Integration of Lexical and Compositional Semantics: Genitives in English and Russian.

Project Description

1. Issues at the Interface of Lexical and Compositional Semantics.

1.1. Lexical and compositional semantics need each other.
    Lexical and compositional semantics both have well-established traditions, sometimes several, but relatively little integration. In particular, there is a very long and rich tradition of Moscow school lexical semantics (Apresjan, Mel'chuk and Zholkovsky (1969), Apresjan 1994) ; and there is a recent explosion of interest in the lexicon in both theoretical and computational approaches in the west (Levin 1993, Pustejovsky 1995). Moscow school lexical semantics is very rich in descriptive detail and in identifying rich sublexical structure relevant for distinguishing meanings within semantic fields and for many different classes of lexical items, both closed and open. Western lexical semantics within the generative grammar tradition has been particularly interested in the syntax-lexicon interface, as more and more of the grammar comes to be located in the lexicon.
    Compositional semantics is centered on the problem of how the meanings of phrases and sentences are built up from the meanings of the parts: this requires a theory of the meanings of the smallest parts (words or morphemes), of how the parts are put together, i.e. syntax, and of the rules or principles of semantic composition. The perspective of formal semantics leads one to look for a theory that characterizes the meaning of a word or morpheme in terms of its contribution to the meaning of larger expressions. Early formal semantics (Montague 1973) limited its lexical concerns to identifying the semantic types of the words of open-class categories and the actual semantics of only a few function words such as determiners.
    As attention to the centrality of the lexicon grows, it becomes clear that it will be impossible to develop an integrated theory of lexical and compositional semantics without enrichments to each side. (It is of course an oversimplification to speak as though there were monolithic "sides".) Formal semantics is benefitting from increased attention to "sublexical structure" in many domains, most notable in work on aspectual structure, and to finer-grained structure in the models (in both the entity domain (Link 1983) and the event domain (Bach 1986), but still remains relatively primitive in lexical matters. Conversely, most approaches to lexical semantics (space precludes enumeration) remain relatively primitive with respect to compositional issues. Much current work on the lexicon in a Chomskyan framework has become very sophisticated with respect to the interface with syntax but much less so with respect to compositional semantics. Work towards synthesis is proceeding on many fronts; our intended contribution to these efforts focuses on Moscow school lexical semantics (although not exclusively) for its descriptive wealth and its attention at least in principle to compositional potential as a crucial aspect of lexical meaning, and on formal semantics in a broadly-construed post-Montague sort (as represented, for instance, by Heim and Kratzer 1998), remaining relatively neutral and

possibly primitive on syntactic issues which are at the center of attention of much other current research.

1.2. Meaning postulates and the need for richer structures

In recent work (Borschev & Partee 1998, in press a,b, Partee & Borschev in press), we have proposed to modify the Moscow school approach to represent lexical information in the form of sets of meaning postulates. We believe the use of meaning postulates is consistent with the core of actual Moscow school practice, and it makes it possible to integrate lexical semantics at least in a primitive way with the compositional "semantics of syntax" (Paducheva's phrase) given by formal semantics. If the formal semantic interpretation of a sentence is represented by a formula of a metalanguage such as Montague's intensional logic in which lexical items are primitives, and lexical semantics is represented as a set of meaning postulates for these lexical items, then their integration can be seen as the drawing of entailments from these sources. This approach is in principle extendable to the integration of semantic interpretation with contextual and topic-focus information as well, as illustrated in Borschev and Partee (1998).

There we semantically represent a sentence or a text as a *theory* consisting of different sorts of formulas, i.e. different sorts of axioms and their entailments. By "theory" here, we mean the set of axioms from various sources plus the consequences that can be drawn from these axioms, which together constitute the interpretation of such a sentence in a given context. Such a theory (see Borschev 1996) characterizes the class of all models that are consistent with the content of the given text, or of the text together with certain aspects of its context, if the theory includes axioms representing contextual information. The most general structure (features and constraints) of such models represent what the Moscow School calls "naivnaja kartina mira" 'the naive picture of the world' (Apresjan 1994), and what formal semanticists, following Bach (1986) and Link (1983), call Natural Language Metaphysics.

On our model-theoretic perspective, all of the "axioms" from all of the different sources jointly constrain the possible models, and their joint effects may account for phenomena ranging from ambiguity reduction to meaning-shift phenomena such as "coercion". It will undoubtedly turn out that the mechanism of axiom interaction is rather complicated, and may include modifications (shifts) in some axioms in the context of the others (Lascarides and Asher 1993).

But it is clear that meaning postulates as they have been used in semantics (Carnap 1952, Dowty 1979) are a rather crude tool, both too powerful (Zimmermann 1993) and insufficiently reflective of current ideas about the lexicon as richly structured and 'dynamic'. We see the idea of casting lexical information in the form of meaning postulates as a good starting point, but we are looking for more structure and more constraints, constraints both on the form of the information in the lexicon and constraints on how that information is integrated with compositional semantic interpretation and with contextual and 'encyclopedic' information.

Thus one of the goals of the present project is to explore ways to put more of the kinds of structure lexical semanticists have identified into an enriched version of meaning postulates, or an enriched alternative to meaning postulates. What is essential to maintain is a "declarative" form for lexical information so that "meaning rules" can still be used as "axioms". One principle we are prepared to argue for is that lexical meanings should not be thought of as "substituted into" slots in sentential meanings, a common view on representationalist approaches, but rather as supplying additional information which can be combined with the information that comes

from the "semantics of the syntax". But while this aspect of our approach will be held constant over this project, we will be actively investigating alternatives to viewing our "axioms" as simple formulas in a logical language like Montague's Intensional Logic (IL). One possibility would be to adapt a version of "LF structures" to serve as the metalanguage; but while these would be better adapted than IL for fitting the syntactic structures of natural languages and hence expressing the compositional interpretation, they are less obviously suited for expressing fine-grained lexical structure. The challenge is to develop a metalanguage which combines the logical rigor and semantic transparency of IL, the syntactic subtleties of LF, and the descriptive richness of the best non-formal descriptions of lexical meaning, such as those available in the Moscow school work.

1.3. Types and sorts. Type-driven interpretation, structure-driven coercion. Argument structure and syntax.

The rigid correspondence between syntactic categories and semantic types of Montague (1973) has been replaced in much current work by the idea that each syntactic category may correspond to a family of types, with principles determining unmarked choices and type-shifting possibilities (Partee and Rooth 1983, Partee 1987, Heim and Kratzer 1998). (When type-shifting is induced by the requirements of a particular construction or structure, one speaks of "coercion".) At the same time there has been much progress in replacing the need to stipulate a specific compositional rule for each syntactic construction with general principles of "type-driven interpretation" according to which the mode of semantic combination can be predicted from the types of the constituents being combined (perhaps together with knowledge of the type of the resultant category.)

But when type-driven translation and structure-driven coercion are simultaneously acknowledged, one immediately encounters tension between them: the types of the parts should determine the mode of combination, but the mode of combination together with any one part may coerce a shift in the other part. This is one of the problems we want to address in working on genitives, where type-shifting and type multiplicity seems to be very much in evidence, and at the same time there are considerable debates about what the relevant syntactic structures are and how particular structural configurations are correlated with particular interpretations.

More fine-grained than semantic types are semantic "sorts", a term we use for the many semantic subclassifications that are often represented by taxonomic classifications or by systems of semantic features. We return to sorts below, since we see them as crucial in many cases of coercion of genitives which the crude sieve of types doesn't touch. The investigation of sortal structure makes a very promising area for exploring ways to integrate formal and lexical semantics, since sorts are just incrementally more fine-grained than the types that formal semanticists already work with, and also reflect the "taxonomic" levels that many lexical semanticists work with. As Borschev and Knorina (1990) clearly showed, sortal structure is often one of the most crucial determinants of the interpretation of a genitive modifier, as well as being a cornerstone of lexical information and arguably a crucial part of a number of productive processes of metaphor formation. The genitive puzzles described in part 2 below offer fertile ground for exploring the linguistically relevant sort structure of nouns and its role in mediating the integration of lexical and compositional semantics.

A great deal of work on the relation between lexicon and syntactic structure in western

approaches concerns the argument structure of various classes of lexical items and the projection of that structure in the syntax (Grimshaw 1990, Levin 1993). This work has obvious relevance to the relation between lexical and compositional semantic structure. Internal to the noun phrase, however, argument structure is even more a matter of dispute than it is in verbal projections, and these disputes can hardly be avoided in working on any version of "genitive" constructions: the very heterogeneity of terminology surrounding genitives and/or possessives often reflects competing views about whether some, all, or no "genitives" are arguments of nouns, and if so which and of what kind.

With respect to the syntactic aspects of these issues, we plan to be as agnostic as possible, and to focus on the semantic issues of the integration of various kinds of "satellites" to a noun, particularly all sorts of genitives and possessives, with the noun and its modifiers and determiners. The distinction between arguments and modifiers will be an issue we will have to wrestle with, but the question of whether some arguments (or modifiers) of non-deverbal nouns can be identified as "subjects" or "objects" will be secondary. The particular semantic issues we plan to focus on are described below. As we work, we will pay attention to what others are saying about argument structure inside the NP in English, Russian, and other languages, and will explore points of contact between our work and such work, but we do not pretend to be capable of contributing directly to discussions of syntax at a sophisticated level in a Chomskyan framework. But we believe that it is possible to investigate many issues concerning types, sorts, and argument structure, including issues at the syntax-semantics interface, without commitment to the details of a single syntactic framework. Where that is not the case, we will address the syntactic issues as best we can in the frameworks in which they are raised by other scholars whose ideas we are building on or critiquing, respectively.

2. Genitive puzzles and our central questions
2.1. "Genitives" and related constructions

Terminology surrounding "genitives" is confusing, since the correspondences among morphological forms, syntactic positions, grammatical relations, and semantic interpretations are complex and debated, and vary considerably across languages. For clarification, let us distinguish at least the following, all of which are relevant to the proposed project: (E = English, R = Russian)

a. Possessive pronouns: E. *my, his*; R. *moj* 'my'*, ego* 'his'; E. predicative forms *mine, his* and postnominal forms *of mine, of his.*
b. English "Saxon genitives": *John's*, and the postnominal Saxon genitive *of John's*.
c. English PP with *of* + Acc.
d. Russian genitive NP (postnominal): *Mendeleeva* 'of Mendeleev'*, tigra* 'of a/the tiger'
e. Russian possessive adjective (prenominal): *Mašin dom* 'Masha's house'.

We will use the term 'genitive' in its broadest possible sense to cover all of the above; we will use 'genitive NP' to cover cases b and d above; and we will introduce other terminology in context. In the Russian literature the Russian genitive NP is often referred to as a "genitive modifier" (GM) construction, a practice we will also follow without intending any implications for the correct structural analysis. Some of the problems we are concerned with affect all or most of these constructions very similarly, others require distinguishing among them or making other groupings.

2.2. The variability of interpretations of genitive modifiers

The substantive topic to which we are bringing our theoretical concerns is a family of puzzles concerning the interpretation of the English and Russian genitive constructions with relational and non-relational nouns (*John's father* vs. *John's team*). The same or very similar problems arise in corresponding constructions in many other languages, and related problems arise with the English verb *have* and its lexical and constructional counterparts in other languages (Freeze 1992, Jensen and Vikner 1996).

One starting point is the following data from Partee 1983/97:

(1)   (a) John's team
        (b) A team of John's
        (c) That team is John's
(2)   (a) John's brother
        (b) A brother of John's
        (c) (#) That brother is John's
(3)   (a) John's favorite movie
        (b) A favorite movie of John's
        (c) (#) That favorite movie is John's

Informally, a unified interpretation of genitive phrase "John's" that applies to all of these cases is that the genitive phrase always expresses one argument of a relation, for which we will use the descriptive term "genitive relation", following Jensen & Vikner (1994). But the relation can come from any of three sources: (i) the context, as in (1) ("plays for", "owns", "is a fan of", etc.); this happens when the noun is a plain 1-place predicate; (ii) an inherently relational noun like "brother"; (iii) an inherently relational adjective like *favorite*. The puzzles include these: can (and should) examples (1a) and (2a) be given a uniform analysis, and if so, how? Or does the genitive construction combine differently with plain and relational nouns, and if so, are these differences predictable from some general principles? Should the first case be split into two distinct cases, one being a default preference of the "genitive" construction itself for a genitive relation in the family of "owns", "possesses", "controls", possibly with a distinct syntactic source? The examples in (3) show that argument-like genitives cannot always simply be analyzed as complements of a lexical noun, since it is the whole N-bar *favorite movie* that provides the relation of which *John* is an argument.

The Russian "genitive modifier" (GM) construction exemplified in (4) presents similar challenges, showing a similarly diverse range of "genitive relations", with a similar range of relational and non-relational nouns, although there are interesting differences between English and Russian to account for as well.

(4) *ljubitel' košek*   'lover of cats, cat-lover'
    rost čeloveka   'height of the/a man'
    sled tigra   'track of the/a tiger'
    nožka stola   'leg of the table, table leg'
    krug syra   'circle (wheel) of cheese'
    sobaka dočeri   'the daughter's dog'
    nebo Andreja Bolkonskogo   'Andrej Bolkonsky's sky'

In the case of Russian, the question of whether the examples in (4) are all instances of a single construction is even more difficult than in the case of English, since the uses of the Russian genitive NP cover uses analogous to both the English Saxon genitive in (1-3) and English PPs with *of* + Acc.

At a descriptive level, virtually all authors who have grappled with the semantics of genitive constructions are agreed that in some cases the genitive NP seems argument-like and in other cases it seems modifier-like. The "argument" nature of at least some genitives is clearest in the case of some deverbal nouns, those called "Complex Event Nominals" by Schoorlemmer 1995, "Derived Nominals" by Babby 1997, and "process nominals" by Rappaport 1998.

2.3. Competing hypotheses about genitive interpretation.
2.3.1. The locus of the "free relation".
In this subsection, we postpone the question of how many distinct syntactic positions there may be (at any level of analysis) for the genitive constructions exemplified in (1-4) in the previous section, and we ignore deverbal "process nominals". Starting as if we are dealing with a single syntactic "genitive construction" in each language, we raise the question of whether semantic considerations support a uniform analysis or would require a split into two different constructions with different semantic principles determining their interpretation. The central issue here is how best to account for the variability in the "genitive relation."

The schematic phrase structure tree of Borschev and Partee (in press b), which represents our relatively neutral syntax, is shown in linearized form below.

(5) $[_N$ N   NP$_{GEN}$] , where N is a cover term for N^0 and non-maximal N-bar (Montague's CN and CNP), and NP is a cover term for both N^{MAX} and DP.

The puzzle, as noted above, is whether the genitive construction has a uniform compositional interpretation, or whether the genitive NP combines in different ways with a relational N-bar like *brother* or *favorite movie* vs. a plain 1-place N(-bar) like *team*? There is on the one hand an appealing unity: the NP *John* in the genitive phrase *(of) John's* always expresses one argument of a relation, and the genitive phrase can be said to form a restrictive relational modifier of the head N-bar. At the same time there is heterogeneity in that the relation may come from the head N (*brother*), from a relational adjective (*favorite*), or from context (as in the case of *team*, where the relevant relation may be *owns, plays for, is a fan of, …*).

Two competing proposals have played roles in the evolution of our thought on this problem. Partee 1983/97 proposed two distinct genitive constructions with relational and non-relational nouns, the latter incorporating a "free relation variable R" whose value must be supplied by context. On the other hand, (a modified version of) Jensen and Vikner 1994 offers a uniform interpretation of the genitive, with coerced type-shifting of the N-bar to a relational reading when necessary. The investigation of the differences between these two approaches, in part through an ongoing dialogue which Borschev and Partee have been carrying on with Jensen and Vikner over the past two years, has led us to an appreciation that the problem of the semantics of

the genitive construction(s) is a much richer domain of inquiry than we had originally imagined, and to convergence on some issues and new questions on others.

A note about notation: In what follows we use CN for a ("plain") N-bar of type <e,t> (one-place predicate, with only a "referential" θ-role (Williams 1981; the R role of Babby 1997), and TCN for a ("transitive" or "relational") N-bar of type <e,<e,t>> like *father, favorite movie*.

The analysis of Partee (1983/97) posits an ambiguity in the construction, with the N-bar supplying the relation if it is relational, and with the construction supplying a "free relation variable" if the N-bar is not relational. We illustrate the postnominal genitive, as in (1b), (2b), (3b), which Partee (1983/97) analyzed as a modifier, treating the prenominal genitive in (1a), (2a), (3a) as a composition of the postnominal genitive with an implicit definite determiner.

Postnominal genitive (*of John's*): combines with CN or TCN to make a CN.

When genitive NP combines with a plain CN, type <e,t>: the construction provides a "free $\boldsymbol{R}$".
(6) *of John's*: $\lambda P \lambda x[P(x) \,\&\, R_i(\textbf{John})(x)]$
     team of John's: $\lambda x[\textit{team}(x) \,\&\, R_i(\textbf{John})(x)]$

When genitive NP combines with a TCN, type <e,<e,t>>, the TCN provides its "inherent $\boldsymbol{R}$".
(7) *of John's*: $\lambda R[\lambda x[R(\textbf{John})(x)]]$ or equivalently, $\lambda R[R(\textbf{John})]$
     teacher of John's: $\lambda x[\textit{teacher}(\textbf{John})(x)]]$

Jensen and Vikner (1994) present, within the framework of Pustejovsky (1993), an alternative proposal: the genitive must always combine with a relational common noun (phrase), coercing a one-place predicate noun to a two-place relational meaning ("team" to an appropriate sense of "team-of"). Their analysis corresponds to the "inherent $\boldsymbol{R}$" case of Partee (1983/97), and with a relational noun like *teacher* the two analyses agree. The difference arises with a plain one-place CN like *chair* or *team*, which on their analysis is coerced to a TCN interpretation. Jensen and Vikner follow Pustejovsky in appealing to the *qualia structure* of the lexical entry to guide the coercion, so that for instance the *telic* role of *chair* ("chairs are to sit in") licenses the shift of CN *chair* to TCN *chair* illustrated below.

(8) **CN *chair***: $\lambda x[\textit{chair}(x)]$
     TCN *chair*: $\lambda y \lambda x[\textit{chair}(x) \,\&\, \textbf{sits-in}(x)(y)]$

Initially we had some important differences with Jensen and Vikner concerning the degree to which lexical meaning drives coercion. In their current work and ours, we are agreed that on the most general version of their approach, the genitive construction should always demand a TCN to combine with, and if it finds instead a CN it will coerce it by whatever means are available and "natural", sometimes lexical, sometimes pragmatic. (We make a less sharp distinction between lexically and contextually supplied shifted meanings than Jensen and Vikner do, because of the outlook on the integration of information from lexical and other sources described in Section 1.) A "pragmatic" coercion is seen as shifting the noun to a relational reading that incorporates the "free relation variable" of Partee (1983/97) into the shifted noun meaning.

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(9) **TCN** *team*: $\lambda y \lambda x[\textbf{\textit{team}}(x) \, \& \, R_i(x)(y)]$

As in Partee's analysis, a felicitous use of an expression with a free variable requires that the context make a particular choice of value for the variable salient.

   One main difference between the two approaches is then in *where* a "free relation variable" is added in a case where context is driving a pragmatically based coercion. Let's suppose that *team of Mary's* is such a case.

(10)   **Jensen and Vikner:**
       of Mary's: $\lambda R[\lambda x[R(\textbf{Mary})(x)]]$
       (shifted) *team:* $\lambda y[\lambda x[\textbf{team}(x) \, \& \, R_i(y)(x)]]$
       team of Mary's: $\lambda x[\textbf{team}(x) \, \& \, R_i(\textbf{Mary})(x)]]$

(11)   **Partee(1983):**
       of Mary's: $\lambda P \lambda x[P(x) \, \& \, R_i(\textbf{Mary})(x)]$
       (non-shifted) *team:*   **team**
       team of Mary's: $\lambda x[\textbf{team}(x) \, \& \, R_i(\textbf{Mary})(x)]]$

The final result is the same; but for Jensen and Vikner the free relation variable comes in as part of the meaning of the shifted noun, while for Partee (1983/97) it comes in as part of the meaning of the genitive construction itself. Does this difference in "where" the free relation variable is situated ever make a detectable difference? Yes.

   Partee and Borschev (in press) discuss the problem of choosing between these empirically almost equivalent approaches. There we propose extensions to Jensen and Vikner's coercion approach to cover also the "contextual" cases, and point to a need for more fine-grained coercion principles to cover phenomena involving the relational adjective *favorite* and the difference in "most likely relation" in the interpretation of examples like *John's movie* and *John's favorite movie*.

   That paper concludes in favor of the extended version of Jensen and Vikner's approach, the most critical argument coming from examples like *Mary's former mansion* (an example suggested to us by Norvin Richards): a compositional semantics should be able to account for two possible interpretations, one on which some "former mansion" is "Mary's", and another on which the referent was formerly "Mary's mansion"; Partee's analysis generates only the former reading, while Jensen and Vikner's approach can in principle account for both.

   For most cases, the Partee (1983/97) approach and the (modified) Jensen and Vikner approach give identical results. Theoretical considerations favor Jensen and Vikner's more uniform and principled approach, at least as long as we do not take account of possible independent arguments in favor of distinguishing "argument genitives" from "genitive modifiers". The case of *Mary's former mansion* is in fact the only crucial type of example we have found so far. We intend to continue to examine other approaches which have suggested non-uniform derivations of genitives for different sorts of reasons.

   One conclusion of this preliminary work is that it is important to consider the interaction of genitives with modified nouns, and not just with lexical nouns alone. Partee and Borschev (in press) also reexamine Partee's earlier analysis of the inherently relational modifier *favorite*, and

conclude that a Jensen and Vikner-style analysis might be applied to it as well: instead of saying that *favorite* combines with either a CN or a TCN to make a TCN, a more uniform analysis would say that it always combines with a TCN to make a TCN, triggering coercion of any plain CN to a TCN before they combine. A close examination of the different kinds of readings that result from coercion by *favorite* vs. coercion by a genitive shows that coercion principles must be sensitive not only to <u>types</u> but also to <u>sorts</u> and other fine-grained information about the semantics of the functions and arguments that are "trying to fit together". One of our goals will accordingly be to investigate in more detail the interaction between structural factors (such as syntax and type structure) and systematic properties of lexical meanings that help to predict their meaning-shifting potential.

2.3.2. Exploring sortal structure and its role in meaning shifts and coercion.

The uniform-genitive approach, extended as suggested above, is further developed in Jensen and Vikner (ms. 1998); in Borschev and Partee (in press a,b), we apply it to the Russian "genitive modifier" (GM) constructions illustrated in (4), with initial exploration of the role of "sorts" in the coerced meaning shifts observed.

With the genitive construction, the head N or N-bar is always construed relationally, as being of type <e,<e,t>>; this is the heart of the unified interpretation. But it is to be emphasized that relational Ns are still Ns; both simple and relational Ns characterize the entities filling their "referential role" as belonging to a certain "sort". Relational Ns (TCNs above) differ from simple sortal Ns (CNs above) in having an additional argument place; they describe their referents not only (and sometimes not primarily) as being of a certain "sort" but as standing in a certain relation to some other entity or entities. Using "Thing" as a place-holder for a sortal property and "Related-to" as a place-holder for a relation, the basic scheme of the interpretation of a simple sortal N is as in (12a), and that of a relational N as in (12b).

(12)   (a) $\lambda x[\textbf{Thing}(x)]$
          (b) $\lambda y \lambda x[\textbf{Thing}(x) \ \& \ \textbf{Related-to}\text{-}y\,(x)]$

For different relational nouns, and for whole families of relational nouns of different sorts, there are different distributions of lexical information concerning the "sortal part" and the "relational part" of their meaning, including important differences about how much is explicit in the lexicon and how much often comes from stereotypically associated information or from the context. We illustrate these remarks briefly here; more detailed treatment of some particular examples can be found in Borschev and Partee (in press a).

A basic sortal N, type <e,t>, has a referential role and a characterizing property. In (13) below, the referential role is filled by *x*, and the characterizing property is indicated as **nožka**.

(13)   *nožka* in type <e,t> $\lambda x[\textbf{nožka}(x)]$
          'leg (of furniture)'

A relational N's referential role is characterized as one term of a relation. We can represent a directly relational N as in (14a) (the more "standard" representation) or, following the schema of (12b), as in (14b); an indirectly relational N is represented as in (14c).

(14)　　(a) *ljubitel'* in type <e,<e,t>>:　　　　$\lambda y \lambda x[\textbf{ljubitel'}(y)(x)]$
　　　　　　 'lover'
　　　　(b) *ljubitel'* <e,<e,t>>:　　　　　　　$\lambda y \lambda x[\textbf{person}(x) \ \& \ \textbf{ljubitel'-of-}y \ (x)]$
　　　　　　 'lover'
　　　　(c) *nožka* in type <e,<e,t>>:　　　　　$\lambda y \lambda x[\textbf{nožka}(x) \ \& \ \textbf{Part-of-}y \ (x)]$
　　　　　　 'leg'

　　　We then take the whole GM construction to be picking out an entity or a class of entities (of a sort normally determined by the head N), described as standing in a certain relation to some other entity or entities denoted by the GEN NP. We have noted that where the relation "comes from" can vary. The semantic "sort" of the head N often dictates a "most easily available" choice of relation, as discussed in Knorina (1988), Borschev and Knorina (1990), Pustejovsky (1995) (who appeals to a specific kind of "qualia structure"), Borschev and Partee (in press a,b). Thus the classification of *nožka* as a 'furniture part' makes the relation 'Part of' saliently accessible.

　　　Sometimes, as in *nebo Andreja Bolkonskogo* 'Andrej Bolkonsky's sky', the relation is not understandable without a strong supporting context (such as the description in *War and Peace* of the sky seen by the wounded Bolkonsky). In such cases, we take the context to be locally enriching the normal dictionary 'theory' of *nebo*; this is our way of integrating the "contextual relation" cases into Jensen and Vikner's approach on which the head N is always the locus of the relation in the GM construction. So we represent the *nebo* example as in (15).

(15)　　*nebo* in type <e,<e,t>>:　　$\lambda y \lambda x[\textbf{nebo}(x) \ \& \ \textbf{seen-by-}y \ (x)]$
　　　　 'sky'
　　　The rule for interpreting a GEN NP is simple and uniform, as illustrated in (16):

(16)　　GEN NP interpretation: *stola:*　　　$\lambda R[R(\textbf{stol})]$
　　　　　　　　　　　　　　　 'table-GEN'
　　　The resulting GEN NP meaning is partly modifier-like and partly argument-like: it is modifier-like in that it combines with an N meaning to give a new N meaning, but it is not a normal endocentric modifier, since it combines with an N meaning of type <e,<e,t>> to give a new N meaning of type <e,t>. And it does this by "filling in" the internal argument role of the relational N meaning with the value of the NP in the GEN NP.

　　　The rule for combining a GEN NP with a relational N is just function-argument application. The application of the GEN NP *stola* (see (16)) to the relational N *nožka* (see (14c)) is as shown in (17).

(17)　　$\lambda R[R(\textbf{stol})](\ \lambda y \lambda x[\textbf{nožka}(x) \ \& \ \textbf{Part-of-}y \ (x)])$
　　　　$= \ \lambda y \lambda x[\textbf{nožka}(x) \ \& \ \textbf{Part-of-}y \ (x)] \ (\textbf{stol})$
　　　　$= \lambda x[\textbf{nožka}(x) \ \& \ \textbf{Part-of-stol} \ (x)]$

　　　The formulas given above are rather schematic and primitive; more discussion of the compositional semantics is found in Partee and Borschev (in press) and of the role of semantic sorts of nouns in predicting natural shifts to relational meanings in Borschev and Partee (in press a). Similar issues are addressed in Copestake 1992 and Lascarides and Copestake 1995. A great

deal of work on the sortal structure of nouns (as well as verbs and adjectives) can be found in the literature of the Moscow school; see, for instance, Paducheva 1992, 1997 and Rakhilina and Plungian 1994.

2.3.3. How many constructions?

While we have been engaged in our previous research with semantic arguments for or against a unified treatment of the semantically highly variable-seeming interpretation of "simple" genitive constructions (avoiding examples of process nominals), there has been a great deal of research which argues on other grounds for splitting the genitive constructions in various ways, the exact nature of the split being controversial.

Engelhardt and Trugman (1997) distinguish two positions for GEN NPs: sister to N, and in Spec,DP, the latter position hosting "subjects" and "possessors" (plus a third position, adjunct to N-max, for what Borschev and Knorina (1990) call 'genitives with obligatory third term'). Schoorlemmer (1995) allows just one structural genitive case position in NPs, sister to N, and only with deverbal nouns, plus a "possessive adjunct" position for all nouns, noting that "possessives can express an infinite array of relations to the N, including 'object'". Relative to Schoorlemmer's assumptions, our work so far has been restricted to the problem of the semantics of the possessive. Babby (1997) distinguishes two positions, sister to N ('adnominal genitives') and sister to N-bar ('possessive genitives'), both internal positions, homologous to direct and indirect object positions, and both positions in which genitive is configurationally assigned ('structural case') but may also be lexically governed ('quirky' genitives). The Russian Academy Grammar (1980) separates deverbal from plain nouns, and for the latter, distinguishes genitives that are governed by the head N from genitive adjuncts (*primykanie*), noting that the distinction is not always easy to draw. Rappaport (1998) distinguishes three positions for genitive NPs with different properties in NPs (DPs) headed by "material nouns" (versus "action nominals", Grimshaw's complex event nominals). For relational nouns that take arguments, like the first three or four in the list in (4), the (argument) genitive NP is a complement to the head N, which assigns it inherent (lexical) case. "Genitives with obligatory third term" like *medved' srednej veličiny* 'a bear of average size', and some other cases which he considers attributive modifiers, are treated as "derived modifiers"; for this second class he has no formal account but posits a derivational rule. A postnominal specifier position can also host a genitive NP; this he regards as the site for possessors and agents.

Note that on Rappaport's account, as on any standard X-bar account, there is no obvious way to let an adjective-plus-noun complex like *favorite movie* take an argument, which is another difficulty for the goal of making clear distinctions between arguments and adjuncts, since semantically, *favorite* insists on having an argument supplied. Babby does seem to be prepared to countenance arguments of N-bars, since he assigns structural genitive case to the sister of N-bar.

These and other authors differ not only on how many distinct structural positions are posited for genitives and what semantic roles are associated with each position, but they also differ on whether they posit the same kinds of structures and distinctions for simple nouns as for deverbal nouns (process nominals). There are also important and long-standing differences on the question of which if any genitives are assigned structural case within the NP and which lexical case. Interest in this topic appears to be growing, and we plan to educate ourselves about

ongoing work in syntax and at the syntax-semantics interface early in our project and hope to be able to contribute to the integration of syntactic with lexical and compositional semantic work on the genitive construction(s). The slightly technical Chomskyan framework of some of the 'western' syntactic discussion may limit its accessibility to the Russian participants in our project, but for the most part the distinctions can be described within a relatively simple X-bar framework, with allowances for differences as to whether the middle N-bar position is recursive or not and with debates about whether Russian has an NP-DP distinction like that generally assumed for English.

If there is really more than one syntactic GM construction in Russian (aside from the "obligatory third term" construction, which is surely a distinct construction), as many scholars argue, how does that bear on the semantic questions that have been the focus of our work so far? Does it argue against the kind of semantically unified analysis pursued by Borschev and Partee? How can one decide?

The schematic phrase structure tree of Borschev and Partee (in press b), repeated below, actually would allow for two distinct positions within the possibilities we conflated.

(18)　　$[_N$　N　NP_{GEN}] , where N is a cover term for N^0 and non-maximal N-bar (Montague's CN and CNP), and NP is a cover term for both N^{MAX} and DP.

There could be a "sister of N" position plus an "adjunct to N-bar" position, as in Babby or as in Schoorlemmer. Our structure is inconsistent only with the structure proposed by Engelhardt and Trugman, where one of the positions is a D position (analogous to English prenominal possessives). But we have not delved seriously into this problem so far. The hard question here is whether, if one excludes deverbal nouns from consideration, there are any strong arguments for two syntactically distinct positions with plain nouns, and if so, whether there is any consistent semantic difference between the kinds of "genitive relations" in the two positions. Our approach does not predict any such difference.

Semantically, our approach is consistent with recursion, but we would predict that recursion would lead to processing difficulty. On our approach, a GEN NP combines with an N(-bar) of type $<e,<e,t>>$ to make an N-bar of type $<e,t>$, which could (under coercion with a strong supporting context) be shifted to an $<e,<e,t>>$ interpretation and could then combine with another GEN NP. It would presumably be quite difficult to have multiple shifts _within_ a single NP; so we expect multiple GEN NPs to be easiest to interpret when one is clearly an argument of the head N and the other is interpreted with respect to a contextually salient relation or the default possessive relation of ownership or control; this is the case in the prototypical "good" example of two genitives, as in (19) below, discussed by Padučeva 1984, p.60, and by Babby 1997, p.61.

(19)　　tablica elementov　　　　Mendeleeva
　　　　table　elements-GEN Mendeleev-GEN
　　　　'Mendeleev's table of the elements'

Relevant open issues not explored here include the hypothesis that "possessives" (in adjunct position) are more "subject-like" and real "arguments" of relational nouns more "object-like"(as

suggested by the Academy Grammar); whether possessive adjectives like *Petin* 'Petja's' can replace "possessive" genitives but not "argument" genitives (as Schoorlemmer claims; the first author of this paper disagrees). We also plan to look further into the question of which kinds of genitives can be replaced by possessive pronouns, following up on the pioneering work of Paducheva 1984.

2.4. Larger questions surrounding the genitive puzzles.
　　One major issue concerns the form of "meaning postulates" or their replacements and the content and structure of the semantic metalanguage. It can't just be classical logic; just as in other areas of linguistics, the search for the optimal metalanguage has to be guided in large part by the demands of empirical linguistic phenomena to be "captured". What metalanguage is appropriate for the representation of real text structure, of model structures, of relevant aspects of context, etc.? We would not expect to provide full answers to such questions, and we probably will not try to get very far into such important issues as the visual/language interface explored in Jackendoff's recent work.. The strategy will be to identify particular concrete issues in this larger area which relate directly to our problem domain. The claims made by Pustejovsky (1993), and used by Jensen & Vikner (1994, ms. 1998), concerning the form of "qualia structure" information in lexical entries, about which we are somewhat skeptical, will provide one natural starting place.
　　Another central issue, alluded to earlier, is type-structure and sortal structure. We are concerned with the structure of lexical domains, and how that structure interacts with compositional semantics. We can see progress from both sides, from the development of formal semantics on the one side and from work on lexical semantics on the other. In formal semantics, attention to type structure began with Montague's use of type theory to capture function-argument structure and intensionality; second big step exemplified by Link's work on structure internal to the entity domain (plural and singular entities, atomic and non-atomic semilattice structures) and work by Dowty (1979) and others on model-theoretic treatment of Aktionsart and aspectual distinctions. Further work is going on now on subclasses of Adjectives, Nouns, and Verbs, subkinds of quantifiers, and the interaction of such subclasses with ideas about "type-driven translation".
　　From the Moscow lexical and descriptive side, progress includes not only much fine-grained lexical semantic descriptive work on many areas of the lexicon, and much related work on the interaction of verb semantics and the interpretation of aspectual forms, but also such work as Knorina's classification of the semantics of genitive constructions reported in Borschev and Knorina 1990. Our first task will be to try to integrate existing work of these kinds, knowing in advance that integration will inevitably require insightful reworking of existing approaches before they can fit together.
　　A more specific question, but one which runs through work on the genitive in many different traditions, is the question of the validity of analogies often made between the subject and object of a sentence on the one hand and certain NP-internal positions on the other hand. In particular, it is frequently claimed that possessives, possibly associated more closely with the determiner position, are subjects, and a direct genitival complement (argument) of a relational noun is analogous to an object.

Two extreme views can be contrasted here: the approach of Jensen & Vikner (1994) and of Partee & Borschev (in press) would be most simply compatible with a uniform view of all genitives as modifiers, sisters to N-bar, which is one extreme view. Such a treatment is not implausible for English postnominal "Saxon genitives", but it is probably too simplistic for the Slavic languages, where the genitives corresponding to English *of* + Acc PPs are more reasonably treated as complements of the N^0. On the other hand, the other extreme view which would see all genitives as analogous to subjects or objects is also undoubtedly too strong. There are attractions to both views, certainly, and the goal will be to capture what is attractive about both views as well as carefully sorting through arguments for various intermediate views, such as Grimshaw's (1990) positing of "argument adjuncts" and Babby's (1997) assignment of structural case to a sister of N-bar position.

In sum, there is a rich and overlapping family of problems related to the lexical semantics of nouns and the compositional semantics of the parts of the NP and DP. Genitive constructions clearly offer a challenging and important area for developing and testing hypotheses concerning the interaction of compositional semantics, lexical semantics, and contextual influences. In the result we hope to gain a better understanding not only of the interpretation of genitives but of the structure of the lexical semantics of nouns and of the principles for meaning-shifting and, and a deeper understanding of the nature of the "free relation variables" that seem to figure so prominently in the interpretation of genitives.

3. Plan of work

The three consultants on this project will all be integral team members; they are classified as consultants principally because any other arrangement is bureaucratically unmanageable, given the lack of a functioning infrastructure in the Russian scientific world at present. Partee is a specialist in formal semantics with a growing interest in Moscow school lexical semantics and an interest in the genitive construction. Borschev is a specialist in the formal semantics of formal languages (including computer languages) with a growing interest in the formal and lexical semantics of natural languages and also with prior work on the genitive (with Knorina and more recently with Partee). Paducheva has been a leading figure in the development of semantics in Russia, with strong interests in compositional semantics, in lexical semantics, and in the semantics-syntax interface. She has worked on the lexical structure of denominal verbs as well as on the genitive and on possessive pronouns. Rakhilina has done some investigations of compositional semantics but her main work has been in lexical semantics in many areas, including a good deal of work on the semantics of various classes of nouns.

Considerable groundwork has already been laid. In Russia in the fall of 1996 Partee taught a course at Moscow State University on Formal semantics and the lexicon. Also in the fall of 1996, Partee, Borschev, Paducheva, and Rakhilina began holding weekly meetings to discuss their points of view on how semantics ought to work, and over the course of those discussions we generated the beginning hypotheses described above as well as some ideas about the Russian "genitive of negation" reported in Borschev and Partee (1998). Partee and Borschev taught short courses together on formal and lexical semantics at the Mathesius Institute in Prague in 1996 and at the Netherlands Graduate Linguistic School (LOT) in Nijmegen in January 1997.

In May 1998 Borschev and Partee visited Jensen and Vikner at the Kolding Business School in Denmark, where they jointly taught a mini-course on Formal Semantics and Lexical

Semantics which was followed by a symposium with Jensen and Vikner on the semantics of genitives. There is a tentative plan for another two-week visit in January 2000 to continue mutual discussions; in the meantime drafts of work in progress are being exchanged frequently.

In each of the three years of the grant, Partee will spend approximately seven months in Russia (a semester plus summer) where the whole team will work together. Borschev will spend four months each year in the U.S. where he will continue working on the project with Partee, with correspondence and exchange of drafts of work in progress with Paducheva and Rakhilina continuing by mail and e-mail. A graduate research assistant will be based year-round in Amherst, with a 4 to 6 week stay in Russia in each of the last two summers. In the middle summer, the R.A. will help us build up and organize a collection of relevant material from the burgeoning syntactic and syntax-semantics literature; keeping up with that literature is impossible for the three Russian consultants and difficult for Partee, focused on semantics, but we recognize the importance of exploring alternative hypotheses concerning the structural part of the input to the semantics. The R.A. will participate in discussions concerning the points of contact between that literature and our central semantic concerns. In the final year, the R.A. will have assigned writing tasks of his/her own (and ideally a related dissertation topic), and will spend four to six weeks in Russia for discussion of his/her results and participation in informal workshop sessions in which the four principals will invite Russian colleagues to join in discussion of the emerging results of the project. (Note: knowledge of Russian is not an absolute requirement for the R.A., since the discussions with the principals can be in English; but knowledge of some Slavic language would be helpful, and we do currently have two second-year Polish-speaking graduate students and a first-year Russian-speaking student, all of whom have an interest in syntax and semantics and who appear to be very good choices for such a position.)

The budget includes travel funds for the P.I. and some of the consultants to attend conferences each year to give papers on the ongoing research, consult with colleagues, and participate in scholarly debates on these controversial topics. In at least one of the years it is likely that Partee and Borschev would use international travel funds to visit Jensen and Vikner in Denmark, since our week with them in the spring of 1998 was one of the inspirational wellsprings of the present project. The budget also includes travel for Borschev to the U.S. each year, and for at least one of the other consultants in the last year.

Other relevant events that will feed into the project include a conference on the syntax and semantics of adjuncts in Oslo in September 1999 which Partee and Paducheva hope to attend, for which Partee will prepare a paper on type-shifting and the challenge of formalizing and explicating intuitions that the line between arguments and modifiers is not always sharp; this is particularly true for "oblique" arguments of verbs, and for almost all arguments of nouns, with the genitive a particularly thorny case in point.

Partee also has relevant courses planned for the coming years. As a visiting Leibniz professor at the University of Leipzig in summer term 1999 she will teach Introduction to Formal Semantics and an advanced course on Integrating Formal and Lexical Semantics. In the summer school of the Netherlands Graduate Linguistics program (LOT) in Potsdam in July 1999, Partee and Borschev will teach a joint course, "Integrating Formal and Lexical Semantics: Genitives."

Partee has a Fulbright lecturing award pending (first stage approval Oct 1998) for the Spring semester of 2000 at the Russian State Humanities University (RGGU). She plans to offer

Introduction to Formal Semantics, plus a research seminar working with advanced students on problems in the semantics of Russian, including genitives.

At the University of Massachusetts, Partee has considerable flexibility in choosing topics for graduate semantics seminars and proseminars, and can plan grant-related topics once the success and timing of the grant is known. She taught a relevant proseminar on Categories and Types in the fall of 1997; a seminar with genitives as its main topic could be offered in the fall of 1999 or 2000, to be followed by a seminar on the lexicon from the perspective of formal semantics. The possibilities for offering relevant seminars at UMass considerable and varied, including the possibility of team-teaching with interested colleagues in syntax or other colleagues in semantics.

The bulk of the actual grant work will involve a combination of frequent discussions among the four of us leading to the writing and exchanging of research papers as we explore these topics in greater depth. Because of the long period of relative lack of contact between our different rich traditions, it is impossible to work fruitfully together without a great deal of discussion, since each approach has developed a sizable set of unspoken but crucial working assumptions, and these often have the status of unspoken presuppositions by now for those who hold them. We have found discussion, particularly centered on specific analytical problems such as the genitive, to be possible and fruitful and are convinced that a commitment to several years of intense interaction will pay off not only in our research on the integration of formal and lexical semantics and on the problems of the genitive but in the opening up of new bridges between these important traditions.