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The Projection Principle and the Syntax of Synthetic Compounds.

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1. Introduction.

It has become fairly generally accepted in recent years that a valid approach to the study of syntax is the investigation of principles of well-formedness rather than rules of grammar. Under this conception what few rules there are overgenerate massively and the output of this overgenerating base is pruned down to size by the principles.

Even more recently, there have been a few suggestions that the same might be true in morphology. One such suggestion is due to Lieber (1983) where it is suggested that a form of the overgenerating syntax be carried over into the lexical structure component. In particular, she argues, there is a principle of argument linking which governs the well-formedness of compounds, and which she states as follows:

(1) Argument-Linking Principle

a) In the configuration $[]_{\{V P\}} []_{\alpha}$

or $[]_{\alpha} []_{\{V P\}}$, where α ranges over all categories, $\{V P\}$ must be able to link all internal arguments.

b) If a stem $[]_{\alpha}$ is free in a compound which also contains an argument-taking stem, α must be interpretable as a semantic argument of the argument-taking stem, i.e. as a Locative, Manner, Agentive, Instrumental, or Benefactive argument.

In this paper I shall have essentially nothing to say about the (b) part of this Principle, and shall concentrate rather on the first half. I shall argue that the effect of (1a) for synthetic compounds and related constructions is fully derivable from a rather natural constraint on the Projection Principle. The paper is organized as follows. In the next subsection (section 2.1), I shall introduce the constraint on the Projection Principle, and show why it is capable of deriving the facts covered by (1a) in Lieber's account. In the subsequent subsection I shall show that the present account does not suffer from some problems which were inherent in Lieber's account. In the final section I shall discuss the implications of the current approach, if it should turn out to be correct.

2. Projection and Projection.

2.1

Consider a noun like *construction*. As is well known, this noun has two possible meanings, one which is generally termed the result meaning, as in (2a) and the other which may be termed the event reading, as in (2b):

- (2) a. This construction is ugly.
 b. John's construction of a polyhedral model of himself surprised even Mary.

One question which comes to mind in connection with (2a) is, how are the thematic requirements of *construct* satisfied? Evidently they are not, since *construct* requires an internal argument (a THEME) and such would appear to be absent here. One way around this would be to suggest, following Borer (1984), that the Projection Principle, namely the requirement that the subcategorization requirements--i.e., the internal arguments--of lexical items be satisfied at all syntactic levels, not apply "within the lexical component."¹ Another way of looking at it, however, is as follows: let us imagine that there is an intimate linkage between Projection, in the sense of the

Projection Principle, and Projection in the sense of X-bar theory. Let us, in fact, propose the following constraint on the application of the Projection Principle:

(3) Constraint on the Projection Principle.

The Projection Principle holds of α within a structure

$[_\gamma \dots \alpha \dots]$ wherever α is the syntactic head of γ .

Simply put, this says that the Projection Principle need only hold of a lexical item within a certain construction, when that lexical item is the head of that construction. (This is not to say, by the way, that argument structure for non-heads may not be satisfied; this assertion would be false, since modifiers of heads, which discharge their thematic structure to the head do certainly exist.) Now, with respect to the result nominal *construction* the structure will be as follows:

(4) $[_N [_V \text{construct}] \text{ion}]_{\langle V, N \rangle}^2$

Construct is not the head of a verbal projection and therefore the Projection Principle does not apply to it; its subcategorization requirements, therefore, need not be met. In the case of the event nominal *construction*, we may assume that the thematic grid of the verb is passed on to the noun and that it is the noun whose thematic properties are being satisfied in (2b). For an account of this, see Sproat (1985). At the other end of the spectrum, constructions such as verb phrases will have the Projection Principle applying to their heads, by (3).

Turning now to synthetic compounds, the following range of data is easy to explain:

- (5) John is a foot-eater.
- (6) *Mary is a candy-giver to children.
- (7) *Mary is a child-giver of candy.
- (8) *Mary is a child-giver.

These kinds of examples are well known, of course, and are discussed in, among other places, Selkirk (1982). Indeed, the system proposed here has much the same effect as her First Order Projection Condition, which we give below:

(9) The First Order Projection Condition.

All non-SUBJ arguments of a lexical category X_i must be satisfied within the first order projection of X_i .

We return to this point later on. Also, note that Pesetsky (1985) makes essentially the same claim about the relation of the Projection Principle to synthetic compounds, and Roeper and Siegel's (1978) First Sister Principle can be seen as an early statement of this relation (thanks to D. Pesetsky for pointing this out to me.)

The system proposed here is able to explain a paradigm such as (5-7) fairly straightforwardly. To see this, let us consider first, the compound in example (5). This will, following Lieber, have a structure like the following:

(10) [_N [_V [_N foot] [_V eat]] er_{<V,N>}]

Since *eat* is the head of a projection--in this case of the same bar level as itself, namely V^0 --it will follow from (3) that the Projection Principle applies to it. This being the case, its *internal* theta roles must be satisfied. Given that we have chosen the lexical entry for *eat* which requires an internal theta role, it will follow that the lefthand member of the compound must fill that function.

Turning now to the more interesting cases in (6-7) it is easy to see why the constraint on the Projection Principle derives the facts. Take (6), for example:

(11) [_{NP} [_{N'} [_N [_V [_N candy][_V give]] er_{<V,N>}] to children]]

Here, again, *give* is the head of a verbal projection. This means that its internal thematic structure must be satisfied within this projection. Now, *candy* can fill one of the slots in this argument structure but clearly the other slot must go unfilled. Now, in fact *candy giver* is well formed on its own, because the GOAL argument of *give* is optional, but the presence of *to children* in (6) either forces the two-argument interpretation of *give*, which is impossible by (3) and the Projection Principle, or must be interpreted in some other way as not being related to the thematic positions of *give* at all. This would seem, presumably because of the semantics of *to* to be an impossibility, and the construction is therefore completely ruled out.

A similar story can be told about (7) except that here, since *children* is filling the GOAL role of *give* and since therefore the two-argument interpretation of *give* is forced, there is no option but to try to interpret *of candy* as an internal argument of *give*, which, again, is impossible; note, in this regard, (8).

We have seen, then, that the proposed system is capable of handling the data in a rather natural way.

2.2

One crucial difference between the approach argued for here and that of Lieber (1983) is that Lieber is apparently forced to make a seemingly undesirable stipulation concerning the ability of theta grids to percolate or be inherited across category changes. This assumption she makes on page 268:

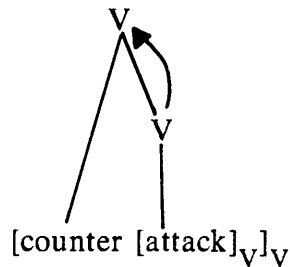
(It is assumed that features of one category cannot percolate to a node dominated by another category.)

Thus, in compounds, given that the highest V^0 is dominated by N as in (11) above, for instance, the inability of thematic structure to percolate across the categorial boundary would derive the fact that since the argument structure of the verb must be satisfied (given part (a) of the Argument Linking Principle) it must in fact be satisfied within the compound since it cannot in any case percolate across the category change from V to N. Note that if this stipulation were not made, we would predict that examples like (11) would be grammatical since the partly satisfied theta grid of *give* could percolate to the noun, and then be finally satisfied within the noun phrase. Nonetheless, despite the fact that the assumption Lieber makes works, it is by no means obvious that it is a valid assumption.

First of all, it would appear to violate her own Percolation Conventions (Lieber, 1980), at least without further conditions. In particular, Convention III says the following:

(12) Convention III

If a branching node fails to obtain features by Convention II, features from the next lowest labeled node automatically percolate up to the unlabeled branching node.
For example:



Convention II, it will be recalled, states that features of the affix percolate to the whole word, but, if the word fails to obtain certain features from the affix, then those features may, by Convention III, percolate from the next labeled node rather than from the affix. Now, while it is presumably invalid to assume that affixes such as agentive *-er* have no argument structure, nevertheless, it seems fair to assume that they have a fairly impoverished argument structure compared to that of the verbs to which they attach, and we might therefore allow, following the Percolation Conventions, that argument structure could indeed percolate from the verb to the noun. But this would, of course, contradict Lieber's assumption, which seems necessary for her analysis to work.

The other objection against the assumption Lieber makes is that it would appear to be empirically inadequate: There does indeed appear to be evidence that thematic structure is inherited across categories, presumably by some mechanism such as percolation. Consider the following paradigm:

- (13) a) John makes plastic sushi.
 b) *John makes.
 c) John is a plastic-sushi-maker.
 d) *John is a maker.
 e) John is a maker of plastic-sushi.

Note first the contrast in (a-b). *Make* is an obligatorily transitive verb, at least in its normal non-idiomatic reading (that is, John can be said to *make* if he is successful and generally a fast mover who is "where the action is" but that is not a relevant reading.) This fact is shown simply enough by the ungrammaticality of (b) contrasted with the grammaticality of (a). Now, in (c), the construction of *plastic-sushi-maker* is equivalent to that in (10), so that *make* is sister to *plastic-sushi* and is therefore obliged, by (3) and hence the Projection Principle to discharge its internal theta roles. In (d) on the other hand, *make* is not sister to any noun and by (3), we do not need to satisfy the argument structure of it. However, assuming for the moment that whenever there is argument structure to percolate it will indeed

percolate in *-er* nouns, we can say then that *maker* has inherited the argument structure from *make*. But if this is the case, and if, as seems reasonable, an internal argument, if obligatory, remains obligatory across such operations as percolation, it will follow that since *maker* is dominated by a node of the same category as itself, namely N', the Projection Principle, by (3) will apply to it, and the construction in (d) will be ruled out just as the construction in (b) was. Of course, this implies that if we were to supply *maker* with an NP complement, then the construction should once again become grammatical. Example (e) bears this prediction out.

Consider another set of examples:

- (14) a) Fred drinks melon juice.
 b) Fred drinks.
 c) Fred is a melon-juice-drinker.
 d) Fred is a drinker.
 e) Fred is a drinker of melon juice.

Again (a) is grammatical with *melon-juice* satisfying the internal thematic structure of *drink*. (b) is also grammatical, but with only with the somewhat restricted meaning that Fred is a partaker of alcoholic beverages. Example (c) is analogous to (a), with the argument structure of *drink* being satisfied within the compound, and (e) is analogous to (a) with the argument structure of *drinker* being satisfied by the complement NP. Example (d) is also well-formed, of course, but here again we get the idiomatic reading only suggesting that the thematic grid of *drinker* which allows for having no complement is precisely the same as the thematic grid of the related verb which also allows for no complement.

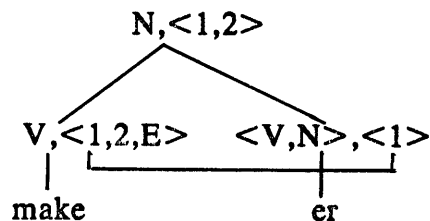
In summary, there appears to be strong reason to suppose that the thematic grids of nominals have much in common, in at least some classes of derived nouns, with those of the verbs from which they are derived. And this in turn suggests that such a relationship should be derived by inheritance. So Lieber's assumption about the inability of thematic structure to percolate seems inadequate.

Fortunately, such an assumption is unnecessary in the approach argued for here. When we say that the Projection Principle holds of V in a construction [_V N V] we mean, according to the normal notion of the Projection Principle that the verb must satisfy its thematic structure within its projection. Hence **child-giver of candy* could not be well-formed and we do not need to make any stipulations about the non-percolation of thematic structure across categories in order to ensure this.

Still, there is the question of how we ensure that the thematic structure in *-er* nominals in particular does in the general case percolate from the verb to the noun: In fact, for our account to work it *must* be the case that this is true since otherwise we could not explain the complete parallel between the verb and the *-er* nominal exemplified in (13-14); if the percolation were not guaranteed, then we would allow that the verb's theta grid could fail to percolate and that it would become "locked up" in the morphology. Given (3), the Projection Principle would not apply to the verb, and neither would it apply to the noun in which case examples like (13d) should be completely well-formed. The fact that they are not implies, as we have seen, that the grids must percolate.

I think that the correct approach to solving this problem has to do with the thematic structure for the affix *-er*. Briefly,³ let me suggest that the affix has a thematic position of its own, which associates with the external thematic position of the verb. In terms of the semantic formalism of Higginbotham (1985) we can notate this by saying that the thematic position of *-er* identifies with that of the verb's external theta role:

(15)



Ignoring the Event position (which is notated as E, and which we may assume is uninherited by the noun by a general principle that nouns may not *have* events even though they may *refer to* events; we will assume that it is existentially bound) the structure in (15) will be a relational noun denoting a relation between an entity (the referent of the NP dominated by N), which is identified with the external argument of the verb from which the noun is derived⁴ and an entity identified with the internal argument of the verb, and which is actually the noun's argument. In terms of Higginbotham's formalism:

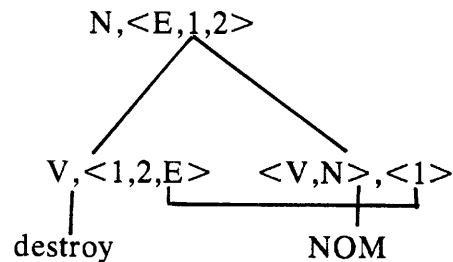
(16) $v \langle \langle z,y \rangle, N \rangle \langle \text{---} \rangle (\exists e) [\text{drive } \langle z,y,e \rangle]$

Let us make furthermore the following assumption, namely that whenever an affix regularly associates with a particular thematic position of the

members of the class to which it attaches, the thematic grid of the stem is inherited by the word headed by the affix, modulo the changes forced by the association of the two thematic positions, and the changes necessitated by thematic restrictions on the category to which the output belongs. Given such a principle we would expect that *-er* nouns would in general inherit the thematic structures of the verbs from which they are derived simply because the affix involved is one whose thematic behavior reliably involves identification with a particular position in the verb's thematic grid.

Further evidence for such a principle comes from the more classic class of derived nominals, nominals such as *destruction* and *command*. Let us abstract away from the particular phonological realization of the change from noun to verb and assume that there is a noun-forming affix, which we may call NOM. NOM regularly forms nouns referring to events, so we may assume, analogously with the behavior of *-er* that NOM has a single theta position which identifies with the E(vent) position of the verb:

(17)



This, then, will be a relational noun referring to an event of *x* performing the action of the verb on *y*, or in terms of Higginbotham's notation:

(18) $v \langle \langle e, x, y \rangle, N \rangle \langle \text{---} \rangle \text{Event } (e) \ \& \ [\text{destroy } (x, y, e)]$

Given this we would expect that whenever a nominal refers to an event it is likely that it will inherit the verb's argument structure whereas those nominals which do not refer to events, and thus which do not partake of the regular association of the thematic position of NOM with the E position of the verbal grid, will not inherit the argument structure. Let us take as an indication of the inheritance of argument structure the test that if the verb takes a direct object, the noun also takes a direct object--i.e., a noun phrase introduced by the preposition *of* but not by another preposition. Furthermore, let us follow Davidson (1966) in assuming that instrumentals and temporals are modifiers of events and hence can only be present when there is an event to modify. We would then expect the following

biconditional to hold of derived nominals:

(19) Instrumental PP iff has the same argument structure as the verb

By and large, this seems correct:

- (20) a) John's destruction of the termite mound with a machete....
 b) Mary's evasion of the CIA for two years....
 c) The contractors' construction of the building using Elmer's glue....
- (21) a) *The general's command to the troops with a megaphone....
 a') *The general's command of the troops...(wrong reading)
 b) *John's direction to the soldiers to fire using semaphore...
 b') *John's direction of the soldiers.....
 c) *John's solution to the problem with a pencil and paper...
 c') *John's solution of the problem

In (20) all of the examples refer to events as evidenced by the fact that they can take instrumental or temporal modifiers. They also all allow direct arguments as do their related verbs. In (21) in contrast, none of the nominals allow direct arguments, and neither do they apparently allow instrumental modifiers, indicating that they do not refer to events.

There is, of course, much more that could be said on this topic, but there at least seems to be reason to believe that we can guarantee the inheritance of the thematic structure of the verb in *-er* nominals because of the nature of the thematic association between the verb and the affix.

In summary, then, we are able to derive much about the behavior of synthetic compounds and related constructions in English by a fairly simple and natural constraint on the Projection Principle. No special principles governing compounds are needed.

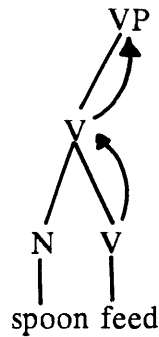
One topic remains to be discussed with regard to synthetic compound-like constructions, and this is the treatment of verbal constructions of the following form:

- (22) a) spoon-feed, play-act, hand-wash
 b) flower-arrange, carol-sing.

All of these examples are from Lieber (pp. 262-263). Let us consider the set in (a) first. In this set the noun in compound with the verb is interpreted as, as Lieber puts it, a semantic argument, that is, as an instrumental or some other "argument" of the verb which is presumably not actually marked in the verb's thematic grid. The question to answer is why in general we

are forced to so interpret the left-hand member of such compounds. Lieber, of course, has a ready explanation in that for her the thematic grid percolates to the highest projection of the lexical category.

(23)



Hence, it is not available for satisfaction within the compound, and the left-hand member can only be interpreted semantically. Within the approach taken here, we are bound to answer two questions: Firstly, how can we guarantee that we interpret the left-hand member semantically, as opposed to as a direct argument? And secondly, why are we forced to interpret it as any kind of argument whatsoever? That is, since the left-hand member *spoon* is clearly not serving to satisfy the obligatory thematic requirements of the verb *feed* why are we nevertheless bound to interpret it as a semantic argument? In answer to the first question, we want to hazard a guess at a principle which can derive this fact, i.e., which has the effect of Lieber's Percolation Conventions for these data. Let me suggest the following as a crude approximation:

(24) The thematic structure of a lexical item X is obligatorily satisfiable at the highest available projection of X.

The effect of such a principle for a construction such as (23) is that *feed* will necessarily satisfy its thematic requirement within the scope of VP rather than just the scope of the V dominating it. This will mean in turn that it must satisfy its thematic requirement in a "verb-phrasal manner", i.e., by discharge to an NP complement, rather than simply by discharge to a noun within the local compound.

We note in passing, too, that (24) has the effect of forcing the structure for synthetic compounds which we assumed in the above discussion, namely:

(25) [[foot eat] er]

The alternative conceivable structure, namely,

(26) [foot [eat er]]

would be ruled out since *eater* like *feed* in (23) would have to satisfy its requirements within the full NP rather than within the local nominal compound. The structure in (25) circumvents this problem since *foot* is sister to *eat* and the verb is indeed satisfying its requirements within the highest available projection.

It would be nice to be able to reduce this to the Projection Principle also though I don't quite see how to do this; nevertheless, the reasoning would go somewhat as follows: Taking the full VP in (23) to be ultimately the projection of *feed* it will necessarily be the case that this full VP will instantiate (by its syntactic properties) the lexical structure of the head. This will therefore require that the structure of the VP be a reflection of the thematic properties of *feed*.

In answer to the second question I have less to say. It may be that something like the second part of Lieber's Argument Linking principle needs to be stipulated thus ensuring that all free stems in compounds with argument-takers must be interpreted as being a semantic argument of the argument-taking stem. One approach which might make this ultimately unnecessary is to say, that in the case of verbs such as *spoon feed* and so forth, the left-hand member, if not otherwise engaged, must be interpreted as a modifier of the Event position of the verb, and thus range over the possible event modifiers such as Locative, Instrument, Manner, and so forth. This is not by any means unproblematic, however, since we still have to guarantee this interpretation.

Turning now to the examples in (22b), we seem to find counterexamples to everything we have just said, as Lieber, of course, also noted. Nevertheless, the fact that these constructions are fairly limited and sporadic suggests that we are not dealing with a productive process.

3. Conclusions.

I have shown, then, that it is apparently possible to derive the properties of synthetic compounds from a constraint on the Projection Principle, namely (3), which seems to be fairly natural. To recapitulate, (3) states that the Projection Principle need only apply to a lexical item--and therefore that that lexical item's thematic structure must be satisfied--when the item is the head of a syntactic construction. A number of further refinements have been suggested along the way.

What is the point of such an approach? The point is that it seems possible to reduce the behavior of at least some lexical constructions to principles familiar from syntax. In this respect, as noted above, the approach taken here has much in common with that of Selkirk (1982) whose First Order Projection Condition applies across both sentential- and word-syntax. Given that this approach is successful, we might be led to speculate on exactly how much of word-formation should really be viewed as separate from syntax; if the same principles as serve to determine well-formedness in sentences also serve to determine well-formedness of words, we might find in this an argument that morphology *per se* does not constitute a separate component of the grammar.

FOOTNOTES

¹In this paper, the following definition of the projection principle will be assumed (from Chomsky, 1981):

Representations at each syntactic level (i.e., LF and D- and S-structure) are projected from the lexicon, in that they observe the subcategorization properties of lexical items.

²The subscript $\langle V, N \rangle$ is a notational device taken from categorial grammar to refer to an affix which takes a verb and forms nouns. In general, $\langle A, B \rangle$ is an affix which takes A's and yields B's. See also Sproat (1985).

³The reader is referred to Sproat (1985) for a detailed discussion of this point.

⁴There may be some further condition on the identification of *-er* with the external theta role of the verb, such as that this role must be either an instrument or an agent. We will not pursue this point here.

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