advised Peter to jog already as a child

While the theory of Bailyn explains this, we are not aware of other comparable syntactic solutions which would explain this restriction and treat the assignment of INSTR uniformly. If Bailyn's theory is adopted, however, we see no way of a lexical treatment of instrumental adjuncts in the way Wunderlich (1997) proposes for secondary predication. Wunderlich's proposal is suggestive here, because the instrumental case can be the case of secondary pedicaion, too.

Note that since the PrP clause responsible for the cases under consideration is attached to the IP node we can speculate on the role of syntactic scope. We spoke about semantic control in Russian in section 1.1.. We actually meant the possibilities of the identification of the discourse referent introduced by PRO with some discourse referent in the domain of the DRS. We might define an accessibility order on the universe of the DRS which depends on syntactic scope, i.e. on the c-command relation. We can postulate that the identification of a DR u with the DR of PRO (i. e. semantic control) can take place only if the PRO-node discourse referent

[12] We are working on the problem of how to handle these syntactic constraints in inference.

can access u in the c-command ordering. if this convention is adopted, then the attachment site at IP would only allow the identification of the disourse referents which have no syntactic realisation. The temporal use 1 case, when the subject provides the DR to control PRO would then have the same structure, as (8). Indeed, this position might be a good alternative proposal for all kinds of PrP-Adjuncts. We have not yet clarified the relative merits of the two proposals.

Another problem is that of the scope of the treatment. We proposed that any discourse referent in the domain of the situation can serve as the subject of predication. Some discourse referents in the domain of the discourse representation of the situation seem never to be able to be the subjects of *instr*-predication. This can be formally reflected, but is conceptually unsatisfactory without an explanation. We used discourse referents for the source and the goal of movement in movement situations, for instance, following Kamp and Rossdeutscher (1994). But these referents do not seem to enter the predication relation. However, it can probably be argued that ls and lg are not legal semantic referents for either core or periferal grammatical cases, since they are narrowly connected to PP-adjuncts. This line of thought requires a more elaborate picture of situation types and their discourse referents (Strigin, 1999, discusses some similar cases). In case it is viable, it can also be a contribution to a theory of the semantic PRO-control in Russian.

The three uses of the free instrumental are not the only ones, as (1f) showed. We intend to extend the theory to all non-idiosyncratic uses of the instrumental case, including the construction of secondary predication in Russian, but this is future work.

What we hope to obtain as a side effect of providing an interpretation of sentences with a DP_{instr} is

- to provide a contribution to the constructional conception of meaning (meaning in context);
- to provide a contribution to the study of the interpretation of adjuncts;
- to further develop the inferential approach to semantic interpretation.

A Appendix. The Semantic Basics of DRT

For the sake of better integration of thee results of this work into general semantic theory we present a small portion of the discourse representation theory, DRT. The main references are Kamp and Reyle (1993), Kamp and Rossdeutscher (1994), Cooper et al. (1994), Asher (1993). The exposition here follows mostly Cooper et al. (1994). The definition of the part of a language of DRT used in this paper is given in (1).

(1) The vocabulary of a simple DRS language consists of
- (i) a set $Cons$ of individual constants, e. g. now
- (ii) a set Ref of discourse referents
- (iii) a set $Pred$ of predicate constants
- (iv) a set Sym of logical symbols, e. g. $=, \rightarrow$

The set of terms $Terms = \{Const \cup Ref\}$

A discourse representation structure (DRS) is essentially a set of discourse individuals (the universe of DRS) with a set of conditions on them which are required to hold in a situation modelled.

(2) DRSs and DRS conditions are usually defined by simultaneous recursion, but since our example DRS are all simple, we leave the recursive protion of the definition of conditions out.
- (i) if U is a (possibly empty) set of discourse referents $x_i \in Ref$, CON a (possibly empty) set of conditions con_j, then $< U, CON >$ is a DRS and U is its universe
- (ii) if $x_i, \ldots x_j \in Ref$, then $x_i = x_j$ is a condition
- (iii) if $c_i \in Const$ and $x_j \in Ref$, then $c_i = x_j$ is a condition
- (iv) if P is an n-place relation name in Rel and $t_1, \ldots t_n \in Terms$, then $P(t_1, \ldots, t_n)$ is a condition

DRS are defined in (i), atomic conditions in (ii)-(iv). There are no complex conditions in our language. There are two logical symbols used in the examples which do not occur in the definition of a condition, & and $\rightarrow$. Neither is needed in the standard development of the DRT. We use them in their standard logical meaning only to compute the semantic representations and do not want to use any of the deduction rules of the DRT for this purpose. The move is harmless, but since we do not attempt to integrate the logical terminology, we simply take care that standard modell-theoretical notions of DRT are defined on DRS which contain the results of abductive inferencing and no exressions containing & and $\rightarrow$.

In the model theory of this fragment of DRT we represent the world by a total model $\mathcal{M} =< \mathcal{U}, \Im >$ with $\mathcal{U}$ the domain of individuals of $\mathcal{M}$ and $\Im$ the interpretation function of $\mathcal{M}$, which maps constants in $Const$ into elements of $\mathcal{U}$ and n-ary relation names in Rel into elements of the the set $\wp(\mathcal{U}^n)$. A total model evaluates all sentences of the language we model as either true or false. We want a discourse representation structure (DRS) $K =< U, CON >$ to come out true in $\mathcal{M}$, if its discourse referents $u \in U$ are mapped into the elements of $\mathcal{U}$ in such a way that under this mapping all the conditions $con_i \in CON_K$ come out true in $\mathcal{M}$. Let $g\,[y]\,f$ be an

extension g of f, i. e. a function such that $Dom(g) = Dom(f) \cup y$

(3)
(i) $h \models_{\mathcal{M},g} < U, CON >$ iff $h\,[U]\,g$ and for all $con_i \in CON$: $\models_{\mathcal{M},h} con_i$
(ii) $\models_{\mathcal{M},g} x_i = x_j$ iff $g(x_i) = g(x_j)$
(iii) $\models_{\mathcal{M},g} c_i = x$ iff $\Im(c_i) = g(x)$
(iv) $\models_{\mathcal{M},g} P(t_1, \ldots, t_n)$ iff $< g(t_1), \ldots, g(t_n) > \in \Im(P)$

A mapping from K to $\mathcal{M}$ like in (3) is called *a verifying embedding of K into $\mathcal{M}$.*

(4) A DRS K is true in a model $\mathcal{M}$ with respect to an assignment g iff there *exists* a verifying embedding h for K in $\mathcal{M}$ with respect to g. In mathematical terms, $\models_{\mathcal{M},g} K$ iff $h \models_{\mathcal{M},g} K$.

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