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No Nouns, No Verbs: Psycholinguistic Arguments in Favor of Lexical Underspecification

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Abstract

It is often assumed that the primitive units of grammar are words that are marked for grammatical category (e.g., DiSciullo, A.M., Williams, E., 1987. *On the Definition of Word*: MIT Press, Cambridge, MA). Based on a review of research in linguistics, neurolinguistics, and developmental psychology, we argue that dividing the lexicon into categories such as noun and verb *offers* no descriptive edge, and adds unnecessary complexity to both the theory of grammar and language acquisition. Specifically, we argue that a theory without lexical categories provides a better account of creative language use and category-specific neurological deficits, while also *offering* a natural solution to the bootstrapping problem in language acquisition (Pinker, S., 1982. A theory of the acquisition of lexico-interpretive grammars. In: Bresnan, J. (Ed.), *The Mental Representation of Grammatical Relations*. MIT Press, Cambridge, MA, pp. 655– 726).

Introduction

Traditionally, the analysis of particular grammars and their acquisition has made appeal to grammatical categories such as noun, verb, adjective, etc. Language acquisition has been imagined, in part, to involve establishing lexical items and marking them individually with features such as +/-N(oun), and +/-V(erb). By observing the behavior of tokens marked differentially for noun and verb features, the child can construct phrase structure rules, set parameters, or whatever may be required of the particular theory being proposed (Chomsky, 1986a; Pinker, 1984). However, recent developments in linguistic theory have provided a framework within which it has become possible to question the lexical distinction between nouns and verbs, without necessarily affecting descriptive adequacy (Halle and Marantz, 1993, 1994; Marantz, 1997; Harley and Noyer, 1999). According to the approach, lexical roots like $\sqrt{grow}$ and $\sqrt{destroy}$ are category neutral; “when placed in a nominal environment the result is a ‘nominalization’; when the roots are placed in a verbal environment they become verbs” (Marantz, 1997). Consequently, language acquisition does not involve marking lexical items for grammatical category features.

Given this modification, the picture of how acquisition proceeds is radically altered. One major consequence, of particular interest to the present paper, is that certain psycholinguistic accounts of early acquisition cannot be maintained. For example, solutions to what Pinker (1984) termed the “bootstrapping” problem in language acquisition hinge on lexical distinctions such as noun/verb and mass/count. According to one such approach, known as “semantic bootstrapping” (e.g., Grimshaw, 1981; Macnamara, 1982; Pinker, 1984), children exploit unlearned mappings between syntax and semantics to identify

abstract syntactic units such as nouns, verbs, and adjectives in the primary linguistic data (PLD). Clearly, a theory without lexical categories requires some other account of how children come to identify the syntactic structures in their PLD and how they establish abstract, language particular representations.

The consequences for early acquisition may constitute some of the most compelling reasons to adopt a theory without lexical marking. Not only does lexical underspecification reduce the learning of formal features and conversion rules, it also permits an intuitive solution to the bootstrapping problem. To demonstrate this, the present paper evaluates lexical underspecification from both linguistic and psycholinguistic perspectives, and sketches an account of early acquisition.

Upon demonstrating that a theory without lexical categories provides a relatively adequate description of linguistic representation, we discuss some objections that the theory might elicit from psycholinguistic circles, specifically regarding grammatical overgeneration and evidence from the study of category-specific aphasic impairments. We then move to the problem of acquisition, and show that lexical under-specification greatly simplifies the process, while providing a solution to the bootstrapping problem that is supported by evidence from linguistic and psychological inquiry.

A Grammar Without Nouns and Verbs: The Case of Distributed Morphology

Until quite recently, almost all theories of how language is presented in the mind had assumed that the lexicon projects word-sized units to syntax. Words, according to this view, are complex objects consisting essentially in a special sound/meaning correspondence, argument structure profile, and categorical status among other things. By this view, words have been seen to come about in one of two ways. First, memorized forms

of words can be listed explicitly, providing alternations of particular roots, such as mass/count, noun/verb, etc. Second, words can be generated by lexical conversion rules, thus allowing the derivation of nouns from verb roots (e.g., *create* → *creation*), and verbs from noun roots (e.g., *a saddle* → *to saddle*). For example, the structure in (1) might be attributed to lexical verbs:

$$(1) \begin{pmatrix} \text{Verb} \\ \alpha \text{ Phonological Specification} \\ \beta \text{ Argument Structure} \\ \gamma \text{ Tense} \\ \delta \text{ Aspect} \end{pmatrix}$$

Perhaps inaccurately after Chomsky (1970), this approach has been called the *lexicalist hypothesis*, or *lexicalism* (see DiSciullo and Williams, 1987; Lieber, 1992; and Selkirk, 1982), and can be summarized as follows:

- (2) Lexicalism: words are created in the lexicon, by processes distinct from the syntactic process of putting morphemes/words together. Some phonology and some structure/meaning connections are derived in the lexicon, while other aspects of phonology and other aspects of structure/meaning relations are derived in (and after) the syntax (Marantz, 1997: 201).

In contrast to this traditional approach, theories such as Distributed Morphology (DM) minimize the explicit listing of special sound/meaning pairings, argument structure alternations and categorical specifications (Halle and Marantz, 1993, 1994; Marantz, 1997; Harley and Noyer, 1999). This is achieved by positing multiple, distributed points of insertion into syntax (for example, separating root insertion from insertion of phonological forms), and by enriching the correspondence between syntactic structure and meaning. For example.

According to DM, alternations such as that between transitive and intransitive *grow* result from a single root $\sqrt{\text{grow}}$, which can be optionally inserted into either a transitive or intransitive construction, with each combination of root and structure yielding a particular composed meaning (see Harley and Noyer, 1999; Goldberg, 1995 for similar suggestions). Likewise, alternations between mass and count forms of words can be explained as contextual, where a root's status as mass or count is determined by the construction into which it is inserted (Bunt, 1979; also, see Nemo, 2001, for a similar account of functional morphemes such as *but*). In this way, DM proposes that words are built in the syntax by the same mechanisms that build phrases. This view of grammar can be summarized as follows:

- (3) Non-lexicalism: words are created in the syntax by processes not distinct from syntactic processes of putting morphemes/words together. No phonology or structure-meaning connections are derived in the (narrow) lexicon; the lexicon is exploded into a number of distributed, non-computational lists, which independently contribute roots, sounds, and special meanings.

As noted by Marantz (1997), Chomsky's *Remarks on Nominalization* is often touted as the birthplace of lexicalism, although in fact the paper neutralizes arguments for what is now called the lexicalist position. As part of a larger discussion, Chomsky (1970) noted that while the formation of certain expressions can be given explanation through transformational rules in the syntax (circa 1970), others cannot. For example, whereas gerundive nominals (e.g., *growing*, *destroying*) seem to bear a systematic relationship to sentences containing their associated verbs (e.g., *to grow*; *to destroy*), so-called "derived nominals" do not (e.g., *growth*, *destruction*).

The point is apparent in examples (4)–(6):

- (4) a. John grows tomatoes.
- b. Godzilla destroyed the city.
- (5) a. John's growing tomatoes (is a good idea).
- b. Godzilla's destroying the city (is not a good idea).
- (6) a. *John's growth of tomatoes (was not dangerous).
- b. Godzilla's destruction of the city (was dangerous).

In (4) the verbs *grow* and *destroy* both allow agent and theme arguments. Similarly, in (5), both gerundive nominals allow both kinds of argument. However, in (6), only *destruction* allows both agent and theme to be expressed, while *growth* allows only the theme. Such examples were taken by Chomsky to support his version of lexicalism, since transformational rules could not provide a unified account of how to derive the transitive form of *destruction* while prohibiting that of *growth*. It is crucial to note that, while directed at syntactic transformations, Chomsky's arguments also applied to proposals positing lexical word formation. In either case, rules designed to explicate conversion of verbs to nouns make the wrong predictions; any rule that would make the right prediction about deriving *destruction* from *destroy* would correspondingly make the wrong prediction about *growth* and *grow*. Thus, Chomsky's discussion was about how to replace such (deficient) rules altogether, whether by extending notions of base components (e.g., altering the status of lexical categories), or by altering the kinds of transformations allowed in the syntax. Chomsky opts for the former possibility in *Remarks on Nominalization*, and in extending his notions of base rules he goes so far as to suggest the elimination of lexical categories like noun, verb, and adjective:

We can enter *refuse* in the lexicon as an item with certain fixed selectional and strict subcategorization features, which is free with respect to the categorical features [noun] and [verb]. Fairly idiosyncratic morphological rules will determine the phonological form of *refuse*, *destroy*, etc., when these items appear in the noun position (Chomsky, 1970: 21).

Given such a framework, the difference between roots such as $\sqrt{grow}$ and $\sqrt{destroy}$ is handled by features of their respective semantic categories. Marantz (1997), based on Levin and Rappaport Hovav (1995), proposes that the two roots are distinguished by a feature of internal/external causation. For example, given that *growth* can come about spontaneously, it is marked as *+internal causation*. *Destruction*, on the other hand, cannot come about spontaneously, and thus is marked as *+external causation*. Roots marked as *+internal causation* are not interpreted as having an agent unless used in a verb position, while roots marked as *+external causation* are understood as being caused by an agent both when used as noun and verb.

To summarize, asymmetries in how given roots appear as nominalizations can be handled by a model of grammar where lexical roots are unspecified with respect to grammatical category distinctions like N/V, and where so-called “encyclopedic” information (such as features regarding internal/external causation) accounts for the acceptability or unacceptability of given constructions. Following the null hypothesis with regards to lexical marking, DM posits no categorical distinctions in the lexicon, and requires no special lexical rules (e.g., for conversion). Instead, like phrases, words are built in the syntax. Roots are inserted into syntax where functional heads determine their status as nouns

or verbs.¹ In turn, phonological forms are inserted based on the featural status of roots in context, constituting a process of “late-insertion” not entirely unlike two-stage lexical models found in the psycholinguistic literature (e.g., Bock, 1986; Butterworth, 1989; Garrett, 1993; Levelt, 1992).

Some apparent problems for lexical underspecification

In response to the non-lexicalist model of grammar discussed above, two largely psycholinguistic concerns are likely to be raised. The first objection pertains to overgeneration: “If there really are no nouns and verbs, and roots are freely projected to either NP or VP contexts in the syntax, then why don’t we use *root-x* as a verb?” The second objection pertains to evidence from aphasia and category-specific noun/verb impairments: “Hasn’t it been shown that certain patients are selectively impaired for nouns or verbs? Doesn’t this evidence mean that nouns and verbs *must* be marked in the lexicon?”. Each of these questions requires careful consideration. However, as it turns out, rather than arguing against the non-lexicalist approach to grammar, the points that arise seem to actually recommend lexical under-specification. As will be shown, lexicalism encounters the same problems regarding overgeneration as does non-lexicalism, but requires a greater amount of machinery to deal with it. Also, whereas non-lexicalism appears to be consistent with evidence from aphasia, certain lexicalist models of grammar do not make the correct predictions about category-specific impairment. Instead, the potential problems that arise point to more global questions concerning theories of

¹ All that is syntactically required to support the notion of categorial functional heads is a syntactic system that allows for complex heads in the phrase structure (consisting of the root plus the functional head). The most obvious candidate for a complex head is the following structure where R represents the root and F represents the functional head: [X-head R F]. This structure is compatible with Bare Phrase Structure (Chomsky 1996: 241–249) and, in practice, X-bar theory (for one example see Haegeman 1991: 578). Another possible candidate is the “adjunction” structure as follows: [X-head-1 R [X-head-2 F]]. Such a structure is compatible with a stricter form of X-bar theory and even Kayne’s (1994) Linear Correspondence Axiom.

grammar, and illustrate that underspecification may *offer* the simplest solution.

First Problem: Why Isn't Root-X Used as a Verb?

One objection that lexical underspecification might draw, especially in psycholinguistic circles, is that the theory seems to overgenerate, predicting the use of any root as verb, noun, count, or mass. According to the objection, such flexibility is not attested in language use, and would not be considered grammatical were it to be explored. For example, the sentences in (7) present apparently clear-cut cases of unacceptable utterances, where roots that ordinarily appear only as nouns appear in verb contexts:²

- (7) a. *John spidered yesterday.
- b. *John falled in France this year.
- c. *Don't broom my mess.
- d. *I'm going to basket those apples.
- e. *You're gunning him.
- f. *He Steve-ed me again.

There are two arguments as to why such sentences are not a problem for lexical underspecification. First, we believe that overgeneration is equally (un-)problematic for lexicalist theories of language that employ conversion rules to derive novel coinages.

² The zero-derivation found in our example sentences reflects an accidental property of English, upon which our argument does not hinge. We would like our discussion to apply universally, not only to languages where noun and verb expressions of roots are phonetically identical (e.g., *a swim/to swim*). According to theories like DM, the *homophony* of noun and verb forms is less significant than phonetic *similarity*, which provides evidence of a shared root. According to our approach, English is treated like Hebrew, where roots are inexpressible by themselves, only becoming expressible when inserted into verb or noun constructions. For example, the verb meaning “to write” in Hebrew is *katav*, while the noun for a piece of writing is *ktiva*. These forms are derived when the root consonant triad *k-t-v*, is inserted into either a noun or verb template. For example, *CaCaC* is a template for a verb environment, where the ‘C’ represents the places to insert the consonants. Thus, throughout our discussion, it is not crucial that the noun and verb forms be identical, but only that phonetic evidence exists for a shared root.

Although lexicalist theories attempt to constrain their grammars using lexical marking, conversion of certain items is nonetheless possible, resulting in deverbal nominalizations (e.g., *He took a swim*) and denominal verbs (e.g., *She corralled the horses*). The problem is that no indication is normally given as to which lexical items can undergo such conversions and which cannot. To the extent that a theory with lexical underspecification might be held responsible for constraining the use of roots, lexical theories should be equally responsible for constraining the overgeneration of conversion rules.

However, it is not clear that theories of grammar should, or even could be held responsible for constraining productivity in the manner indicated (so as to prohibit 7a–f, but allow other typical derivations). Instead, objections concerning overgeneration—e.g., why is such and such a root never *used* as a verb?—should be neutralized when a proper distinction is maintained between linguistic productivity and frequency (or normativity) of productions (see Dressler and Ladanyi, 2000). Grammatical productivity is a concern for developing a theory of I-language (as defined by Chomsky, 1986b), whereas frequency or normativity of productions is not.

That is, theories of *grammar* are designed to account for the set of possible grammatical utterances, and nothing more. What one knows about language, and what one does with this knowledge are two different fields of inquiry (the former is concerned with explaining mental systems, and the latter is concerned with describing behavior). For the present discussion, the important point is that the sentences in (7) are not necessarily ungrammatical, but rather could be viewed as merely unacceptable. That is, the sentences do indeed sound bad, but not necessarily for reasons stemming from rules of grammar (indeed, no rule of grammar currently presents itself as a candidate for excluding these

and allowing other flexible noun/verb uses). For example, the use of *spider* in example (7a) illustrates that certain forms may be suppressed due to a lack of cogent interpretation, largely stemming from a lack of feasible pragmatic context (Corbin, 1997; Dressler and Ladanyi, 2000; Marle, 1992). However, where context is sufficiently rich, such verb coinages become entirely acceptable, as is shown by (8) below.

(8) The agile climber spidered up the face of the mountain.

The use of *fall* as a verb in (7b) demonstrates blocking by homophony, whereby coinages with apparent homonyms are unacceptable in ambiguous sentential contexts (see Bauer, 1983; Clark, 1987, 1993; Rainer, 1988, for discussion). In such contexts, homophony is confusing, and so the coinages are judged bad. Where pragmatic context is sufficiently unambiguous, or where precluding homonyms are absent, such expressions should be judged as acceptable (as in 9):

(9) John summered/wintered in France this year.

Sentences (7c–e) suffer a similar problem in their use of *broom*, *gun*, and *basket* as verbs, this time relating to blocking by synonymy. Expressions such as *broomed* are precluded by existing synonyms like *sweeping*. However, where a precluding element does not exist or cannot be accessed, like in the case of the child acquiring language or the anomic aphasic, such expressions as *brooming* are commonplace. In fact, sentences (7c–e) are drawn directly from child language corpora (Clark, 1993). For children, whose vocabularies are small, spontaneous coinages should at first show many apparent errors, since they lack pre-emptive vocabulary (Clark, 1993). For instance, according to Maratsos and Chalkley (1981), the most frequent grammatical category “error” is the

use of verbs in noun contexts. Examples in early child speech include: “Give me the rub” (eraser), and “Where’s the shoot?” (gun), (Smith, 1933). Use of roots that ordinarily appear only as nouns in verb contexts is also common in child speech: “You’re gunning him” (Kuczaj, 1978), “Mommy trousers me”, “Don’t broom my mess”, “It’s trucking”, and “I’m going to basket those apples” (Clark, 1982). Systematic studies of noun and verb use in English indicate that children use many words flexibly from the earliest stages of acquisition (e.g., Barner et al., 2001), while studies of languages like Hebrew indicate that children produce many noun and verb innovations in both spontaneous and elicited speech (Berman, 1999). For example, in her investigation of Hebrew noun-verb acquisition, Berman (1999) reported 493 innovative items in spontaneous speech samples, of which approximately 60% were verbs and 40% were nouns. Also, in a structured elicitation task investigating 60 children, Berman found that 3-year-olds nominalized creatively on 83% of trials, a figure that only increased with age. By age 4, the number of innovations reaches near ceiling (87%), as potential coinages are blocked by existing vocabulary (see Clark, 1993).³

Finally, the use of proper-name roots as verbs is also normally deemed unacceptable (as in 7f), but can be judged acceptable if a unique bearer of the name (in a realm of discourse) is associated with a characteristic action. Such is often the case with “in-jokes” concerning peculiar behavior of acquaintances, such as the lateness of Steve (*He Steved me again* to mean *He showed up late again*). More common is the use of names of famous persons, such as in (10).

(10) He Olly-Northed the company’s financial records

³ Note that this does not entail a change in the child’s grammar (i.e. retreat). Rather, blocking of vocabulary is seen to operate at an extra-linguistic level, without effect on lexical or syntactic representations.

One reason why proper-name roots are not often used as verbs may be that they bear systematically different meanings from grammar to grammar. Whereas it is common for strangers to agree on the meaning of a word like *cat*, it is far more rare for them to understand the same thing by the word *Steve*. Also, even under ideal circumstances use of proper-name roots as verbs should be rare, since people by nature perform a multitude of actions, making them difficult to pin with just one. *Steve* isn't *just* late in life (hopefully), and so the verb *to Steve* may be so under-specified as to be uninformative, no matter how well *Steve* is known (i.e. the lexical root for words used as names are not specified for functions or characteristic actions). Nevertheless, when a rich context of interpretation is provided pragmatically, or when a name is uniquely associated with a person or thing that has one characteristic function, use of names as verbs should sometimes attain acceptability, as is seen in the following passage from computer columnist David Blatner:

There is no greater glory than becoming a verb. Font maven Kathleen Tinkel bestowed that honor on me after I gave her the world's best garlic press: she later told me she no longer presses garlic, she "Blatnerizes" it. It happens with products, too. People xerox important papers, even on Canon copiers, and later Fed Ex them, even if they use Airborne or another overnight delivery service (Blatner, 2000).

Beyond the points already discussed, Dressler and Ladanyi (2000) indicate a variety of additional factors that might contribute to determining probability of word-formation, including pragmatic incompatibilities related to reference (Bauer, 1983; Corbin, 1997), pragmatic self-evidence (e.g., *bearded man* versus **eyed man*), stylistic convention and various socio-linguistic considerations. In addition, Clark and Clark (1979)

provide a comprehensive list of denominal verbs in English, and how the use of such verbs might be constrained by extra-linguistic or pragmatic factors.

In summary, we suggest that neither lexicalism nor non-lexicalism is better equipped to account for certain classes of overgeneration. Although some unacceptable forms may be explained in a reasonably principled fashion, both under-specification and conversion rules generate forms that are not attested in language use. However, we suggest that a great number of sentences commonly thought to be ungrammatical are instead only unacceptable, and that the unacceptability of these certain sentences may result from a multitude of extra-linguistic sources,⁴ not all of which fall within the boundaries of coherent scientific study.⁵ In any case, non-lexicalism matches its alternative in terms of descriptive adequacy, and does so without lexical marking, and without conversion rules.

Second Problem: Evidence from Category-Specific Impairments in Aphasia

A second natural objection to lexical underspecification is that it is inconsistent with evidence from aphasia that shows category-specific noun/verb impairments. For example, patients diagnosed with agrammatism are often reported to show reduced fluency in production of verbs, while anomorphic aphasics are characterized by their difficulty in producing

⁴ There is a possibility that grammatical factors may come into play for limiting certain utterances. For example if a root in Hebrew were not a consonant triad, but had a phonological form like $\sqrt{grow}$ in English (i.e. /gro/), then such a root could not be combined with a functional morpheme that is normally represented as a template into which consonants are inserted (see footnote 2). In other words, in principle, the underlying representation is permitted but the derivation crashes due to phonological considerations. However, for now we leave such issues for a later date.

⁵ Although we entertain that normativity might play a role in constraining language use, this does not mean that we accept the notion that there exists a cohesive, individuated public language that could be the object of linguistic study. For example, the notion of normativity might enter internalist theories of mind where it is claimed that language users *perceive* the existence of norms, and establish something akin to post-processors (extra-linguistic operations) that constrain use. In addition to explaining lack of flexibility for some words, we feel that something like this would be needed to account for the phenomenon of those language users who (attempt to) follow prescriptive grammars.

nouns. Furthermore, such difficulties do not seem to be artifacts of problems with semantic categories such as *object* or *action*, but seem to affect the categories noun and verb. The crucial question, however, is *where* these categories are affected.

In a study by Caramazza and Hillis (1991), it is noted that selective impairment of nouns and verbs is consistently modality-specific, affecting either speech or orthography but not both. For example, Caramazza and Hillis (1991) reported a patient, who, although impaired in her spoken production of target verbs, showed no corresponding problem writing the same words. Also, this patient showed no difficulty comprehending the words she could not produce in speech, whether by orthographic or spoken modality. As noted by Caramazza and Hillis (1991), such behavior would not come about if verb roots themselves were damaged, since this would predict problems with both modalities, and with both comprehension and production. For this reason, they suggested that while lexical roots themselves remain intact, selective impairment may result from damage to one of two discrete *output lexicons*, housing orthographic and phonological forms of words, respectively

In further support of this, several studies have reported patients that show impairment in only orthography. For example, two patients described by Caramazza and Hillis (1991) and Baxter and Warrington (1985), respectively, were selectively impaired in their production of written verb forms, while a third patient demonstrated a selective noun impairment in written production only (Zingeser and Berndt, 1988).

In addition to these cases, Hillis and Caramazza (1995) reported a patient who showed selective impairment for verbs in written comprehension, but for nouns in oral

production. Such problems could not likely result from damage to root morphemes or semantic representations. In trying to account for such deficits, Caramazza and Hillis (1991) hypothesized that it is modality-specific output and input lexicons for speech and orthography that are impaired.

Furthermore, Caramazza and Hillis (1991) claimed that such results present “clear evidence for the hypothesis that knowledge of the phonological and orthographic forms of the words is organized by grammatical category” (p. 789), mirroring Baxter and Warrington’s (1985) assertion that “there is a lexicon for orthographic knowledge and this is categorical in its organization” (p. 662).⁶

However, equally consistent with available data is the possibility that neurological deficits result from a problem with the process of mapping from the verb functional head to phonological form, or vice-versa, in the case of a verb deficit (while a noun deficit would involve the noun functional head). For example, within a theory employing lexical underspecification, the verb *climb* would result from the insertion of $\sqrt{climb}$ into a verb functional head context. Therefore, any problem mapping the verb functional head to phonological form could cause a problem mapping the entire verb representation to phonological form, resulting in either total or partial omission, in the case of production.

The explanation involving lexical underspecification is supported on two counts. First, it is commonly observed that patients who show difficulty producing verbs do not always omit target forms from their speech. Instead, patients commonly produce the target verb in its bare infinitive form (i.e. bare root form), demonstrating a particular difficulty

⁶ Although it is not our intention to adopt or deny this claim, factors independent to the issue of lexical underspecification would lead us to prefer a view whereby Caramazza and Hillis’ proposal involving distinct input and output lexicons be recast, such that what are affected are not modality specific input or output lexicons, but operations of language processing, which are specific to either production or comprehension of, for example, orthographic strings. However, we leave this issue for a later date.

with verb morphology. Such behavior indicates that while phonological forms for roots are available, patients are having difficulty with the mapping of phonology to morphology specific to the particular functional category (e.g., VP). Second, the hypothesis that category-specific impairments reflect problems with phonology for functional heads predicts that some roots, which are normally used with frequency in either noun or verb contexts, will appear as only one or the other in patients with a category-specific impairment. In fact, this is exactly what is found. Papers by Berndt et al. (1997), Miceli et al. (1984)⁷ and McCarthy and Warrington (1985) each describe patients who produce nominalized forms of target verbs, including: “The washing up”, “The wiping up”, “The jumping”, and “The climber was up the mountain”.

Such results are important because (1) they suggest that impairment affects the insertion of phonological and/or orthographic forms but not root morphemes, a result consistent with lexical underspecification, and (2) they provide evidence against theories that have lexical markings and conversion rules. For such theories, nominalizations like *climber* are derived from verb roots. Consequently, if affected verbs cannot be produced in verb positions, then they should also not be produced as their nominalized positions. For this reason, to explain the evidence from category-specific impairments, lexicalist theories must give up on conversion rules, and stipulate that the nominalized forms constitute separate lexical entries. Theories such as DM, on the other hand, can maintain the relation between noun and verb forms of a given root, without marking the roots as verbs in the lexicon. Specifically, noun and verb forms of particular roots differ by virtue of their association with a particular functional head in the syntax (i.e. noun or verb heads

⁷ Unlike the other neurological studies mentioned, the Miceli et al. paper reported on data from Italian speakers and not English speakers.

respectively), and thus the representation of a nominalized form, for example, does not necessarily contain a verb functional head. Selective impairments are due to problems in mapping functional morphemes with their phonological specifications.

Overall, evidence from category-specific impairment appears to support *only* the view whereby lexical roots are unmarked for grammatical category, and where noun and verb forms are not related by conversion rules, but are created by insertion of roots into syntax with appropriate functional morphemes.

Lexical Underspecification and Language Acquisition

Thus far, we have defended a specific claim about linguistic representation involving underspecification for categories such as noun/verb, and mass/count, and we have provided some independent evidence from category-specific impairments to support the idea that only lexical underspecification satisfies explanatory adequacy. In any case, we take our position to represent the null hypothesis; until strong evidence to the contrary emerges, we see no motivation for the lexical proliferation engendered by standard lexicalist views of grammar.

Below, we evaluate the overall feasibility of lexical underspecification for language acquisition. We begin by noting some general advantages of underspecification over its alternative. We then review a psycholinguistic debate that has explicitly investigated the status of lexical marking of grammatical categories, and how such categories are mapped to semantic representations. Specifically, we review the bootstrapping problem (Grimshaw, 1981; Macnamara, 1972, 1982; Pinker, 1984) and some recent proposals that have attempted to solve it (Bloom, 1999). We argue that lexical under-specification vastly simplifies the problem, and conclude with a theory of acquisition that is uniquely consistent

with adult and child language data.

The Burden of Lexicalism to the Child Learner

Perhaps the most attractive benefit of eliminating lexical distinctions such as noun/verb is the resulting simplification of how we might explain early language acquisition. Pinker (1994) estimates that the average child must know some 13,000 words by 6 years old (based on calculations that high-school students graduate have around 45,000 words at their disposal). Given this, he determines that children would need to be “lexical vacuum cleaners”, acquiring words at a rate of something like two words every hour—an impressive rate indeed. However, given lexicalism, things might be more challenging still. In fact, the child might need to acquire four or more lexical entries every hour in order to fix all of the lexical markings proposed by such theories. Take, for example, the toy vocabulary in (11). Beside each is listed its ranking in terms of relative frequency (from a list of 1634 nouns) in the speech of Brown’s (1973) Sarah:

(11) $\sqrt{\text{hair}}$ (7th)

$\sqrt{\text{water}}$ (12th)

$\sqrt{\text{milk}}$ (19th)

$\sqrt{\text{paper}}$ (23rd)

Now consider that Sarah used each of $\sqrt{\text{hair}}$, $\sqrt{\text{water}}$, $\sqrt{\text{milk}}$, $\sqrt{\text{paper}}$ as both mass and count, and $\sqrt{\text{name}}$ as both noun and verb (*cut*, *drink*, *swing*, *bite*, *kiss*, *dance*, and *kick* are some other frequent words that Sarah uttered as both noun and verb; see Barner, 2001, for details on flexible noun/verb use in young English speaking children). Consider too that in adult speech, *hair*, $\sqrt{\text{water}}$, $\sqrt{\text{milk}}$, have common adjectival forms (*hairy*, *watery*, *milky*), that $\sqrt{\text{water}}$ and $\sqrt{\text{milk}}$ are often used as verbs, and that all but $\sqrt{\text{name}}$ can be used as count nouns that refer not

only to particulars, but also to kinds of things (e.g., *the various papers produced in Japan*; *the milks available in France, including cow, goat, and sheep milk, etc.*). Given these facts, the attainment of adult linguistic knowledge would involve establishing the following entries for $\sqrt{\text{water alone}}$:

- (12) *water* [mass noun]
 water [count noun 1]
 water [count noun 2-kind]
 water-y [adjective]
 water [verb]

By relegating such knowledge to the lexicon, the child's learning burden becomes five times greater than what is proposed in a non-lexicalist account, where only $\sqrt{\text{water}}$ is learned explicitly and variations thereof are created in the syntax. Erring on the side of conservatism, if even a quarter of the 1600 "nouns" learned by Sarah in her first 5 years of life had two forms (e.g., both count and mass; both adjective and count; both noun and verb), an additional 400 entries would need to be acquired. However, the situation is likely much worse, since for Sarah's 25 most frequently used words, a total of 50 variations are possible (based on dictionary listings for mass, count, noun, verb, and kind possibilities). Were this extended to all of Sarah's vocabulary, she would need to learn twice as many words than what is indicated by common estimates. Note also that this would not account for true adult competence, since most language users go well beyond dictionary usage, understanding what it means to eat *cat* (despite maybe being disgusted by it), or to be *catty*. Given lexicalism, the child would need to well exceed the capacity of the average vacuum—he would need to *hoover* his way to adult competence.

The alternative, of course, is to minimize learning by allowing alternations between mass, count, noun, and verb to be generated in the syntax. By learning once which interpretation each syntactic context imposes on a lexical root (a task required anyhow by lexicalist approaches), and leaving roots unmarked for grammatical category, the child's task in acquisition is considerably lightened. Not only is the required rate of learning reduced, but the cognitive burden of distributional analysis in acquisition is removed. Rather than acting as a miniature Zellig Harris, meticulously recording the distributional profiles of words, use after use, the child might approach acquisition with an adult-like interest, focusing primarily on the pairing of meanings to sounds.

By this view, what distinguishes the child's treatment of language from that of the adult, aside from missing lexical entries/roots, is the child's initial ignorance of how his/her particular grammar expresses syntactic configurations at the level of phonological form (PF). That is, the child needs to fix phonological values for functional morphemes such as those implicated in VP, NP, count noun and mass noun syntactic positions. However, the child is faced with a paradox, since in order to discover functional morphemes to label them with sound, his or her only linguistic evidence is sound itself. This problem, and some of its early solutions, are discussed below

The Bootstrapping Problem

Perhaps one of the most celebrated areas of psycholinguistic theorizing over the past 20 years has concerned what Pinker (1984) called the "bootstrapping problem". According to Pinker (1984, 1987), the problem is that in order to acquire a particular grammar, the child must observe the behavior of abstract entities such as nouns and verbs in the primary linguistic data, to "fix the parameters of variation in his or her universal

rules schemas’’ (Pinker, 1984: 38). Pinker argues that across the world’s attested languages such entities as nouns are not marked in the acoustic signal in any consistent way. For example, he claims that nouns do not occupy particular serial positions, have characteristic pitch or stress level, nor any universal identifying affix. Although nouns may have characteristic distributional profiles in particular languages, this fact is said to be of little help, since to identify such a profile means determining it in terms of some pre-established entity, such as the category noun. Pinker also notes that innate knowledge of nouns is not sufficient to begin acquisition. In order to build a particular grammar based on the PLD, the child must be able to find nouns in the input (Fodor, 1966; Macnamara, 1989; see also Chomsky, 1986a).

Based on the rejection of distributional analysis and phonological approaches to bootstrapping, several researchers have proposed that in order to move from analysis of words to analysis of abstract syntactic entities, semantics must play a central role in early acquisition (Braine, 1992; Grimshaw, 1981; Macnamara, 1982; Maratsos, 1990; Pinker, 1984, 1989; Schlesinger, 1971, 1988). Macnamara (1982) suggests that grammatical categories are learnable “on the basis of innate semantic abilities’’ (p. 142). So, for example, the grammatical category noun is built from the semantic category *object*:

What is innate about the grammatical category noun is that the initial rules for inducing it are expressed in specific semantic terms. The general schema for noun, proper and common, is something like this: noun is that grammatical category, eventually distinguished in terms of morphological rules and phrase structure functions, that is initially induced on the basis of a semantic word category, i.e., word that names an object (proper) or word for a kind of object, natural or

artificial (common). (Macnamara, 1982, p. 130)

Similarly, Grimshaw (1981) proposes that children use semantico-cognitive categories like “object” and “action” as the basis for assigning words to innate categories. “If a word is the name of an object, it is assigned the category N. If it describes an action, it is assigned the category V.” (p. 174) Like Macnamara (1982), Grimshaw argues that based on such early word learning, the acquisition device can then construct phrase structure rules for NP and VP by observing the words, and the structural generalizations governing the distribution of N and V (see Pinker, 1982, 1984, 1987 for discussion).

Clearly, under the view of grammar discussed in the present paper, such solutions to the bootstrapping problem will not account for how children move from sound to syntax. The idea of lexical underspecification for features like noun/verb clashes with existing accounts of semantic bootstrapping on two main fronts. First, owing to their lexicalist assumptions, existing hypotheses posit mapping between semantic and syntactic features of *lexical items* (e.g., +physical object → +noun). However, since the present model does not permit marking of lexical roots in this way, such mapping rules cannot be of help to the hypothetical child. Knowledge of a particular grammar must be fixed without reference to the features of individual lexical items. Instead, what is needed is a theory whereby the child uses non-linguistic information to identify *syntactic structures* in the language input, such as NP, VP, and AP positions. Identification of these structures could lead to the fixing of phonological values for functional and root morphemes, whose behavior could henceforth cue further learning.

A second problem with previous accounts of semantic bootstrapping is that the mapping scheme does not seem to hold for either adults or even the youngest of

children. As noted by Maratsos and Chalkley, (1981), Maratsos (1982), and countless others, semantic flags such as *action* are not exclusively represented by VPs (e.g., *take a run*), and VPs do not exclusively represent actions (e.g., *to believe*). For semantic bootstrapping, such exceptions necessitate an explanation of either how parents modify child-directed speech to preclude misclassification (Hochberg and Pinker, 1985; Rondal and Cession, 1990), or of how the child is constrained to ignore problematic input (Macnamara, 1982). However, evidence that both parents and very young children use abstract and action-denoting nouns brings such add-ons into question (Nelson et al., 1993; Barner, 2001).

Very clear evidence pertaining to syntax/semantics mappings is available in the case of the distinction between mass and count nouns and their acquisition. For certain versions of semantic bootstrapping, mapping for mass/count takes the form of (13):

- (13) a. discrete physical object → count noun
 b. substance → mass noun

According to this view, children infer the existence and use of count nouns based on instances of reference to discrete physical objects (like a ball), and take reference to substances (e.g., water) to indicate use of mass nouns. Alternatively (e.g., Macnamara, 1982), “substance” and “discrete physical object” are seen as notional cores for the categories “mass” and “count”, and children are thought to begin with purely semantic rules that become syntactic over time (via distributional analysis or assimilation). However, as with the noun/verb distinction, the problem again is that neither adults nor children show evidence of respecting such mappings. As pointed out by Bloom (1999), many words used as count nouns are not marked for +object: *dream*, *puddle*, *song*,

thought, cause, etc. Furthermore, though seldom discussed in the literature, many words used as mass nouns have nothing to do with substances. Consider, for example, the following mass nouns: *furniture, rice, pasta, infantry, traffic, footwear, toast, cutlery, drapery, fruit*, and *clothing*. Unlike substances such as water or glue, one could quite conceivably count the footwear or furniture in a room, or sit on the curb counting traffic (see Gillon, 1996 for a defense of this point).

Adding to the evidence that grammars do not map objects and substances to count and mass nouns, respectively, is the vast collection of words that can be used as either mass or count. Flexible words include *hamburger, apple, carrot, water, orange, banana, chicken, deer, fish, duck, steak, difference, coffee, tea, meaning, hope*, etc. As noted by Ware (1979), “Depending on one’s imagination and tolerance, many more data or much more data could be suggested” (p. 19), especially given thought experiments such as Pelletier’s (1979) universal grinder, where a super-natural machine swallows up concrete and abstract objects, and grinds them up into piles of stuff. As has been argued thus far for nouns and verbs, “the mass/count distinction is not really a distinction among words, but a distinction among ways of using them” (Bunt, 1979: 249). At least for adults, simple referential distinctions between mass and count nouns do not seem possible.

For children, the case against a simple referential distinction seems equally strong. Several studies suggest that children’s acquisition of the mass/count distinction is not based on an object/substance distinction, but on more general properties of quantification common to adult linguistic competence (Gathercole, 1985; Gordon, 1985, 1988). For example, according to Gordon (1985), when provided with syntactic and semantic cues, children ranging in age between 3;5 and 5;5 years-old overwhelmingly

categorized words on the basis of syntactic context, even when syntactic and semantic cues were in conflict. In fact, when semantic cues were provided to children in isolation, only older subjects (between 4;6 and 6-years-old) were able to consistently use semantics as a basis for category assignment, a result that directly contradicts semantic bootstrapping predictions (since children should be kicking the semantic ladder away at later stages, *not* pulling it towards them).

As noted by Bloom (1999), such early mapping theories as those proposed by Grimshaw and Macnamara do not capture what children seem to know about the relation between NPs and their semantics. To begin, various studies suggest that, very early in life, children have an abstract notion of individuation, which is superordinate to the notion *physical object*, and which parallels the semantics of count noun quantification in adult linguistic competence (e.g. Gordon, 1985, 1988; Bloom, 1994; Xu, 1997; Xu and Carey, 1996). For example, evidence exists that 6-month olds quantify over non-objects like sounds (Starkey et al., 1990), and that 2-year olds can count sounds or actions at the same time that object counting emerges (Wynn, 1990). Studies of language development mirror these results, showing that children are sensitive to syntactic information when acquiring nouns that refer to sounds (Bloom, 1994), puddles (Soja, 1992) and collections of things (Bloom and Keleman, 1995; Bloom and Veres, 1999). As noted by Gordon (1985), early knowledge of grammar seems to reflect an adult-like appreciation of quantification, and seems to have little concern for semantic distinctions such as object/substance.

Based on this kind of evidence, Bloom (1999) suggests that children identify count and mass nouns in the input on the basis of their use to refer to individuals or non-

individuals (see Gordon, 1985, 1988; Xu and Carey, 1996; Macnamara, 1989 for similar suggestions). For example, hearing the word *chair* used to refer to an individual thing, the child infers that a count noun expression is being used. Likewise, having construed a spatially bounded body of water to be an individual thing, the child takes the word *puddle* to be a constituent of a count noun phrase. In any case where the child construes a referent to be an individual, whether that individual be a chair, puddle, sound, idea, or unified group of objects, the child takes the noun phrase expression used to express the concept to be a count noun phrase (see Bloom, 1994, 1996; Bloom and Keleman, 1995; Bloom and Veres, 1999). Correspondingly, any phenomenon referred to by a noun phrase (i.e. that is quantified over), yet that is not an individual, is mapped to a mass noun phrase, yielding the following mapping theory:

(14) a. individual $\rightarrow$ count noun

b. non-individual $\rightarrow$ mass noun

While this account of how children begin acquisition seems most consistent with data from adult and child language, it also is consistent with the non-lexicalist view of grammar and acquisition currently under discussion. Given the fact that count nouns and mass nouns are always uttered in the context of a larger syntactic expression, semantic features pertaining to individuation could be exploited by children to identify sounds corresponding to functional heads of specific syntactic structures. Sensing that a given expression has been used to refer to an individual thing, the child could note the sound corresponding first to the lexical root, and second to the functional head within which the root has appeared. In a limited number of learning trials, the child could decipher sounds associated with functional or *derivational* morphology of nouns and verbs (e.g., *-tion*, *-*

ity, -s, -ing, -ed), and then focus attention to acquiring sounds for remaining lexical roots.

Note, however, that by this view the child does not mark lexical concepts for features pertaining to individuation. Rather, the feature *+/-individual* (IND) is syntactic, and coerces lexical items, forcing one or the other interpretation upon them given the particular instance of use (thus the syntactic feature contributes to semantic interpretation). By consequence, any lexical item can be *grammatically* projected to syntax in the context of, for example, a +IND feature. Where the lexical item is projected is determined at each instance of use, depending on the communicative requirements of the situation and how the lexical concept in question is to be interpreted at the conceptual/intentional interface of grammar and beyond.

Extending the paradigm further still, we can propose that children identify the VP functional element of syntax based on its distinct relation to causation. Specifically, note that verb phrases permit the implication that the external argument (subject) of a structure is an agent, and thus the causer of some state or event. Recall the examples from (3):

(15) a. John grows tomatoes.

b. Godzilla destroyed the city.

Only in the context of a VP can both *+internal causation* words (e.g., *grow*) and → *external causation* words (e.g., *destroy*) take an agent argument. Thus, by noting when a root marked as *+internal causation* is used with an agent, the child can infer that the word has been used as a verb. Based on this initial observation, the child can then learn how the verb functional head is expressed phonetically.

Presumably, solutions such as those discussed for NP and VP acquisition can be extended to other aspects of syntax. However, further work on the exact relationships

between semantic features and syntactic constructions is yet needed. This, and the question of how semantic features in the language faculty relate to features in other cognitive systems, is currently under investigation (Bale and Barner, in preparation).

Conclusion

To conclude, we have presented a case for the null-hypothesis concerning lexical categories such as noun and verb—specifically, that there are no such distinctions in the lexicon. It has been argued that dividing the lexicon into grammatical categories provides no particular descriptive edge, and instead forces the introduction of much lexical marking, lexical proliferation (sense enumeration) and conversion rules, without any particular gain.

As an alternative to lexicalism, a model of grammar without lexical marking has been investigated, whereby alternations of argument structure and grammatical category are handled in the syntax, where words are formed. It has been argued that this account is supported by neurolinguistic evidence concerning category-specific impairments.

Finally, it has been shown that lexical underspecification simplifies language acquisition by reducing the amount of learned and innate structure required. Not only is a great amount of distributional analysis eliminated but the number of words to be learned is also vastly reduced. Additionally, although our investigation concerned mostly English, this simplification of language acquisition holds for any language whose speakers demonstrate cross-categorical creativity, such as coining novel nouns from roots that are normally realized as verbs, or novel verbs from roots that are normally realized as nouns.⁸

The approach permits a theory of acquisition that is alone consistent with data from child and adult language. By the theory presented, creativity in the use of

⁸ Such evidence already exists for Hebrew (see Berman, 1999), and we suspect that as more languages are investigated, novel cross-categorical coinages will exist for most if not all of the world's languages.

mass/count and noun/verb is naturally accounted for, and the acquisition of such distinctions proceeds without ad hoc or child-specific mapping theories. The bootstrapping problem is seen to involve the discovery of syntactic contexts, which are located and attributed sounds. Discovery of such contexts is based on the interaction of syntactic constructions with semantic features, which may be related to features in other systems of the mind/brain.

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