Lexical Pragmatics

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Abstract

Lexical Pragmatics is a research field that tries to give a systematic and explanatory account of pragmatic phenomena that are connected with the semantic underspecification of lexical items. Cases in point are the pragmatics of adjectives, systematic polysemy, the distribution of lexical and productive causatives, blocking phenomena, the interpretation of compounds, and many phenomena presently discussed within the framework of Cognitive Semantics.

The approach combines a constrained-based semantics with a general mechanism of conversational implicature. The basic pragmatic mechanism rests on conditions of updating the common ground and allows to give a precise explication of notions as generalized conversational implicature and pragmatic anomaly. The fruitfulness of the basic account is established by its application to a variety of recalcitrant phenomena among which its precise treatment of Atlas & Levinson's Q- and I-principles and the formalization of the balance between informativeness and efficiency in natural language processing (Horn's division of pragmatic labor) deserve particular mention. The basic mechanism is subsequently extended by an abductive reasoning system which is guided by subjective probability. The extended mechanism turned out to be capable of giving a principled account of lexical blocking, the pragmatics of adjectives, and systematic polysemy.

1. Introduction

The aim of linguistic pragmatics is to provide an explicit account of utterance-interpretation. Being more specific, such an account has to clarify how disambiguation is achieved, how anaphoric and cataphoric relationships are resolved, how deictic expressions are used, how presuppositions are projected, what role accommodation phenomena play, how conversational implicatures are worked out, how sentence fragments and ungrammatical utterances are interpreted, how contextual and encyclopedic knowledge is brought to bear, and so on (cf. for example, Sperber & Wilson 1981).

In many cases the interest in pragmatics generally arises through concern with the problems of semantics. For example, it has been the evident divergence between the formal devices ~, ∧, ∨, ⊃, (∀x), (∃x), (ιx) (in its standard two-valued interpretation) and its natural language counterparts that has built the starting point of Grice's *logic and conversation* (Grice 1968). And it have been the products of Carnap's and Montague's model theoretic semantics leaving basic theoretical issues regarding commonplace linguistic phenomena largely unresolved (conditionals, generic plural, aspect etc.) that have lead Thomason to his thoughts about the fundamentals of pragmatics (Thomason 1990).

It is tempting to characterize Lexical Pragmatics as that area of pragmatics that arises as reaction to specific problems of Lexical Semantics. Here Lexical Semantics has to be understood in its "classical" sense as a truth-functional, static semantics of lexical items. From a Grician perspective, two different ideas of how to overcome the divergences between the classical theory and the natural language demands come into mind. The first one uses conventional implicatures

as an enlargement of the classical information entries. (One standard example is to describe the difference between *and* vs. *but* by means of this idea). The second idea uses conversational implicatures as method to overcome the divergences between (formal) meaning and natural language interpretation. Whereas I believe that modern semantic theories (which usually are characterized as dynamic, epistemic, nonmonotonic) make the conception of conventional implicature superfluous as an addendum to the semantic component, I do not think so of conversational implicature. In fact, in this paper I will argue that the proper use of conversational implicature will resolve some of the problems of lexical interpretation that remain unsolved otherwise.

The conceptual core of Lexical Pragmatics demands a straight formulation of conversational implicature. Paired with the idea of (radical) semantic underspecification in the lexicon and an appropriate representation of contextual and encyclopedic knowledge this conception avoids both unmotivated lexical ambiguities as the need for expansive re-interpretation and coercion mechanisms. Furthermore, I hope to illustrate how an appropriate formulation of the mechanism of conversational implicatures explains the restrictions on interpretations that can be observed with regard to the traditional areas of polysemy, metonomy, and adjectival modification.

The main goals of this paper will be to develop a sensitive feeling of what kind of problems can be approached within Lexical Pragmatics, to explain some characteristics that a proper theory of Lexical Pragmatics has to take account of, and to demonstrate how (a fragment of) the theory works as a restrictive, explanatory account. The discussion proceeds as follows. In the next section, I give some examples illustrating the kind of problems Lexical Pragmatics has to deal with. In section 3 a straightforward formulation of conversational implicature is provided that rests on pragmatic conditions of updating the common ground. Furthermore, some consequences of the basic mechanism are discussed demonstrating the integrating and unifying character of the basic mechanism. Finally, five theses are considered that are designed to characterize Lexical Pragmatics as a proper theoretical program. In section 4 the basic mechanism is extended by including an abductive reasoning system guided by subjective probability, and it is shown how this specific model solves some of the problems stated before.

2. The range of Lexical Pragmatics: Some examples

The examples selected in this chapter are not intended to give a complete survey of the aims and problems of Lexical Pragmatics. Admitting that the selection is rather accidental, I hope that the two classes of examples chosen give a reliable body of evidence at least about some core problems. Since it is not always straightforward to distinguish problems about the semantics of lexical units from problems of Lexical Pragmatics, some solicitude has been spent in order to diagnose the latter kind of problems. Needless to say, that to a certain degree certain theoretical predestinations are unavoidable to perform this diagnosis. I believe, however, that these predestinations aren't superficial and don't lead to perverse problems.

2.1 The pragmatics of adjectives

In a very simplistic view the meanings of adjectives like *red, interesting,* or *straight* are taken as one-place predicates. This assumption about the meaning of adjectives leads to straightforward

consequences when it comes to exploit the compositional character of our linguistic system. In rough approximation that is sufficient for the present purpose *the principle of compositionality* states that "a lexical item must make approximately the same semantic contribution to each expression in which it occurs" (Fodor and Pylyshyn 1988). Examples like *this cow is brown* suggest that in this case the one place predicate standing for the meaning of the adjective *brown* directly applies to the meaning of the subject term yielding the truth value of the whole sentence. In adjective-noun combinations, on the other hand, it is the intersection operation that forms the meaning of the compound expression. As a consequence of this view we get a nice explanation of certain entailments. Fodor and Pylyshyn put this point as follows (p. 42):

> Consider predicates like ... *is a brown cow*. This expression bears a straightforward semantical relation to the predicates ... *is a cow* and ... *is brown*; viz., that the first predicate is true of a thing if and only if both of the others are. That is, *is a brown cow* severally entails ... *is brown* and *is a cow* and is entailed by their conjunction. Moreover—and this is important—this semantical pattern is not peculiar to the cases cited. On the contrary, it holds for a very large range of predicates (see ... *is a red square, ... is a funny old German soldier, ... is a child prodigy,* and so forth).

The *systematicity of linguistic competence* is another phenomenon that can be accounted for by means of the simple ideas developed so far. According to Fodor and Pylyshyn (pp. 41-42) the systematicity of linguistic competence consists in the fact that the ability to understand and produce some expressions is intrinsically connected to the speaker's ability to produce and understand other expressions that are semantically related. When a speaker understands the expressions *brown cow* and *black horse*, he understands the expressions *brown horse* and *black cow* as well. Again, it is the use of the intersection operation that explains the phenomenon.

Unfortunately, the view that a large range of adjectives behaves intersectively has been shown to be wrong. For example, Quine (1960) notes the contrast between *red apple* (red on the outside) and *pink grapefruit* (pink on the inside), and between the different colors denoted by *red* in *red apple* and *red hair*. In a similar vein, Lahav (1989, 1993) argues that an adjective as *brown* doesn't make a simple and fixed contribution to any composite expression in which it appears.

> In order for a cow to be brown most of its body's surface should be brown, though not its udders, eyes, or internal organs. A brown crystal, on the other hand, needs to be brown both inside and outside. A brown book is brown if its cover, but not necessarily its inner pages, are mostly brown, while a newspaper is brown only if all its pages are brown. For a potato to be brown it needs to be brown only outside, ...Furthermore, in order for a cow or a bird to be brown the brown color should be the animal's natural color, since it is regarded as being 'really' brown even if it is painted with all over. A table, on the other hand, is brown even if is only painted brown and its 'natural' color underneath the paint is, say, yellow. But while a table or a bird are not brown if covered with brown sugar, a cookie is. In short, what is to be brown is different for different types of objects. To be sure, brown objects do have something in common: a salient part that is wholly brownish. But this hardly suffices for an object to count as brown. A significant component of the applicability condition of the predicate 'brown' varies from one linguistic context to another. (Lahav 1993: p. 76)

Some authors—for example, Keenan (1974), Partee (1984), Lahav (1989, 1993)—conclude from facts of this kind that the *simplistic view* mentioned above must be abolished. As suggested by Montague (1970), Keenan (1974), Kamp (1975) and others, there is a simple solution that addresses such facts in a descriptive way and to obey the principle of compositionality. This solution considers adjectives essentially as adnominal functors. Such functors, for example, turn the properties expressed by *apple* into those expressed by *red apple*. Of course, such functors have to be defined disjunctively in the manner illustrated in (1):

(1)   RED(X) means roughly the property

        (a)   of having a red inner volume if X denotes fruits only the inside of which is edible
        (b)   of having a red surface if X denotes fruits with edible outside
        (c)   of having a functional part that is red if X denotes tools
        ...

Let us call this view the *functional view*. It should be stressed that the functional view describes the facts mentioned above only by enumeration. Consequently, it doesn't account for any kind of systematicity concerning our competence to deal with adjective-noun combinations in an interesting way. Another (notorious) problem of this view has to do with the treatment of predicatively used adjectives. In that case the adjectives must at least implicitly be supplemented by a noun. Various artificial assumptions are necessary which make such a theory inappropriate (cf. Bierwisch 1989 for more discussion of this point).

    Before I come to a more systematic discussion of these and some further problems, let me introduce a third view about treating the meanings of adjectives which I call the *free variable view*. In a certain sense, this view can be seen as preserving the advantages of both the simplistic as well as the functional view, but as overcoming their shortcomings. The free variable view has been developed in considerable details in case of gradable adjectives (see for example, Bierwisch 1989, and the references given therein). It is well known that the applicability conditions of restricting adjectives that denote gradable properties, such as *tall, high, long, short, quick, intelligent* vary depending upon the type of object to which they apply. What is high for a chair is not high for a tower and what is clever for a young child is not clever for an adult. Oversimplifying, I can state the free variable view as follows. Similar to the first view the meanings of adjectives are taken as one place predicates. But now we assume that these predicates are complex expressions that contain a free variable. Using an extensional language allowing λ-abstraction, we can represent the adjective *long* (in its contrastive interpretation), for example, as λx LONG(x,X), denoting the class of objects that are long with regard to a comparison class, which is indicated by the free variable X.[1] At least on the representational level the predicative and the attributive use of adjectives can be treated as in the first view: *The train is long* translates to (after λ-conversation) LONG(**t**,X) and *long train* translates to λx [LONG(x,X) $\wedge$ T(x)]. In these formulas **t** is a term denoting a specific train and T refers to the predicate of being a train.

    The free variable account, however, becomes problematic if expressions of the demonstrated kind should be interpreted within the framework of classical (static) model theoretic semantics (where the concepts of compositionality and intersectivity can be defined in a contentful and precise way cf., for example, Keena n 1974). I refer the reader to the general discussion in Partee (1984) and add that also the use of indexical parameters instead of free variables would be problematic (cf., for example, the theory of context-dependent interpretations developed in Bartsch (1989) where the relevant fact can be described by enumeration only similar to the

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[1]   As shown by Bierwisch (1989) it is useful to decompose relational expressions as λx LONG(x,X) in a straightforward way. Simplifying matters this decomposition would look like
        λx $\exists c$[QUANT MAX x = NORM(X) +c] expressing that the degree of x on the scale specified by MAX (maximum dimension of object x) extends the norm of the contextually determined comparison class X by some (positive) degree c. For further details and sophistications I refer the reader to the original literature.

functional view).

In the following, let us envisage the free variable account from the point of view of a (representational) semantics where meanings are identified with patterns of some sort ("semantical representations"). As stressed by Partee (1984: 284) "the compositional principle can still be formulated for such systems, but it then becomes a much more syntactic notation, basically a constraint on the translation rules that map syntactic representations onto semantic ones". Free variables now simply have the status of place holders for more elaborated subpatterns and expressions containing free variables should be explained as representational schemes. Free variables stand not only as place holders for a comparison class X as just indicated. The view can be generalized to include other types of free variables as well, for example a type of variables connected with the specification of the dimension of evaluation in cases of adjectives as *good* and *bad* or a type of variables connected with the determination of the object-dependent spatial dimensions in cases of spatial adjectives as *wide* and *deep*. In what follows, a variety of other kinds of variables will be considered leading to rather complex types of lexical underspecification.

Of course, it is not sufficient to postulate underspecified lexical representations and to indicate what the sets of semantically possible specifications of the variables are. In order to grasp natural language interpretation it is also required to provide a restrictive account explaining how the free variables are instantiated in the appropriate way. Obviously, such a mechanism has to take into consideration various aspects of world and discourse knowledge. We are presented here with a kind of *selection task*: how to select from a set of possibilities an appropriate one where (weak) restrictions are given in form of world and discourse knowledge. The main idea of Lexical Pragmatics now suggests that it is the mechanism of conversational implicatures-explicated and formalized in an appropriate way-that fills the gap of selecting the "right" specification from the set of semantically possible ones in the cases under discussion. In principle, this mechanism is based on all kinds of world and discourse knowledge. However, a proper formulation of the mechanisms should make it possible to extract which aspects of general world knowledge and discourse knowledge are really relevant in specifying a certain variable that results from a specific type of lexical underspecification.

Let us call now three general problems which are intended to give some clear impression of what kind of questions should be approached within Lexical Pragmatics and what are the challenges for Lexical Pragmatics as a proper theoretic program. The first problem can be stated as the problem of *(pragmatic) compositionality*. The problem can by explained at best by way of an example. In (2) I have adopted an example discussed by Pustejovsky & Bogurajev (1993) showing the context dependence of the adjective *fast*, where the interpretation of the predicate varies depending on the noun being modified.

(2)	(a)	a fast car	[one that moves quickly]
	(b)	a fast typist	[a person that performs the act of typing quickly]
	(c)	a fast book	[one that can be read in a short time]
	(d)	a fast driver	[one who drives quickly]

Examples of this kind suggest that the adjective modifies a specific conceptual component connected with the noun, namely its purpose or function. With regard to this component the adjective seems to make an unitary contribution, it qualifies this component (the act of moving, typing, reading or driving) in a specific and unitary way. In the general case the principle of pragmatic compositionality says that it is possible to decompose the lexical items in conceptual components and that these components determine the conceptual interpretation of the whole expression. In some cases it seems that the conceptual components of a lexical item are associated *semantically* with it, i.e., those components determine the meaning of the lexical item. In other cases the association of the conceptual components is via general world knowledge and this information is detachable from the word meaning. The former case is exemplified by the information concerning the purpose or function of artefact terms. The latter case may be illustrated by the information determining the designation of the spatial properties of spatial object terms (e.g. Lang 1989).

As an exercise that demonstrates a typical case of the notion of compositionality just under discussion let us calculate the "conceptual interpretation" of the expression *fast car*. In (3a) the semantic analysis of the noun *car* is sketched in some relevant aspects. The analysis states that the concept related to cars is characterized (besides other things) by a telic role (purpose or function) that qualifies a situation s associated with cars as a moving process. The semantic analysis of the adjective *fast* given in (b) expresses that it affects the telic role only. In (c) the expression given in (a) and (b) are combined by the intersection operation, and in (d) the resulting interpretation (a car that moves quickly) is obtained by unifying the free variables.

(3)	(a)	*car*:	$\lambda x\ [CAR(x) \wedge TELIC(x,s) \wedge MOVE(s) \wedge ...]$
	(b)	*fast*:	$\lambda x\ [TELIC(x,s') \wedge FAST(s')]$
	(c)	*fast car*:	$\lambda x\ [CAR(x) \wedge TELIC(x,s) \wedge MOVE(s) \wedge$
			$TELIC(x,s') \wedge FAST(s') \wedge ...]$
	(d)	unification $\rightsquigarrow$	$\lambda x\ [CAR(x) \wedge TELIC(x,s) \wedge MOVE(s) \wedge FAST(s) \wedge ...]$

It is straightforward how the analysis can be extended to the other cases given in (2).

It seems to me that this kind of analysis works well in cases like (2). The problems of the account become visible, however, when we consider other types of adjectives, for example color and taste adjectives. Suppose that we want to describe that a red apple is one whose surface is red (but not necessarily its inside), and a red grapefruit is one having a red inner volume (but not necessarily a red surface). According the account just sketched we can try do describe this by assuming an application condition for *red* saying that a salient part of the object is wholly reddish: $\lambda x\ [SAL\text{-}PART(x,y') \wedge RED(y')]$. Furthermore, we have to postulate that the salient part of an apple is its surface and the salient part of a grapefruit is its inner volume. However, what counts as salient part with regard to color is not necessarily salient with regard to other aspects. What counts as the salient part of an apple with regard to taste, for example, seems to be the inner volume and not the peel. Thus, according to the view under discussion we have to change the semantic entry for *red* to something like shown in (4a) whereas the entry for sweet would look like (4b). Furthermore, in order to make the procedure pragmatically compositional, we would

have to postulate a conceptual analysis for *apple* as sketched out in (4c).

(4)　　(a)　　*red*:　　$\lambda x\ [\text{SAL-PART}_{COLOR}(x,y')\wedge\text{RED}(y')]$
　　　　(b)　　*sweet*:　$\lambda x\ [\text{SAL-PART}_{TASTE}(x,y')\wedge\text{SWEET}(y')]$
　　　　(c)　　*apple*:　$\lambda x\ [\text{APPLE}(x)\wedge\text{SAL-PART}_{TASTE}(x,y_1)\wedge\text{PULP}(y_1)\wedge$
　　　　　　　　　　$\text{SAL-PART}_{COLOR}(x,y_2)\wedge\text{PEEL}(y_2)\wedge...]$

Although such an "analysis" gives the right input for satisfying pragmatic compositionality, it doesn't describe the data more systematically than the functional view sketched before. Obviously, both views describe the data only by enumerating them. What can be learned from this observation is simple that compositionality always can be retained, but at the expense of systematicity.[2] As a matter of fact, in the former case the notion of *semantic* compositionality is saved by enumerating the adjectives' applicability conditions for different objects. In the second case, on the other hand, the notion of *pragmatic* compositionality is saved by enumerating the salient parts of objects with regard to any aspect (color, taste,...). In this case, the cumbersome has to do with the relational notion of salience which obviously cannot be analyzed in a way which is systematic and compositional at the same time. Lahav (1993) notes further examples stressing this point and demonstrates that our pragmatic capacities have salient non-compositional aspects. As a consequence, we are challenged to develop a non-compositional account of the selection task stated above.

Next, let us consider a problem which I will call the problem of pragmatic anomaly. In (5) the examples (a-d) seem to make correct (but not necessarily true) statements about a conceivable state of affairs. The examples (e-h), on the other hand, are somehow defective, but they are defective for different reasons: (g) and (h) represent true category violations, while (e) and (f) represent the phenomenon of pragmatic anomaly.
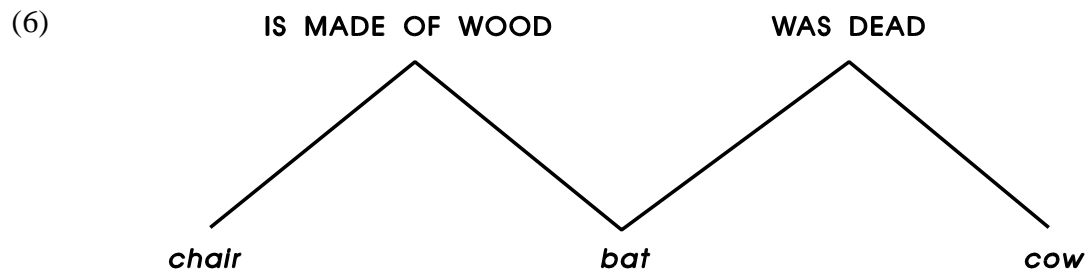
(5)　　(a)　　The tractor is red
　　　　(b)　　The tractor is defective
　　　　(c)　　The tractor is loud
　　　　(d)　　The tractor is gassed up
　　　　(e)　　?The tractor is pumped up
　　　　(f)　　?The tractor is sweet
　　　　(g)　　*The tractor is pregnant
　　　　(h)　　*The tractor is bald-headed

The importance of this distinction has been noted, for example by Keil (1979). Category mistakes can be explained on grounds of an ontological category violation as described by Sommers (1959, 1963) and Keil (1979). Pragmatic anomaly, on the other hand, has only indirectly to do with the so-called ontological level describing the basic categories of existence in terms of which we conceptualize our everyday world. That *sweet* is not an appropriate attribute of *tractors* can't be explained on grounds of an ontological category violation. A tractor *can* be sweet, by the way.
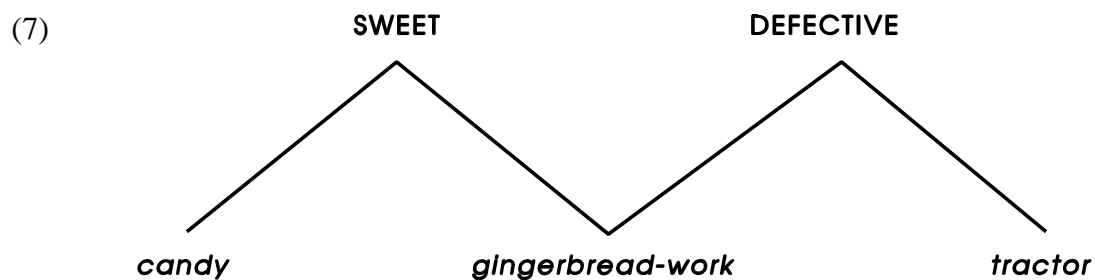
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[2]　In more general terms, Zadrozny has shown recently (Zadrozny 1994) that any semantics can be encoded as a compositional semantics, which means that, essentially, the standard definition of compositionality is formally vacuous. Furthermore, this author has shown that it is possible to distinguish between grammars with compositional and non-compositional semantics when the meaning functions are restricted by using the conception of *systematic* meaning functions.

Taste one: it might surprise you. Consequently, pragmatic anomalies aren't relevant to the construction of a predictability tree (see Keil 1979).
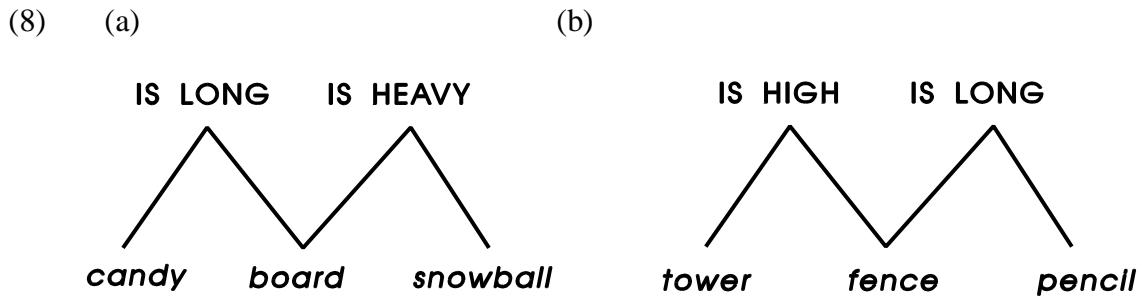
The problem of pragmatic anomaly has to do (i) with the distinction between category mistakes and pragmatic anomaly and (ii) with the formal treatment of the latter kind of deviance. Since it is not always easy to distinguish true category violations from pragmatic anomaly a kind of diagnostics seems to be desirable. I suggest to use Sommer's M-principle as a sensitive diagnostic instrument. This principle says that our intuitions about category mistakes are representable as trees, where this predictability trees never form an "M" of the kind shown in (6).

(6)

IS MADE OF WOOD   WAS DEAD

chair   bat   cow

Deviations from the M-principle Keil (1979) terms M-violations. According to Keil, M-violations are artificial and are caused, for example, by ambiguous terms or predicates. (note that (6) shows an example, where the M-violation occurs because of two entirely different meanings of the lexical unit "bat": *baseball bat, mammalian bat*). However, apparent M-violation also can arise when category violations are confused with pragmatic anomalies, since only category mistakes, not pragmatic anomalies, are relevant to the construction of a predictability tree. Example (7) gives an illustration for an apparent M-violation that doesn't depend upon semantic or conceptual ambiguity, but can be resolved by the plausible assumption that the strange predication *?the tractor is sweet* represent a case of pragmatic anomaly, and not a true category mistake.

(7)

SWEET   DEFECTIVE

candy   gingerbread-work   tractor

A domain where it is not always simple (by intuitive means) to distinguish true category violations from pragmatic anomaly clusters around spatial predicates. In (8) two examples are presented, where the M-principle can be used as a diagnostic instrument in claiming that something else than category mistakes must be involved.

(8)   (a)   (b)

IS LONG   IS HEAVY   IS HIGH   IS LONG

candy   board   snowball   tower   fence   pencil

I guess that the strange predications *?the snowball is long* and *?the tower is long* should be analyzed as cases of pragmatic anomaly.

Both the phenomenon of category violations and pragmatic anomaly are intimately based upon the conceptual information associated with lexical items. As a consequence, both kinds of phenomena should find a proper place within Lexical Pragmatics. Since almost nothing is known about the proper treatment of pragmatic anomaly, this phenomenon seems to be an especially exiting challenge for Lexical Pragmatics.

A third problem that Lexical Pragmatics has to deal with concerns the phenomenon called *lexical blocking*. This phenomenon has been demonstrated by a number of examples where the appropriate use of a given expression formed by a relatively productive process is restricted by the existence of a more "lexicalized" alternative to this expression. One case in point is due to Householder (1971). The adjective *pale* can be combined with a great many color words: *pale green, pale blue, pale yellow.* However, the combination *pale red* is limited in a way that the other combinations are not. For some speakers *pale red* is simply anomalous, for others it picks up whatever part of the pale domain of red *pink has not preempted.* This suggests that the collocation of *pale* is fully or partially blocked by the lexical alternative *pink*.

The phenomenon of lexical blocking has been approached theoretically in different ways. In the context of language acquisition, for example, Clark (1990 and the references therein) has formulated a principle of contrast that, in its most succient form, goes as follows: "Every two forms contrast in meaning" (Clark 1990: 417). In the context of word formation Kiparsky (1982) has formulated a general condition which he calls Avoid Synonymy: "The output of a lexical rule may not be synonymous with an existing lexical item". While there is something right about these principles, they are still too strong, as it has been repeatedly argued. For example, Horn (1984) has observed that words like *fridge, icebox* and *refrigerator* can coexist within a single idiolect despite their referential equivalence; furthermore he notices the doublets *synonymy* and *synonymity* which seem to be perfect synonyms. To handle these and other cases, starting with McCawley (1978) another line of research has been formulated which rests on a reformulation of Grice's theory of conversational implicature (see, for example Atlas and Levinson 1981; Horn 1984; Levinson 1987; Matsumoto 1995). Lexical Pragmatics accounts for the phenomenon of lexical blocking in a closely related way.

2.2 Systematic polysemy

Systematic polysemy refers to the phenomenon that one lexical unit may be associated with a whole range of senses which are related to each other in a systematic way. The phenomenon has traditionally been thought intractable, and in fact it *is* intractable when considered as a problem

of Lexical Semantics in the traditional sense. In the following I want to suggest that a considerable part of the phenomenon can be accounted for by using the conception of Lexical Pragmatics: pairing (radical) semantic underspecification in the lexicon with an pragmatic mechanism of contextual enrichment.

Unfortunately, the term *systematic polysemy* indicates a whole family of empirically different subphenomena for which no unified terminology is available. Expressions as *open and closed polysemy* (Deane 1988), *conceptual specification* and *conceptual shift* (Bierwisch 1983), *sense modulation* and *sense change* (Cruse 1986), *constructional polysemy* and *sense extension* (Copstake and Briscoe 1995) may be convenient to indicate a rough outline of the classification. I hasten to add that such divisions should not be based only on stipulations reflecting some intuitively appealing ideas. Instead they should result, at least in part, (i) from general cognitive principles (making the human able to think flexibly) and (ii) from the peculiarities of the conceptual knowledge domain (contextual and encyclopedic knowledge). (For an elaboration of this position, cf. Deane 1988).

Early work on polysemy has concentrated itself on the analysis of the various senses of singular lexical units, relating these senses via certain semantic rules. From the structure of these rules certain conclusions about the structure of the (mental) lexicon may be derived. As an example for this kind of research I refer to seminal work of Caramazza & Grober (1977). These authors investigated 26 senses of the word *line*. Clustering and scaling analyses revealed five major groupings of these senses for which clear descriptions can be given. Distinguishing a core meaning level from the level of conceptually salient senses, Caramazza and Grober have proposed EXTENSION as the underlying abstract core meaning of *line* and they have presumed "instruction rules" of the form REALIZE X AS Y (where X and Y correspond to semantic representations) in order to produce the abstract meanings of the five clusters. Thereafter, the application of subsequent instructions produce the senses realized in specific contexts. As an example of how the instruction rules might work, Caramazza & Grober (1977) consider the derivation of the sense of *line* in *draw a line under the title of the book*. The "linguistic dictionary" correlates the sound part of *line* with its core meaning EXTENSION. Using the instruction REALIZE EXTENSION AS UNIDIMENSIONAL EXTENSION, an output corresponding to a certain cluster of concrete senses would be realized. Applying a further instruction, say REALIZE UNIDIMENSIONAL EXTENSION AS VISUAL PERCEPTIBLE, would help to isolate the intended surface sense.

Though investigations of that kind may be extremely instructive and interesting from a psycholinguistic point of view, they leave an important point out of consideration: the isolated investigation of singular lexical units closes one's eyes to certain regularities and restricting conditions that may arise alone from investigating the semantic relations between different but in some aspects similar lexical units.

> The lexicologist must show the relationships between all the senses of a lexical item (a task which conventional dictionaries have done well) and also the relationships of related senses of different lexical items (a task which recently linguists have begun doing), but few studies attempt to do both of these tasks." (Lehrer 1978: 95).

Following this methodological insight, Lehrer has investigated cooking words (Lehrer 1968), temperature words (Lehrer 1970), and sensory words for taste, smell, feel (Lehrer 1978), and she has suggested the following hypothesis:

> If there is a set of words that have semantic relationship in a semantic field (where such relationships
> are described in terms of synonymy, antonymy, hyponymy, etc., and if one or more items pattern in
> another semantic field, then the other items in the first field are available for extension to the second
> semantic field. Perceived similarity is not necessary. (Lehrer 1978: 96).

As a necessary condition on semantic transfer–the transfer of words with a meaning in one domain to another–this principle is certainly interesting. However, as Lehrer suggested herself, not each potential transfer of meaning that satisfies the principle is realized and becomes permanent in the usage of the speech community. As an example let us consider the English touch word *sharp* which transfers to taste, smell and sound. However, not each touch word related to *sharp* in the touch domain may transfer to the other domains. *Blunt*, for example, may transfer neither to taste nor to smell. Consequently, the quoted hypothesis cannot be the whole story. There must be some kind(s) of extra conditions which determine which kind of potential transfers of meaning remain in the language and which disappear.

Cast in Caramazza's & Grober's (1977) framework of instruction rules, it is the question of restrictions on rules that becomes important. Why is the application of an instruction rule possible in case of *sharp* but impossible in case of *blunt*? And what is the theoretic status of these restrictions? Are they reflecting only idiosyncratic properties of the lexicon? Or are they more systematic and perhaps related to properties of the conceptual domains under discussion? The complex of questions raised in this connection I call the *restriction problem* of polysemy.

Bierwisch (1983) has explicitly considered the restriction problem in connection with *institute*-type words, like *school, university, government, parliament*. For these nouns, Bierwisch has proposed semantic entries of the following general form:

(9) $\lambda x [PURPOSE(x,w) \wedge CC(w)]$

"PURPOSE" is a semantic prime, "x" a bound variable and "w" a free variable that refers to a conceptual complex to which the condition CC (a predicate constant) applies. It is this semantic conditions which discriminates school from university, parliament from government, and so on. In the case of *school*, CC is LEARNING_&_TEACHING (Bierwisch 1983: 86). That leads us to the following semantic entry for *school*:

(10) $\lambda x [PURPOSE(x,w) \wedge LEARNING\_\&\_TEACHING(w)]$

Bierwisch (1983: 88) stresses that the semantic entry for *school* is underspecified with regard to the level of conceptually salient senses. He proposes several functions or "templates" which can be seen as explicating Caramazza's & Grober's (1977) instruction rules in the domain under discussion (Bierwisch 1983: 87):

(11)   (a) $\lambda P\lambda x [INSTITUTION(x) \wedge P(x)]$
         (b) $\lambda P\lambda x [BUILDING(x) \wedge P(x)]$
         (c) $\lambda P\lambda x [PROCESS(x) \wedge P(x)]$

Applying these λ-expressions to the semantic entry (10) for *school*, we get the following representations identifying three conceptual variants for *school*, the institution-, building-, and process-reading:

(12)   (a) λx [PURPOSE(x,w) $\wedge$ LEARNING_&_TEACHING(w) $\wedge$ INSTIT(x)]
           (b) λx [PURPOSE(x,w) $\wedge$ LEARNING_&_TEACHING(w) $\wedge$ BUILDING(x)]
           (c) λx [PURPOSE(x,w) $\wedge$ LEARNING_&_TEACHING(w) $\wedge$ PROCESS(x)]

The unitary semantic entry of *school* thus comes to be interpreted as a kind of institution, a kind of building, or a kind of process. For some institution words, however, the range of interpretations is more restricted. Bierwisch compares *Regierung* (English *government*) and *Parlament* (*parliament*). Whereas the latter may have both the institution and the building interpretation (in German and English), the former lacks the building interpretation (cf. Bierwisch 1983: 83):

(13)   (a)   Das Parlament hat die Frage bereits entschieden.
                    The parliament has already come to a decision on the issue.
           (b)   Das Parlament liegt am Stadtrand.
                    The parliament is situated on the outskirts of the city.

(14)   (a)   Die Regierung hat die Frage bereits entschieden.
                    The government has already come to a decision on the issue.
           (b)   ?Die Regierung liegt am Stadtrand.
                    ?The government is situated on the outskirts of the city.

Here we are confronted with the restriction problem of polysemy. Bierwisch solves it by stipulating a corresponding constraint in the lexicon, giving *Regierung* a more restricted representation than *Parlament*:

(15)   (a)   Parlament $\rightsquigarrow$ λx [PURPOSE(x,w) $\wedge$ CC$_{parliament}$(w)]
           (b)   Regierung $\rightsquigarrow$ λx [PURPOSE(x,w) $\wedge$ INSTITUTION(x) $\wedge$ CC$_{government}$(w)]

Using (15b) as the semantic entry for *Regierung* excludes the templates (12b,c) from being applied, for applying them would result in sortal incorrectness. Generally speaking, Bierwisch's restrictions on interpretation are determined exclusively by the lexical system of grammar and certain conditions on sortal correctness. As a consequence, the anomaly of utterances like (14b) comes out as a semantic anomaly.

    The view to treat the restriction problem as a purely linguistic problem has been criticized by various authors (e.g. Meyer 1994, Taylor 1994, Blutner 1995). Taylor (1994), for example, argues that the different restrictions for *Parlament* and *Regierung* are

> closely linked to conceptual knowledge of what a parliament and a government actually are. A parliament is primarily a legislative institution, whose members are housed in a specially dedicated building; while a government is primarily a group of people with executive authority, but who do not necessarily or typically congregate in a special building to carry out their duties. (Taylor 1994: 16).

A proper way to check the view whether conceptual knowledge may restrict the range of polysemous variants might to consider the influence of "social-cultural" factors on the realization of polysemy. A nice illustration may be provided by considering the way people in Munich and Saarbruecken use these words. Contrary to the normal situation just mentioned, in Munich and Saarbruecken the government typically congregates in a special building that is well-known to the

people. Surprising only for advocates seeing the restrictions on polysemy as "rein sprachlich", it turns out that utterances like

(16)   ?Die Regierung liegt nicht weit vom Stadtzentrum.
        ?The government is situated not far from the center of the city.

are not deviant for most people in Munich and Saarbruecken.[3]

If this line of argumentation is correct, then it can be concluded that the restriction problem may be solved by finding a systematic explanation of pragmatic anomalies. The latter kind of problem has been called the problem of pragmatic anomaly in Section 2.1, and its solution has been stressed as one of the principal task for *Lexical Pragmatics*.

There is a second kind of consideration that may call a semantic treatment of the restriction problem into question. Consider Table 1, which gives a fairly adequate view of the range of possible interpretations for German *institute*-type words.

Institution Building Process	● ● ●	● ● x	● x ●	● x x	x ● x
	TYPE 1	TYPE 2	TYPE 3	TYPE 4	
	Schule, Universität, Theater, Oper, Kirche, Akademie	Museum, Parlament, Ministerium, Versicherung, Gefängnis, Hotel, Kaufhaus, Leihhaus, Gasthaus	Armee, Ehe	Regierung, Ausschuß	Palast, Geburtshaus, ...

Table 1:   Variants of interpretation for German *institute*-type words (●: the variant is realized in German; x: the variant isn't realized normally)

The table illustrates four types of German *institute*-words. Type 1 comprises the words with the less restricted interpretations, whereas type 4 comprises the words with the most restricted interpretation. If only words of these two types were available, a semantic treatment of the restrictions on interpretation would be comprehensible: Words of type 1 would get maximum underspecified semantic entries as indicated in (9), and word of type 4 would get the special restriction INSTITUTION(x) which force the institution reading only. However, the existence of type 3 words, and more importantly the existence of the very productive class of type 2 words

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[3]   In a similar vein, Taylor (1984: 16) argues that the contrast between German *Palast* and English *palace* seems to reflect facts of a "social-cultural" nature: "The institution reading of *palace* is surely sanctioned by the fact that speakers of (British) English are citizens of a still extant monarchy, while the absence of an institution reading of *Palast* follows from the fact that for German speakers a "palace", probably, is no more than just another kind of historical monument."

casts doubt on this view. Of course, we could stipulate a disjunctive condition, for example INSTITUTION(x)∨BUILDING to single out the process reading of type 2 words. However, the stipulation of such entries is highly implausible from a psycholinguistic point of view. The complexity of the conditions that have to be stipulated simply does not correspond to the cognitive complexity observed. Obviously, type 2 is much more productive than type 4, but the complexity of the corresponding entries would lead to the opposite prediction.

Lexical Pragmatics suggests that part of the restriction problem can be treated in terms of pragmatic restrictions. However, reducing the restriction problem to a problem of pragmatic anomaly may not be the whole story. Nunberg (1995: 118) lists a number of examples demonstrating that there are "language-specific constraints that seem to have no general pragmatic explanation". For example, in Russian the name of an organ can be used to denote a disease of that organ, whereas in German, French and English that isn't possible. Analogously, there seems to be no good reason why French-speakers should use the names of fruits to refer to the brandies made from them (*une prune, un poire*) whereas English-speakers do not.

Nunberg & Zaenen (1992) introduce the term "lexical licenses" for indicating a device that determines whether an usage of a word is part of the conventions of use or not. It is a challenge for Lexical Pragmatics to incorporate this idea into the basic mechanism of conceptual enrichment. In this connection it is important to stress that what is conventionalized is not the mechanism of contextual enrichment per se, but only the particular conceptual domains contextual enrichment is allowed to operate on.

In the previous subsection I discussed two further problems in order to demonstrate some challenges for Lexical Pragmatics: the fallacy of (pragmatic) compositionality and the problem of handling lexical blocking. Both problems have interesting consequences within the domain of systematic polysemy as well. Let's consider first lexical blocking. Take the well-known phenomenon of "conceptual grinding", whereby ordinary count nouns get a mass noun reading denoting the stuff the individual objects are made of, as in *Fish is on the table* or *Dog is all over the street*. There are several factors that determine whether "grinding" may apply, and, more specific, what kind of "grinding" (meat grinding, fur grinding, universe grinding, ...) may apply. Some of these factors have to do with the conceptual system, while others are language-dependent (cf. Nunberg & Zaenen 1992; Copstake and Briscoe 1995; Leßmöllmann 1996).

Lexical blocking is a language-dependent factor. It refers to the fact that the existence of a specialized item can block a general/regular process that would lead to the formation of an otherwise expected interpretation equivalent with it. For example, in English the specialized mass terms *pork, beef, wood* usually block the grinding mechanism in connection with the count nouns *pig, cow, tree*. This explains the contrasts given in (17).

(17)　　(a)　　I ate pork/?pig
　　　　(b)　　I like beef/?cow
　　　　(c)　　The table is made of wood/?tree

It is important to note that blocking is not absolute, but may be canceled under special contextual conditions. Nunberg & Zaenen (1992) consider the following example:

(18)　　Hindus are forbidden to eat cow/?beef

They argue that "what makes *beef* odd here is that the interdiction concerns the status of the animal as a whole, and not simply its meat. That is, Hindus are forbidden to eat beef only because

it is cow-stuff." (Nunberg & Zaenen 1992: 391). Examples of this kind strongly suggest that the blocking phenomenon is pragmatic in nature and may be explicable on the basis of Gricean principles. In section 3.1 I will present an explicit account of conversational implicature that aims to explain the blocking phenomenon.

Many researchers agree in seeing compositionality as a principle satisfied at the semantic level of representation but violated at the level of utterance interpretation. Respecting in principle the non-compositionality of utterance interpretation, most of these researchers seem to consider it as virtuous and advantageous to deviate from compositionality in a minimalist way. A typical approach which follows this path of virtue is the so-called coercion view. Generally, it can be characterized by four assumptions:
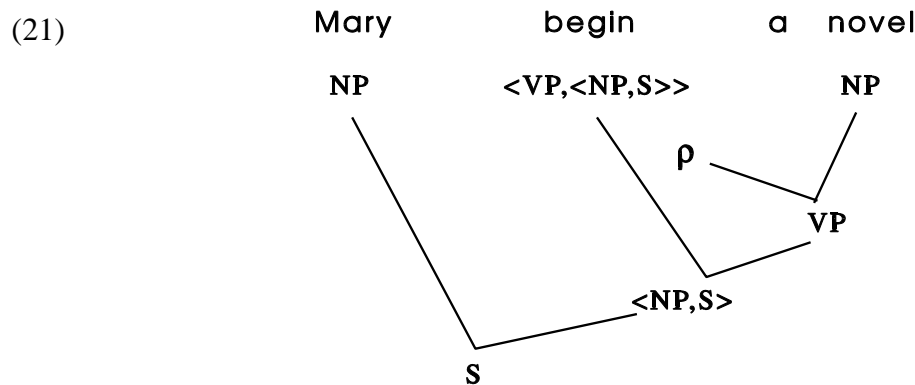
(19)   **The Coercion View**

   (a)   Every lexical unit determines a primary conceptual variant which can be grasped as its (literal) meaning.
   (b)   The combinatorial system of language determines how the lexical units are combined into larger units (phrases, sentences).
   (c)   There is a system of type and sortal restrictions which determines whether the resulting structures are well-formed.
   (d)   There is a generative device (called type/sort coercion) that tries to overcome type or sortal conflicts that may arise by strict application of the combinatorial system of language. The coercion device is triggered (only) by type or sort violations.

A widely known system that follows these assumptions has been presented by Pustejovsky (1989, 1991, 1993, 1995). Pustejovsky considers cases of "logical polysemy" as illustrated in (20) and argues that it would seem arbitrary to create separate word senses for a lexical item just because it can participate in distinct syntactic realizations.

(20)   (a)   Mary began to read a novel
       (b)   Mary began to write a novel
       (c)   Mary began a novel

The type for *begin* in (20a,b) is <VP,<NP,S>> and appears to be <NP,<NP,S>> in (20c). Pustejovsky suggests that it is sufficient to assume one basic type, namely <VP,<NP,S>>, and that well-formed construction (c) is the result of *coercing* the complement (the NP *a novel*) to another type. In general, type coercion is realized by "a semantic operation that converts an argument to the type which is expected by a function, where it would otherwise result in a type error" (Pustejovsky 1993: 83). Type coercion leads to the derivation tree shown in (21) for (20c).

(21)

Mary   begin   a   novel

NP   **<VP,<NP,S>>**   NP

ρ

VP

<NP,S>

S

Here ρ denotes a shifting-operator. In its most general form, this shifting operator is the *relate*-operator. It has the following form (when applied to the semantics of *a novel*):

(22) $\rho(A\ NOVEL) = \lambda x \exists P[P(A\ NOVEL)(x)]$

Using this operator the combinatorial derivation shown in (21) leads to the result (23) (after performing several conversions explained in Pustejovsky (1993: 86)). This expression leaves the relation between John and the novel underspecified (the existential quantifier should not be taken too literally).

(23) $BEGIN(\exists P[P(A\ NOVEL)(JOHN)])(JOHN)$

Pustejovsky uses such underspecified forms only for the interpretation of *contextually dependent* cases of (20c). Such a case can be exemplified by the following question-answer pair:

(24)   What about John's restoring?
           He began the novel.

For the usual *contextually independent* interpretation of (20c), where *write* or *read* stand for the intended relations, Pustejovsky (1989, 1991, 1993) suggests another mechanism. This mechanism doesn't make use of the general *relate*-operator (22). The idea is to assume a system of basic roles that characterize the semantics of nominals, very much like the argument structure of verbs. Pustejovsky calls this system—inspired by Aristotle—the *Qualia Structure*. For the present purposes, these roles can be defined as operators over the semantic content of the NP. Two of these operators, the telic role and the agentive role, are given in (25):

(25)   (a) $Q_T(A\ NOVEL) = \lambda x\ READ(A\ NOVEL)(x)$
       (a) $Q_A(A\ NOVEL) = \lambda x\ WRITE(A\ NOVEL)(x)$

In a certain sense, these operations may be seen as default realizations of the "underspecified" operator ρ and we may make use of the general doctrine to follow default options before applying stricter options, in case the former can be applied consistently. By applying the operators (25a,b) the expressions (26a,b) result; they are conform to the interpretations of (20a,b).

(26)   (a) BEGIN([READ(A NOVEL)(John)])(JOHN)
        (b) BEGIN([WRITE(A NOVEL)(John)])(JOHN)

Pustejovsky (1991) tries to illustrate the restrictiveness of this mechanism by considering the qualia structure of the noun *dictionary*, which lacks an appropriate event type associated with the telic role, and by considering the noun *rock*, which lacks an appropriate predicate associated with both the telic role and the agentive role. Consequently, the distribution presented in (27) falls out rather naturally.
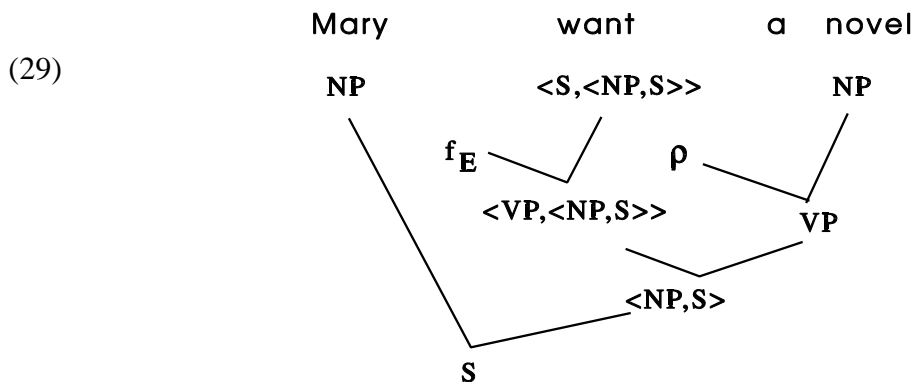
(27)   (a)   Mary began a dictionary (Agentive)
        (b)   ?? Mary began a dictionary (Telic)
        (c)   *Mary began a rock

However, the approach loses much of its initial fascination and becomes rather questionable when confronted with examples like (28):

(28)   (a)   John wants a novel
        (b)   John wants to have a novel
        (c)   Johns wants to read a novel
        (d)   John wants to write a novel

The interpretation of (28a) conforms with the interpretation of (28b). Its interpretation in the sense of (28c,d) is almost completely excluded.
    The combinatorial derivation for the interpretation of (28a) suggested by Pustejovsky (1989, 1993) is given in (29).

(29)

$$
\begin{array}{c}
\text{Mary} \qquad \text{want} \qquad \text{a novel} \\
\text{NP} \qquad \text{<S,<NP,S>>} \qquad \text{NP} \\
f_E \qquad \rho \\
\text{<VP,<NP,S>>} \qquad \text{VP} \\
\text{<NP,S>} \\
\text{S}
\end{array}
$$

Apart from the (independently motivated) Equi operator f_E, this derivation looks very similar to that for the interpretation of (20c) shown in (21). By applying the default options (25a,b), consequently, we would expect that (28a) has two preferred interpretations, which conform to the interpretations of (28c,d). However, this prediction clearly fails in the face of the empirical facts.
    Within Pustejovsky's coercion framework the only possibility to exclude this unwanted conclusion would be to stipulate a rather complicated system of semantic selectional restrictions connected with the matrix verb. However, the empirical data can also be taken for motivating another picture of the computational machinery, a picture exhibiting a much stronger view of non-

compositionality than that adopted by Pustejovsky.

The problem of the *restrictiveness* of the coercion mechanism is only one problem that is connected with Pustejovsky's account. Another one looks like a technical problem and is perhaps avoidable.[4] The problem is connected with the apparent inflation of shifting operations. Certainly we need the information provided by the telic and agentive role of nouns like *novel* that express two salient and highly context-independent properties of novels: that they are typically created by the process of writing and that their purpose is for reading. But why double these elements of stereotypic knowledge by stipulating extra shifting-operations that express exactly the same information?

The third point of criticism is connected with a substantial trait of natural language processing systems. Motivated by the *combinatorial explosion puzzle*, recent work on underspecification and semantic interpretation (e.g. Alshawi & Crouch 1992; van Deemter & Peters 1996) has stressed the monotonicity property of language processing. The idea is to eliminate non-monotonic operations involving loss of information and destructive operations of semantic representations and "to provide a model for semantic interpretation that is fully monotonic in both linguistic and contextual aspects of interpretation" (Alshawi & Crouch 1992: 32). The coercion view isn't in principle in conflict with this idea. However, the insufficient restrictiveness of the generative coercion mechanism and the stipulation of an additional checking mechanism diminishes the use of monotonic processing and makes it very difficult to generate the right things immediately.

Copstake & Briscoe (1995: 30 ff) point out other problems with Pustejovsky's analysis of "logical polysemy" stemming from the possibility of co-predication. Taken together, all of these problems may suggest that it is more promising to favor an alternative view. This view is more radically founded on underspecified representations and makes use of a straightforward mechanism of contextual enrichment.

(30)   **The Radical Underspecification View**

   (a)   Every lexical unit determines an underspecified representation (i.e. a representation that may contain, for example, place holders and restrictions for individual and relational concepts)
   (b)   The combinatorial system of language determines how lexical units are combined into larger units (phrases, sentences).
   (c)   There is a system of type and sortal restrictions which determines whether structures of a certain degree of (under)specification are well-formed.
   (d)   There is a mechanism of contextual enrichment (pragmatic strengthening based on contextual and encyclopedic knowledge).

The mechanism of contextual enrichment carries the main burden in explaining restrictions on interpretation. Because of its inferential character, this mechanism is structured non-compositionally. Inferential processing must be controlled by cost factors. Such cost factors may reflect non-representational means as salience and relevance. For example, it may be the "privileged" status of relations as writing and reading with regard to a concept like "novel" that gives the appropriate enrichments discussed in cases like (20c). And it may be the existence of a highly prominent stereotype (in our culture), namely the tendency that we want to *possess* things

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4   Pustejovsky (1995) seeks to avoid the problem by introducing a mechanism of qualia unification.

we are interested in, that favors the interpretation (28b) of the utterance (28a), and blocks the interpretations (28c,d). As we shell see in section 4, the idea of (radical) underspecification and contextual enrichment nicely fits in the picture of monotonic processing. Moreover, it is this feature of processing which crucially is involved in explaining pragmatic anomaly.

3. Lexical Pragmatics and the theory of conversational implicature

Based on the material presented in the last section the task of this section is mainly to evolve and propose a set of guidelines for realizing Lexical Pragmatics as a proper theoretic setting. As we shall see, these guidelines aim at a straightforward formulation of the notion of *conversational implicature* as a necessary prerequisite to develop Lexical Pragmatics. Before we are ready to speculate on what a proper treatment of conversational implicatures might be, let me first make some remarks concerning present accounts of conversational implicatures.

For Griceans, conversational implicatures are those non-truth-functional aspects of utterance interpretation which are conveyed by virtue of the assumption that the speaker and the hearer are obeying the *cooperative principle of conversation*, and, more specifically, various *conversational maxims*: *maxims of quantity, quality, relation* and *manner*[5].

While the notion of conversational implicature doesn't seem hard to grasp intuitively, it has proven difficult to define precisely. The generality of the cooperative principle and the conversational maxims makes it difficult to specify just which maxims are involved in particular implicatures. Essential concepts mentioned in the maxims are left undefined (what is *relevance, adequate evidence*, etc.). However, before we can start to "flesh out" something like the maxims, Grice's view of implicature raises even more basic questions. Are there just the maxims Grice mentioned, or might others be needed (as he suggested himself)? Or could the number of maxims be reduced? Sperber & Wilson (1986) are an extreme case in suggesting one only—the maxim

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[5]   Quality: Try to make your contribution one that is true
         1.   Do not say what you believe to be false.
         2.   Do not say that for which you lack adequate evidence.

    Quantity:
         1.   Make your contribution as informative as is required (for the current purposes of the exchange).
         2.   Do not make your contribution more informative than is required.

    Relation:
         Be relevant.

    Manner:
         1.   Avoid obscurity of expressions.
         2.   Avoid ambiguity.
         3.   Be brief (avoid unnecessary prolixity).
         4.   Be orderly.

    (Grice 1975: 45-46)

of relevance. And what is the rationale behind the cooperative principle and the maxims? Are they norms which speakers and hearers must *know* in order to communicate adequately (as Grice and most followers suggest)? Or are they generalizations about certain forms of inferential behavior which speakers and hearers need no more to know to communicate than they need to know the principles of digestion to digest (Sperber and Wilson's position, a position which is also adopted in the present account).

An important step in reducing and explicating the Gricean framework has been made by Atlas and Levinson (1981) and Horn (1984). Taking Quantity as starting point they distinguish between two principles, the Q-principle and the I-principle (termed R-principle by Horn 1984).[6] Simple but informal formulations of these principles are as follows:

(31)   *Q-principle*:   Say as much as you can (given I) (Horn 1984: 13).
                 Make your contribution as informative (strong) as possible (Matsumoto 1995: 23).
                 Do not provide a statement that is informationally weaker than your knowledge of the world allows, unless providing a stronger statement would contravene the I-principle (Levinson 1987: 401).

       I-principle: Say no more than you must (given Q) (Horn 1984: 13).
                 Say as little as necessary, i.e. produce the minimal linguistic information sufficient to achieve your communicational ends (bearing the Q-principle in mind) (Levinson 1987: 402)
                 Read as much into an utterance as is consistent with what you know about the world. (Levinson 1983: 146-147)

Obviously, the Q-principle corresponds to the first part of Grice's quantity maxim (*make your contribution as informative as required*), while it can be argued that the countervailing I-principle collects the second part of the quantity maxim (*do not make your contribution more informative than is required*), the maxim of relation and possibly all the manner maxims. As Horn (1984) seeks to demonstrate, the two principles can be seen as representing two competing forces, one force of *unification* minimizing the Speaker's effort (I-principle), and one force of *diversification* minimizing the Auditor's effort (Q-principle).

Conversational implicatures which are derivable essentially by appeal to the Q-principle are called Q-based implicatures. Standard examples are given in (32). As a general characteristics "this implicata limit *what is said* by shrinking the range of possible states of affairs associated with *what is said* to a smaller range of those states of affairs associated with *what is communicated*. *What is communicated* is MORE DEFINITE than *what is said*." (Atlas and Levinson 1981: 35).

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[6]   Sperber & Wilson's (1986) extreme position of reducing the maxims to just one-the maxim of relevance-isn't relevant in the present context. As argued by Levinson (1989), Sperber & Wilson try the "impossibility of reducing countervailing principles to one mega-principle". They concentrate on the phenomena of classic particularized Relevance implicatures illustrated by Grice, and they fail to account for the whole range of generalized conversational implicatures-the implicatures that are most important for lexical pragmatics.

(32) (a) Some of the boys are at the party
           -->   Not all of the boys are at the party

      (b) I'm happy
           -->   I'm happy but not ecstatic

                                    (*Scalar implicatures*, Gazdar 1979)

      (c) Rick is a philosopher or a poet
           -->   Rick is not both a philosopher and a poet
                        (*Scalar implicatures*, Grice 1968; Atlas and Levinson 1981)

      (d) Rick is a philosopher or a poet
           -->   Rick may (not) be a philosopher
           -->   Rick may (not) be a poet
                        (*Clausal implicatures*, Gazdar 1979; Atlas and Levinson 1981)

      (e) Black Bart caused the sheriff to die
           -->   Black Burt didn't kill the sheriff in a direct way
                                                  (McCawley 1978)

Conversational implicatures which are derivable essentially by appeal to the I-principle are called I-based implicatures. These implicatures can be generally characterized as "enriching *what is said* by reshaping the range of the possible states of affairs associated with *what is communicated. What is communicated* is MORE PRECISE than *what is said*." (Atlas and Levinson 1981: 36). Some standard examples are given in (33)

(33) (a) John turned the key and the engine started
           -->   John turned the key and then the engine started (temporal sequence);
           -->   John turned the key and therefore the engine started (causal connectedness)
                                    (*Conjunction buttressing*, Atlas & Levinson, 1981)

      (b) If you mow the lawn, I'll give you $5 -->
                   If and only if you move the lawn, will I give you $5
                                    (*Conditional perfection*, Geis & Zwicky, 1971)

      (c) John unpacked the picnic. The beer was warm. -->
                   The beer was part of the picnic.
                                    (*Bridging*, Clark & Haviland, 1977)

      (d) John said 'Hello' to the secretary and then he smiled -->
                   John said 'Hello' to the female secretary and then he smiled
                                    (*Inference to stereotype*, Atlas & Levinson 1981)

      (e) Harry and Sue bought a piano -->
           -->   They bought it together, not one each.
                                    (*Mirror maxim*, Harnish, 1976)

(f)   John came in and he sat down
             $John_1$ came in and he_1 sat down

(Preferred Co-reference)

3.1 Toward the proper treatment of conversational implicature

I guess that the proper treatment of conversational implicatures crucially depends on the proper formulation of the Q- and the I-principle. As I will demonstrate subsequently, such a formulation also has to account for the interplay of these two principles and their interaction with the two quality maxims.

Let me start with giving a more explicit formulation of the Q- and I-principle. In order to do that, we need a distinction between those aspects of an utterance that can be described in purely linguistic (conventional) terms and a description of the intended content of the utterance.[7] Let us abbreviate the linguistic part of an utterance by α where α includes phonological, syntactic and semantic information indicated by phon(α), syn(α), and sem(α), respectively. For the sake of explicitness, in the present paper we identify the intended content of an utterance (better: a possible interpretive hypotheses about the *content* of the utterance) with a (partial) state description and denote it with m.[8] Furthermore, we have the general idea that the semantic description of the utterance, sem(α), is a kind of underspecified representation determining a whole range of possible specifications or refinements one of which is the intended content $m_{intended}$. Let us express this idea by assuming a general constraint $\mathbb{C}$ defining the set of the possible pairs [sem(α),m]. In the simplest case sem(α) is a first-order formula, m a state description in the sense of Carnap (1947) and $\mathbb{C}$ is realized as Carnap's *holds in*: [sem(α),m]∈$\mathbb{C}$ iff sem(α) holds in m (usually written as m ⊨ sem(α)). Obviously, the set $\mathbb{C}$ of pairs is defined context-independently in this case. However, it also is possible and more appropriate for natural language applications to use $\mathbb{C}$s that are dependent on general world and discourse knowledge (see section 4). To reduce our notational apparatus we simply write [α,m]∈$\mathbb{C}$ instead of [sem(α),m]∈$\mathbb{C}$. Furthermore, we use the abbreviation $\mathbb{C}$(α) for the set {m: [α, m]∈$\mathbb{C}$}.

Let us assume now that the conversational maxims (or their explicanda) are conceptualized as further constraints on [sem(α), m]-pairs. This idea is not so surprising and can already be traced back to Grice (1989: 86):

> I have suggested a provisional account of a kind of nonconventional implicature, namely a conversational implicature; what is implicated is what is required that one assume a speaker to think in order to preserve the assumption that he is observing the Cooperative Principle (and perhaps some conversational maxims as well), if not at the level of what is said, at least at the level of what is implicated.

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[7]   See, for example, Bierwisch (1983) and Jackendoff (1983) for similiar distinctions. The important point of this distinction correlates with Grice's proposal in his William James Lectures to make a distinction within the "total signification" of a linguistic utterance between what a communicator has *said* (in a certain favored, and maybe to some degree artificial, sense of *said*), and what is a communicator has *meant* beyond it (what she has implicated, indicated, suggested).

[8]   *Mental model* and *conceptual representation* are more psychologically colored terms, *information state* is the favored term used in formal semantics.

The wording of the original formulation of the maxims seems to suggest that some concern primarily what is said—so to speak, they co ncern sem(α) (e.g. the maxims under "Manner"), while others concern primarily what is meant (e.g. "be relevant"). So it is certainly an appropriate picture to explicate the maxims as constraining [sem(α), m]-pairs. In order to capture notions as linguistic complexity and informativeness let us assume a global cost-function $\underline{c}(\alpha,m)$. This function combines the complexity compl(α) of the linguistic aspects with a cost function c(sem(α),m) expressing the cost to correlate the linguistic meaning sem(α) with the (partial) state description m. As a first approximation, for the latter cost we will assume them as inversely related to the (subjective) probability to associate some m with a given sem(α). That means, the more probable the realization of a certain (partial) state description m—given the range of possible models provided by sem(α)—the less surprising this m should be and the less it should cost to assume. For the sake of concreteness let us follow information theory in seeking for a numerical measure of the surprise associated with a given information state. Within information theory[9] *surprise* is expressed as negative logarithm of probability. Thus, information theory leads us to the following assumption: c(sem(α),m) = -$\log_2$ pr(m|sem(α)), where pr(m|sem(α)) is the conditional probability that an instance of the proposition sem(α) is an instance of the (partial) state description m in a given space of eventualities or possible worlds. Using a simple factorial analysis for the total cost function $\underline{c}(\alpha,m)$, we get the following ansatz:

(34) $\underline{c}(\alpha,m)$ = compl(α)$\cdot$c(sem(α),m), where compl(α) is a positive real number and c(sem(α),m) = -$\log_2$ pr(m|sem(α))

Now let me suggest the following first approximation to the Q- and the I-principle, respectively:

(35)   (a)   [α, m] satisfies the Q-principle iff there is no [α', m]$\in\mathbb{C}$ such that $\underline{c}(\alpha',m) < \underline{c}(\alpha,m)$

        (b)   [α, m] satisfies the I-principle iff there is no [α, m']$\in\mathbb{C}$ such that $\underline{c}(\alpha,m') < \underline{c}(\alpha,m)$.

In this formulation, the Q- and the I-principle constrain the set $\mathbb{C}$ of possible [sem(α),m]-pairs in two different ways. The I-principle constraints the set by selecting the *minimal surprising* state descriptions with respect to a given semantic content sem(α)[10] and the Q-principle constraints the set by blocking those state descriptions which can be grasped more economically by an alternative linguistic input α'. I should not miss to add that I have tried to formulate the Q- and the I-priciple from the perspective of language comprehension. Due to the very symmetric formulation of the principles, switching to the production perspective may be realized simply by switching Q and I.

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[9]   See, for example, McEliece (1977).

[10]   In section 4 a more refined cost function is developed which sometimes allows the selection of state descriptions that are not minimal surprising. However, these state descriptions can be characterized as the "better interpretations" because they are more unifying and, in some sense, more relevant than less surprising ones. This formulation brings us closer to the idea of Atlas and Levinson (1981) where the I-principle is intended as inference to "the best interpretation" (with "best interpretation" informally understood as interpretation which prefers coreferential readings of entities, making use of stereotypical relations between referents or events. However, it should be added that the way in which Atlas and Levinson (1981) try to formalize their Principle of Informativeness seems rather misleading.

Before we come to a more close inspection of the formulation (35) we have to introduce the notion of *common ground* in our theoretic framework and we have to investigate the effects of the *maxims of quality*. According to conventional wisdom, a common ground cg is an information state that contains all the propositions that are shared by several participants (for example, S and H). In more formal terms that means, that an information state cg (non-empty set of possible worlds) counts as common ground iff for each proposition ϕ it holds: cg $\models \phi \Leftrightarrow$ cg $\models K_S(\phi) \wedge K_H(\phi)$.[11]

Let us write cg$[\alpha]$ for the common ground that results from cg by updating it with α. Intuitively, the notion cg$[\alpha]$ aims to realize the strengthening of cg by adding an appropriate state description m of sem(α). There are two conditions that are suggested by this intuition: (i) each appropriate state description m is consistent with the common ground cg$[\alpha]$; and (ii) the informational content of the disjunction of the possible state descriptions m is contained in the common ground cg$[\alpha]$. I guess the first condition may be seen as related to the first maxim of quality (*Do not say what you believe is false*). And under certain conditions the second condition may be seen as related to the second maxim of quality (*Do not say what you lack evidence for*).

If that is right, then crucial consequences of the *maxims of quality* and their very special status within the overall theory[12] can be formulated in terms of conditions on updating the common ground. Let us use the abbreviation $\wp_Q(\alpha)$ for the set of possible state descriptions that are constraint both truth-conditionally (by means of $\mathbb{C}$) and by means of the Q-principle, i.e. $\wp_Q(\alpha) =_{def} \{$m: $[\alpha, m] \in \mathbb{C}$ and $[\alpha, m]$ satisfies Q-principle$\}$. Analogously we have the definition $\wp_I(\alpha) =_{def} \{$m: $[\alpha, m] \in \mathbb{C}$ and $[\alpha, m]$ satisfies I-principle$\}$. We simply write $\wp(\alpha)$ referring to the intersection of both conditions: $\wp(\alpha) =_{def} \wp_Q(\alpha) \cap \wp_I(\alpha)$. Using this notation we can state the two conditions related to the quality maxims as follows:

(36)   (a)   Quality 1: for each m $\in \wp(\alpha)$: m is consistent with cg$[\alpha]$

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[11]   Here K is the epistemic operator indexed to H and S, respectively. The epistemic logic I assume is Hintikka's (1962). As discussed by Zeevat (1995), this condition on common grounds is only a necessary one. Developing a more refined definition of *common ground*, Zeevat formulates also an update operation for common grounds. His conception, however, ignores the effects of conversational implicatures which also influence the common ground. The present account seeks to grasp these effects in a first and rather sketchy manner. Furthermore, it should be noticed that I use the notion of information state sometimes as referring to a set of possible worlds and sometimes as a representational structure (state description or disjunction of state descriptions).

[12]   "It is obvious that the observance of some of the maxims is a matter of less urgency than is the observance of others; a man who has expressed himself with undue prolixity would, in general, be open to milder comment than would a man who has said something he believes to be false. Indeed, it might be felt that the importance of at least the first maxim of Quality is such that it should not be included in a scheme of the kind I am constructing; other maxims come into operation only on the assumption that this maxim of Quality is satisfied." (Grice 1989: 27)
   "The maxims do not seem *to be coordinate* [my emphasis, R.B.]. The maxim of Quality, enjoining the provision of contributions which are genuine rather than spurious (truthful rather than mendacious), does not seem to be just one among a number of recipes for producing contributions; it seems rather to spell out the difference between something's being, and (strictly speaking) failing to be any kind of contribution at all. False information is not an inferior kind of information; it just is not information." (Grice 1989: 371)

(b)   Quality 2: $\wp(\alpha)$ is a non-empty set and $\bigvee\wp(\alpha)$ holds in $cg[\alpha]$[13]

Let us call an update *pragmatically licensed* iff it satisfies the conditions (36)(a,b). Now we call an utterance α *pragmatically anomalous* iff there is no pragmatically licensed update for it. Furthermore, a proposition ϕ is called a *conversational implicature* of α iff $cg[\alpha] \models \phi$ for each pragmatically licensed update. If this relationship holds for each common ground cg we may speak of generalized implicatures. Restricting the corresponding notions to specific classes of common grounds, we may define implicatures of the *particularized* variety.

Let us now consider some simple examples to see how the proposed mechanism is working. First consider Moore's paradox exemplified by the contrast between (37a) and (37b).

(37)   (a)   The cat is on the mat, but John doesn't know it.
        (b)   ?The cat is on the mat, but I don't know it.

The absurdity of (37b) falls out straight away as a case of pragmatic anomaly. The explanation immediately results from the formulation of the quality maxims in (36) and the conditions on common grounds. To see the crucial point, we have to show first that whenever α has a pragmatically licensed update $cg[\alpha]$, then the proposition $K_S(sem(\alpha))$ must be logically consistent. This assertion follows from the fact that the proposition $\bigvee\wp(\alpha)$ logically entails the proposition $sem(\alpha)$ and the fact that $\bigvee\wp(\alpha)$ is contained in the common ground $cg[\alpha]$. The latter directly results from the condition (36b). As a consequence $sem(\alpha)$ must be contained in $cg[\alpha]$. From our conditions on common grounds it follows that $K_S(sem(\alpha))$ must also be contained in $cg[\alpha]$ and therefore must be consistent.

Hintikka (1962) calls a proposition ϕ *epistemically indefensible* just in case the proposition $K_S\phi$ is inconsistent (with regard to his epistemic logic system). Using this notion, we can summarize our argumentation as follows: There can be no pragmatically licensed update for α in case the proposition $sem(\alpha)$ is epistemically indefensible. Utterances with epistemically indefensible $sem(\alpha)$ come out as *pragmatically anomalous* utterances according to the definition given above. It is a simple exercise to show that expressions of the form $\phi\wedge\neg K_S\phi$ are epistemically indefensible (i.e. $K_S(\phi\wedge\neg K_S\phi)$ is inconsistent). Consequently, the absurdity of (37b) comes out as a case of pragmatic anomaly. Other cases of epistemically indefensible statements are discussed by Karttunen (1972) and Gazdar (1979) and demonstrate the importance of this subcase of pragmatic anomalies.

Next, consider a simple example showing the generation of scalar and clausal implicatures. We consider the expression $\alpha = S_1$ *or* S_2 and the competing expression $\alpha' = S_1$ *and* S_2 and we assume that both expressions are of the same linguistic complexity: $compl(\alpha) = compl(\alpha')$. The derivation of the clausal and scalar implicatures of α is schematized in (38).

(38)   (a) α: $</S_1$ or $S_2/, p\vee q>)$
                 $\mathbb{C}(\alpha) = \{m_1, m_2, m_3\}$, where $m_1 = (p,q)$, $m_2 = (p,\neg q)$, $m_3 = (\neg p,q)\}$

        (b) α': $</S_1$ and $S_2/, p\wedge q>$
                 $\mathbb{C}(\alpha) =\{m_1\}$

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[13]   Identifying state descriptions with sets of possible worlds and $\wp(\alpha)$ with a family of sets of possible worlds, we can write this condition in the following way: $\cup\wp(\alpha) \supseteq cg[\alpha]$.

(c) $\wp_I(\alpha) = \{m_1, m_2, m_3\}$, since $\underline{c}(\alpha,m_1) = \underline{c}(\alpha,m_2) = \underline{c}(\alpha,m_3)$
        $\wp_Q(\alpha) = \{m_2, m_3\}$, since $\underline{c}(\alpha',m_1) < \underline{c}(\alpha,m_1)$
        $\wp(\alpha) = \wp_Q(\alpha) \cap \wp_I(\alpha) = \{m_2, m_3\}$

(d)   if cg[α] is a pragmatically licensed update, then[14]
        cg[α] $\models P_S p, P_S \neg p, P_S q, P_S \neg q, ...$ (Quality 1: clausal implicatures)
        cg[α] $\models K_S \neg(p \wedge q)$ (Quality 2: scalar implicature)

The derivation crucially rests on the assumption that the logically stronger expression S_1 *and* S_2 realizes the state description m_1 with higher probability than the logically weaker expression S_1 *or* S_2 and therefore can block this state description for the interpretation of S_1 *or* S_2.

   It is worth noting that the present approach to "scalar implicatures" has some advantages over the traditional approach based on Horn-scales (cf. Gazdar 1979). In an exercise in his logic book McCawley (1993: 324) points out that the derivation of the exclusive interpretation by means of Horn-scales breaks down as soon as we consider disjunctions having more than two arguments. Consider the connectives AND and OR where both are construed as n-place operators, AND yielding truth when all n arguments are true and OR yielding truth when at least one argument is true. Clearly, as in the binary case we get for any number of arguments <AND, OR> as a Horn-scale which predicts that (39a) implies (39b).

(39)   (a) $OR(S_1, S_2, ..., S_n)$
        (b) $NOT\ AND(S_1, S_2, ..., S_n)$

Unfortunately this prediction is too weak. The conjunction of (39a) and (39b) yields an formula which is true if any number of disjuncts smaller than n is true. This is correct for n = 2, but wrong for more arguments since a general account of the exclusive interpretation would have to predict the interpretation according to which it is true in case one (and only one) disjunct is. The utterance of (40) certainly does not invite you to take either one or two of the items mentioned.

(40)   With the salmon you can have fries, rice or a baked potato.

It is easy to check that the current account yields the right result. As an example consider the case of three disjuncts $\alpha = OR(S_1, S_2, S_3)$. The derivation of the exclusive interpretation runs as above, but now based on the following alternatives $\alpha'_0 = AND(S_1, S_2, S_3)$, $\alpha'_1 = AND(S_1, S_2)$, $\alpha'_2 = AND(S_1, S_3)$, $\alpha'_3 = AND(S_2, S_3)$. Again the central point is that the stronger expressions realizes the relevant state descriptions with higher probability than the weaker expressions thereby blocking them for the interpretation of OR(S1, S2, S3).

   It should be noted that we did not include the single disjuncts among the alternatives. This is motivated by the independent requirement (which any theory of Q-based implicatures has to make, but which is notoriously difficult to formalize) that the alternatives must contrast in view of an element which is qualitatively similar in a relevant sense. This is a general phenomenon. In

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[14] Beside the epistemic operator K we need its dual P $=_{def} \neg K \neg$. Hintikka reads $K_a\ \phi$ as *a knows that ϕ*. It is important to note that Hintikka is using the verb *know* in a technical sense without the usual factive presupposition. In this vein, $\neg K_a\ \phi$ can be read as *what a knows is not that p*, and $P_a\ \phi$ ($=_{def} \neg K_a \neg \phi$) can be read as *for all a knows, it is possible that p*.

spite of the entailment relation licensed by existential generalization a proper name as 'John' does not form a contrast class with a quantifier like 'some'. 'All' being a quantifier itself does.

This latter requirement also points the way out of the following puzzle. Semantically an existential quantifier can be seen as a generalized disjunction. Given a domain of n relevant individuals Exist x (Fx) can equally well be represented by $OR(Fc_1, ..., Fc_n)$. The explicit disjunction and the corresponding quantified sentence differ however in their pragmatic properties. Though we tend to infer from the disjunction that only one of the disjuncts is true, the corresponding quantified sentence only gives rise to a much weaker inference. Instead of being interpreted exhaustively (as *at most one* in case it is marked singular and as *at most two* in case it is marked plural) it only implicates that F does not hold of all individuals.

The crucial difference is the following. In the first case we are able to extract from the linguistic form a set of expression alternatives containing an element which is qualitatively similar, that is alternatives containing a conjunctive operator (OR_i for $2 \leq i \leq n$), in the second case only alternatives containing a quantified expression qualify.[15]

The next class of examples deals with the phenomenon of (partial) lexical blocking. Aronoff (1976) has shown that the existence of a simple lexical item can block the formation of an otherwise expected affixally derived form synonymous with it. In particular, the existence of a simple abstract nominal underlying a given *-ous* adjective blocks its nominalization with *-ity*:

(41)　(a)　curious - curiosity
　　　　　　tenacious - tenacity
　　　(b)　furious - *furiosity - fury
　　　　　　fallacious - *fallacity - fallacy

While Aronoff's formulation of blocking has been limited to derivational processes, Kiparsky (1982) notes that blocking may also extend to inflectional processes and he suggests a reformulation of Aronoff's blocking as a subcase of the *Elsewhere Condition* (Special rules block general rules in their shared domain). However, Kiparsky cites examples of *partial blocking* in order to show that this formulation is too strong. According to Kiparsky, partial blocking corresponds to the phenomenon that the special (less productive) affix occurs in some restricted meaning and the general (more productive) affix picks up the remaining meaning (consider examples like *refrigerant - refrigerator, informant - informer, contestant - contester*). To handle these and other cases Kiparsky (1982) formulates his general condition *Avoid Synonymy* cited above.

Working independent of the Aronoff-Kiparsky line, McCawley (1978) collects a number of further examples demonstrating the phenomenon of partial blocking outside the domain of derivational and inflectional processes. For example, he observes that the distribution of productive causatives (in English, Japanese, German, and other languages) is restricted by the existence of a corresponding lexical causative. Whereas lexical causatives (e.g. (42a)) tend to be restricted in their distribution to the stereotypic causative situation (direct, unmediated causation through physical action), productive (periphrastic) causatives tend to pick up more marked situations of mediated, indirect causation. For example, (42b) could have been used appropriately

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[15] The presented arguments showing the advantages of the present approach over the traditional approach based on Horn-scales are due to Rob van der Sandt. I thank him for allowing me to include his considerations in this article.

when Black Bart caused the sheriff's gun to backfire by stuffing it with cotton.

(42)   (a)   Black Bart killed the sheriff
        (b)   Black Bart caused the sheriff to die

Let me now demonstrate how the theory developed so far accounts for total blocking. Consider two expressions α and α' that are semantically equivalent, i.e. $\mathbb{C}(\alpha) = \mathbb{C}(\alpha')$. In case that the expression α is less complex linguistically than the expression α', i.e. compl$(\alpha) <$ compl(α'), it results (from (34)) that $\underline{c}(\alpha,m) < \underline{c}(\alpha',m)$ for each $m \in \mathbb{C}(\alpha)$. Consequently, we obtain $\wp_Q(\alpha') = \emptyset$. The latter implicates $\wp(\alpha') = \emptyset$ and we can conclude that there is no pragmatically licensed update for α'. In other words, the existence of a linguistically simpler (less marked) expression α equivalent to α' has totally blocked the more complex one. In case that the expressions α and α' are of comparable linguistic complexity, i.e. compl$(\alpha) =$ compl(α'), it results $\underline{c}(\alpha,m) = \underline{c}(\alpha',m)$ for each $m \in \mathbb{C}(\alpha)$. From this we get $\wp_Q(\alpha) = \wp_Q(\alpha') = \mathbb{C}(\alpha)$ and the expressions α and α' may coexist selecting the same state descriptions.

The latter result predicts that synonymous expressions are possible in case their linguistic complexities are the same. This prediction contradicts Kiparsky's (1982) principle *Avoid Synonymy*. However, as mentioned by Horn (1984), Kiparsky's principle seems to be too strong: pairs of expressions like *icebox - refrigerator, synonymy - synonymity, persuade from not ... - dissuade from ...* can coexist within a single idiolect despite their referential equivalence. Furthermore, Horn argues that in these cases the inherent complexities (as demonstrated by psycholinguistic evidence) are approximately of the same size. Though it is not completely clear which factors influence the inherent complexity of a linguistic expression, Horn's counterexamples suggest that our prediction is of the right kind.

The theory developed so far has been shown to predict that the more complex one of two semantically equivalent expressions must be blocked in *all* its interpretations. However, this prediction seems too strong and would conflict with examples like (42). There are several possibilities how to avoid this conclusion. First, we could stipulate that α and α' would not be semantically equivalent in such cases. Essentially we had to stipulate that the less complex expression applies semantically to stereotypic causative situation only, whereas the more complex expression is not restricted semantically in a related way but gets its restriction (to the indirect causative situation) by way of the Q-principle. Another way out of the dilemma of total blocking would accept the semantic equivalence of expressions like (42)(a,b) but would claim that the principles (35)(a,b) have default character only, with a preference to the Q-principle in case of conflicts. I think that both "solutions" are unsatisfactory for conceptual reasons and would not really explain the general tendency that "unmarked forms tend to be used for unmarked situations and marked forms for marked situations" (Horn 1984: 26)-a tendency that Horn (1984: 22) calls *"the division of pragmatic labor"*.

I think a better solution to this problem and a real explanation of *"the division of pragmatic labor"* has to start with a reformulation of the I- and Q-principle. The informal formulation of these principles as documented in (31) stresses a kind of partial circularity: in expressing the Q-principle reference to the I-principle has been made and vice versa. I think we have to live with this kind of partial circularity, but we have to give a precise formulation for it in order to see its consequences. The following is an attempt in this direction:

(43)   (a) $[\alpha, m]$ satisfies the Q-principle iff there is no $[\alpha', m] \in \mathbb{C}$ satisfying the I-principle
               such that $\underline{c}(\alpha',m) < \underline{c}(\alpha,m)$

(b) $[\alpha, m]$ satisfies the I-principle iff there is no $[\alpha, m'] \in \mathbb{C}$ satisfying the Q-principle such that $\underline{c}(\alpha, m') < \underline{c}(\alpha, m)$.

Let me now demonstrate how this explication of the Q- and I-principle explains Horn's "division of pragmatic labor". Let me keep the previous notations but giving them a slightly changed content by referring to the principles in (43) instead of those in (35). Consider again two expressions α and α' that are semantically equivalent, i.e. $\mathbb{C}(\alpha) = \mathbb{C}(\alpha')$ and let us assume furthermore that $\mathbb{C}(\alpha)$ and $\mathbb{C}(\alpha')$, respectively, contain exactly two elements m_{dir} and m_{indir} of different complexity, say $c(sem(\alpha), m_{dir}) = c(sem(\alpha'), m_{dir}) < c(sem(\alpha), m_{indir}) = c(sem(\alpha'), m_{indir})$. In case that the expression α is less complex linguistically than the expression α', i.e. $compl(\alpha) < compl(\alpha')$, we can calculate the set $\wp_Q(\alpha)$ if it assumed that there is no expression α'' that expresses the content of α less costly than α itself. The application of (43a) simply yields $\wp_Q(\alpha) = \{m_{dir}, m_{indir}\}$. With this result at hand we can apply (43b) and get $\wp_I(\alpha) = \{m_{dir}\}$ (since $\underline{c}(\alpha, m_{dir}) < \underline{c}(\alpha, m_{indir})$). Consequently, we obtain $\wp(\alpha) = \{m_{dir}\}$, i.e., the unmarked form selects the unmarked situation.

Now consider the marked expression α'. In this case the application of (43a) yields $\wp_Q(\alpha') = \{m_{indir}\}$. This result contrasts with the outcome of total blocking by using the earlier formulation of the Q-principle (35a). The difference, of course, is due to the fact that a pair $[\alpha', m_i]$ can be blocked only by a less complex pair $[\alpha, m_i]$ if the latter satisfies the I-principle; thus, only $[\alpha', m_{dir}]$ is blocked but not $[\alpha', m_{indir}]$. Furthermore, it is a simple exercise to show that $\wp_I(\alpha') = \{m_{dir}, m_{indir}\}$. Consequently, we obtain $\wp(\alpha') = \{m_{indir}\}$, i.e., the marked form selects the marked situation.

It is important to see that this explanation of the "division of pragmatic labor" doesn't rest on specific lexical stipulations or stipulations with regard to the costs, but is a general consequence of our formulation of the Q- and I-principle as presented in (43). According to an earlier formulation (e.g. Atlas & Levinson 1981; Horn 1984), the Q- and I- (R-)based principles often directly collide, and a general preference for the Q-principle has been stipulated.[16] The present reformulation of the Q- and I-principle avoids this stipulation and predicts that in the "conflicting cases" the Q-principle yields a more restricting output than the I-principle.

In the literature cases of Q- versus I-clashes have been discussed that seem to contradict this general pattern. Consider the material presented in (44).

(44)   "Q-principle" wins   "I-principle" wins
          I slept on a boat yesterday   I lost a book yesterday
          -->   The boat was not mine   -->   The book was mine
          I slept in a car yesterday   I broke a finger yesterday
          -->   The car was not mine   -->   The finger was mine

In the examples on the left hand side the Q-principle (earlier formulation) seems to win, but in the examples on the right hand side the facts suggest the I-principle (earlier formulation) as the

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16   "For the class of indefinite descriptions just discussed, the upshot seems to be that where there is an implicature at all (not all indefinite descriptions yield them) Quantity takes precedence over Informativeness unless the results contradict our background Conventions of Noncontroversiality." (Atlas & Levinson 1981: 50).

winner. But there is a crucial difference between both kinds of examples that may resolve the matter. While it is plausible to assume that I have only one boat or one car it is implausible to assume that I have only one book or one finger. Only in the former case the more precise genitive form (*I slept on my book; I slept in my car*) can block the corresponding interpretation. In treating the examples on the right hand side, we have to take into account also those interpretations where more than one book or one finger is involved; in this case there is no alternative expression that may block the ego-centered interpretations and they may be selected by means of the I-principle.

Summarizing, the present account of conversational implicature tries to give a real unification of the two competing "forces" expressed by the Q-principle and the I-principle, respectively. This approach contrasts with most recent theoretical accounts (e.g. Hirschberg 1991; Matsumoto 1995) that have focussed on single classes of conversational implicatures only. In contrast, the present account tries to address the integration of different kinds of conversational implicatures.

The main problems addressed in this paper are problems of Lexical Pragmatics. Before I come to a detailed treatment of some typical examples, I want to discuss five theses that are designed to characterize Lexical Pragmatics from a methodological point of view.

3.2 Five theses of Lexical Pragmatics

Lexical Pragmatics is a research field that tries to give a systematic and explanatory account of pragmatic phenomena that are intimately connected with the semantic underspecification of lexical items. The approach combines a compositional semantics with a general mechanism of conversational implicature. Starting off from a underspecified semantic representation a mechanism of information enrichment (abduction) is invoked to yield the appropriate specification with regard to the common ground.

In section 2 the range of Lexical Pragmatics has been characterized by several examples, and some general, typical problems have been discussed. The present subsection tries to sharpen the rather impressionistic picture that has been evolved and attempts to illuminate it from a methodological perspective.

I like the idea of trying to have a formal pragmatic account, and trying to pin down what exactly the contribution of context to the various domains is, say to the interpretation of adjectives, compounds, polysemy, and adverbs of quantification. In the present paper, I try to achieve this task based on the proposed machinery of conversational implicature. Owing to its generality, this theory seems promising for giving a systematic and explanatory account of the phenomena under discussion. Thesis 1 is an intimation of this goal.

Thesis 1: Lexical Pragmatics is systematic and explanatory

Besides generality, the main prerequisite for satisfying the goal is to have a rather explicit and formal theory of conversational implicature. It would be premature to claim we had satisfied this prerequisite. There are too many factors that should be stated more precisely before definite conclusions may be drawn. This factors concern, first of all, the representation of contextual and encyclopedic knowledge, next the details of the mechanism of information enrichment (symbolized by $\mathbb{C}$) and the details of the cost function.

In spite of this insufficiency, I claim that specific models can be developed within the given

framework that are more systematic and more explanatory than most alternative accounts mentioned in section 2.

Thesis 2: Lexical Pragmatics is non-compositional

In section 2 I argued against the principle of *pragmatic compositionality*. This principle says that it is possible to decompose the lexical items of an compound expression into conceptual components which combined together determine the conceptual interpretation of the whole expression. I have tried to make it clear that neither the influence of salience nor the phenomenon of lexical blocking can be approached in this way supposed the relevant data should not be described only by enumeration but in a more systematic way. The cumbersome has to do with the relational nature of salience, the existence of blocking effects, i.e. the influence of items that don't occur in the expression under discussion but nevertheless are important to determine its interpretation, and the whole idea of inferential reasoning.

The main doctrine of Lexical Pragmatics aims at the combination of a compositional semantics with a general mechanism of conversational implicature. It is the second part of this doctrine which accounts for the non-compositional character of Lexical Pragmatics. Almost everything in the formulation of conversational implicature has this non-compositional character: both the formulation of the Q-principle as well as the I-principle are "holistic" in addressing a whole range of alternative expressions; the conceptions of informativeness, surprise (measured in terms of conditional probability), and linguistic complexity are non-combinatorial and cannot be reduced to the corresponding properties of the parts of an expression; the mechanism of information enrichment ℂ as based on abductive inference (see section 4) is non-compositional.

Thesis 3: Lexical Pragmatics crucially involves non-representational means

Beside the question "Is Lexical Pragmatics compositional?" we have the related question "Is Lexical Pragmatics combinatorial?". The basic intuition underlying the combinatorial approach is that a cognitive activity is a process of manipulating representations, typically a sequential procedure consisting of discrete steps in accordance with definite criteria. The combinatorial approach contrasts with the connectionist approach (e.g. Rumelhart, McClelland & the PDP Research Group 1986) viewing the cognitive system as a network of units connected to each other through links of various strengths. The cognitive activity in these systems consists of a parallel spread of activation instead of the combinatorial sequential procedure.

Perhaps, there are arguments against the view that lexical pragmatic is combinatorial (cf. the discussion in Lahav (1993) with regard to the pragmatics of adjectives). However, I want to be cautious with regard to this issue, which is difficult to decide, and I will ask a different, but related question instead, namely the question of whether Lexical Pragmatics involves *non-representational means* of manipulating representations. The answer to this question, I claim, is clearly affirmative. Notions as salience, cue validity, diagnostic value, informativeness, surprise, relevance, frequency of use and so on, are candidates for such non-representational means. It would be a fallacy to assume according to a superficial reflection of the concept of *mental representation* that each quantity that is involved in determining our mental behavior must be mentally represented in order to become effective. Parameters like salience and cue validity need not be represented mentally in order to exist and to determine our cognitive activity. Instead, such parameters involve the *non-representational* dimension of our computational system.[17] With

regard to the theoretical framework of Lexical Pragmatics, the whole conception of *cost function* is interspersed with non-representational means. Problem for ordinary symbolism: We need a way to manipulate non-representational elements.

Thesis 4: Lexical Pragmatics crucially involves Economy principles

Economy principles are crucially involved in determining how non-representational parameters control the selection and suppression of representations. With Zipf (1949) as a forerunner we have to acknowledge two basic and competing forces, one force of unification, or Speaker's economy (I-principle), and the antithetical force of diversification, or Auditor's economy (Q-principle). The two opposing economies are in extreme conflict, and we have reformulated this conflict in a way that makes is possible to get definite outcomes with regard to the selection of interpretive hypotheses. However, I feel that there must be an independent justification of this kind of Economy principles, perhaps one derived from the general economics involved in defining connectionist network behavior (e.g. Rumelhart, McClelland & the PDP Research Group 1986).

Thesis 5: Lexical Pragmatics has to explain when conversational implicatures are cancelable and when not

Does cancelability constitute a necessary condition for conversational implicatures? Grice himself notes that cancelability doesn't hold for all kinds of conversational implicatures and mentions implicatures based on the Quality maxim as an exceptional case. Our discussion of Moore's paradox has demonstrated this case in the context of the present theory. Another type of conversational implicature constituting a counterexample against the claim that cancelability is necessary for conversational implicatures has been pointed out by Sadock (1978) in his seminal paper attacking the usefulness of the cancellation test for conversational implicature.

> Grice states explicitly that generalized conversational implicatures, those that have little to do with context, are cancelable. But is it not possible that some conversational implicatures are so little dependent on context that cancellation of them will result in something approaching invariable infelicity? In a paper in preparation, I argue that sentences of the form *almost P* only conversationally entail *not P*, contrary to the claim made by Karttunen and Peters (1979). The implicature is straightforwardly calculable and highly nondetachable but, unfortunately for my thesis, just about uncancelable. The sentence *Gertrude not only almost swam the English Channel, in fact she swam it* is, I admit, pretty strange. (Sadock 1978: 293)

Langendoen's (1978) analysis of reciprocals give rise to another kind of examples suggesting that cancelability is not necessary for conversational implicatures. Langendoen assumes that the reciprocal makes a uniform semantic contribution on every occasion of its use. This semantic contribution, he assumes, must be reflected by truth conditions included in every instance of use of the reciprocals. His analysis, then, rules out all but the weakest meaning he discusses, Weak Reciprocity, as the correct meaning of the reciprocal. However, as discussed in Dalrymple et al. (1994), Langendoen wouldn't deny that expressions like (45) appear to express Strong

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[17] Only under very special conditions it is possible to construct representational pendants to the non-representational elements, for example when we develop *intuitions* about our cognitive system or about our mental activity. In this sense, the representation of salience, relevance, and so one is possible. Usually, these representations are comparative in character and aren't quantitatively scaled.

Reciprocity.

(45)   Willow School's fifth-graders know each other

> An advocate of this position needs to explain why such examples appear to mean something stronger
> than Weak Reciprocity. Doing so will presumably involve appeal to pragmatic strengthening of the
> proposition that according to them is the sentence's literal meaning. One way such strengthening
> might occur is through conversational implicature. (Dalrymple et al. 1994: 76).

As observed by Dalrymple et al., the added strength of (45) over Weak Reciprocity does not seem to be cancelable, as evidenced by the inficility of the following canceling expression:

(46)   *Willow School's fifth-graders know each other, but the oldest one doesn't know the youngest.

Hirschberg (1991), Dalrymple et al. (1994) and others insist on taking cancelability as a hallmark of conversational implicature. They would reject an analysis of these examples in terms of conversational implicature. It seems, however, that this claim is not so much based on their treatment of conversational implicature but is rather a consequence of the old dictum *semantics is strong and pragmatics is weak*. The present account to conversational implicature suggests that the borderline between semantics and pragmatics (conversational implicature) cannot be drawn by the condition of cancelability. The discussion of blocking has shown that pragmatic anomaly isn't necessarily connected with inconsistency. In a similar vein, non-cancelable implicatures can arise in spite of the consistency of the corresponding canceling expressions. To take a typical example from the pragmatics of adjectives, (47a) would suggest (47b) as an conversational implicature.

(47)   (a)   This apple is sweet
         (b)   Its pulp is sweet
         (c)   ?This apple is sweet, but its pulp is not (perhaps, its peel is)

The corresponding canceling expression (47c), however, can be shown to be pragmatically anomalous for very general classes of common grounds (in spite of its semantic consistency). The theoretic treatment of such examples (see section 4) strongly suggests that a proper treatment of conversational implicatures may explain when an implicature is cancelable and when not. In this sense, the dictum *semantics is strong* (leading to non-cancelable inferences in each case) and *pragmatics is weak* (justifying cancelable inferences only) must be abandoned.[18] Instead, it is as an important task for Lexical Pragmatics to explain when conversational implicatures are cancelable and when not.

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[18] With regard to the first part of the dictum, seeing non-cancelability as necessary condition of entailment (or seeing cancelability as a sufficient condition of conversational implicature) I agree with Hirschberg (1991) and assume that it is right, at least if it is possible to discriminate cancelation from suspension (the *calling into question* of an asserted proposition), from contextual disambiguation, and from certain forms of speaking *loosely* (for careful discussion, cf. Hirschberg 1991: 28 ff).

4. Underspecification and abduction

In the former section, we have introduced the general constraint $\mathbb{C}$ defining the range of possible refinements of an underspecified semantic representation. However, we have only considered a rather provisional explication of this constraint. In this section we consider a realization of $\mathbb{C}$ that seems refined enough to analyze some specific phenomena of Lexical Pragmatics. The main idea is to consider $\mathbb{C}(\alpha)$ as the set of abductive variants that can be generated from $sem(\alpha)$ by means of a specific common ground that includes crucial aspects of world and discourse knowledge. It is shown how the incorporation of the abductive component in the general pragmatic framework solves some of the problems in connection with the pragmatics of adjectives and the phenomenon of sytematic polysemy.

4.1 Cost-based abduction: An extension of the basic mechanism

For the sake of explicitness, let us consider $sem(\alpha)$ as a conjunction of positive literals and let us propose weighted abduction (Stickel 1989, Hobbs et al. 1993) as general method to specify $sem(\alpha)$ by exploiting Horn clause knowledge bases. The use of weighted abduction allows us to pair the abduced variants m_i with its proof costs. The earlier measure of the global costs $\underline{c}(\alpha, m_i)$ (formula (34)) then should be replaced by an explicit account of those proof costs.

For the present purpose, we adopt Stickel's (1989) PROLOG-like inference system for generating abductive specifications and his mechanism for computing proof costs in a slightly simplified way. It is taken for granted that every literal in the initial formula is annotated with (non-negative) assumption costs c_i: $q_1^{c1}, ..., q_n^{cn}$. The knowledge base is assumed to provide formulas of the form $p_1^{\omega 1}, ... p_n^{\omega n} \rightarrow q$, where the literals p_j in the antecedent are annotated with weights ω_j.

There are four inference rules that constitute abductive proofs and determine the assignment of concrete proof costs (for details, see Stickel 1989):

<u>Resolution with a fact</u>: If a current goal clause contains a literal that is unifiable with a fact in the knowledge base, then this literal is marked as proved. (The retention of a proved literal allows its use in future factoring).

<u>Resolution with a rule</u>: Let the current goal clause be $...q'^c...$ and let there be an axiom $p_1^{\omega 1}, ... p_n^{\omega n} \rightarrow q$ in the knowledge base. If q' and q are unifiable with most general unifier σ, then the goal clause
$...p_1^{c \cdot \omega 1}\sigma, ... ,p_n^{c \cdot \omega n}\sigma, q'\sigma...$ can be derived (where $q'\sigma$ is marked as proved). Obviously, we assume that the new assumption costs can be calculated by multiplying the corresponding weight factors with the assumption cost c of the literal q' in the old goal clause.

<u>Making an assumption</u>: Any unproved literal in a goal clause can be marked as assumed.

<u>Factoring</u>: If a literal q occurs repeatedly in a proof, each time with different costs, the occurrences of q are unified and the lowest cost is taken.

An abductive proof is complete when all literals are either proved or assumed. The cost measure for an abductive proof is the sum of all costs of the axioms involved in the proof plus the costs for the assumption of literals that are not proved. For the following, we will assume that all axiom costs are zero. Furthermore, we aim to bring our system as close as possible to a Bayesian network. As Charniak & Shimony (1990) have shown, this can be achieved when costs are interpreted as negative logarithms of certain conditional probabilities and when, besides other
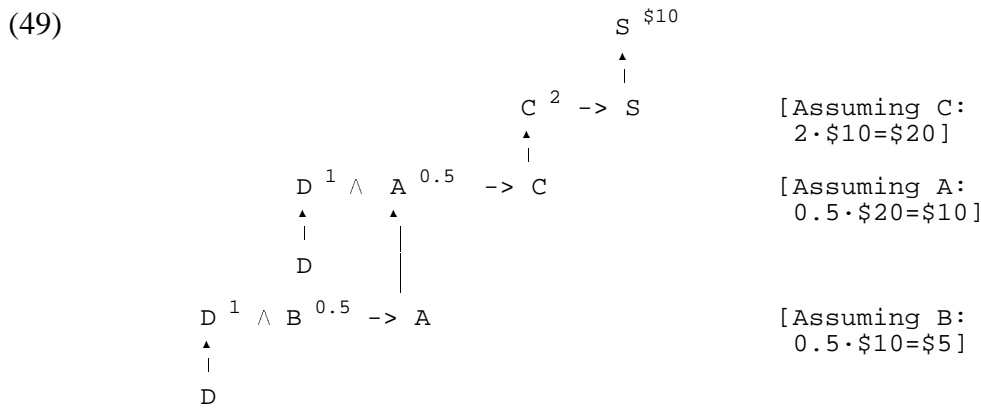
simplifying assumptions, no factoring occurs in the abductive proof. In the following, we will adopt the probabilistic interpretation of costs, but we will not refrain from using factoring. Factoring some literals obtained by backward chaining can be proven to be a very useful operation in natural language interpretation (cf. Stickel 1989).

It is now possible to incorporate the abductive component in the general pragmatic framework viewing natural language interpretation as inferences to pragmatically licensed updates. For simplicity's sake let me illustrate the incorporation of abduction by way of an elementary example. This gives me the opportunity to discuss some crucial differences between the present approach and the Hobbs-Stickel account where natural language interpretation is viewed as abductive inference to the *best explanation*. In order to simplify matters, I will exclude effects of blocking via the Q-principle. That means, I will assume that there are no expression alternatives α' that may block any interpretation of α.

Let us assume a knowledge base as presented in (48) and let us accept that all axiom costs are zero.

(48)   **cg:** $C^2 \to S$
                $D^1 \wedge A^{0.5} \to C$
                $D^1 \wedge B^{0.5} \to A$
                $\to D$

The diagram (49) shows the abductive inference graph in case (48) is taken as common ground and sem(α) = S is taken as the starting clause.

(49)

```
                                          S $10
                                          ▲
                                          ¦
                          C  2 ->  S            [Assuming C:
                          ▲                       2·$10=$20]
                          ¦
              D 1 ∧  A 0.5  -> C            [Assuming A:
              ▲         ▲                     0.5·$20=$10]
              ¦         ¦
              D         ¦
                        ¦
      D 1 ∧ B 0.5 -> A                      [Assuming B:
      ▲                                       0.5·$10=$5]
      ¦
      D
```

The resulting set of abductive variants is presented in (50a) and the costs associated with these variants are given in (50b).

(50)   (a) $\mathbb{C}(S)$ = {A, B, C}
        (b) $\underline{c}(S, A)$ = \$10, $\underline{c}(S, B)$ = \$5, $\underline{c}(S, C)$ = \$20
        (c) $\wp(S)$ = {B}
        (d)   cg[S] = cg $\cup$ {B}

Since we have assumed that there are no blocking alternatives, the condition (43a) becomes vacuous and the set $\wp(S)$ is the set of cost-minimal variants, given in (50c). Since the expression B is consistent with cg, a pragmatically licensed update exists (satisfying the Quality conditions (36a,b)). It is given in (50d).

The Hobbs-Stickel account is looking for *minimal explanations*, that means it selects the cost-
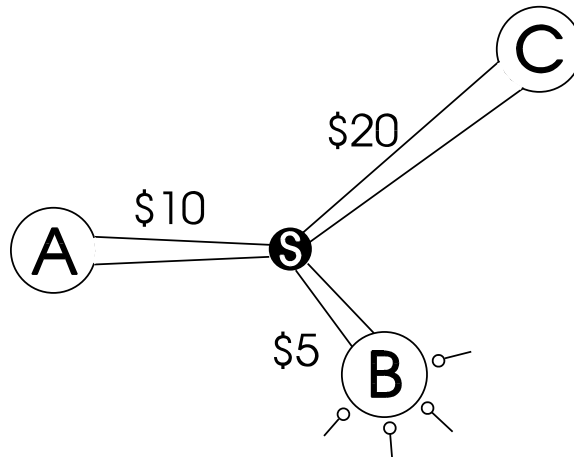
minimal variants from the set of the *consistent* abductive variants. This contrasts with the former view which first selects the cost-minimal variants from the set of all abductive variants and then checks them with regard to consistency. However, in the present case this makes no difference, since the minimal variant B is consistent with cg, and consequently it is at the same time the minimal explanation of S. The updating of cg by the minimal explanation gives the same result as already presented in (50d).

Now consider the common ground cg' given in (51), which is cg augmented by the clause B -> (i.e. by ¬B).

(51)   **cg':** $C^2 \to S$
$\quad\quad\quad D^1 \land A^{0.5} \to C$
$\quad\quad\quad D^1 \land B^{0.5} \to A$
$\quad\quad\quad \to D$
$\quad\quad\quad B \to$

In this case we have the same abductive inference graph as shown before in (49), and we get the same abductive variants and the same costs associated with them. But now the cost-minimal variant B is inconsistent with cg'. From this fact it follows that there is no pragmatically licensed update for S with regard to cg'. In other words, S becomes pragmatically anomalous with regard to cg'.

(52)

Now look at the Hobbs-Stickel account. It gives A as the minimal explanation (cf. the diagram (52)). This leads to the postulation of cg'∪{A} as update. Consequently, there is an important difference between the Hobbs-Stickel account and the present one. On the Hobbs-Stickel view there is an update in each case when the starting clause sem(α) is consistent with cg. The present account, on the other hand, yields a much more restricted notion of update. There is a pragmatically licensed update only in case one of the cost-minimal abduced variants is consistent with cg. If all cost-minimal variants are inconsistent with cg they can be seen as "blocking" any interpretation of the starting clause. As shown in the next section, this device is appropriate to capture cases of pragmatic anomalies in natural language interpretation.

From a computational point of view, the present approach looks well if it is assumed that the abductive machine generates the abductive variants in the order of its (estimated) costs. In this case, we have to assume simply that the abductive system stops if it has completed its first

abductive proof. The result is then given to the consistency checker. In case the result is consistent, the system has found an interpretation. If not, the system may tell that it doesn't understand⸺the only interpretation it can find is a faulty one. Perhaps, there is a mechanism of accommodating the knowledge base that restores interpretability after all, but even then there is no possibility to access other variants than the cost-minimal ones.

The overall architecture of the Hobbs-Stickel account designates to access non-minimal variants when the minimal ones do not provide explanations. This feature makes processing less efficient, and it makes it difficult to discriminate between "good" and "bad" interpretations. In contrast, the present view of interpretation connects an efficient processing architecture with the possibility to give an explanation of pragmatic anomalies. Straightforwardly, this way of realizing efficient processing is conform to realizing the monotonicity property of language processing (e.g. Alshawi & Crouch 1992; cf. section 2.2), and it is this idea which helps us to explain pragmatic anomaly.

There is yet another important feature distinguishing the present account from the Hobbs-Stickel approach, the possibility of having non-cancelable implicatures. Let us call a conversational implicature ϕ of an utterance α in cg *contextually cancelable* iff there is a strengthening cg' of cg such that α is interpretable in cg' but ϕ is not longer a conversational implicature of α in cg'.

Obviously, the entailment $cg \cup \{sem(\alpha)\} \models \phi$ excludes the contextual cancelability of ϕ in cg. But what when we exclude simple entailments? Are conversational implicatures always cancelable? Is cancelability a necessary feature of conversational implicatures? According to the standard view the answer is yes.

With regard to our earlier example, B is a conversational implicature of S in cg and it is not entailed by $cg \cup \{S\}$. However, there is no (obvious) strengthening of cg that leaves the utterance α interpretable and defeats the proposition B. For example, if we strengthen cg by adding ¬B (as in (51)) S will be pragmatically anomalous in the new context. This shows that on the current account cancelability is not a necessary feature of conversational implicature; some implicatures may be non-cancelable. The Hobbs-Stickel approach, on the other hand, is in agreement with the standard view (resting on the highly defeasible notion of minimal explanation).

The usefulness of cancellation as a test for conversational implicature has been challenged in connection with the thesis 5 of section 3.2. The present account to conversational implicature suggests that a proper treatment of conversational implicature may explain when an implicature is cancelable and when not. The next subsection provides an analysis of the pragmatics of adjectives that gives further evidence for this view.

4.2 Abduction and the pragmatics of adjectives

One part of speech is especially suited for demonstrating the phenomenon of semantic underspecification: the adjective. In section 2.1 we considered the *free variable view* as an especially promising account of treating the meaning of adjectives. It had been stressed that the specification of free variables is necessary for a full interpretation of an utterance. I will now demonstrate how the current theory yields an appropriate mechanism of (contextual) specification by applying it to the kind of examples discussed by Quine (1960) and Lahav (1993) (cf. section 2.1).

(53)　(a)　The apple is red
　　　(b)　Its peel is red
　　　(c)　Its pulp is red
　　　(d)　APPLE(d)∧PART(d,x)∧COLOR(x,u)∧u=red
　　　(e)　APPLE(d)∧PART(d,x)∧PEEL(x)∧COLOR(x,u)∧u=red

My claim is that (53b) but not (53c) can be construed as a conversational implicature of (53a). Input of the analysis is the underspecified semantic representation given in (53d).[19] One of the abductive specifications of this semantic input specifies x as the peel part of the apple (see (53e)). For the calculation of the corresponding costs we start with assumption costs as given in the first line of (54). Note that we take the assumption cost for the "slots" PART(d,x) and COLOR(x,u) as negligible with regard to the costs of the more "specific" elements of the representation[20]. This contrasts with corresponding stipulations by Hobbs et al. (1993) but it agrees with the general picture that specificity is the primary determinator of the assumption costs. Furthermore, we refer to axioms of the form $q <- p_1^{\omega 1} \wedge p_2^{\omega 2}$, where the weights ω_1, ω_2 are monotonic functions of certain conditional probabilities: $\omega_i \propto prob(q|p_i)$ (cf. Hobbs et al. 1993). If the p_i are necessary conditions for q, then we have $\omega_1 + \omega_2 = 1$, and the weights ω_i can be interpreted to estimate the saliences of the feature complexes p_i with regard to p.

(54)

$$\text{APPLE(d)}^{\$1} \quad \wedge \quad \text{PART(d,x)}^{\$0} \qquad \wedge \qquad \text{COLOR(x,u)}^{\$0} \quad \wedge \quad \text{u=red}^{\$1}$$

$$\text{APPLE(d)} \quad <- \quad \text{PART(d,x)}^{\alpha\gamma} \wedge \text{PEEL(x)}^{\alpha(1-\gamma)} \wedge \text{etc}^{1-\alpha}$$

$$\text{PEEL(x)} \quad <- \quad \text{COLOR(x,u)}^{\beta} \wedge \text{etc}^{1-\beta}$$

Red Peel*-Variant

total costs: $ 2-\alpha\gamma-\alpha\beta(1-\gamma) \approx \$ 2-\alpha\beta$

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[19]　Perhaps it is more plausible to take simply APPLE(d)∧COLOR(d,u)∧u=red as the "underspecified" input. Then, in a first abductive step, the representation (53d) can be derived by means of the (default) axiom COLOR(d,u) ⟨- PART(d,x)∧COLOR(x,u)∧etc. Substantially, this variant of analysis doesn't change much.

[20]　As assumption cost of these units I have stipulated $1. You may see this stipulation as fixing the $-unit.

The diagram (54) shows that part of the abductive inference graph that is relevant for abducing the *red peel*-interpretation (53e) starting with (53d). The axiom in the second line of (54) can be seen as decomposing the concept of an apple into a peel part (salience α) and a residue, where the peel part is taken as a kind of slot-filler structure; γ may be interpreted as the salience of the part-relation for apples ($\gamma \ll 1$). In a similar vein, β may be interpreted as the salience of the color slot for the peels of apples.

Given the assumption that the color of the peel is more diagnostic for classifying apples than the color of other apple parts, for example, the color of the pulp, the *red peel*-specification is arguably the cost minimal specification. To make this point explicit, let us consider the calculation performed in (54). It crucially rests on the factoring operation which unifies the part- and color-slots of the predicate complex of the utterance with the corresponding slots that emerge while conceptually decomposing the subject term of the utterance. The *red peel*-specification comes out as the cost minimal specification if its total costs are smaller than the costs of any other specification. This corresponds to the condition $\alpha\beta > \alpha'\beta'$, where α' and β' are the parameters for any other apple part (e.g. for the pulp). Suppose that, as is rather plausible, this condition is satisfied, then the I-principle selects the *red peel*-interpretation and blocks the *red pulp*-interpretation. Consequently, we get (53b) as an conversational implicature, but not (53c). Note that the non-existence of the implicature (53c) doesn't *forbid* a discourse as (55) but rather *licenses* it.

(55)   This apple is red. But not only its peel is red. Its pulp also is red.

In the case of (56a) analogous considerations give (56b) but not (56c) as a conversational implicature.

(56)   (a)   The apple is sweet
        (b)   Its pulp is sweet
        (c)   Its peel is sweet

It should be added that the present account evaluates utterances as (57) as pragmatically anomalous (assuming the former axioms and weights)

(57)   ?This apple is red, but its peel is not (perhaps, its pulp is)

This qualifies implicatures like (53b) and (56b) as non-cancelable (under normal circumstances—neglecting the possibility of genetic engineering).
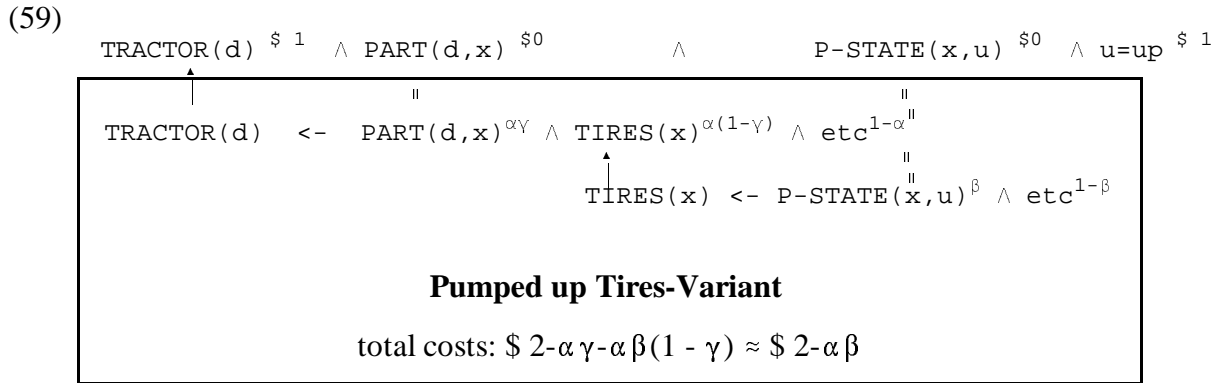
Finally consider the contrast between (58a) and (58b):

(58)   (a)   ?The tractor is pumped up
        (b)   The tires of the tractor are pumped up
        (c)   ?The coachwork of the tractor is pumped up
        (d)   TRACTOR(d)∧PART(d,x)∧PRESSURE(x,u)∧u=pumped up
        (e)   TRACTOR(d)∧PART(d,x)∧TIRES(x)∧P-STATE(x,u)∧u=pumped up
        (f)   TRACTOR(d)∧PART(d,x)∧MOTOR(x)∧P-STATE(x,u)∧u=pumped up

The present account predicts (58a) as pragmatically anomalous. This prediction results from the fact that those parts of tractors that may be pumped on (the tires) are only marginally diagnostic
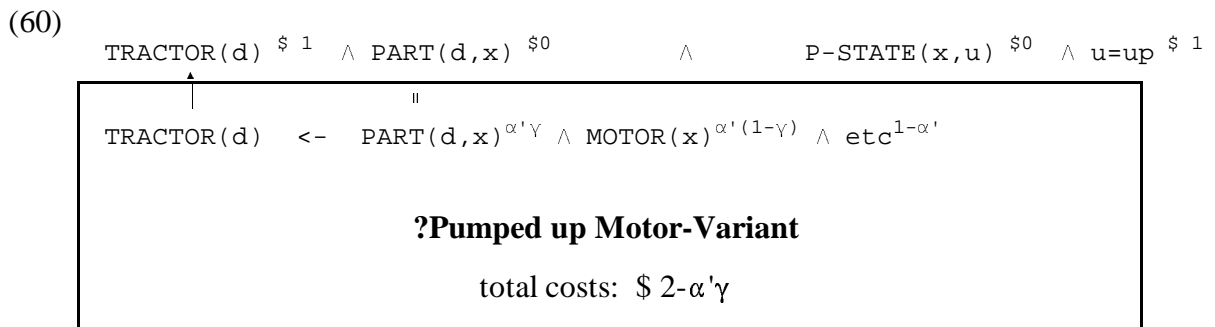
for identifying tractors and therefore the corresponding interpretation (58b) can be blocked by specifications that refer to more salient parts, for example as shown in (58c). However, the latter specifications suffer from sort conflicts and therefore violate the condition (36).

To make the argument explicit, let us start with (58d) as underspecified representation of (58a), and let us compare the cost for calculating the two enrichments (58e) and (58f) (related to (58b) and (58c)). The diagram (59) presents the corresponding abductive inference graph that is relevant for abducing the *pumped up tires*-interpretation (58e).

(59)

$$\text{TRACTOR(d)}^{\$1} \land \text{PART(d,x)}^{\$0} \qquad \land \qquad \text{P-STATE(x,u)}^{\$0} \land u=up^{\$1}$$

$$\text{TRACTOR(d)} \;\;\texttt{<-}\;\; \text{PART(d,x)}^{\alpha\gamma} \land \text{TIRES(x)}^{\alpha(1-\gamma)} \land etc^{1-\alpha}$$

$$\text{TIRES(x)} \;\texttt{<-}\; \text{P-STATE(x,u)}^{\beta} \land etc^{1-\beta}$$

Pumped up Tires-Variant

total costs: $\$\,2 - \alpha\gamma - \alpha\beta(1-\gamma) \approx \$\,2 - \alpha\beta$

Note that this graph has practically the same structure as that given in (54). In the present case the factoring operation unifies the part and pressure-state slots arising from the predicate complex of the utterance (58a) with those that emerge while conceptually decomposing the subject term *the tractor*.

Next let us consider an abductive inference that corresponds to an enrichment referring to more salient parts as the tires, say the motor of the tractor as it is given in (60).

(60)

$$\text{TRACTOR(d)}^{\$1} \land \text{PART(d,x)}^{\$0} \qquad \land \qquad \text{P-STATE(x,u)}^{\$0} \land u=up^{\$1}$$

$$\text{TRACTOR(d)} \;\;\texttt{<-}\;\; \text{PART(d,x)}^{\alpha'\gamma} \land \text{MOTOR(x)}^{\alpha'(1-\gamma)} \land etc^{1-\alpha'}$$

?Pumped up Motor-Variant

total costs: $\$\,2 - \alpha'\gamma$

In this case only the part slot of the initial representation (first line of (60)) can be unified with a corresponding slot arising from the conceptual decomposition of the subject term. The pressure-state slot, on the other hand, cannot be used in factoring because the composition of concept of a tractor's motor doesn't involve a pressure-state slot in the intended sense. The cost calculations for the two enrichments (58e) and (58f) are as given in (59) and (60). It is obvious that the *pumped up motor*-variant wins over the *pumped up tires*-variant when the condition $\alpha'\gamma > \alpha\beta$ holds, i.e. $\alpha'/\alpha > \beta/\gamma$. Here α may be interpreted as the salience of the tire parts of the tractor, α' as the salience of the motor part of the tractor, β as the salience of the p(ressure)-state slot for the tires of the tractor, and γ as the salience of the part slot for tractors. Suppose that the

condition $\alpha'/\alpha > \beta/\gamma$ is satisfied, as it is rather plausible if we assume that the saliences for the different slots are approximately the same, but the saliences of the various fillers of a slot may vary considerably, for example, it appears that the salience of the motor as part of the tractor is much higher than the salience of the tires. Then the I-principle selects the *pumped up motor*-variant and blocks the *pumped up tires*-interpretation. Intuitively, the winning variant (*pumped up motor*) suffers from sort conflicts. I refrain from expressing this formally by a corresponding axiom. The existence of this sort conflict leads to a violation of the Quality 1 condition (with regard to common grounds that satisfy plausible common sense assumptions). Consequently, under plausible context conditions, there is no pragmatically licensed update for an utterance of (58a), and it comes out as pragmatically anomalous.

Let us consider an utterance like (61)

(61)   The bicycle is pumped up

This utterance does not have the highly marked status of (58a). The present account explains this by making the plausible assumption that the tires of bicycles are one of the most salient parts of bicycles. Consequently, in this case the *pumped up tires*-interpretation comes out as a cost minimal one, and it doesn`t suffer from sort conflict.

Needless to say the present considerations regarding the amounts of the parameters have to be supported by careful empirical studies. However, as a first step considerations of this kind may be valuable. They may demonstrate at least which kinds of influence are conceivable, and this again may be tested empirically. Perhaps some people would reject that pragmatics can do any explanatory job. Especially, they would reject the idea that pragmatic principles can explain, at least in part, the sytematicity of our competence to understand natural language expressions.

What about the "systematicity" of the proposed solution? This question adresses a number of phenomena in the domain of language acquisition. We have to ask, for instance, why very young children interpret sentences as (53a) and (56a) in the intended way immediately, without effort, and without being trained. And we have to ask why already very young children may see the contrast between (61) and (58a), although they never were trained with negative examples as (58a). Perhaps these questions don't address the kind of systematicity Fodor & Pylyshyn (1988) had in mind. Nevertheless, these phenomena are real and address systematic aspects of comprehension which need to be explained. The present view sees the probabilistic aspects of conceptual knowledge as the crucial point for such an explanation. The probabilistic aspects of conceptual knowledge determines not only aspects of language interpretation, but is also decisive for the way we identify, classify, and regulate reality, and is crucial for the way we draw inferences and accommodate new knowledge. There a deep relationships between these areas (e.g. Rosch & Lloyd 1978, Lehrer & Kitty 1992), establishing the kind of systematicity I have in mind.

4.3 Abduction and systematic polysemy

In section 2.2 I formulated the restriction problem of polysemy and I illustrated it by considering words of the institute type. In this section I will demonstrate how the ideas put forward in section 4.1 may provide a mechanism for generating the range of the conceptually salient senses of *institute*-type words—a mechanism that solves the restriction problem of polysemy. Adopting the radical underspecification view (section 2.2), I will show how the extended mechanism of conversational implicature is capable of giving a principled account.

The general idea that leads us to underspecified representations in case of *institute*-type words is as follows. Suppose there are certain entities which can be understood as conceptual frames or schemata and can be classified according to the variety of *institute*-types (as government, school, parliament etc.). Suppose further that these entities can be considered under different perspectives. These perspectives are assumed to provide more concrete realizations of the rather abstract concept of a certain *institute*-type e, perhaps as building, process, or institution proper. However, the particular perspective adopted and, consequently, the concrete realization of the intended *institute*-type remains open.

In a first approximation, the semantic representation of *institute*-type nominals may look like (62a); examples are (62b,c).

(62)   (a) $\lambda x \exists e[\text{INSTITUTE-TYPE}(e) \wedge \text{REALIZE}(e,x)]$
         (b) $\lambda x \exists e[\text{SCHOOL}(e) \wedge \text{REALIZE}(e,x)]$
         (c) $\lambda x \exists e[\text{GOVERNMENT}(e) \wedge \text{REALIZE}(e,x)]$

Note, that the specification of x as building, process, or institution proper has not been specified in the lexicon. That means that the variety of different interpretations has not been treated by stipulating semantic ambiguities. Note furthermore that the different *restrictions* on interpretative variants, for example for *school* and *government*, are no longer treated semantically. As a consequence, the restriction problem of polysemy has to be analyzed pragmatically.

In the previous subsection we used an axiom of the form $q <- p_1^{\omega 1} \wedge p_2^{\omega 2}$ to abduce, for instance, the existence of peel parts of an assumed apple from the existence of the apple. In a similar vein, we now use axioms of this form in order to abduce, for instance, the existence of a building and/or an institution realization from the existence of an entity of type *school* or *government*. Weighted abduction rules that provide the corresponding decompositions are presented in (63a,b) for the case of *school*:

(63)   (a) $\text{SCHOOL}(e) <- \text{REALIZE}(e,x)^{\alpha\gamma} \wedge \text{BUILD}(x)^{\alpha(1-\gamma)} \wedge \text{etc}^{1-\alpha}$
         (b) $\text{SCHOOL}(e) <- \text{REALIZE}(e,x)^{\alpha'\gamma} \wedge \text{INSTIT}(x)^{\alpha'(1-\gamma)} \wedge \text{etc}^{1-\alpha'}$

Analogously to the case discussed before, the parameters may be interpreted as follows: α as the salience of the building realization of a school, α' as the salience of the institution realization, and γ as the salience of the realization slot ($\gamma < 1$).

Let me now demonstrate by an example (i) how the abductive machinery can be used to generate the possible interpretations as conversational implicatures, and (ii) how the mechanism excludes the impossible interpretations as cases of pragmatic anomaly. More concretely, I will illustrate how the content of (64b) may be construed as a conversational implicature of (64a).

(64)   (a)   The school has a flat roof.
         (b)   The school building has a flat roof.

Moreover, I will demonstrate why the utterance of (65a) appears as a pragmatic anomaly (under normal circumstances) and, consequently, why the interpretation of (65b) is suppressed as a conversational implicature of (65a).
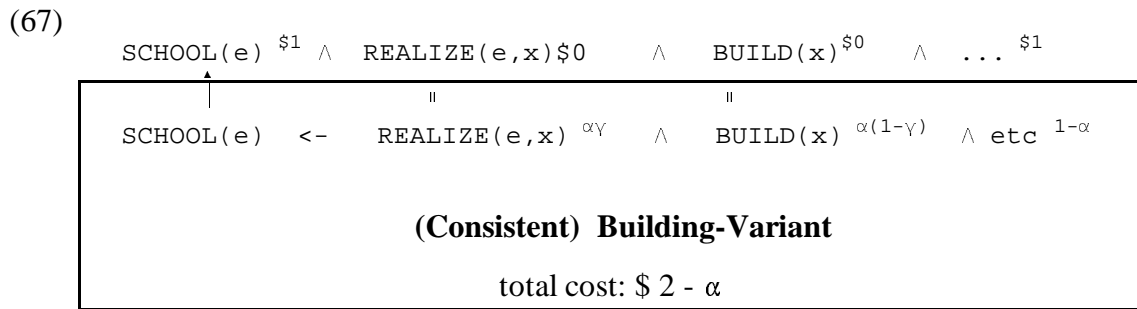
(65)   (a)   ?The government has a flat roof.
         (b)   The government building has a flat roof.

Simplifying, the underspecified semantic representation of the sentences (64a) and (65a) are as indicated in (66a,b).
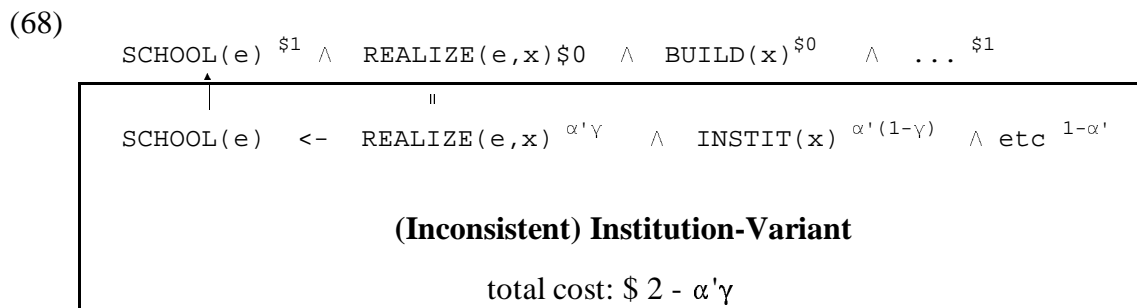
(66) (a) ∃e[SCHOOL(e)∧REALIZE(e,x)∧BUILDING(x)∧HAS_A_FLAT_ROOF(x)]
      (b) ∃e[GOV(e)∧REALIZE(e,x)∧BUILDING(x)∧HAS_A_FLAT_ROOF(x)]

In both cases, the first two conjuncts result from the lexical inputs of the *institute*-type nominals, and the remaining ones correspondingly to the predicate complex. The expression BUILDING(x) is due to the assumed sort restriction provided by the predicate complex, and it is singled out as an important representational element in the present analysis.

The diagram (67) shows the part of the abductive inference graph that is relevant for abducing the building-interpretation (64b) starting with (64a) (in its pre-analyzed form (66a)). Note that there is no real abduction in this very crude and simplifying analysis. The graph shows a "conceptual decomposition" of the subject term and a factoring operation that unifies the occurrence of BUILD(x) resulting from this decomposition with its occurrence resulting from the predicate complex. This effects a saving in assumption costs (by an amount of α).

(67)

```
SCHOOL(e) $1 ∧  REALIZE(e,x)$0    ∧   BUILD(x)$0   ∧  ... $1
```

SCHOOL(e) <-   REALIZE(e,x) $^{\alpha\gamma}$ ∧   BUILD(x) $^{\alpha(1-\gamma)}$ ∧ etc $^{1-\alpha}$

(Consistent) Building-Variant

total cost: $ 2 - α

By using the alternative rule (63b) for decomposing the subject term, the inference graph (68) results.

(68)

```
SCHOOL(e) $1 ∧  REALIZE(e,x)$0  ∧  BUILD(x)$0   ∧   ... $1
```

SCHOOL(e) <- REALIZE(e,x) $^{\alpha'\gamma}$ ∧   INSTIT(x) $^{\alpha'(1-\gamma)}$ ∧ etc $^{1-\alpha'}$

(Inconsistent) Institution-Variant
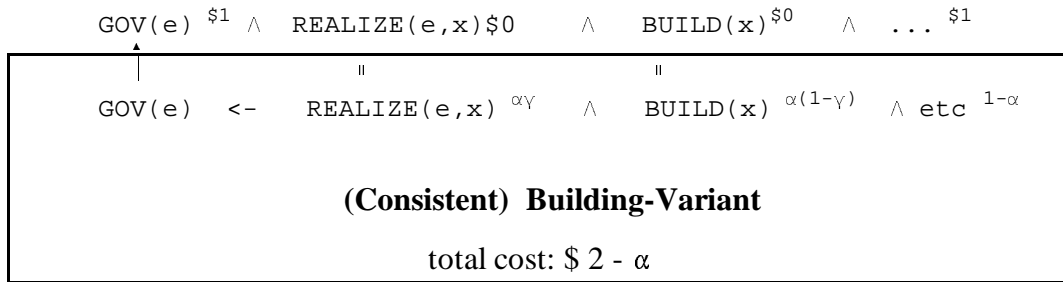
total cost: $ 2 - $\alpha'\gamma$

In this case, an inconsistent institution reading is generated. Since factoring doesn't apply as before, we get only a reduced rate of saving (by $\alpha'\gamma$). From the two considered variants, the I-principle selects the building variant when the condition $\alpha/\alpha' > \gamma$ is satisfied, and the (inconsistent) institution variant is suppressed in this case. It is plausible to assume that α and α' are of comparable amount, since the building and institution reading of school can be seen as realizing concepts of both the basic level of buildings and that of institutions. Consequently, the
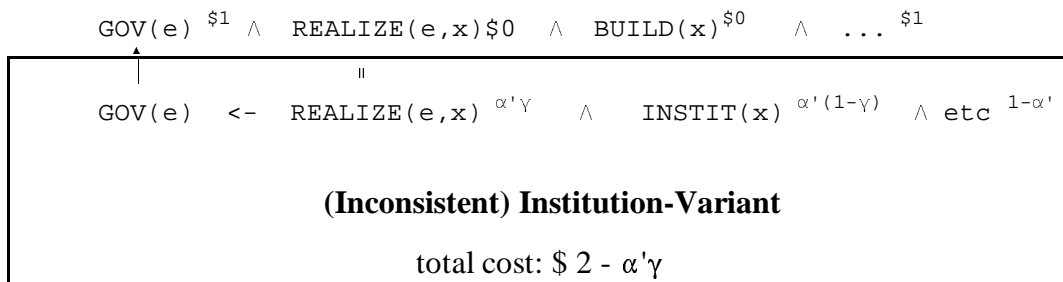
condition $\alpha/\alpha' > \gamma$ (with $\gamma \ll 1$) may be assumed to hold and the I-principle selects the building variant. We can conclude that (64b) comes out as a conversational implicature of (64a).

Now I want to argue that (65a) comes out as pragmatically anomalous. As before, we have to contrast two abductive inference graphs. They are shown in (69) and (70).

(69)

$$\text{GOV(e)}^{\$1} \land \text{REALIZE(e,x)}\$0 \land \text{BUILD(x)}^{\$0} \land \ldots^{\$1}$$

$$\text{GOV(e)} \gets \text{REALIZE(e,x)}^{\alpha\gamma} \land \text{BUILD(x)}^{\alpha(1-\gamma)} \land \text{etc}^{1-\alpha}$$

(Consistent) Building-Variant

total cost: $ 2 - α

(70)

$$\text{GOV(e)}^{\$1} \land \text{REALIZE(e,x)}\$0 \land \text{BUILD(x)}^{\$0} \land \ldots^{\$1}$$

$$\text{GOV(e)} \gets \text{REALIZE(e,x)}^{\alpha'\gamma} \land \text{INSTIT(x)}^{\alpha'(1-\gamma)} \land \text{etc}^{1-\alpha'}$$

(Inconsistent) Institution-Variant

total cost: $ 2 - $\alpha'\gamma$

Again, the condition $\alpha/\alpha' > \gamma$ becomes relevant and the I-principle selects the (consistent) building variant when the condition is satisfied. In the other case, when the converse condition $\alpha/\alpha' > \gamma$ is satisfied, the I-principle selects the (inconsistent) institution variant. I think that the latter possibility is actually realized. This follows from the assumption that government buildings are certainly not basic level buildings (at least with regard to my "cultural background" which is not that of Munich or Saarbruecken; cf. section 2.2). Consequently $\alpha' \ll \alpha$ and it is plausible to assume that $\alpha/\alpha' > \gamma$ is satisfied. Therefore, the inconsistent institution variant wins over the consistent building variant. The inconsistency of the selected variant leads to a violation of the Quality 1 condition. Consequently, under plausible context conditions there is no pragmatically licensed update for an utterance of (65a) and it comes out as pragmatically anomalous.

Again, it should be stressed that these considerations regarding the amounts of parameters are rather provisional and should be supported by careful empirical studies. Nevertheless, the present view sheds some light on the way how the restriction problem of polysemy may be solved by considering the probabilistic nature of conceptual knowledge.

5. Conclusion

One aim of this paper was to collect some general problems that have a *prima facie* claim on the attention of linguists interested in Lexical Semantics. These problems had to do with the utterance of words within concrete conceptual and contextual settings and went beyond the aspects of meaning typically investigated by a contrastive analysis of lexemes within the Katz-Fodor tradition. Three groups of problems were considered: (i) pragmatic compositionality, (ii) blocking, and (iii) pragmatic anomaly. The problems came to the fore in connection with the pragmatics of adjectives and the phenomenon of systematic polysemy. The same points can be made with regard to word formation in general (e.g. Aronoff 1976, Bauer 1983) and the interpretation of compounds in particular (e.g. Meyer 1993, Wu 1990). Moreover, the investigation of kinds of polysemy other than those found with *institute*-type words may be helpful in order to see the ubiquity of these problems (cf., for instance, Lakoff's (1987) study on English prepositions, Sweetser's (1990) investigation of English perception verbs, and Lüdeling's (1995) reflections on the German main verb *haben*). Furthermore, Fabricius-Hansen's (1993) research on how the interpretation of noun-noun compounds is affected by a genitive attribute may raise the same problems in a more complex area.

The second aim of this paper was to sketch a new approach called *Lexical Pragmatics* that deals with these problems in an explanatory way and tries to give a systematic account of the phenomena under discussion. The paradigm is based on two simple principles: (i) an adequate representation of lexical items has to be given in a semantically underspecified format, and (ii) their actual interpretation has to be derived by a pragmatic strengthening mechanism. The basic pragmatic mechanism rests on conditions of updating the common ground and allows to give a precise explication of notions such as generalized conversational implicature and pragmatic anomaly. The fruitfulness of the basic account was initially established by its application to a variety of recalcitrant phenomena, among which its precise treatment of Atlas & Levinson's Q- and I-principles and the formalization of the balance between informativeness and efficiency in natural language processing (Horn's division of pragmatic labor) deserve particular mention. The basic mechanism was subsequently extended by an abductive reasoning system that is guided by subjective probability. The extended mechanism turned out to be capable of giving a principled account of lexical blocking, the pragmatics of adjectives, and certain types of systematic polysemy.

I find it important to apply the ideas to other possibly more complex and more realistic examples than those considered here. Moreover, methods are needed that allow one to measure the values of the probabilistic parameters that control and organize conceptual knowledge.

Seen from a moderately distant viewpoint, the standard accounts of Lexical Semantics may appear as an incoherent research field which is at odds with itself. As an endeavor that has to access Grammar, Semantics and aspects of utterance interpretation at the same time it multiplies the diversion of these disciplines. Overstretched by the task of theory formation it either combines theoretical rigor with descriptive poverty, or, more predominantly, it leads to linguistic anecdotalism, collecting pretty and curious observations without theoretic control. I sense that it is the inadequateness or the lack of a genuine pragmatic component that has led to this situation. Insofar as Lexical Pragmatics tries to take pragmatics seriously–especially the conception of conversational implicature–, and insofar as it is explicit about this component, it may substantiate a division of labor between grammatical and pragmatic aspects of the lexicon. This may widen the way for overcoming the unfortunate situation just mentioned.

Perhaps most details concerning the main ideas of the present account in concrete terms may prove false in the future. This may concern, first at all, the Economy principles and their interaction. In order to really justify the details of these principles we need more empirical evidence and studies. But it is also crucial to discover the reasons that explain why the principles are just as they are. This brings us to a reductionist program as it is currently pursued in the domain of *Integrative Connectionism* (e.g. Smolensky 1995). A first attempt of achieving a full reduction of Speaker's economy (I-principle) and Hearer's economy (Q-principle) to connectionist principles is currently under way.

References

Alshawi, H. & Crouch, R (1992), 'Monotonic Semantic Interpretation', in *Proceedings of ACL*, Newark, Delaware, 32-39.

Aronoff, M. (1976), *Word Formation in Generative Grammar*, MIT Press, Cambridge, Mass.

Atlas, J. & Levinson, S. (1981), '*It*-clefts, informativeness and logical form', in P. Cole (ed), *Radical Pragmatics*, Academic Press, New York, 1-61.

Bartsch, R. (1989), 'Context-dependent interpretations of lexical items', in R. Bartsch, J. van Benthem & P. van Emde-Boas (eds.), *Semantics and Contextual Expressions*, Foris, Dordrecht.

Bauer, L. (1983), *English Word-Formation*, Cambridge University Press, Cambridge.

Bierwisch, M. (1983), 'Semantische und konzeptuelle Repräsentation lexikalischer Einheiten', in W. Motsch & R. Ruzicka (Hrsg.), *Untersuchungen zur Semantik*, Akademie Verlag, Berlin, 61-99.

- (1989), 'The semantics of gradation', in M. Bierwisch & E. Lang (eds), *Dimensional Adjectives*, Springer-Verlag, Berlin etc., 71-261.

Blutner, R. (1995), 'Ansätze zur Erzeugung und Beschränkung von Interpretationsvarianten', *Arbeitspapiere des SFB 340*, Bericht Nr. 71, University of Stuttgart, 33-67.

Caramazza, A. & Grober, E. (1977), 'Polysemy and the structure of the subjective lexicon', in C. Rameh (ed.), *Georgetown University roundtable on language and linguistics*, Georgetown University Press. Washington.

Carnap, R. (1947), *Meaning and Necessity*, The University of Chicago Press, Chicago & London.

Charniak, E. & Shimony, E.S. (1990), 'Probabilistic semantics for cost based abduction', Technical Report CS-90-02, Computer Science Department, Brown University.

Clark, E.V. (1990), 'On the pragmatics of contrast', *Journal of Child Language*, **17**, 417-431.

Clark, H. & Haviland, S. (1977), 'Comprehension and the given-new contract', in R. Freedle (ed), *Discourse Production and Comprehension*, Ablex, Norwood, NJ.

Copstake, A. & Briscoe, T. (1995), 'Semi-productive polysemy and sense extension', *Journal of Semantics*, **12**, 15-67.

Cruse, D.A. (1986), *Lexical Semantics*, Cambridge University Press, Cambridge.

Deane, P.D. (1988), 'Polysemy and cognition', *Lingua*, **75**, 325-361.

Dalrymple, M., Kanazawa, M., Mchombo, & Peters, S. (1994), 'What do reciprocals mean?', in M. Harvey & L. Santelmann (eds.), *Proceedings of the Fourth Semantics and Linguistic Theory Conference: SALT IV*, Cornell University, Ithaka.

Fabricius-Hansen, C. (1993), 'Nominalphrasen mit Kompositum als Kern', *Beiträge zur Geschichte der deutschen Sprache und Literatur*, **115**, 193-243.

Fodor, J.A. & Pylyshyn Z.W. (1988), 'Connectionism and cognitive architecture: a critical analysis', *Cognition*, **28**, 3-71.

Gazdar, G. (1979), *Pragmatics*, Academic Press, New York.

Geis, M. & Zwicky, A.M. (1971), 'On invited inference', *Linguistic Inquiry*, **2**, 561-566.

Grice, P. (1968), *Logic and Conversation*, text of Grice's William James lectures at Harvard University, published in Grice (1989).

- (1989), *Studies in the Way of Words*, Harvard University Press, Cambridge, MA.

Harnish, R.M. (1976), 'Logical form and implicature', in T. Bever, J. Katz & T. Langendoen (eds.), *An Integrated Theory of Linguistic Ability*, Crowell, New York, 464-479.

Hintikka, J. (1962), *Knowledge and Belief. An Introduction to the Logic of the Two Notions*, York, Cornell University Press, Ithaca & New.

Hirschberg, J. (1991), *A Theory of Scalar Implicature*, Garland Publishing, INC., New York & London.

Hobbs, J.R., Stickel, M.E., Appelt, D.E., & Martin, P. (1993), 'Interpretation as abduction', *Artificial Intelligence*, **63**, 69-142.

Horn, L.R. (1984), 'Toward a new taxonomy for pragmatic inference: Q-based and R-based implicatures', in D. Schiffrin (ed), *Meaning, Form, and Use in Context*, Georgetown University Press, Washington, 11-42.

Householder, F.W. (1971), *Linguistic Speculations*, Cambridge University Press, London and New York.

Jackendoff, R. (1983), *Semantics and Cognition*, MIT Press, Cambridge, Mass.

Kamp, H. (1975), 'Two theories about adjectives', in E.L. Keenan (ed.), *Formal Semantics for Natural Language*, Cambridge University Press, Cambridge, 123-155.

Karttunen, L. (1972), 'Possible and must', in J.P. Kimball (ed.), *Syntax and semantics 1*, University Press, New York.

Karttunen, L. & Peters, S. (1979). 'Conventional implicature', in C.-K Oh and D.A. Dinneen (eds), *Syntax and Semantics 11: Presupposition*, Academic Press, New York, 1-56.

Keenan, E.L. (1974), 'The functional principle: Generalizing the notion of Subject of', in *Papers from the Tenth Regional Meeting of the Chicago Linguistic Society,* Chicago, Illinois, 298-310.

Keil, F.C. (1979), *Semantics and Conceptual development*, Harvard University Press, Cambridge, Mass.

Kiparsky, P. (1982), 'Word-formation and the lexicon', in F. Ingeman (ed), *Proceedings of the 1982 Mid-America Linguistic Conference*.

Lahav, R. (1989), 'Against compositionality: the case of adjectives', *Philosophical Studies*, **55**, 111-129.

- (1993), 'The combinatorial-connectionist debate and the pragmatics of adjectives', *Pragmatics and Cognition*, **1**, 71-88.

Lakoff, R. (1987), *Women, Fire, and Dangerous Things: What Categories Reveal About the Mind*, University of Chicago Press, Chicago.

Lang, E. (1989), 'The semantics of dimensional designation of spatial objects', in M. Bierwisch & E. Lang (eds), *Dimensional Adjectives*, Springer-Verlag, Berlin etc., 71-261.

Langendoen, D.T. (1978), 'The logic of reciprocity', *Linguistic Inquiry*, **9**, 177-197.

Lehrer, A. (1968), 'Semantic cuisine', *Journal of Linguistics*, **5**, 39-56.

- (1970), 'Static and dynamic elements in semantics: *hot, warm, cool, cold*', *Papers in Linguistics*, **3**, 49-74.

- (1978), Structures of the lexicon and transfer of meaning, *Lingua*, **45**, 95-123.

Lehrer, A. & Kittay, E.F. (eds.) (1992), *Frames, Fields, and Contrasts*, Lawrence Erlbaum, Hillsdale, N.J.

Leßmöllmann, A. (1996), *Das Problem der Modifikation polysemer Ausdrücke*, Magister Artium, Humboldt University Berlin.

Levinson, S. (1983), *Pragmatics*, Cambridge University Press, Cambridge, England.

- (1987), 'Pragmatics and the grammar of anaphora', *Journal of Linguistics*, **23**, 379-434.

- (1989), 'Relevance', *Journal of Linguistics*, **25**, 455-472.

Lüdeling, Anke (1995), *Untersuchungen zu einer konzeptuellen Fundierung der lexikalischen Semantik am Beispiel des Vollverbs haben*, Working Papers of the Institute for Logic and Linguistics, IBM Deutschland Informationssysteme GmbH, Scientific Center, Heidelberg, 11/1995.

Matsumoto, Y. (1995), 'The conversational condition on Horn scales', *Linguistics and Philosophy*, **18**, 21-60.

McCawley, J.D. (1978), 'Conversational implicature and the lexicon', in P. Cole (ed.), *Syntax and Semantics 9: Pragmatics*, Academic Press, New York, 245-259.

- (1993), *Everything that Linguists have Always Wanted to Know about Logic but were Ashamed to Ask*, Second Edition, University of Chicago Press, Chicago.

McEliece, R. (1977), *Theory of Information and Coding*, Addison-Wesley, Reading, Mass.

Meyer, R. (1993), *Compound Comprehension in Isolation and in Context*, Max Niemeyer Verlag, Tübingen.

- (1994), Probleme von Zwei-Ebenen-Semantiken. *Kognitionswissenschaft,* **4**, 32-46.

Montague, R. (1970), 'Universal Grammar', *Theoria*, **36**, 373-398.

Nunberg, G. (1979), 'The non-uniqueness of semantic solutions: Polysemy', *Linguistics and Philosophy*, **3**, 143-184.

- (1995). 'Transfers of meaning', *Journal of Semantics*, **12**, 109-132.

- & Zaenen, A. (1992), 'Systematic polysemy in lexicology and lexicography', in K. Varantola, H. Tommola, T. Salmi-Tolonen & J. Schopp (eds), *Euralex II, Tampere, Finland*.

Partee, B. (1984), 'Compositionality', in F. Landman and F. Veltman (eds), *Varieties of Formal Semantics*, Foris, Dordrecht, 281-311.

Pustejovsky, J. (1989), 'Type coercion and selection', Paper presented at WCCFL VIII, April 1989, Vancouver, B.C.

- (1991), 'The generative lexicon', *Computational Linguistics*, **17**, 4, 409-441.

- (1993), 'Type coercion and lexical selection', in J. Pustejovsky (ed.), *Semantics and the Lexicon*, Kluwer,

Dordrecht, 73-96.

- (1995), *The Generative Lexicon*, The MIT Press, Cambridge, Mass.

- & Boguraev, B. (1993), 'Lexical knowledge representation and natural language processing', *Artificial Intelligence*, **63**, 193-223.

Quine, W.V.O. (1960), *Word and Object*, MIT Press, Cambridge, Mass.

Rosch, E. & Lloyd, L.L. (eds.) (1978), *Cognition and Categorization*, Lawrence Erlbaum, Hillsdale. N.J.

Rumelhart, D.E., McClelland J.L., and the PDP Research Group (1986), *Parallel Distributed Processing: Explorations in the Microstructure of Cognition, Vol. 1: Foundations*, MIT Press/Bradford Books.

Sadock, J.M. (1978), 'On testing for conversational implicature', in P. Cole (ed.), *Syntax and Semantics*, Vol. 9: *Pragmatics*, Academic Press, New York, 281-297.

Smolensky, P. (1995), 'Constituent structure and explanation in an integrated connectionist/symbolic cognitive architecture', in C. Macdonald & G. Macdonald (eds), *Connectionism: Debates on Psychological Explanation, Volume Two*, Basil Blackwell: Oxford, 221-290.

Sommers, F. (1959), 'The ordinary language tree', *Mind*, **68**, 160-185.

- (1963), 'Types and ontology', *Philosophical Review*, **72**, 327-363.

Sperber, D. & Wilson, D. (1986), *Relevance*, Blackwell, Oxford.

Stickel, M. E. (1989), 'Rational and methods for abductive reasoning in natural language interpretation, in R. Studer (ed.), *Natural Language and Logic*, Springer- Verlag, Berlin, 233-252.

Sweetser, E.E. (1990), *From Etymology to Pragmatics*, Cambridge University Press, Cambridge.

Taylor, J.R. (1994), The two-level approach to meaning, *Linguistische Berichte*, **149**, 3-28.

Thomason, R.H (1990), 'Accommodation, meaning, and implicature: interdisciplinary foundations for pragmatics', in P.R. Cohen, J. Morgan, and M.E. Pollack (eds), *Intentions in Communication*, MIT Press, Cambridge, Mass.

van Deemter, K. & Peters, S. (1996), *Semantic Ambiguity and Underspecification*, CSLI Publications, Stanford, California.

Wu, D. (1990), 'Probabilistic unification-based intergration of syntactic and semantic preferences for nominal compounds', *Proceedings of the 13th International Conference on Computational Linguistics (COLING 90)*, Helsinki, 413-418.

Zadrozny, W. (1994), 'From compositional to systematic semantics', Linguistics and Philosopy, **17**, 329-342.

Zeevat, H. 1995, 'The common ground', Unpublished manuscript, University of Amsterdam.

Zipf, G.K. (1949), *Human Behavior and the Principle of Least Effort*, Addison-Wesley, Cambridge.