*Computational Intelligence*, Volume 17, Number 1, 2001

# CHOICES FOR LEXICAL SEMANTICS

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The modern computational lexical semantics has reached a point in its development when it has become useful to compare the goals and methods of the various approaches to it. This article proposes several choices in terms of which these goals and methods can be discussed. It is argued that the central questions include the use of lexical rules for generating word senses; the role of syntax and formal semantics in the specification of lexical meaning; the use of a world model, or ontology, as the organizing principle for lexical-semantic descriptions; the relation between static and dynamic resources; the commitment to descriptive coverage; the tradeoff between generalization and idiosyncracy; and finally, the adherence to the "supply side" (method-oriented) or "demand side" (task-oriented) ideology of research. The discussion is inspired by, but not limited to, the comparison between the generative lexicon approach and the ontologic semantic approach to lexical semantics.

It is fair to say that *lexical semantics*, the study of word meaning and of its representation in the lexicon, experienced a powerful resurgence within the last decade. The lexical semantics community is quite heterogeneous. It includes former syntacticians, reformed and dyed-in-the-wool formal semanticists, and a considerable chunk of the NLP community. It includes both linguists and computer scientists, some with a strong statistical and probabilistic bent and others pursuing the use of large corpora and MRDs, some actively engaged in developing NLP systems and some others working on designs for the systems of the immediate future. It also includes some "engineer" types who opt to view the field through the prism of an individual concrete application or technique.

This article attempts to carry out a comparative analysis of several major directions in lexical semantics. Accordingly, this article differs in genre from most "standard" contributions in the field in that instead of describing a particular phenomenon, method, or system, it intends take stock of the field in its current state of development. There is nothing really novel in this genre, since every academic field at a certain stage develops a need for self-assessment in substantive terms. Articles such as this are often couched, overtly or implicitly, as polemics. While the works Chomsky (1959) or Weinreich (1966) could not be called purely theoretical articles, their contribution to the scientific process was outstanding and arguably more important than that of many nonpolemical works. While not competing with these classics, this article follows, as it were, in their footsteps.

Our main objective has been to try to tease out the often unstated preferences and differences among the practicioners of lexical semantics. Our device for this is to propose a set of issues that we think are important for the field and to try to recreate the attitudes of various researchers toward these issues. By doing so, we may have created a few "straw men" on the way, but no position we will list is without well-recorded support in the community.

## 1. GENERATIVITY

Pustejovsky (1991, 1995) introduces the generative lexicon (GL) as an alternative to the lexicons in which all the senses are independent and simply enumerated. In this

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section we attempt to demonstrate that while GL may indeed be superior to an enumerative lexicon based on corpus-attested usages, it has no advantages over a well-compiled broad-coverage enumerative lexicon suitable for realistic applications. In particular, the claimed ability of GL to account for novel senses is matched by good-quality enumerative lexicons. The difference between generative and enumerative lexicons, then, is reduced to a preference to use some lexical knowledge at run time or at lexicon acquisition time.

### 1.1. Generative Lexicon: Main Idea

The main lexical semantic idea behind the generative lexicon is basically true, if not novel. It is two-prong:

- Senses of a polysemous lexical item can be related in a systematic way, with types of such relations recurring across various lexical items.
- By identifying these relations, it is possible to list fewer senses in a lexical entry and to derive all the other senses with the help of (lexical) rules based on these relations.

The paradigmatic (static, as opposed to syntagmatic, or context-determined) relations among word meanings have been explored and implemented in dictionaries of various sizes and for various languages by the members of the meaning-text school of thought since the mid-1960s (Zholkovsky et al. 1961; Apresyan et al. 1969, 1973; Mel'ÿuk 1974, 1979). These scholars vastly enriched the list of paradigmatic relations, similarly to the way it is done in the generative lexicon, although the latter focuses only on those word meanings which are senses of the same lexical item. Even closer to the currently popular lexical rules, Givón (1967) and McCawley (1968, pp. 130–132) came up with similar ideas earlier.

Our own experience in lexical semantics and particularly in large-scale lexical acquisition since the mid-1980s also confirms that it is much more productive to derive as many entries as possible from others according to as many lexical rules as can be found; clearly, it is common sense that acquiring a whole new entry by a ready-made formula is a lot easier and can be done by less skilled acquirers than acquiring an entry from scratch. In fact, we have established a pretty reliable quantitative ratio: Acquiring from scratch can be as slow as 1 to 2 entries an hour by the "master" lexicographer, and acquiring via a lexical rule is up to 30 entries an hour by an inexperienced lexicographer (obviously, the former acquires lexical entry types, or templates, which are emulated by the latter—see, e.g., Raskin and Nirenburg 1995, 1996a, 1996b; Viegas and Nirenburg 1996; Viegas and Raskin 1998).

Some claims made about the generative lexicon strike us as somewhat misleading and often spurious. These claims, however, do not seem essential to the concept of generative lexicon, and therefore, in what follows (Sections 1.2 to 1.3), we critically examine them, in the spirit of freeing a good idea of unnecessary ballast.

### 1.2. Generative versus Enumerative?

The generative lexicon is motivated, in part, by the shortcomings of the entity it is juxtaposed against, the enumerative lexicon. The enumerative lexicon is criticized for

- Having the senses for each lexical item just listed without any relations established among them.

- The arbitrariness of (or, at least, a lack of a consistent criterion for) sense selection and coverage
- Failing to cover the complete range of usages for a lexical item
- Inability to cover novel, unattested senses

Such enumerative lexicons are certainly real enough (most human-oriented dictionaries conform to the description to some extent), and there are quite a few of them around. However, there may be good enumerative lexicons that cannot serve as convenient foils for the generative lexicon.

Enumerative lexicons could, in fact, be acquired using a well-thought-out and carefully planned procedure based on a sound and efficient methodology, underlain, in turn, by a theory. The acquisition environment would include a library of automatic and semiautomatic search means, concordance browsers, and other acquisition tools to make the production of lexical entries easier, faster, and more uniform. The methodology would include the following steps:

- Obtaining a large and representative set of corpora, complete with a fast lookup tool
- Examining a large set of existing lexicons and subjecting them to the semiautomatic polysemy reduction procedure (see Raskin and Nirenburg 1995, pp. 41–45, and Beale et al. 1995)
- Determining a small set of entry types that have to be created from scratch
- Identifying sets of large-scale lexical rules that derive lexical entries from entry types and from other lexical entries semiautomatically

Such an enumerative lexicon will cover exactly the same senses as the generative lexicon, with the relations among these senses as clearly marked.[2] Whether, in a computational application, lexical rules are triggered at acquisition or run time may have a computational significance, but their generative capacity, e.g., in the sense of Chomsky (1965, p. 60), i.e., their output, is not affected by that, one way or another (see Viegas et al. 1996b). The corpora are used in such an enumerative approach for lookup purposes, not to limit the senses of lexical entries. Instead, all the applicable lexical rules are applied to all eligible lexical entries, thus creating virtual or actual entries for all the derived senses, many of them not attested in the corpora.

### 1.3. Generative Lexicon and Novel Senses

In view of the equivalence of the outputs of the generative lexicon, on the one hand, and a high-quality enumerative lexicon, on the other, the claimed ability of the generative lexicon to generate novel, creative senses of lexical items needs to be examined more closely. What does this claim mean? What counts as a novel sense? Theoretically, it is a sense that is not previously attested to and which is a new, original usage. This, of course, is something that occurs rather rarely. Practically, it is a sense that does not occur in a corpus and in the lexicon based on this corpus. Neither the generative lexicon nor a good enumerative lexicon will—or should—list all the senses overtly. Many, if not actually most, senses are derived through the application of lexical rules. However, even if not listed, such a derived sense is present in the lexicon virtually, as it were, because it is fully determined by the preexisting domain of a preexisting lexical rule.

[2]It would be instructive to recall at this point that the term *generative,* as introduced into linguistics by Chomsky (1957) and as inherited by Pustejovsky, means a way of enumeration through mathematical derivation, albeit a sophisticated and intelligent one.

Does the claim of novelty mean that senses are novel and creative if they are not recorded in some given enumerative lexicon? If so, then the object chosen for comparison is of low quality (unless it was built based exclusively on a given corpus of texts) and therefore not the most appropriate one, as one should assume a similar quality of the lexicons under comparison. While the literature is not quite explicit on this point, several contributions (e.g., Johnston et al. 1995; Copestake 1995) seem to indicate the implicit existence of a given inferior lexicon or a nonrepresentative corpus against which the comparison is made.

The other line of reasoning for justifying the claim of novelty involves the phenomena of type shifting and type coercion. A creative usage is one that arises from a rule that would overcome a sortal or other incongruity to avoid having to reject an input sentence as ill-formed. However, there are rules that make type shifting and type coercion work. They are all preexisting, not post hoc rules, and therefore, just as other lexical rules, they fully determine, or enumerate (see below), their output in advance.

It is perhaps appropriate here to resort to simple formalism to clarify this point further, especially since the proponents of the generative lexicon approach seem to treat formalism-based analogies and illustrations as the best devices for clinching arguments. Let $L$ be the finite set of all lexical rules $l$ used to derive senses from other senses; let $T$ be the finite set of all type-shifting and coercion rules $t$; let $S$ be the (much smaller) set of the senses $s$ of a lexical entry $e$ in the generative lexicon $G$. Then $G = \{e_1^G, e_2^G, \ldots, e_n^G\}$ and $S_e = \{s_1^e, s_2^e, \ldots, s_m^e\}$. If $l(s_e)$ is a sense of an entry derived with the help of lexical rule $l$ and $t(s_e)$ is a sense of an entry derived with the help of a type-shifting or coercion rule $t$, then let us define $V_e$ as the set of all such derived senses of an entry: $V_e = \{v\colon \forall v\, \exists s\, \exists e\, \exists l\, \exists t\ v = l(s_e) \vee v = t(s_e)\}$. Let $W^G$ be the set of all derived senses for all the entries in $G$: $W^{GLT} = \{w\colon \forall w\, \exists s\, \exists e\, \exists l\, \exists t\ w = l(s_e) \vee w = t(s_e)\}$. Finally, let $U^{GLT}$ be the set of all senses listed or derived in $G$: $U^{GLT} = W^{GLT} \cup C^G$, where $C^G = \{c\colon \forall c\, \exists s\, \exists e\ c = s_e\}$. $U^{GLT}$ represents the weak generative capacity of $G$, given the predefined sets $L^G$ and $T^G$ of lexical and type-shifting rules associated with the generative lexicon.

$U^{GLT}$ is also an *enumerable* set in the calculus $I$ defined by the set of rules $L^G \cup T^G$ applied to $C^G$ in the sense that there is a finite procedure $P$ of (typically, one-step) application of a rule to a listed (or, rarely, derived) sense such that each element in $U^{GLT}$ is generated by $P$ ($P$ includes zero, or nonapplication, of any rule so as to include $C^G$ in the calculus). In fact, $U^{GLT}$ is also decidable in the sense that for each of its elements $i$ there is an algorithm in $I$ that determines how it is generated, i.e., an algorithm that identifies, typically, a listed entry and a rule applied to it to generate $i$. The set of all these identified pairs of listed entries and rules applied to them determines the strong generative capacity of $G$.

Then the only way the lexicon may be able to generate, i.e., define, a sense $s$ is if $s \in U^{GLT}$. In what way can such a sense $h$ be novel or creative if it is already predetermined in $G$ by $L$ and $T$? This notion makes sense only if the existence of a proper subset $B$ of $U^{GLT}$ is implied such that $h \in U^{GLT} \wedge h \notin B$. Then a deficient enumerative lexicon $M$ would list all the senses of $B$ and not use any lexical or type-shifting rules: $E = \{e_1^e, e_2^e, \ldots, e_k^e\}$, $B = \{b\colon \forall b\, \exists s\, \exists e\ b = s_e\}$ and $L^E = T^E = \varnothing$.

Obviously, if a lexicon $O$ does enumerate some senses and derives others in such a way that every sense in $U^{GLT}$ is either listed or derived in $O$ as well, so that both the weak and strong generative capacities of $O$ equal—or exceed—those of $U^{GLT}$, then $G$ does not generate any novel, creative senses with regard to $O$. It also follows that the generative lexicon approach must specify explicitly, about each sense claimed to

be novel and creative, relative to what corpus or lexicon it is claimed to be novel and creative.

The preceding both clarifies the notion of a novel, creative sense as used in the generative lexicon approach and renders it rather trivial. It is not that there is anything special about senses claimed to be such, but rather that the corpus or lexicon, relative to which these senses are novel and creative, is incomplete. The claim of novelty is then reduced to a statement that it is better to have a high-quality corpus or lexicon than a lower-quality one, and obviously, nobody will argue with this! The lack of clarity on this account in GL leads to an overstatement of its unique ability to treat novel senses.

We suggest that a truly novel and creative usage will not have a ready-made generative device, for which it is a possible output, and this is precisely what will make this sense novel and creative. Such a usage will present a problem for a generative lexicon, just as it will for an enumerative one or, as a matter of fact, for a human trying to treat creative usage as metaphorical, allusive, ironic, or humorous.

## 2. SYNTAX VERSUS SEMANTICS

The principal choice for lexical semantics with respect to the relations to syntax is whether to assume that each syntactic distinction suggests a semantic difference. GL's position on this issue is expressed repeatedly as the dependence of semantics on "basic lexical categories" (Pustejovsky 1995, p. 1), on "syntactic patterns" and "grammatical alternations" (Pustejovsky 1995, p. 8), as the search for "semantic discriminants leading to the distinct behavior of the transitive verbs" in the examples (Pustejovsky 1995, p. 10), or as an "approach [that] would allow variation in complement selection to be represented as distinct senses" (Pustejovsky 1995, p. 35). It is indeed in the analyses of examples (as well as examples used by other lexical semanticists subscribing to the idea of generative lexicon—see, e.g., Lascarides 1995, p. 75) that the apparently complete and unquestioned dependency on syntax comes through most clearly.

Thus, dealing with his own variations of Chomsky's (1957) famous examples of *John is eager to please* and *John is easy to please* in terms of *tough*-Movement and the availability or nonavailability of alternating constructions, Pustejovsky (1995, pp. 21–22) makes it clear that these different syntactic behaviors, essentially, constitute the semantic difference between adjectives like *eager* and adjectives like *easy*. We have demonstrated elsewhere (Raskin and Nirenburg 1995) that much more semantics is involved in the analysis of differences between these two adjectives and that these differences are not at all syntax-dependent. *Easy* is a typical scalar, whose value is a range on the EASE/DIFFICULTY scale and which modifies events; *eager* is an event-derived adjective modifying the agent of the event. This difference does explain the different syntactic behaviors of these adjectives but not the other way around.

One interesting offshoot of the earlier syntax versus semantics debates has been a recent strong interest in "grammatical semantics," the subset of the semantics of natural languages that is overtly grammaticalized (see, e,g., Frawley 1992—cf. Raskin 1994; in computational-semantic literature, B. Levin 1993 and Nirenburg and L. Levin 1992—who call this field "syntax-driven lexical semantics"—are noteworthy). This is a perfectly legitimate enterprise as long as one keeps in mind that semantics does not end there.

Wilks (1996) presents another example of an intelligent division of labor between syntax and semantics. He shows that up to 92% of homography recorded in Longman's Dictionary of Contemporary English (LDOCE) can be disambiguated based exclusively on the knowledge of the part-of-speech marker of a homograph. Homography is, of

course, a form of polysemy, and it is useful to know that the labor-intensive semantic methods are not necessary to process all of it. Thus semantics can focus on the residual polysemy where syntax does not help. In a system not relying on LDOCE, a comparable result may be achieved if word senses are arranged in a hierarchy, with homography at top levels, and if disambiguation is required only down to some nonterminal node in it. Needless to say, the work of semantics is made easier by this to a very small extent, but every little bit counts!

It is also very important to understand that ideally grammatical semantics should not assume that each syntactic distinction is reflected in semantic distinction—instead, it should look at grammaticalized semantic distinctions, i.e., such semantic phenomena that have overt morphologic or syntactic realizations. Consequently, work in grammatical semantics should not consist in detecting semantic distinctions for classes of lexical items with different values on a given syntactic feature (see, e.g., Briscoe et al. 1995; Copestake 1995; Briscoe and Copestake 1996).

The dependence on syntax in semantic analysis may lead to artificially constrained and misleading analyses. Thus the analysis of the sense of *fast* in *fast motorway* (see, e.g., Lascarides 1995, p. 75) as a new and creative sense of the adjective as opposed, say, to its sense in *fast runner* ignores the important difference between syntactic and semantic modification. It is predicated on the implicit conviction that the use of the adjective with a different noun subcategory—which constitutes, since Chomsky (1965), a different syntactic environment for the adjective—automatically creates a different sense for *fast*. As shown in Raskin and Nirenburg (1995), however, many adjectives do not modify semantically the nouns they modify syntactically, and this phenomenon covers many more examples than the well-known *occasional pizza* or *relentless miles*. Separating syntactic and semantic modification in the case of fast shows that it is, in fact, a modifier for an event, whose surface realization can be, at least in English, syntactically attached to the realizations of several semantic roles of, for instance, *run* or *drive*, namely, AGENT in *fast runner*, INSTRUMENT in *fast car*, and LOCATION (or PATH) in *fast motorway*. Throughout these examples, *fast* is used in exactly the same sense, and letting syntax drive semantics distorts the latter seriously.

Postulating a new sense for *fast* in *fast motorway* begs the notorious issue of the "plasticity" of the adjectival meaning [see Raskin and Nirenburg (1995, p. 21); specifically, on the plasticity of adjectival meaning, see also Marx (1977, 1983), Szalay and Deese (1978), and Lahav (1989)], i.e., the tendency of many, if not all, adjectives to modify their meanings depending on that of the nouns they modify syntactically. The meaning of the adjective *good* is perhaps the most explored example of this phenomenon (see, e.g., Ziff 1960; Vendler 1963; Katz 1972; Pustejovsky 1995, p. 32; Fodor and Lepore 1998, p. 11). Our own argument against the proliferation of different senses for *good* is twofold: First, the adjective practically never modifies semantically the noun it modifies syntactically, expressing instead a general positive attitude to the concept evoked by the noun on the part of the speaker; second, we argue against the further detailing of the meaning on the grounds of granularity and practical effability; i.e., basically, that, in MT, for instance, an equally generalized notion of goodness will be expressed in another natural language by a similar adjective, which does appear to be a universal or near-universal—the fact that, by and of itself, would indicate the integrity of the vague concept of goodness in the human mind (Raskin and Nirenburg 1995, pp. 28–29, 43–47, and 49–50). The upshot of this discussion is that no purported syntactic distinctions should lead automatically to the fracturing of one meaning into several.

Distinguishing word senses on the basis of differences in syntactic behavior does not seem to be a very promising practice [cf. the Dorr et al. (1994–1995) attempt to

develop B. Levin's approach into doing precisely this] also because such an endeavor can only be based on the implicit assumption of isomorphism between the set of syntactic constructions and the set of lexical meanings. However, it seems obvious that there are more lexical meanings than syntactic distinctions, orders of magnitude more. This means that syntactic distinctions can at best define classes of lexical meanings, and indeed, this is precisely what the earlier incursions from syntax into semantics achieved: just very crude, coarse-grained taxonomies of meanings in terms of preciously few features. On top of this, the case of *good* above further weakens the isomorphism assumption by demonstrating that it does not hold also because there are cases where several purported syntactic distinctions still correspond to the same meaning.

## 3. LEXICAL SEMANTICS AND SENTENTIAL MEANING

Semantics as a whole can be said to be the study of lexical and sentential meaning. When the work of lexical semantics is finished, the question arises as to how word meanings are combined into the meaning of a sentence. In many lexical semantic approaches, including GL, it is assumed that deriving sentential meaning is the task of formal semantics. The other choice would be developing a dedicated theory for this purpose. An additional choice is whether simply to acknowledge the need for treating sentential meaning as the continuation of work in lexical semantics or actively to develop the means of doing so. In what follows, we will discuss these choices.

### 3.1. Formal Semantics for Sentential Meaning

Despite Pustejovsky's (1995, p. 1) initial and fully justified rejection of formal semantics as a basis of achieving the GL goals with respect to sentential meaning, the approach did not find anything else in contemporary linguistic semantics for dealing with sentential meaning than rather shallow analyses of quantifiers and other closed-class phenomena. Formal semantics currently holds a monopoly on compositionality and extends at least into the quantifiers among the closed-class lexical phenomena.

This creates a problem for the GL approach: There is no ready-made semantic theory it can use for the task of sentential meaning representation of a sufficiently fine granularity that NLP requires. This situation is familiar to all lexical semanticists. In GL, Pustejovsky tries to enhance the concept of compositionality as an alternative to standard formal semantics. In the GL approach, compositionality ends up as a part of lexical semantics proper, whereas formal semantics takes over in the realm of sentential meaning.

Formal semantics, however, is not necessarily the best candidate for the theory of sentential meaning. It is a direct application of mathematical logic to natural language. All the central concepts in logic are taken from outside natural language, and the fit between these concepts and the language phenomena is not natural. Formal semantics thus follows a method-driven approach, exploring all the language phenomena to which it is applicable and, by necessity, ignoring the rest. An alternative to such an approach is an investigation of all relevant language phenomena, with methods and formalisms derived for the express purpose of such an investigation (see Section 5).

### 3.2. Ontological Semantics for Sentential Meaning

These latter problem-driven approaches include conceptual dependency (e.g., Schank 1975), preference semantics (Wilks 1975), and our own ontologic semantics

(e.g., Onyshkevych and Nirenburg 1994). In ontologic semantics, *sentential meaning* is defined as an expression, *text meaning representation* (TMR), consisting of a set of event and state instances with their participants, and properties identified (all the events, states, participants, and properties are either mentioned in the text or inferred from it). TMRs in ontologic semantics are treated as the goal of natural language analysis and the starting point of text synthesis. TMRs are obtained through application of the sets of rules for syntactic analysis of the source text, for linking syntactic dependencies into ontologic dependencies, and for establishing the meaning of source text lexical units. The crucial element of this theory is a formal world model, or ontology.

Every lexical semantic theory must make a choice concerning the conceptual status of its metalanguage. The introduction of an explicit ontology is one way to make this choice. Other choices also exist, as exemplified by the GL approach, in which "nonlinguistic conceptual organizing principles" (Pustejovsky 1995, p. 6) are considered useful, although they remain undeveloped.

We believe that the notational elements that are treated as theory in GL can be legitimately considered as elements of semantic theory only if they are anchored in a well-designed model of the world, or ontology. The alternative is a lack of certainty about the status of these notions and an osmosis- or emulation-based usage of them; a new feature and certainly a new value for a feature always can be expected to be produced if needed, the ad hoc way. A good example of this state of affairs is the basic concept of qualia in GL.

The qualia structure in GL consists of a prescribed set of four roles with an open-ended set of values. The enterprise carries an unintended resemblance to the type of work fashionable in AI NLP in the late 1960s and 1970s: proposing sets of properties (notably, semantic cases or case roles) for characterizing the semantic dependency behavior of argument-taking lexical units (see, e.g., Bruce 1975). That tradition also involved proposals for systems of semantic atoms, primitives, used for describing actual meanings of lexical units. This latter issue is outside the sphere of interest of GL, although not, in our opinion, of lexical semantic theory.

The definitions of the four qualia roles are in terms of meaning and carry all the difficulties of circumscribing the meaning of case roles. Assignment of values to roles is not discussed by Pustejovsky in any detail, and some of the assignments are problematic, such as, for instance, the value "narrative" for the constitutive role [which is defined as "the relation between an object and its constitutive parts" (1995, p. 76)], for the lexicon entry of *novel* (1995, p. 78). The usage of *telic* has been made quite plastic as well (1995, p. 99–100), by introducing "direct" and "purpose" telicity, without specifying a rule about how to understand whether a particular value is direct or purpose.

One would expect to have all such elements as the four qualia specified explicitly with regard to their scope, and this is, in fact, what theories are for. What is the conceptual space from which the qualia and other notational elements of the approach emerge? Why does the GL miss an opportunity to define that space explicitly in such a way that the necessity and sufficiency of the notational concepts it does introduce become clear to us—including, of course, an opportunity to falsify its conclusions on the basis of its own explicitly stated rules?[3] An explicit ontology would have done all of the above for the GL.

To be fair, some suggestions have been made for generalizing meaning descriptions in GL using the concept of *lexical conceptual paradigms* (e.g., Pustejovsky and Boguraev 1993; Pustejovsky and Anick 1988; Pustejovsky et al. 1993). These paradigms "encode

[3]An examination of the Aristotelian roots of the qualia theory fails to fill the vacuum either.

basic lexical knowledge that is not associated with individual entries but with sets of entries or concepts" (Bergler 1995, p. 169). Such "metalexical" paradigms combine with linking information through an associated syntactic schema to supply each lexical entry with information necessary for processing. While it is possible to view this as simply a convenience device that allows the lexicographer to specify a set of constraints for a group of lexical entries at once [as was, for instance, done in the KBMT-89 project (Nirenburg et al. 1992)], this approach can be seen as a step toward incorporating an ontology.

Bergler (1995) extends the amount of these metalexical structures recognized by the generative lexicon to include many elements that are required for actual text understanding. She, for instance, incorporates a set of properties she calls a "style sheet," whose genesis can be traced to the "pragmatic factors" of PAULINE (Hovy 1988) or TAMERLAN (e.g., Nirenburg and Defrise 1993). She stops short, however, of incorporating a full-fledged ontology and instead introduces nine features, in terms of which she describes reporting verbs in English. A similar approach to semantic analysis with a set number of disjoint semantic features playing the role of the underlying meaning model was used in the Panglyzer analyzer (see, e.g., Pangloss Mark III 1994).

There is, of course, a great deal of apprehension and, we think, miscomprehension about the nature of ontology in the literature, and we addressed some of these and related issues in Nirenburg et al. (1995). One recurring trend in the writings of scholars from the AI tradition is toward erasing the boundaries between ontologies and taxonomies of natural language concepts. This can be found in Hirst (1995), who acknowledges the insights of Kay (1971). Both articles treat ontology as the lexicon of a natural (though invented) language, and Hirst objects to it, basically, along the lines of the redundancy and awkwardness of treating one natural language in terms of another. Similarly, Wilks et al. (1996, p. 59) sees ontologic efforts as adding another natural language (see also Johnston et al. 1995, p. 72), albeit artificially concocted, to the existing ones while somehow claiming its priority.

By contrast, in the Mikrokosmos *(http://crl.nmsu.edu/Research/Projects/mikro/index.html)* implementation of ontologic semantics, an ontology for NLP purposes is seen not at all as a natural language but rather as a language-neutral "body of knowledge about the world (or a domain) that (a) is a repository of primitive symbols used in meaning representation; (b) organizes these symbols in a tangled subsumption hierarchy; and (c) further interconnects these symbols using a rich system of semantic and discourse-pragmatic relations defined among the concepts" (Mahesh and Nirenburg 1995, p. 1). The names of concepts in the ontology may look like English words or phrases, but their semantics is quite different and is defined in terms of explicitly stated interrelationships among these concepts. The function of the ontology is to supply "world knowledge to lexical, syntactic, and semantic processes" (1995, p. 1), and in fact, we use exactly the same ontology for supporting multilingual machine translation.

An ontology like this comes at a considerable cost—it requires a deep commitment in time, effort, and intellectual engagement. It requires a well-developed methodology based on a clear theoretical foundation (see Mahesh 1996). The rewards, however, are also huge: a powerful base of primitives with a rich content and rich inheritance that is made available for the lexical entries, ensuring their consistency and nonarbitrariness.[4]

[4]The Mikrokosmos lexicons fit Fillmore and Atkins' (1992, p. 75) vision of an ideal dictionary of the future: ". . . we imagine, for some distant future, an online lexical resource, which we can refer to as a 'frame-based' dictionary, which will be adequate to our aims. In such a dictionary (housed on a workstation with multiple windowing capabilities), individual word senses, relationships among the senses of the polysemous words, and relationships between (senses of) semantically related words will be linked with the cognitive structures (or 'frames'), knowledge of which is presupposed by the concepts encoded by the words."

We address and reject as inapplicable (Nirenburg et al. 1995) the standard charge of irreproducibility for ontologies; on the one hand, we accept as expected that different groups and individuals will come up with different ontologies, even for a limited domain; on the other hand, we believe—and actually know for a well—established fact—that groups and individuals with similar training and facing an identical task would, indeed, come up with very similar ontologies. Note that no two grammars or lexicons of particular languages, even in a given theoretical paradigm, are expected by anybody to be identical

To enhance the uniformity of ontology acquisition (e.g., by different acquirers), we have developed weak semiautomatic methods of acquisition, supported by semiautomatic acquisition tools. We also have discovered heuristic techniques and recurring patterns of acquisition. Again, this adds to the cost of lexical semantic work. This cost, however, buys a very desirable (at least to us) result—the much enhanced depth and complexity of lexical entries not resulting from lexical acquisition but rather contributed "free of charge" by the inheritance, properties, and constraints on preacquired ontologic concepts on which the lexical entries are based.[5]

### 3.3. Static and Dynamic Resources for Deriving Sentential Meaning

An important part of a computational theory, besides its format, the notation it introduces, and its foundation, is the architecture of the processing environment associated with the theory. The operational environment of Mikrokosmos, for example, contains the following *static* resources:

- An ontology, which includes scriptlike prototype complex events
- A lexicon that has already subsumed the ontology (by being anchored in it) and the results of the application of lexical rules
- The output of a syntactic parser
- A text-meaning representation language

Besides these, ontological semantics needs at least the following *dynamic* resources:

- Context information, including the analysis of sentences before and after the current one and extralinguistic context involving knowledge about a particular speech situation, its participants, etc.
- Rules of the (crucial) microtheory of semantic dependency construction, which is, among other things, connected with the microtheory of modification, including discrepancies between syntactic and semantic modification, for a system that does not give syntax a privileged status among the clues for semantic dependency
- Large family of analysis (dynamic) microtheories, such as those of aspect, modality, etc.

It is the dynamic resources that define our view on compositionality, and we fail to see how compositionality can be viewed without identifying such modules. We also think that *compositionality* is an unfortunate term for the agglomerate of dynamic resources within semantic theory. After all, the traditional use of the term covers the combinatorics of assembling the meaning of the sentence out of the meanings of the words that

[5]It is notable, again, that Fodor and Lepore (1998, p. 269) attack Pustejovsky (1995) for too much complexity in his lexical entries, while we advocate much more complex entries.

make up the sentence, the combinatorics that involve selection restrictions in weeding out incompatible combinations of the senses of the polysemous words.

However, semantic theory also requires resources that manipulate meanings of whole sentences. Thus the context dynamic resource is not compositional at all. If everything non- or supracompositional is assigned by the GL approach to pragmatics, this will mean that this dynamic resource is taken out of semantics. We do not think it would be a good decision; not only would it assign something knowable to the land of the unknowable or only very partially and selectively knowable, but it also would declare each and every sentence uninterpretable within semantics.

Another blow against *compositionality* as a term and as an approach is the issue of the tension between the meaning of the text and word meaning. The compositional approach assumes the latter as a given, but one has to be mindful of the fact that word meaning is, for many linguists, only a definitional construct for semantic theory, "an artifact of theory and training" (Wilks 1996). Throughout the millennia, there have been views in linguistic thought that only sentences are real and basic, and words acquire their meanings only in sentences [see, e.g., Gardiner (1951), who traces this tradition back to the earliest Indian thinkers; Firth (1957) Zvegintzev (1968), and Raskin (1971) treat word meaning as a function of the usage of a word with other words in sentences]. Of course, this opinion effectively denies the existence of lexical semantics as a separate field.

## 4. DESCRIPTION COVERAGE

In principle, any theory prefers to seek general and elegant solutions to the entire set of phenomena in its purview. In practice, lexical semantics has to choose whether to pursue generalizations on the phenomena that lend themselves to such treatment or to force descriptions on the entire set of phenomena required by a domain or an application.

GL shares with the rest of theoretical linguistics the practice of high selectivity with regard to its material. This makes such works great fun to read: Interesting phenomena are selected; borderline cases are examined. In the GL approach, new and relatively unexplored lexical rules have been focused on, at the expense of large-scope rules that may be more obvious. In theoretical linguistics, borderline cases are dwelt on as testing grounds for certain rules that may prop up or expose vulnerability in a paradigm. In both cases, an assumption is tacitly made that the ordinary cases are easy to account for, and so they are not processed. As we mentioned elsewhere (Raskin and Nirenburg 1995), in the whole of transformational and posttransformational semantic theory, only a handful of examples has ever been actually described, with no emphasis on coverage.

Contrary to this, large-scale applications require the description of every lexical semantic phenomenon (and a finer-grained description than that provided by a handful of features, often conveniently borrowed from syntax), and the task is to develop a theory for such applications underlying a principled methodology for complete descriptive coverage of the material. The implementation of any such project would clearly demonstrate that the proverbial common case is not so common: There are many nontrivial decisions and choices to make, many of them widely applicable and extrapolable to large classes of data. In practice, the descriptive task is always inseparable from pure theory. This was well understood by the American descriptivists of the last first half of the last century, but it has not been part of the linguistic experience—or education—for several decades now.

Good theorists carry out descriptive work in full expectation that a close scrutiny of data will lead to often significant modifications of their *a priori* notions. Thus the sizable theoretical-linguistic scholarship on the lexical category of adjective barely touches on the concept of scale (see Raskin and Nirenburg 1995, pp. 4–21), whereas even a cursory look at the data shows that it is very natural to represent the meaning of a prevalent semantic subclass of adjectives[6] using scales: e.g., *big* (scale: SIZE), good (scale: QUALITY), or *beautiful* (scale: APPEARANCE). Consequently, the discovery of a few dozen scale properties underlying and determining the meaning of the statistically dominant subclass of English adjectives becomes an important descriptive subtask, basically completely unanticipated by the preceding theory.

Conversely, the much touted borderline case of the relative/qualitative adjective, such as *old* used relatively in *old boyfriend*, in the sense of "former," on the one hand, and qualitatively in *old man*, on the other, the case that has been presumed to be central to the study of the adjective (Raskin and Nirenburg 1995, pp. 16–17), has very little descriptive significance or challenge to it, fading and merging with other numerous cases of multiple senses of the same word within the adjective superentry and receiving the same, standard treatment.

There are many reasons to attempt to write language descriptions in the most general manner—the more generally applicable the rules, the fewer rules need to be written; the smaller the set of rules (of a given complexity) can be found to be sufficient for a particular task, the more elegant the solution, etc. In the area of the lexicon, for example, the ideal of generalizability and productivity is to devise simple entries that, when used as data by a set of syntactic and semantic analysis operations, regularly yield predictable results in a compositional manner. To be maximally general, much of the information in lexical entries should be inherited, based on class membership, or should be predictable from general principles.

However, experience with NLP applications shows that the pursuit of generalization promises only limited success. In a multitude of routine cases, it becomes difficult to use general rules—Briscoe and Copestake (1996) is an attempt to alleviate this problem through nonlinguistic means. The enterprise of building a language description maximizing the role of generalizations is neatly encapsulated by Sparck Jones: "We may have a formalism with axioms, rules of inference, and so forth which is quite kosher as far as the manifest criteria for logics go, but which is a logic only in the letter, not the spirit. This is because, to do its job, it has to absorb the *ad hoc* miscellaneity that makes language only approximately systematic" (1991, p. 137).

This state of affairs, all too familiar to anybody who has attempted even a medium-scale description of an actual language beyond the stages of morphology and syntax, leads to the necessity of directly representing, usually in the lexicon, information about how to process small classes of phenomena that could not be covered by general rules. An important goal for developers of NLP systems is thus to find the correct balance between what can be processed on general principles and what is idiosyncratic in language, what we can calculate and what we must know literally, what is compositional and what is conventional. In other words, the decision as to what to put into a set of general rules and what to store in a static knowledge base such as the lexicon becomes a crucial early decision in designing computational-linguistic theories and applications. Thus the question is: To generalize or not to generalize?

The firmly negative answer ("never generalize") is not common in NLP applications these days—after all, some generalizations are very easy to make, and exceptions

[6]It is especially true of English, where the grammatical realization of nonscalar, denominal modifiers is usually nominal.

to some rules do not faze too many people; morphology rules are a good example. A skeptical position on generalization, i.e., "generalize only when it is beneficial," is usually taken by developers of large-scale applications, having to deal with deadlines and deliverables. Only rules with respectable-sized scopes are typically worth pursuing according to this position (see Viegas et al. 1996b). The "nasty" question here is: Are you ready then to substitute "a bag of tricks" for the actual rules of language? Of course, the jury is still out on the issue of whether language can be fully explained or modeled—short of really knowing what is going on in the mind of the native speaker—with anything that is not, at least to some extent, a bag of tricks.

Rules and generalizations not only can be expensive but also may be in need of corrective work due to overgeneralization, and this has been a legitimate recent concern (see, e.g., Copestake 1995; Briscoe et al. 1995). Indeed, a rule for forming the plurals of English nouns, though certainly justified in that its domain (scope) is vast, will produce, if not corrected, forms like *gooses* and *childs*. For this particular rule, providing a "stop list" of (around 200) irregular forms is relatively cheap and therefore acceptable on the grounds of overall economy. The rule for forming mass nouns determining meat (or fur) of an animal from count nouns denoting animals (as in *He doesn't like camel*), discussed in Copestake and Briscoe (1992) as the "grinding" rule, is an altogether different story. The delineation of the domain of the rule is rather difficult (e.g., one has to deal with its applicability to *shrimp* but not to *mussel*, possibly to *ox* but certainly not to *heifer* or *effer*, and if one generalizes to nonanimal food, its applicability to *cabbage* but not *carrot*). Some mechanisms were suggested for dealing with the issue, such as, for instance, the device of "blocking" (see Briscoe et al. 1995), which prevents the application of a rule to a noun for which there is already a specific word in the language (e.g., *beef* for cow). Blocking can only work, of course, if the general lexicon is sufficiently complete, and even then a special connection between the appropriate senses of *cow* and *beef* must be overtly made, manually.

Other corrective measures may become necessary as well, such as constraints on the rules, counterrules, etc. They need to be discovered. At a certain point, the specification of the domains of the rules loses its semantic validity, and complaints to this effect are made within the approach [see, e.g., Briscoe and Copestake (1996) about such deficiencies in Pinker (1989) and B. Levin (1993) and Pustejovsky (1995, p. 10) about B. Levin's (1993) classes].

Criticism of the generative lexicon approach becomes, at this point, similar methodologically to Weinreich's (1966) charge of infinite polysemy against Katz and Fodor (1963): If a theory does not have a criterion stipulating when a meaning should not be subdivided any further, then any superentry may be infinitely polysemous, and in Katz and Fodor's interpretive semantics, the all-important boundary between semantic markers, to which the theory is sensitive, and semantic distinguishers, ignored by the theory, is forever moving, depending on the grain size of description Ultimately, it is easy to show that semantic distinguishers may remain empty because one would need to include everything in the description into the theory.

Similarly, a semantic lexicon that stresses generalization faces the problem of having to deal with rules whose scope becomes progressively smaller, i.e., the rule becomes applicable to fewer and fewer lexical units as the fight against overgeneration (including blocking and other means) is gradually won. At some point, it becomes methodologically silly to continue to formulate rules for creation of just a handful of new senses. It becomes easier to define these senses extensionally, simply by enumerating the domain of the rule and writing the corresponding lexical entries overtly.

Even if it were not the case that the need to treat exceptions reduces the scope of the rules postulated to do this, the overall size of the original scope of a rule, such as the grinding rule (see also Atkins 1991; Briscoe and Copestake 1991; Ostler and Atkins 1992), should cause a considerable amount of apprehension. Its relatively small size and the inapplicability of the grinding rule to meanings outside of it should raise a methodologic question about the nature of one's interest in this rule. Is it of interest to one per se, just because "it is there," one thinks, or is it representative of a certain type of rules? Unless one claims and demonstrates the latter, one runs a serious risk of ending up where the early enthusiasts of componential analysis found themselves; after years and years of perfecting their already excellent applications of their tool to terms of kinship (see, e.g., Goodenough 1956; Greenberg 1949; Kroeber 1952; Lounsbury 1956), that the semantic field of kinship was unique in rendering itself applicable to the method and that other semantic fields quickly ran the technique into the ground through the runaway proliferation of semantic features needed to be postulated for covering those fields adequately. We have found no explicit claims in all the excellent articles on grinding and the blocking of grinding that the rule addresses a property, such that other classes of words also would possess, leading to rules similar to the grinding rule. In other words, amazingly, the concern for maximum generalization with one narrow class of words is, inexplicably, not coupled with a concern for the portability of the methodology outside that class.

We believe that the postulation and use of any small rule, without an explicit concern for its generalizability and portability, is not only bad methodology but also bad theory because a theory should not be littered with generalizations that are not overtly useful. The greater the number of rules and the smaller the classes that are their scopes, the less manageable—and elegant—the theory becomes. Even more important, the smaller the scope and the size of the class, the less likely it is that a formal syntactic criterion (test) can be found for delineating such a class (the use of such a criterion for each rule seems to be a requirement in the generative lexicon paradigm). This means that other criteria must be introduced, those not based on surface syntax observations. These criteria are, then, semantic in nature (unless they are observations of frequency of occurrence in corpora). We suspect that if the enterprise of delineating classes of scopes for rules is taken in a consistent manner, the result will be the creation of an ontology. Since there are no syntactic reasons for determining these classes, new criteria will have to be derived, specifically, the criteria used to justify ontologic decisions in our approach.

This conclusion is further reinforced by the fact that the small classes set up in the battle against overgeneralization are extremely unlikely to be independently justifiable elsewhere within the approach, which goes against the principle of independent justification that has guided linguistic theory since Chomsky (1965), where the still reigning and, we believe, valid paradigm for the introduction of new categories, rules, and notational devices into a theory has been introduced. Now, failure to justify a class independently opens it to the charge of ad hoc-ness, which is indefensible in the paradigm. The only imaginable way out lies, again, in an independently motivated ontology.

## 5. SUPPLY-SIDE VERSUS DEMAND-SIDE

Two distinct methodologic positions can be detected in lexical semantics today. The GL approach belongs firmly to what could be called the *supply-side* school of thought in

contemporary lexical semantics (see Nirenburg 1996), whereas the Mikrokosmos project belongs to the *demand-side* school. Let us try to define the differences as well as the commonalities between the two approaches.

Traditions of research in linguistic semantics can be distinguished in the following way suggested by Paul Kay: "Students concerned with lexical fields and lexical domains ('lexical semanticists') have interested themselves in the paradigmatic relations of contrast that obtain among related lexical items and the substantive detail of how particular lexical items map to the nonlinguistic objects they stand for. 'Formal semanticists' (those who study combinatorial properties of word meanings) have been mostly unconcerned with these issues, concentrating rather on how the meanings of individual words, whatever their internal structure may be and however they may be paradigmatically related to one another, combine into the meanings of phrases and sentences (and recently, to some extent, texts). Combinatorial semanticists have naturally been more concerned with syntax, especially as the leading idea of formal semantics has been the specific combinatorial hypothesis of Fregean compositionality" (1992, p. 309).

Formal semantics, as defined by Kay, is rejected by both sides in lexical semantics. While there are many distinctions among the approaches to lexical semantics, we would like to focus here on one dimension of differences. Some researchers are concentrating on describing the paradigmatic relations of contrast and, more important, semantic derivation relations among lexical meanings without a reference to knowledge about the world (Kay's "nonlinguistic objects") and, consequently, deemphasizing the definition of core lexical meaning. Some other researchers stress the mapping between lexical items and the nonlinguistic objects they stand for and, consequently, make the definition of core lexical meaning a central goal. This task is declared by the former group to be outside their purview: "Undoubtedly, the inferential processes involved in language comprehension extend beyond the limited mechanisms provided within unification-based formalisms; however, it is not clear yet whether lexical operations *per se* require them" (Briscoe 1993, p. 11).

The former group also takes the task of describing lexical meaning to be almost seamlessly connected to lexicalized syntactic theory: "[T]he role of the lexicon in capturing linguistic generalizations[:] more and more of the rules of grammar are coming to be seen as formal devices which manipulate (aspects of) lexical entries, and in the sense that many of these rules are lexically governed and must, therefore, be restricted to more finely specified classes of lexical items than can be obtained from traditional part-of-speech classifications" (Briscoe 1993, p. 2), whereas the other group does not treat syntactic information as privileged but just as one of many clues helping to determine meaning.

Methodologically, the first group is pursuing the formulation of lexical meaning theories as algebraic entities in which the maximizing factor is formal elegance, descriptive power (attained, for instance, through generalization of rules), economy of descriptive means, and absence of exceptions. As a result of this, difficult issues that cannot at present be subject to such discipline are not treated—they are either ignored or declared to be outside the purview of the theory. Thus, for instance, the issue of basic lexical meaning is rarely discussed in this tradition, whereas attention centers on regularity of meaning shifts (and, most recently, differentiate—see, e.g., Hirst 1995; Johnston et al. 1995) under the influence of paradigmatic morphosyntactic transformations and of unexpected syntagmatic cooccurrence of lexical forms in texts. The first group of researchers is much more dependent, therefore, than the second one on the availability of such ready-made or easily obtainable artifact resources as machine-readable dictionaries, tagged corpora, frequency lists, etc. It is the methodology of the first group that

can be reasonably and inoffensively referred to as a supply-side approach; it is based only on what can be offered by the state of the art (or, we should perhaps say, science) in the formal description of linguistic theory divorced from world knowledge.

For supply-siders, the main issues include (among others)

- Lexical semantics as outgrowth of lexical grammar, or grammatical semantics
- Lexical semantics as a counterpoint to formal semantics, i.e., an emphasis on lexical meaning rather than on compositional sentence meaning
- Formalisms for representing lexical knowledge (e.g., the LRL of the ACQUILEX project): feature structures, typed feature structures, and rules for their symbolic manipulation, default inheritance hierarchies, etc.
- Establishing lexical rules for relating word senses
- Constraining the power of lexical rules so that they do not overgenerate
- Capturing valuable generalizations about applicability of lexical rules

A strong temptation for a supply-sider is provided by the availability or an easy accessibility of a computational procedure that seems to yield results that, when a real application is contemplated, may prove to be usable. How about, say, a procedure that runs over a very large corpus and furnishes a word list? Can one assume that this procedure should be adopted immediately as part of an NLP project of the future? It is fair to say that, for a supply-sider, the answer is yes. In fact, a supply-sider's arsenal consists of any such available or easily developable procedures.

The second faction tends to be more cautious with respect to such procedures. Before incorporating one or committing to develop another such procedure, it wants to make sure that there is a legitimate place for this procedure in the overall architecture of an NLP system under development. Thus, is it a given that one needs a word list at any stage of analysis or generation? Or is it possible that the words will appear at the input and need to be analyzed morphologically and lexically as part of the system analyzer, which will never actually use the word list as a useful resource?

One may be tempted to think here that the two approaches being opposed correspond to the dichotomy between the linguistic engineering (LE) approach, for supply-side, and NLP, for the other side [see also Sheremetyeva (1997) for more discussion of LE and its relation to NLP]. In such a dichotomy, the distinctions run, apparently, along these lines: NLP is more theoretical, whereas LE is more practical; NLP is interested both in developing working systems for particular tasks and—probably even more so—in using computer implementations as confirmations or falsifications of hypotheses about human processing of language, whereas LE is interested only in the former; accordingly, NLP is likely to pay less interest than LE to the available resources and ready-made and easily developable procedures to set and achieve the realistic goals of today, favoring instead more theoretical research for developing superior systems in the future. The reality is, however, different. Many supply-siders would welcome LE as just sketched; it is they, however, who typically work toward systems of the future, warehousing all the easily available online resources and procedures as automatically usable in those systems. It is the other faction that has to be cautious about such a general mobilization of all available techniques because the demand-side paradigm is always, by definition, interested in actually developing a system and has to concern itself with the compatibility of such a resource or procedure and the general system architecture. In fact, to put it rather bluntly, the automatic approval of each online resource or procedure for potential use is bad engineering; highly principled selectivity is good engineering. Leaving bad LE aside and without ascribing this defenseless position to

anybody in the field, we can conjecture that the theoretical difference between NLP and good LE lies in that the former applies the entire theory of language to the development of language processing systems, whereas LE applies a reasonable and justified subset of such a theory, with more limited goals. What follows from this position is that both approaches share criteria of quality and use only those resources which fit together and promote the optimal results as opposed to those resources whose only merit is their easy availability.

This group's theoretical work is different in other ways as well. Wilks (1994, p. 586) illustrates this difference well: "There is a great difference between linguistic theory in Chomsky's sense, as motivated entirely by the need to explain, and theories, whether linguistic, AI or whatever, as the basis of procedural, application-orientated accounts of language. The latter stress testability, procedures, coverage, recovery from error, non-standard language, metaphor, textual content, and the interface to general knowledge structures." Thus the methodology of the second faction can be characterized as demand-side, because it pursues theories that are capable of supporting practical applications.

This methodology should not be squarely equated with language engineering either. Indeed, the demand-side tradition does not, as is often believed, presuppose using a pure "bag of tricks" approach. Exponents of this approach, we have demonstrated our overriding concern for theoretical foundations for everything we do throughout this article. The approach is based on the notion of a society of microtheories describing language as well as language-processing phenomena (e.g., meaning assignment heuristics), and it grounds the lexical meaning in an artificial model of the world, as seen by speaker/hearer; the theory also includes the specification of a formalism (for representing not only lexical meaning and world knowledge but also the meaning of texts) and of a computational system for deriving text meaning from text input as well as producing text output from text meaning representation.

Note that the theories produced by the supply-side group also can strive to support practical applications, but they are clearly a side effect of theoretical pursuits. In practice, a lot of additional work is always needed to implement a supply-side theory as a computer program because such theories are usually not formulated with such processing in mind and often do not easily lend themselves to such applications. The problems with demand-side theories include difficulties in algebraic definition and testability and falsifiability exclusively through experimentation.

Burning issues for the demand-siders include (among others)

- Determining the number of lexemes in a lexicon (breadth)
- Establishing criteria for sense specification and delimitation
- Granularity issue I: determining the threshold of synonymy (beyond which two word senses would share a meaning)
- Granularity issue II: determining the threshold of ambiguity (i.e., the appropriate number of senses for a lexeme, whether listed or derived with the help of lexical rules)
- Tuning the depth and breadth of lexical description to the needs of a particular application
- Enhancing the levels of automaticity in lexical acquisition

Specific issues that have, to a greater or lesser degree, been proven important to both supply-and demand-siders include

- The theoretical and applicational status of the lexical rules

- The typology and inventory of the lexical rules
- The place of lexical rules in the control structure of an NLP system

Obviously, both sides are interested in lexical meaning, and while the one side is driven by the availability of acceptable tools and the other by the actual practical goals, both also share a commitment to a common theoretical paradigm, which is definitely post-Chomskian.

## 6. CONCLUSION

Throughout this article, we tried to emphasize the importance for lexical semanticists, independently of the choices they make on the these issues, to be explicit about their premises and goals. Frequently, when lexical semanticists meet, they politely perpetuate the illusion that they all work toward the same goal of creating and optimizing large lexicons for non-toy-meaning-based NLP systems, such as MT systems. It is clear that, for some approaches, this is a more or less remote goal, and they assume that every development in their own approach automatically brings us closer to it. For others, this goal is the next deadline and the subject of their grant report.

These different scientific and sociologic realities often determine the crucial distinctions in priorities and values as well as in the choice of theoretical and methodologic support. A misunderstanding of these distinctions leads to attempts to judge one approach by the rules of another, and there is not much value in that.

## ACKNOWLEDGMENTS

The research reported in this article was supported by Contract MDA904-92-C-5189 with the U.S. Department of Defense. The authors are grateful to James Pustejovsky and Yorick Wilks for constructive criticism of an earlier draft of this article and to the five anonymous reviewers.

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