Some Notes on Economy of Derivation and Representation

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(M. I. T)

The past few years have seen the development of an approach to the study of language that constitutes a fairly radical departure from the historical tradition, more so than contemporary generative grammar at its origins. I am referring to the principles-and-parameters approach,[1] which questions the assumption that a particular language is, in essence, a specific rule system. If this approach is correct, then within syntax (excluding phonology[2]), there are no rules for particular languages and no construction-specific principles.

A language[3] is not, then, a system of rules, but a set of specifications for parameters in an invariant system of principles of universal grammar (UG); and traditional grammatical constructions are perhaps best regarded as taxonomic epiphenomena, collections of structures with properties resulting from the interaction of fixed principles with parameters set one or another way. There remains a derivative sense in which a language *L* is a "rule system" of a kind; namely, the rules of *L* are the principles of UG as parametrized for *L*.

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(1) This is sometimes called "Government-Binding (GB) theory", a misleading term that should be abandoned, in my view; see my *Generative Grammar*, Studies in English Linguistics and Literature, Kyoto University of Foreign Studies, 1988, lecture 2. Generative grammar has engendered a good deal of controversy, sometimes for good reason, often not. There has been a fair amount of plain misunderstanding, beginning with the notion of generative grammar itself. I have always understood a generative grammar to be nothing more than an explicit grammar. Some apparently have a different concept in mind. For example, reviewing my *Knowledge of Language* (New York: Praeger, 1986), James McCawley notes that I interpret the concept here as meaning nothing more than explicit, as I have always done (see, e.g., *Aspects of the Theory of Syntax* (Cambridge: MIT, 1965, p.4)), and concludes erroneously that this is a "sharp change" in my usage that gives the enterprise an entirely different cast from that of the 1960s, when the task as he perceives it, was taken to be "specifying the membership of a set of sentences that is identified with a language" (*Lg* 64.2, June 1988; McCawley takes the set of sentences to be what I have called the "structure" of the language, that is, the set of structural descriptions). But the characterization he gives does not imply that "generative" means anything more than "explicit"; there is, furthermore, no change in usage or conception, at least for me, in this regard. The review contains a series of further misunderstandings, and there are others elsewhere, but I will not discuss these matters here.

(2) On why phonology alone might be expected to have specific rule structure, see Sylvain Bromberger and Morris Halle, "Why Phonology is Different", *LI* 20.1, 1989.

(3) Or what is sometimes called a "core language". The core-periphery distinction, in my view, should be regarded as an expository device, reflecting a level of understanding that should be superseded as clarification of the nature of linguistic inquiry advances. See the first cited reference of note 1.

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In the course of this recent work, certain concepts have emerged with a unifying character in that they appear throughout the components of a highly modular system: c-command and government, for example. There also seem to be fairly general principles involving these concepts, with wide-ranging effects. The Empty Category Principle (ECP), belonging to the theory of government, is one such example, which has been the subject of much fruitful work. Such concepts and principles play a pervasive role in a tightly integrated system; slight modifications in their formulation yield a diverse and often complex array of empirical consequences, which have also been fruitfully explored in a large number of languages. And we may be fairly confident that much remains to be learned about just how they should be expressed.

I think we can also perceive at least the outlines of certain still more general principles, which we might think of as "guidelines", in the sense that they are too vaguely formulated to merit the term "principles of UG". Some of these guidelines have a kind of "least effort" flavor to them, in the sense that they legislate against "superfluous elements" in representations and derivations. Thus the notion of "full interpretation" (FI) requires that representations be minimal in a certain sense. Similarly, the "last resort" condition on movement, which yields a partial explanation for the requirement that A-chains be headed by a Case position and terminate in a theta-position (the "chain condition"), has the corresponding effect of eliminating superfluous steps in derivations, thus minimizing their length.[4] What I would like to do here is to search for some areas where we might be able to tease out empirical effects of such guidelines, with a view towards elevating them to actual principles of Language, if that is, indeed, what they are.

1. Preliminary assumptions

Let us begin with a range of assumptions concerning language design, generally familiar though often controversial, which I will adopt without specific argument.

I will assume the familiar EST framework, understood in the sense of the principles-and-parameters approach. We distinguish the lexicon from the computational system of the language, the syntax in a broad sense (including phonology). Assume that the syntax provides three fundamental levels of representation, each constituting an "interface" of the grammatical system with some other system of the mind/brain: D-structure, PF, and LF.

The lexicon is a set of lexical elements, each an articulated system of features. It must specify, for each such element, the phonetic, semantic and syntactic properties that are idiosyncratic to it, but nothing more; if features of a lexical entry assign it to some category K (say, consonant-initial, verb, or action verb), then the entry should contain no specification of properties of K as such, or generalizations will be missed. The lexical entry of the verb *hit* must specify just enough of its properties to determine its sound, meaning, and syntactic roles through the operation of general principles, parametrized for the language in question. It should not contain redun-

(4) On these notions, see my *Knowledge of Language*. General conditions of this sort were investigated in some detail in the earliest work in generative grammar, in the context of the study of evaluation procedures for grammars; see my *Morphonemics of Modern Hebrew*, ms., 1949, 1951 (New York: Garland, 1979).

dant information, for example, about the quality of the vowel, properties of action verbs generally, or the fact that together with its complement, it forms a VP.[5]

It has been suggested that parameters of UG do not relate to the computational system, but only to the lexicon. We might take this to mean that each parameter refers to properties of specific elements of the lexicon or to categories of lexical items; canonical government, for example. If this proposal can be maintained in a natural form, there is only one human language, apart from the lexicon, and language acquisition is in essence a matter of determining lexical idiosyncracies. Properties of the lexicon too are sharply constrained, by UG or other systems of the mind/brain. If substantive elements (verbs, nouns, etc.) are drawn from an invariant universal vocabulary, then only functional elements will be parametrized. The narrower assumption appears plausible; what follows is consistent with it.[6]

The level of D-structure is directly associated with the lexicon. It is a "pure" representation of theta-structure, expressing theta relations through the medium of the X-bar-theoretic conditions in accordance with the projection principle. It may meet some strong "uniformity condition"[7] and in this sense be invariant across languages. I will assume here a two-level X-bar theory of the conventional sort, perhaps restricted to binary branching in accordance with Richard Kayne's theory of "unambiguous paths".[8]

The level of PF is the interface with motor-perceptual systems, and the level of LF, with conceptual systems.

Each of these levels is a system of representation of a certain type, its properties specified by principles of UG.[9] For a particular language, the choice of D-structure, PF and LF must satisfy the "external" constraints of the interface relation. Furthermore, the three levels must be interrelated by mechanisms permitted by the language faculty. The *structural description* of an expression E in language L includes — perhaps *is* — the set (d, p, l), representations at the levels of D-structure, PF, LF, respectively, each satisfying the "external" conditions.[10] We may understand the

(5) The lexical elements are sometimes called "atomic" from the point of view of the computational operations. Taking the metaphor literally, we would conclude that no feature of a lexical item can be modified or even addressed (say, for checking against another matching element) in a computational operation, and no features can be added to a lexical element). The condition as stated is too strong; just how it holds is a theory-internal question that I will put aside.

(6) See Hagit Borer, *Parametric Syntax* (Dordrecht: Foris, 1984); Naoki Fukui, "Deriving the Differences between English and Japanese: a case study in parametric syntax", *English Linguistics* 5, forthcoming, on restriction to functional elements.

(7) On this matter, see among others Mark Baker, *Incorporation: A theory of grammatical function changing* (Chicago: U. of Chicago Press, 1988).

(8) Kayne, *Connectedness and Binary Branching* (Dordrecht: Foris, 1984). As a matter of notation for X-bar theory, I will use prime instead of bar, X^0 for the lowest level category, and XP for X", for each X.

(9) I have in mind the notion of "level of representation" discussed in my *Logical Structure of Linguistic Theory (LSLT)* (1955-6; New York: Plenum, 1975; Chicago: U. of Chicago, 1985), and subsequent work.

(10) Some have proposed that certain conditions on syntax hold at PF; see, e.g., A. Weinberg, J. Aoun, N. Hornstein and D. Lightfoot, "Two Types of Locality", *LI* 18.4, 1987. It cannot be, strictly speaking, the level of PF at which these conditions apply, since at this level there is no relevant structure, not even words, in general. Rather, this approach assumes an additional level S-P intermediate between S-structure and PF, the purported conditions holding at S-P.

structure of *L* to be the set of structural descriptions, for all expresions *E*. The language *L* itself consists of a lexicon, a specific choice of values for parameters of UG, and such rules as there may be, perhaps restricted to phonology. I understand "language" here in the sense of what I have called elsewhere "I-language", where the terminology is intended to suggest "internalized" and "intensional". Intuitively, a language, so construed, is "a way of speaking and understanding, "in a traditional sense; to have such a way of speaking and understanding (that is, to "have a language" or to "know a language") is to have the I-language as a component of the mind/brain. Note that while "external" to the computational system of language, the interface constraints are "internal" to the mind/brain. Other interactions — for example, those entering into the study of reference and truth — are a different matter.

In accordance with the general EST framework, I assume that the three levels are not related to one another directly, but only through the intermediary level of S-structure, which is the sole point of interaction among the three fundamental levels. From this standpoint, S-structure is a derivate concept. For a specific language *L*, its properties are determined by those of the fundamental levels, and the condition that it be related to them by the appropriate principles. The level of S-structure for *L* is the system that satisfies these conditions, something like the solution to a certain set of equations. Presumably, the principles of language design require that this "solution" be unique.

Exactly how these principles of interaction among levels should be understood is not entirely clear. I will adopt the general assumption that S-structure is related to LF by iterated application of the principle Move-alpha (substitution and adjunction), deletion and insertion — that is, by the principle Affect-alpha in the sense of Lasnik and Saito[11] — and to PF by this principle and the rules of the phonological component.

The relation of S-structure to the lexicon has been construed in various ways. I will assume that the relation is mediated by D-structure, in the manner just outlined, and that D-structure is related to S-structure as S-structure is related to LF and (in part) PF, that is, by iterated application of Affect-alpha. Alternatively, it might be that D-structure is determined by a chain-formation algorithm applying to S-structure (or perhaps LF), and in this sense is "projected" from S-structure as a kind of property of S-structure; this algorithm will then express the relation of S-structure to the lexicon.

The choice between these two options has been open since the origins of trace theory, before the principles-and-parameters approach crystallized. It has never been entirely clear that there is a real empirical issue here. There is, at best, a rather subtle difference between the idea that two levels are simply related, and the idea that the relation is a "directional mapping". Similarly, it is a subtle question whether the relation of S-structure to the lexicon is mediated by a level of D-structure with independent properties, serving as one of the fundamental "interface" levels. My own rather tentative feeling is that there is an issue, and that there is mounting, if rather subtle and inconclusive, evidence in support of the picture sketched earlier, with three fun-

(11) See Howard Lasnik and Mamoru Saito, "On the Nature of Proper Government", *LI* 15, 1984, 235-289.

damental interface levels and the D- to S-structure relation interpreted as a directional mapping.[12] I will adopt this interpretation for expository purposes; it is rather generally adopted in practice, with results then sometimes reconstructed in terms of the alternative conception, a suggestive and possibly meaningful fact. Much of what follows is neutral between the several interpretations of this system.

S-structure may also have to satisfy independent conditions, for example, the binding theory principles, conditions on identification of empty categories, and perhaps X-bar theory.[13]

2. Some properties of Verbal Inflection

Of the many specific areas that might be investigated in an effort to clarify general guidelines of the kind mentioned earlier, I will concentrate on the topic of X^0-movement, a matter of particular interest because of its implications for the study of word formation, though there are other cases, for example, V-movement in the sense of Hilda Koopman and others.[14] With respect to word-formation, there are two major categories where the question of X^0-movement arises: complex predicates (causatives, noun-incorporation, etc.), and inflectional morphology. There is an ongoing and illuminating debate about whether X^0-movement applies in these cases, and if so, how. I will not consider the first category, but will limit attention to inflection, assuming that it involves syntactic rules such as V-raising to INFL, and INFL-lowering to V (Affix-hop). I am thus assuming a sharp and principed distinction between inflectional morphology, part of syntax proper, and strictly derivational morphology, part of the lexicon, perhaps subject to such principles as right-headedness in the sense of Edwin Williams and others. I am, then, assuming something like the earliest version of the lexicalist hypothesis.

With respects to X^0-movement, there is one salient descriptive fact —the Head Movement Constraint (HMC)— and one central question about it: is the HMC reducible, partially or completely, to independently motivated principles of syntactic movement? Assume for now that XP-movement (A- and A-bar-movement) is given, with its principles, specifically ECP. I will assume that ECP reduces to the property of antecedent-government, with the requirement of proper government of trace relating to other conditions that have to do with "identification" of empty categories.[15]

(12) See Luigi Burzio, *Italian Syntax* (Dordrecht: Reidel, 1986), and some remarks in my response to commentary in *Mind and Language* 2.2, 1987, pp. 193-7. Some have felt that there is a profound issue of principle distinguishing "two-level" theories that include a relation of D- to S-structure from "one-level" approaches, which relate S-structure to lexical properties in some different way; for some comment, see my response to queries in H. C. Longuet-Higgins, J. Lyons and D. E. Broadbent, eds., *The Psychological Mechanisms of Language* (London: Royal Society and British Academy, 1981, pp. 63f.), and my *Lectures on Government and Binding* (Dordrecht: Foris, 1981). There may be an issue, but as noted, it is at best a rather subtle one.

(13) On X-bar-theoretic conditions at S-structure, see Henk van Riemsdijk, "Movement and Regeneration", to appear in Paola Benincà, ed., Proceedings of the workshop on dialectology and linguistic theory, GLOW conference, March 1987, Venice. In lectures in Tokyo in January 1986, I suggested some further reasons why such conditions might hold at S-structure.

(14) See Koopman, *The Syntax of Verbs* (Dordrecht: Foris, 1984).

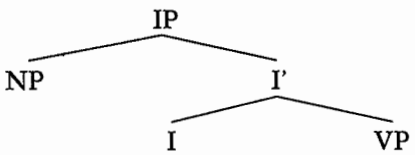
(15) I assume here the general framework of my *Barriers* (Cambridge: MIT, 1986), based essentially on Lasnik & Saito, *op. cit*, though further modifications are in order that I will not consider here.

We then ask whether these same principles yield HMC as a special case. If so, we have a true reduction of HMC, and therefore reduction of properties of word-formation to independently-established principles of syntax.[16]

Let us begin with some recent ideas of Jean-Yves Pollock, based on work by Joseph Emonds on verbal inflection in English-type and French-type languages.[17] I will generally follow Pollock's proposals, adapting some of them in a different way and asking how they might bear on "least effort" guidelines and the status of HMC.

Assume the X-bar-theoretic principle that S=I", so that the basic structure of the clause is (1):[18]

(1)



We leave open the question whether the subject NP is base-generated in place or raised from VP, as proposed in several recent studies; and many others that are not directly relevant.

Emonds's basic idea is that in French-type languages, V raises to I, while in English-type languages, I lowers to V. There is a variety of empirical evidence supporting this conclusion. Assume it to be correct. It will then follow that VP-adverbs, which we take to be generated under VP adjoined to another VP, are preverbal in English and post-verbal in French, as in (2):

(2) (i) John often kisses Mary
(ii) John completely lost his mind
(iii) Jean embrasse souvent Marie
(iv) Jean perdit complètement la tête

But English auxiliaries *have-be* behave approximately like ordinary verbs in French, as in (3):

(3) (i) John has completely lost his mind
(ii) books are often (completely) rewritten for children

(16) Note that there also might be a partial reduction, for example, a formulation of ECP that expresses a generalization holding of X^0-movement and other cases; that would be the import of a proposal by Luigi Rizzi developd in his "Relativized Minimality", ms. Geneva, 1987. We should also look into the other possible case of movement: X'-movement. For some recent evidence supporting this option, see van Riemsdijk, *op. cit.* See also Takayasu Namiki, "Remarks on Prenominal Adjectives and Degree Expressions in English", *Studies in English Linguistics* 7.71- 85, 1979.

(17) Pollock, "Verb Movement, UG and the Structure of IP", ms. Université de Haute Bretagne, Rennes, 1988. I will touch upon only a few of the questions that Pollock addresses. See Emonds, "The Verbal Complex V'-V in French", *LI* 9.151-75 (1978), and his *A Unified Theory of Syntactic Categories* (Dordrecht: Foris, 1985), for a more recent development of his approach.

(18) Order irrelevant, here and below, for abstract formulations.

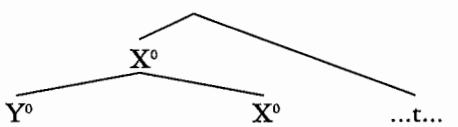
Therefore the distinction is not raising in French versus lowering in English, but some other difference that requires French verbs and English auxiliaries to raise while barring this possibility for other verbs in English.

On other grounds, it has been postulated that the AGR element is "stronger" in French than in English. Assume this to be true. Assume further that weak AGR is unable to "attract" true verbs such as *kiss* or *lose,* though it can attract auxiliaries, while strong AGR attracts all verbs.[19]

Why should weak and strong AGR behave in this fashion? One possibility, suggested by Howard Lasnik, is that it is simply a morphological property: only strong AGR can accept a "heavy" element such as a verb, though any AGR can accept a "light" element such as an auxiliary. Another possibility, developed by Pollock, is that the difference reduces to theta-theory: strong AGR allows an adjoined element to head a theta-chain, but weak AGR does not. If the auxiliaries are not theta-markers, then they can raise to AGR without a violation of the theta criterion, but raising of a true verb to weak AGR will lead to a violation of the theta criterion.

Looking at this option more closely, consider the effect of raising of Y^0 to adjoin to X^0. This process yields the structure (4), where *t* is the trace of Y^0:

(4)

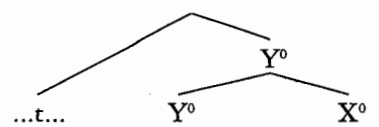


The theory of government must permit Y^0 to govern its trace *t* in this structure, so as to satisfy ECP. If the theory of government precludes government of Y^0 from outside of the complex element X^0 formed by adjunction, then successive-cyclic movement of Y^0 will be barred; thus causative formation, for example, cannot escape HMC (assuming it to reduce to ECP) by successive-cyclic movement. I will assume this to be the case, putting a precise formulation aside.

The chain (Y^0, *t*) will therefore be properly formed in (4) with regard to ECP. Suppose that Y^0 is a theta-marker. Then *t* must be able to theta-mark; the theta-marking property of Y^0 must be "transmitted" through the chain. That will be possible if X^0 is strong, but not if it is weak. We will therefore have a theta criterion violation if a theta-marker Y^0 is adjoined to weak AGR.

Suppose that instead of raising Y^0 to adjoin to X^0 to yield (4), we lower X^0 to adjoin to Y^0. This process again forms the complex element [Y^0-X^0], but with a structure different from (4), namely (5), *t* being the trace of X^0:

(5)

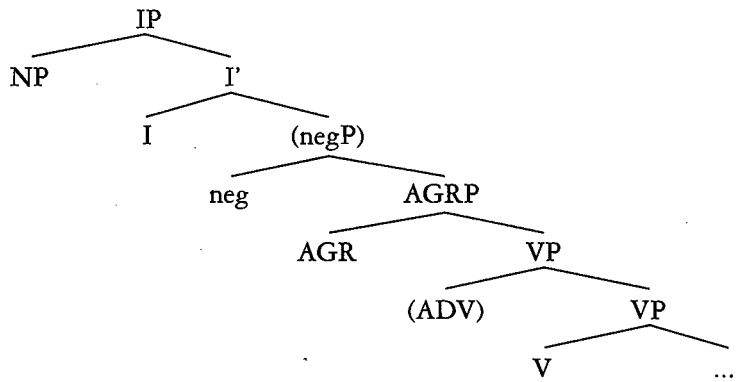


(19) Pollock's terms for "strong", "weak" are "transparent", "opaque", respectively, for reasons that become clear directly.

Here the lower Y^0 is the head of the construction, and we may assume that whatever the character of X^0, Y^0 will retain all relevant relations to other elements, and will therefore retain the capacity to theta-mark a complement. The normal properties of adjunction, then, have the desired effect, as Pollock observes: lowering of weak AGR to the verb *v* does not bar theta-marking of the complement, but raising of *v* to weak AGR does bar theta-marking.

Pollock extends the domain of observation further to negation, proposing the following more articulated structure in a Kayne-style unambiguous path analysis:

(6)



Here I may be [± finite] and *neg* is English *not* or French *pas*.[20] This representation, separating I and AGR, eliminates the odd dual-headedness of INFL in earlier treatments. The assumption is that infinitives have (generally vacuous) AGR.

Suppose that V raises to AGR. Then we have the S-structure order V-Adverb-Object, as in English auxiliaries or French verbs generally. If AGR lowers to V, we have the order Adverb-V-Object, as in English non-auxiliary verbs. If V raises to AGR and then the complex raises further to I, we have such forms as (7):

(7) (i) John has not seen Bill
(ii) Jean (n') aime pas Marie

If V raises to AGR but not to I, we have (8i) in French, with *sembler* ("seem") contrasting with *être* ("be"):

(8) (i) ne pas sembler heureux
(ii) n'être pas heureux

The properties illustrated in (7) and (8) follow on the assumption that [+finite] is strong while [-finite] is weak. Being strong, [+finite] allows the verb *aime* to adjoin to it, crossing *neg (pas)*, in (7ii). Being weak, [-finite] does not permit the verb *sembler* to adjoin to it, crossing *neg*, in (8i), though the auxiliary *être* can raise to weak I just as auxiliaries can raise to weak AGR.

(20) Pollock treats *ne* in the *ne-pas* construction as the clitic head of negP, raising to a higher position. We might think of it as a kind of scope marker.

While the V-raising rule in French is obligatory for tensed clauses, it is optional for infinitives. Thus alongside of (8ii), we have the option (9i); and alongside of the form V-Adv-NP (obligatory for finite as in (2iii)), we have (9ii):

(9) (i) ne pas être heureux
(ii) souvent paraître triste

(9i) results from failure of *être* to raise over *neg* to [-finite] I, and (9ii) from failure of *paraître* to raise over the adverb to AGR in the infinitive.

We return in section 3.2 to the question of why there should be optionality just in the case of infinitive, and in section 5 to some further questions about the nature of AGR. Tentatively, let us assume the analysis just given, putting aside the optionality with infinitives.

At S-structure, the verb must typically be combined with its various affixes, to yield the proper forms at PF; the various affixes in (6) must form a single complex with a verb. Let us suppose that these affixes share some unique feature to guarantee proper association at S-structure. Thus any series of rule applications that separates them is barred by an appropriate S-structure condition, and we need not be concerned if the rule system permits "wild" application of rules that would leave affixes improperly scattered among the words of the sentence generated. Note that other improper rule applications are barred by the requirement that items lexically identified as affixes be properly "attached" at S-structure.

Assuming Pollock's parameter, we have strong and weak inflectional affixes. The [+finite] choice for I (tensed) is strong and the [-finite] choice (infinitive) is weak. AGR is strong in French, weak in English. The basic facts follow, with some idealization of the data.

Pollock observes that earlier stages of English were much like French, suggesting plausibly that a change in the AGR parameter led to the collection of phenomena that differentiate the languages in the current stages. Some of the forms reflect D-structure directly; for example, (9i,ii) in French and their English equivalents. Other forms reflect the consequences of raising of V to AGR or to I, as illustrated. A unitary treatment of the comparative data — with the array of facts involving tense-infinitive, negation and adverbs, verbs and auxiliaries —relies crucially, Pollock points out, on analysis of Tense and Agreement morphemes "as separate syntactic entities at an abstract level of representation", namely D-structure. The analysis, then, provides support for the rigid X-bar-theoretic condition of single-headedness and the consequent distinction between AGR and I, and on the distinction between D- and S-structure representation, Pollock concludes.

3. A "Least Effort" Account

3.1. Minimizing Derivations

Let us now see how an analysis of this nature would bear on the guidelines we have been considering. I will put aside the relation of S-structure to PF and D-structure to lexicon. Thus we are considering the relations among D-structure, S-struc-

ture and LF. For expository convenience, I will refer to the relation of D- to S-structure as "overt syntax" (since the consequences of the operations relating these levels are commonly reflected at PF).

The analysis of verbal inflection outlined in section 2 relies crucially on the principle that raising is necessary if possible. This would follow from the assumption that shorter derivations are always chosen over longer ones. The reason is that lowering of an inflectional element INF, as in the case of English true verbs, yields an improper chain (*t*,..., INF), where INF is adjoined to V at S-structure to form [$_V$V-INF] and t is the trace of INF, which c-commands it. Subsequent LF-raising of [$_V$V-INF] to the position of *t* is therefore required to create a proper chain. The result is essentially the same as would have been achieved with the shorter derivation that involves only raising in the overt syntax. Therefore, by a "least effort" condition, only the latter is permissible.

A closer look shows that the "least effort" condition cannot reduce simply to the matter of counting steps in a derivation. Consider English interrogatives. Let us assume that an interrogative construction has the complementizer Q ([*wh*]) to distinguish it at D-structure from the corresponding declarative, triggering the appropriate intonational structure at PF and the proper interpretation at LF. If Q is, furthermore, an affix, then it must be "completed" in the overt syntax by X^0-raising. The D-structure (10) will yield, by lowering, an S-structure with the verb [V-AGR-I][21] and traces in the positions of I and AGR:

(10) Q John I AGR write books

The resulting form is indistinguishable from the declarative at PF, and is, furthermore, illegitimate (at S-structure) if Q is a real element, as postulated. To permit an output from the legitimate D-structure (10), English makes use of the dummy element *do* to bear the affix, so that lowering does not take place; rather, AGR and I adjoin to *do*. Let us call this process *do*-support, a language-specific process contingent upon the weakness of AGR; for expository purposes, assume it to be a rule of the overt syntax inserting *do* in the Modal position, hence *do*-insertion, attracting the raised affixes and then raising to Q. Given this device, we can form "did John write books" from (10).[22]

The same device, however, permits the illegitimate form "John did write books" (*do* unstressed) alongside of "John wrote books", both deriving from the declarative form corresponding to (10) (lacking Q). In fact, this option is not only available, but is arguably obligatory if shorter derivations are always preferred. The reason is that the illegitimate option requires only the rule of *do*-insertion and raising, while the correct form requires overt lowering and subsequent LF-raising.

(21) More explicitly, the verb [$_V$V[$_{AGR}$AGR-I]].

(22) The mechanics of how modals and *do* relate to the inflectional affixes remain to be specified. If *do*-support can be shown to be a reflex of parameter-fixing (choice of weak AGR, we are assuming), then it is not, strictly speaking, a language-specific rule, though I will continue to use this term for expository purposes. The device of employing dummy elements in this manner is found elsewhere, also plausibly considered to be contingent on parameter-fixing; see section 6.4 for one example.

To yield the correct results, the "least effort" condition must be interpreted so that UG principles are applied wherever possible, with language-particular rules used only to "save" a D-structure yielding no output: interrogative forms without modal or non-theta-marking verbs, in this case. UG principles are thus "less costly" than language-specific principles. We may think of them, intuitively, as "wired-in" and distinguished from the acquired elements of language, which bear a greater cost.[23]

Consider now a negative expression with the D-structure (11):

(11) John I neg AGR write books

The correct derivation involves *do*-insertion and raising of AGR to form the complex verb [*do*-I-AGR], with the S-structure (12):

(12) John did (does) not write books

But again we face a problem: why doesn't I lower to AGR, then to V, yielding the complex verb [V-AGR-I] as in the non-negated form, so that at S-structure and PF we have "John not wrote (writes) books"? Then LF-raising will apply, eliminating the improper chain, exactly as in the case of the non-negative counterpart. This process involves only the UG principles of overt lowering and LF-raising, avoiding the language-particular rule of *do*-insertion. It is therefore not only a permissible derivation, but is actually required by the "least effort" condition, as just revised.

A partial solution to this problem is provided by HMC. The process of LF-raising has to cross *neg,* thus violating HMC. There is, therefore, only one legitimate derivation: the one involving *do*-insertion, which is therefore required in these cases.

We are thus assuming that, given a well-formed D-structure, we necessarily apply the least costly derivation that is legitimate to yield an S-structure and, ultimately, a PF output.

But several further questions arise at once. Consider the French counterpart to (11), or equivalently, the English form (13):

(13) John I neg AGR have written books

Here the correct derivation requires that the verb *have* raise to AGR, then to I crossing *neg,* to yield (14):

(14) John has not written books

And in French, the same will be true of a main verb, as in the counterpart to the D-structure (11). If HMC blocks the unwanted derivation with LF-raising over *neg* in the case of (11), then why does it not equivalently block the *required* derivation with overt raising over *neg* in the case of (14) and the French equivalent to (11)?

Note that there is also a similar question in the case of (11). Thus the required derivation involves raising of AGR over *neg* to I to form the complex verb [*do*-I-

(23) Note that there are empirical consequences to these assumptions. They entail that at the steady state attained in language acquisition, the UG principles remain distinct from language-particular properties. There is suggestive work by Suzanne Flynn on second-language acquisition supporting this conclusion. See her *A Parameter-Setting Model of L2 Acquisition: Experimental Studies in Anaphora* (Dordrecht: Reidel, 1987).

AGR] after *do*-insertion. Why, then, does not overt raising of AGR over *neg* violate HMC?[24]

To deal with these questions, we have to consider more carefully the nature of deletion. Clearly, we cannot delete an element if it plays a role at LF: for example, the trace of a verb. But such considerations do not require that the trace of AGR remain at LF, since it plays no role at that level. We might, then, suppose that the trace of AGR is deletable (I will return to this conclusion in a more general setting in section 6.2). We must also determine exactly what we intend the process of deletion to be. There are various possible answers to this question, generally not addressed because they go beyond known empirical consequences. In the present context, however, there are empirical consequences, so a specific decision must be reached. One plausible answer is that deletion of an element leaves a category lacking features, which we can designate [*e*]. Then deletion leaves a position but no features, in particular, no categorial features. Deletion of [$_{\text{AGR}}$ *t*], the trace of AGR, leaves [*e*], and by X-bar-theoretic principles, the dominating category AGRP is now *e* P, an XP with no features.[25] That is a satisfactory conclusion, since AGRP plays no role at LF.

Making these assumptions, let us return to the problems we faced. Consider first the raising of AGR to I over *neg* to form [*do*-I-AGR] in the correct derivation from the D-structure (11). This process will, in fact, violate the HMC regarded as a condition on derivations, but there will be no ECP violation at LF once the trace of AGR is deleted. Recall that we are taking ECP to be a condition on chains, along the lines discussed in *Barriers,* thus not applicable to the empty categories PRO, pro, *e,* but only to trace. We therefore have no ECP violation, though we do have an HMC violation. But if HMC is reducible to ECP, then we can dismiss HMC as a descriptive artifact, valid only insofar as it does in fact reduce to ECP. The present case would be one in which HMC does not reduce to ECP, and is therefore inoperative.

Let us now turn to the more general question. Why does LF-raising of [V-AGR] to I over *neg* violate HMC, while overt raising of [V-AGR] to I over *neg* (as in the case of English auxiliaries and all French verbs) does not violate HMC? To answer this question, we must again consider more closely the structures formed by adjunction.

Let us return to the D-structures (11), (13), repeated here as (15):

(15) (i) John I neg AGR write books
(ii) John I neg AGR have written books

Lowering of I to AGR forms the element [$_{\text{AGR}}$AGR-I], leaving the trace t_I. Further lowering of the complex element to V forms [$_{\text{V}}$V [$_{\text{AGR}}$ AGR-I]], a verb, leaving the trace t_{AGR}. But this trace deletes, leaving [e], a position lacking features. Applying these processes to (15i), then, we derive the S-structures (16):

(24) There would, in fact, be a straightforward solution to this particular problem in terms of an analysis to which we return in section 5, but I will put that aside here, since it will not bear on the other questions just raised.

(25) Note that *e* is regarded here as an actual symbol of mental representation, but lacking phi-features and categorial features. *e* is not to be confused with the identity element of a syntactic level, regarded as an algebraic construction in the manner of *LSLT.*

(16) John t_I neg [e] [$_{VP}$ [$_V$ write[$_{AGR}$ AGR-I]]books]

We now turn to LF-raising. The complex V raises to the position [e], leaving a V-trace; we may assume this to be substitution, not adjunction, on a natural interpretation of recoverability of deletion. We now raise this element to the position *t* I, again leaving a V-trace. The latter is of course undeletable, being part of a chain with substantive content at LF. This step violates HMC, and its residue, (17), violates ECP at LF:

(17) John [$_V$ write-AGR-I] neg t'_V[$_{VP}$ t_V books]

Here antecedent government of t'_V is blocked by the intermediate element *neg,* under the minimality condition. We therefore have a violation of ECP at LF. In this case, HMC, reducing to ECP, is a valid descriptive principle, violated by the derivation.

Note that the situation contrasts with overt raising of V to AGR, then to I over *neg,* as in the case of (15ii) (and all French verbs). Here raising to AGR is permitted, therefore obligatory by the "least effort" condition. Following the derivation step by step, we first raise V to AGR, leaving V-trace and forming [$_{AGR}$ V-AGR]. We then raise this complex element to I over *neg,* forming [$_I$ V-AGR-I], and leaving AGR-trace; this step violates HMC. The AGR-trace now deletes, leaving [*e*]. We thus derive the form (18):

(18) John [$_I$ have-AGR-I] neg [e] [$_{VP}$ t_V...]

This representation induces no ECP violation,[26] though the derivation that formed it violates HMC. Again, we see that HMC is descriptively valid only insofar as it reduces to ECP.

The range of problems that arise therefore receive straightforward solutions when we consider the nature of adjunction, as standardly defined. Note, however, the crucial assumption that "unnecessary elements" delete at LF; we return to the matter in section 6.2. Also crucial is the assumption that D-structure relates to S-structure by a directional mapping, a step-by-step derivational process. In the S-structure (and LF) representation (18), *have* is "too far" from its trace t_V for ECP to be satisfied, but the locality requirement has been satisfied in the course of the derivation from D- to S-structure.[27]

3.2 The Element I

Let us turn to some speculations on the status of IP and the optionality observed earlier in French infinitival constructions. If I is [+finite] (I=T=tense), then it presumably cannot be deleted, since a tensed phrase plays an LF-role. Therefore, we have either overt raising to [+finite] or LF-raising to the position of its trace.

(26) Recall that we are assuming, essentially, the Lasnik-Saito theory of ECP, as modified in *Barriers.* Under this theory, t_V in (17) is gamma-marked after raising of V to AGR, and subsequent deletion of AGR-trace in this position leaves no ECP violation.

(27) On other cases of a similar sort, see my remarks in *Mind and Language*, cited earlier.

There is, however, no strong reason to suppose that the same is true of [-finite] (infinitive). If [-finite] and its IP projection play no role at LF, then this element should be deletable, just as AGR (actually, t_{AGR}) is. Suppose that this is the case.[28]

Before considering the consequences, we have to resolve a minor technical question about infinitival inflection: does [-finite] attach to the base form of the verb or does it not? Little is at stake in the present connection; for concreteness, let us adopt the former alternative.

Keeping now to French, consider verbs that can raise to weak inflection, for example, *être* ("be"). Suppose that we have the form (19), with *être* raised to AGR:

(19) ne I pas être heureux

In this construction, *être* may raise further to I in the normal way, yielding the form (20):

(20) n'être pas heureux

But there is also another option. The form *être* may remain in place, with I lowering to [être-AGR] leaving not trace but [*e*]. This is permissible on the assumption we are now considering: that [-finite] is deletable, playing no L role. The resulting form is (21), identical to (19) but with [*e*] in place of I:

(21) ne pas être heureux

Each of these options involves one rule application. Therefore the two are equally costly and we have genuine alternatives, in conformity with the "least effort" guideline. As observed earlier, these two cases are both permitted in French.

Consider now a true verb, such as *paraître* ("seem"). We know that it cannot raise to I, so I must lower to AGR, leaving *e*. Suppose now that *paraître* is in an adverbial construction, as in the D-structure (22):

(22) souvent paraître triste

If *paraître* raises to AGR in the usual way, we derive the form (23):

(23) paraître souvent triste

Suppose, however, that AGR-I lowers to the V position, leaving [*e*] rather than trace. The resulting form is (22) itself, a legitimate form with no ECP violation. Again we have two options, (22) and (23), each involving a single rule, each legitimate. The reason is that AGR and its projection, exactly like [-finite] I and its projection, play no role at LF and are therefore deletable.

We conclude, then, that while there are no options in the finite forms, in their infinitival counterparts, we have the options illustrated. Along these lines, we might hope to incorporate Pollock's observations about the range of options for infinitives as distinct from tensed clauses.

(28) Semantic properties of infinitives, then, would be understood as properties of the construction, not its head [-finite].

We have not settled the precise character of LF-raising to the trace of [+finite]. What is required is that the finite (tensed) phrase, functioning at LF, not be deleted. The requirement is met under LF-raising, which might be either adjunction or substitution. If it is adjunction, the resulting form will be (24), which heads TP, where T=[+finite] (tense):

(24) $[_T [_V V [_{AGR}$ AGR-T]] $t_T]$

We must then take this to be a legitimate form, with T c-commanding its trace t_T. If the LF-raising is substitution, we derive (25) in place of (24) in the I position, now heading VP:

(25) $[_V V [_{AGR}$ AGR-T]]

The question of government of t_T does not now arise, but we must ask just how the element (25) in the I position satisfies the requirement of tense interpretation at LF. The further implications are not clear, and I will leave the question open.

4. Summary: On Economy of Derivations

Summarizing, we have selected one particular option available for sharpening the notion of deletion, previously left undetermined; and we have made a distinction between deletable and nondeletable elements on the basis of their LF role. These moves are natural and seem generally unexceptionable. Apart from this, we have kept largely to familiar assumptions along with Pollock's basic analysis, modified in various ways. Attending to the meaning of the formalism for adjunction and other notions, the basic empirical observations follow.

Some more general conclusions are also suggested. First, HMC is not a principle, though it is largely accurate as a descriptive generalization. The principle is valid only insofar as it reduces to ECP, and can be violated when other processes overcome a potential ECP violation by eliminating an "offending trace". Second, with regard to the "least effort" guidelines, we now have a somewhat more specific interpretation. The condition requires that the least costly derivation be used, eliminating the S-structure and PF consequences of more costly derivations. To a first approximation, cost is determined by length; the condition requires the shortest derivation, so that overt raising is required where it is possible. But "cost" has a more subtle meaning: UG principles are less costly than language-specific rules that are contingent upon parameter choices (see note 22); and *do*-insertion, in particular, functions only as a "last resort", to "save" a valid D-structure that otherwise underlies no legitimate derivation.

Other well-known facts suggest further refinement of the notion of "least costly derivation". Consider, for example, a standard case of long-distance movement, as in (26):

(26) how do you think that John said [that Bill fixed the car t]

The sentence is well-formed by successive-cyclic movement. There is, of course, a shorter derivation, namely, in one step, in which case, on the general principles so far assumed, the sentence should have a status no different from (27):

(27) how do you wonder why John asked [which car Bill fixed t]

The shorter derivation does not bar the longer successive-cyclic one in this case. In fact, the *shorter* derivation is barred; it is not the case that (26) is structurally ambiguous, with one interpretation given by the legitimate derivation and another deviant interpretation given by the illegitimate shorter one. Hence it must be that the measure of cost prefers short movement to long movement, and thus requires the former where possible.

In such ways as these, we may proceed to refine the "least effort" conditions on movement, raising them from the status of imprecise guidelines to actual principles of UG.

Notice that this approach tends to eliminate the possibility of optionality in derivation. Choice points will be allowable only if the resulting derivations are all minimal in cost, as in the case of French infinitival constructions discussed earlier. Any remaining examples of optional rule application would then have to be assigned to some other component of the language system, perhaps a "stylistic" component of the mapping of S-structure to PF. This may well be too strong a conclusion, raising a problem for the entire approach.

5. The Agreement System: some speculations

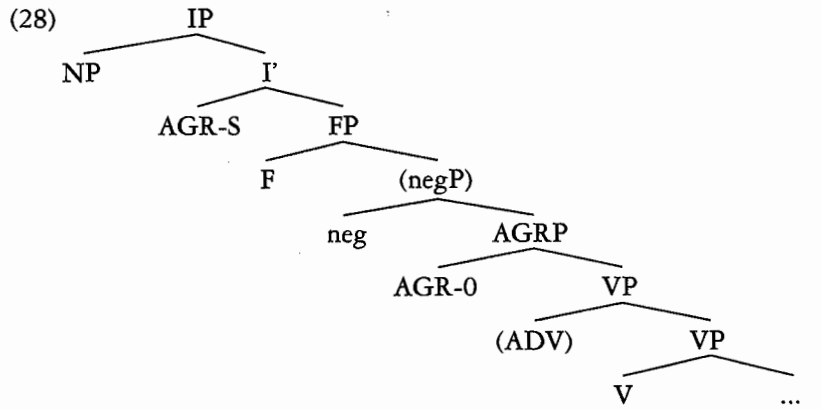
A number of questions arise about the status of AGR in the system just outlined. Following Pollock, we have assumed that AGR is dominated by Tense. But assuming these elements to be dissociated, one might rather expect AGR to dominate tense, since it presumably stands in a government relation with the subject in tensed clauses, to yield the standard subject-verb agreement phenomena. There is morphological evidence suggesting the same conclusion: in a number of languages where it is possible to obtain relevant evidence, the agreement element is "outside" the tense element in the verbal morphology, as would follow from successive adjunction if AGR dominates the tense element.[29] Nevertheless, facts of the kind just illustrated lead Pollock to postulate a position intermediate between Tense and VP, what he takes to be the AGR position.

These conflicts might be reconciled by noting that there are actually two kinds of Verb-NP agreement: with subject and with object. Hence pursuing the basic lines of Pollock's analysis, we should expect to find two AGR elements: the subject-agreement element AGR-S and the object-agreement element AGR-0. On general assumptions, AGR-0 should be close to V, and AGR-S close to the subject, therefore more remote from V.[30] The element AGR in Pollock's structure (6), which we have adopted as the basis for discussion, would therefore be AGR-0, providing an intermediate position for raising. It would then be unnecessary to suppose that infinitives necessarily carry (generally vacuous) subject-agreement, though we would now be assuming that AGR-0 is present even for non-transitives. Pollock's structure (6)

(29) See Adriana Belletti, ms., Geneva, 1988.

(30) A cursory check suggests that the morphological consequences are as expected, in languages where the hierarchic position of object and subject agreement can be detected.

would now be more fully articulated as (28), where AGR-S=I, the head of I' and IP, and F is [± finite]:



In terms of this proposal, the preceding analysis considered only the structure dominated by FP, which is identical with Pollock's (6) (notations aside).[31]

These conclusions are consistent with Kayne's analysis of participle agreement in a variety of Romance languages.[32] Kayne assumes an AGR element heading AGRP with VP as its complement. This element is distinct from the AGR involved in subject agreement; we may take it to be AGR-0. Thus we have such D-structures as (29), for a French participial construction, putting aside I and AGR-S:

(29) NP V_{aux} [$_{AGRP}$ AGR [$_{VP}$ V-participle NP]]

If the NP object is a *wh*-phrase that undergoes raising, then the participle may or may not agree with it. Kayne assumes that these options correspond to two distinct structures, as in (30), where *t, t'* are the traces of the *wh*-phrase "combien de tables":

(30) (i) combien de tables [Paul a [$_{AGRP}$ t' [$_{AGRP}$ AGR [repeint- t]]]]
(ii) combien de tables [Paul a [$_{AGRP}$ AGR [repeint- t]]]

The two forms are synonymous, meaning "how many tables has Paul repainted". In (i), the participle surfaces as *repeintes* (plural), in (ii) as *repeint* (lacking agreement).

In the derivation of (i), the *wh*-phrase raises to the position of the trace *t'*, adjoining to AGRP. In this position, it is in a government relation with AGR (in our terms, AGR-0). The participle thus agrees with its *wh*-phrase object.[33] The underlying assumption is that object agreement is contingent upon a government relation between AGR and an NP, exactly as in the case of subject agreement. In case (ii), the

(31) At various points, the reinterpretation would require slight modifications in the exposition and the resulting analysis. I will omit further comment on these matters, which do not seem to raise any serious problem.

(32) Richard Kayne, "Facets of Romance Past Participle Agreement", ms, MIT, 1987.

(33) More precisely, agreement holds between the *wh*-phrase and AGR-0, to which the participle raises so that it agrees with the *wh*-phrase; the same is true of subject-verb agreement.

wh-phrase has not passed through the adjoined position, so there can be no agreement.[34]

Since *t'*, adjoined to AGRP, is in an A-bar position, it follows, Kayne observes, that there will be no participial agreement with the *wh*-phrase in the case of an expletive subject (as is the case), on the assumption of expletive-replacement, to which we return in section 6.3. The reason is that expletive-replacement would require improper movement of the trace *t'* of the *wh*-phrase from an A-bar to an A-position.

If an NP remains in the object position, there is no participial agreement, though in clitic movement, we again find such agreement, as in (31):

(31) (i) Paul a repeint (*repeintes) les chaises (ii) Paul les a repeintes

The reason is that the object *les chaises* in (i) is not in the appropriate government relation with AGR-0 (the relation is barred by the minimality condition on government, since the participle intervenes[35]), while in case (ii), the clitic has raised to a position governed by AGR, perhaps the specifier of AGRP. Kayne argues further that although the two agreement processes (with *wh*-movement and clitics) are not clearly dissociated in French, comparative evidence shows that they are in fact distinct processes and that the clitic does not adjoin to AGRP.

The question arises why the NP object cannot appear in the postulated position associated with AGR, say, its specifier position, as in (32):

(32) *Paul a [ces tables repeint(es)]

Base-generation is excluded if we take theta-marking to be to the right in French; or, as in recent work that assumes raising of subject from VP to the specifier of IP position, we might assume that theta-marking must be internal to the projection of the theta-marking head, thus impossible in (33):

(33) ... $[_{AGRP}$ NP AGR $[_{VP}$ V]]

Failure of the non-clitic object to raise to the position in (32) follows from the chain condition if the participle assigns Case directly to its object, to its right in the base form, as Kayne assumes.[36]

Without reviewing the further consequences that Kayne develops, note that the analysis supports the idea that there is an AGR position intervening between tense and the V, and that this element is distinct from the subject-agreement element. Furthermore, we have evidence that object agreement, like subject agreement, is based upon a government relation between AGR (in this case, AGR-0) and the noun phrase.

(34) Note that we must assume the two derivations to be "equally costly", each being "minimal" by successive-cyclic movement. This consideration would lead to a further refinement of the notion of "cost".

(35) The minimality condition assumed here is of the "absolute" form discussed in Barriers, not "relativized minimality" in the sense of Rizzi, *op.cit.* That is generally the case when minimality is invoked to block head government of XP.

(36) The case of clitic movement depends upon theory-internal assumptions about cliticization, but no new problems appear to arise here. Kayne's argument is slightly different from the above.

Hilda Koopman has independently proposed that agreement is always the reflection of a specifier-head relation.[37] We might revise this proposal to accord with Kayne's: agreement with an NP is always the reflection of a government relation between the head AGR and the NP, either the SPEC-head relation or the relation of the head to an adjoined element, the AGR typically being associated with the verb at S-structure by the processes we have been discussing. Koopman suggests further that this idea may relate to her earlier proposal that the order parameters of the X-bar system involve two independent factors: directionality of Case- and theta-marking.[38] If Case-marking is to the left and theta-marking to the right, then NP will be in pre-head and other theta-marked complements in post-head positions.

We might carry the proposals a step further, supposing that structural Case generally is correlated with agreement and reflects a government relation between the NP and the appropriate AGR element. Thus subject-verb agreement is associated with nominative Case, and is determined by the relation of the specifier to the AGR-S head of AGR-S" (=IP, in (28)), while verb-object agreement is associated with accusative Case, and is determined by the relation of the NP to the AGR-0 head of AGR-0", either in specifier position or adjoined to AGR-0. The relations might be uniform at LF, parametrized at S-structure, with Case-checking and Case-marking perhaps dissociated.

Note finally that if the proposal just outlined is tenable, with AGR-0 distinct from AGR-S, then one of the problems discussed earlier in connection with example (11), repeated as (34), does not arise:

(34) John I neg AGR write books

The problem was to ensure *do* -insertion and raising of AGR to form the complex verb [v *do* -AGR-I] with no violation of HMC, while barring an alternative derivation with overt lowering. If we were to adopt the structure (28) rather than (6), distinguishing AGR-S from AGR-0, then AGR in (34) is actually AGR-0, which would not raise over *neg,* but would lower to V (with subsequent LF-raising to the position of the trace of AGR-0 to form a proper chain). There is, then, no violation of HMC, straightforwardly. The more general problems discussed earlier however remain, still motivating the argument presented.

6. Economy of Representation

It has been suggested elsewhere that movement is available only as a "last resort". The preceding discussion suggested that deletion might also be regarded as a "last resort" operation, applicable where necessary, but not otherwise, and that the same is true of whatever is involved in *do*-support: insertion, if that is the proper way to interpret the phenomenon. More generally, then, it may be that the principle Affect-

(37) Koopman, "On the Absence of Case Chains in Bambara", ms., UCLA, 1987. She is considering the possibility of object-raising to SPEC of VP; alternatively, we might suppose that the process in question is raising to SPEC of AGRP.

(38) Koopman, *The Syntax of Verbs.* See also Lisa Travis, *Parameters and Effects of Word Order Variation,* Phd dissertation, MIT, 1984.

alpha applies only where necessary. This overarching principle, then, expresses a general property of transformational rules —or more properly, of *the* transformational rule, actually a principle of UG. The intuitive meaning is that derivations must be as economical as possible: there is no superfluous rule application. The intuituive content of this idea, however, is spelled out in terms of specific notions of cost that distinguish UG principles from language-particular properties, introduce locality considerations, and so on. We thus have a plausible "least effort" principle, but a principle that is apparently specific to the language faculty in its actual formulation. This is a familiar conclusion elsewhere as well, one that bears on the nature of the language faculty generally.

The analogous principle for representations would stipulate that, just as there can be no superfluous steps in derivations, so there can be no superfluous symbols in representations. This is the intuitive content of the notion of full interpretation (FI), which holds that an element can appear in a representation only if it is properly "licensed". Let us proceed now to ask how this intuitive notion might be refined, in an effort to move it too from the status of a guideline towards that of a principle of UG.

It would be natural to expect that FI holds at each of the three fundamental levels that constitute an interface between the computational system of language and other systems: hence at the levels of D-structure, PF and LF. If so, then "licensing" under FI is expressed in terms of conditions relating the syntax, broadly construed, to other systems of the mind-brain.

At D-structure, FI holds by definition, this level simply being a projection of lexical structure in terms of the notions of X-bar theory.[39] At PF, it is universally taken for granted, without discussion, that the condition holds in a strong form. That is, a condition on phonetic representation is that each symbol be interpreted in terms of articulatory and perceptual mechanisms in a language-invariant manner; a representation that lacks this property is simply not considered a phonetic representation, but rather a "higher-level" representation, still to be converted to PF. Like D-structure, PF is understood to be defined by some version of FI. The corresponding notion at LF would be that every element that appears at LF must have a language-invariant interpretation in terms of interactions with the conceptual systems. Let us explore this idea further.

6.1. Operators and variables

One consequence is that vacuous quantification should be forbidden. That is, language should differ from typical formal systems that permit vacuous quantification freely, with the well-formed expression "(x)(2 + 2 = 4)" receiving the same interpretation as "2 + 2 = 4". Formal systems are designed this way for ease of description and computation, but the design of human language is different. Thus we cannot have such expressions as (35i) interpreted as "John saw Bill", or (35ii) interpreted as "some person left":

(39) There are further refinements to be considered. For example, should expletives be present at D-structure or inserted in the course of derivation? What is the status of functional elements? And so on.

(35) (i) who John saw Bill, who did John see Bill
(ii) every some person left

Similarly, if a language permits such structures as (36), the vacuous operator interpretation is excluded:

(36) (i) who did Mary see him (ii) the man that Mary saw him

These expressions cannot be interpreted to mean "Mary saw x", "the man y such that Mary saw x", respectively. If some theory of grammar stipulates specific devices and rules to bar such constructions and interpretations, we conclude that it is the wrong theory: it is generating expressions and structures too accurately, and is therefore incorrect. There is nothing paradoxical about this conclusion. The unwanted constructions are excluded on general grounds, in terms of the overarching condition FI; there is no reason to suppose that the mechanisms of language include superfluous devices and rules to achieve, redundantly, the same result in special cases. Similarly, the phonological component contains no rules to express special cases of general properties of universal phonetics or of phonetic representations.

A related question has to do with free variables. What is their status in natural language? Typically, formal systems permit well-formed expressions with free variables, interpreting them as universally quantified or with the free variable treated as an arbitrary name, as in the course of natural deduction and intuitive mathematics generally. One natural language analogue to a free variable would be an empty category bound by an empty operator. There is quite strong evidence that such constructions exist, for example, in complex adjectival constructions such as (37):

(37) (i) John is too clever to catch
(ii) John is too clever to expect anyone to catch
(iii) *John is too clever to meet anyone who caught
(iv) Mary expected John to be too clever to catch

The general properties of these and many other constructions follow from the assumption that the underlying D-structure is as in (38i) (for (37i)), and that empty-operator movement, meeting the usual conditions on A-bar movement, raises the empty category *O* to the COMP position of the bracketed clause (to the specifier position of CP), leaving a trace t in the S-structure (38ii):

(38) (i) John is too clever [$_{CP}$ PRO to catch O]
(ii) John is too clever [$_{CP}$ O [PRO to catch t]]

But variables are subject to the property sometimes called "strong binding": a variable must have a range determined by its restricted quantifier (language permitting no unrestricted quantification, as distinct from typical formal systems), or a value fixed by an antecedent that meets certain structural properties: thus *John* but not *Mary* in (37iv). The latter condition applies when the operator is an empty category. Sentence (i), for example, cannot mean that John is so clever that he cannot catch everything, or that he cannot catch something (someone) or other, analogous to

"John ate", meaning that John ate something or other. In short, language does not permit free variables: the strong binding property determines the curious semantic properties of these constructions. We might think of this condition as a specific application of the UG condition FI.

In these terms, we would interpret the empty operator binding an empty pronominal, in the sense of James Huang's work on Chinese, as "restricted", in that it is necessarily discourse-related.[40] There are semi-free variables such as PRO and *one,* which, however, always appear to have special properties, specifically, human or animate (e.g., "it is easy to roll down a hill" does not refer to a rock). Thus a true free variable interpretation is disallowed.

6.2. Legitimate LF Elements

A further sharpening of the condition FI is suggested by consideration of what counts as a proper element at the LF level. The question here is analogous to the question of what counts as a phonetic element at the PF level. Each relevant element at the LF level is a chain (39), perhaps a one-membered chain:

(39) $(\alpha_1,\ldots,\alpha_n)$

It seems that the following elements are required at LF, each a chain (39):

1. Arguments: each element is in an A-position, α_1 Case-marked and α_n theta-marked, in accordance with the chain condition.[41]

2. Adjuncts: each element is in an A-bar position.

3. Lexical elements: each element is in an X^0-position.

4. Predicates, possibly predicate chains if there is predicate raising, VP-movement in overt syntax,[42] and other cases.

5. Operator-variable constructions, each a chain (α_1, α_2), where the operator α_1 is in an A-bar position and the variable α_2 is in an A-position.

These are the only elements that seem to have an interpretation at LF. Suppose, then, that these are the only elements permitted at LF, in accordance with FI. Then the rule Affect-alpha may apply (and must apply) only to yield such an element, given an illegitimate object. We conclude that AGR-trace (and perhaps the trace of [-finite]) must be eliminated, and V-trace may not be eliminated, as required for the proper functioning of ECP if the argument sketched earlier is correct.[43]

Consider successive-cyclic A-bar movement from an argument position. This will yield a chain that is not a legitimate object; it is a "heterogeneous chain", consisting

(40) Huang, "On the Distribution and Reference of Empty Pronouns", *LI* 15.4, 531-74, 1984.

(41) If we adopt the approach to NP-raising discussed in *Barriers,* then we will have to distinguish the chain (39) formed by movement from the intermediate "derived chain" that takes part in the process of gamma-marking of α_n.

(42) An alternative possibility, suggested by certain facts about binding and trace interpretation, is that VP-movement is restricted to the PF component (as an optional "stylistic rule"), and possibly also to (obligatory) LF movement, along the lines of a reinterpretation of the *Barriers* framework discussed in my lectures at Tokyo in January 1986. This conclusion may indeed follow from the considerations discussed above concerning optionality, within the present framework.

(43) Note that further precision is necessary to make explicit just when and how this condition applies.

of an adjunct chain and an (A-bar, A) pair (an operator-variable construction, where the A-bar position is occupied by a trace). This heterogeneous chain can become a legitimate object, namely a genuine operator-variable construction, only by eliminating intermediate A-bar traces. We conclude, then, that these must be deleted at the point where we reach LF representation.[44] In contrast, intermediate A-bar traces formed by successive-cyclic movement from an A-bar position need not be deleted, since the chain formed is already a legitimate object, namely, an adjunct; since they need not be deleted, they may not be deleted, by the "least effort" principle for derivations already discussed. The same is true for A-chains (arguments) and X^0-chains (lexical elements). On these natural —though of course not logically necessary— assumptions, we derive, in effect, the basic principle for trace-deletion stipulated in the Lasnik-Saito theory of ECP, now a consequence of the general condition FI, with "may delete" strengthened to "must delete". There are further consequences, and interesting questions arise with regard to the specifier of Noun Phrases, which shares some properties of A-positions and other properties of A-bar positions, but I will not pursue these matters here.

6.3. FI and Expletives

Consider finally the status of expletive elements, such as English *there* or Italian *ci,* or their various counterparts, null or overt, in other languages. This element receives no interpretation, and therefore is not licensed as a legitimate LF object. It must therefore be somehow removed.

Elsewhere, I have suggested that *there* is eliminated by LF-substitution.[45] But *there* has specific features, and we might suppose on these grounds that it is undeletable, by the condition on recoverability of deletion —yet to be precisely formulated. Then we must treat *there* as an LF-affix; something must adjoin to it.

The expletive *there* has three salient properties. First, an NP must appear in a certain formal relation to *there* in the construction; let us call this element the *associate* of the expletive, and take the expletive to be licensed by its presence. Second, number agreement is not with *there* but rather with the associate. Third, there is an alternate form with the associate actually in the subject position after overt raising. Thus we have (40), with the associate in italics, but not (41):

(40) (i) there is *a man* in the room
(ii) there are *men* in the room
(iii) *a man* is in the room

(41) (i) there was decided to travel by plane
(ii) there is unlikely that anyone will agree

(44) They might be present at earlier stages, where licensing conditions do not yet apply, serving, as Norbert Hornstein observes, to permit the application of principles for the interpretation of anaphors in displaced phrases of the sort proposed by Andrew Barss, *Chains and Anaphoric Dependence*, Phd Dissertation, MIT, 1986.

(45) See *Knowledge of Language*. For extensive discussion of expletives, which I shall largely follow here, see Burzio, *op. cit.* See also Travis, *op.cit.*, on the typology of expletives. The status of *it* (and its counterparts) in extraposition constructions is more convoluted for various reasons, including the question of whether it occupies a theta-position.

These properties are rather naturally explained on the assumption, deriving from FI, that the expletive is an LF-affix, with its associate adjoining to it. Since *there* lacks inherent phi-features (including number) or category, these features will "percolate" from its associate on usual assumptions. If agreement is checked at LF, then it will already have to have been established at S-structure between AGR-S and the associate of *there,* as in (40i,ii), yielding the observed overt agreement. This analysis fits readily into the framework already outlined, particularly if agreement and Case are treated in the manner suggested: both assigned by S-structure since they may appear overtly, both checked at LF since they have LF consequences having to do with visibility (the Case Filter) and the chain condition.[46] If we assume further that the specifier of IP (AGR-S", if the speculations of section 5 are correct) must be an NP with phi-features matching AGR-S, then it will also follow that the associate must be an NP; and it is this NP that raises in overt syntax, as in (40iii).

Luigi Burzio argues further that if the expletive is a clitic, it will have to satisfy additional conditions holding generally between a clitic and the position associated with it, specifically, a very restrictive locality condition which, he argues, holds at D-structure; on this further assumption, he derives an interesting range of phenomena that differentiate English, Italian, French and Piedmontese expletive constructions. On the general assumptions of the principles-and-parameters approach, we expect to find that expletive constructions of this type have the same basic properties across languages, with differences explicable in terms of the lexical properties of the elements involved.

For such reasons, then, it is plausible to assume that *there* (and its counterparts) is indeed an LF-affix, as required by FI.

In (40i), LF-adjunction of the associate to the expletive yields the phrase (42) as subject, the complex constituting an NP by percolation:

(42) [NP there-[NP a man]]

Other well-established principles conspire to guarantee that the only element that can adjoin to the expletive is the associate with the appropriate properties.

Given that *there* must have an NP associate, it follows that some other expletive (in English, *it*) is associated with clauses, as in (43), contrasting with (41):

(43) (i) it was decided to travel by plane
(ii) it is unlikely that anyone will agree

It should therefore not be necessary to stipulate distributional conditions on *there* and *it* expletives, or their counterparts in other languages, when their lexical properties are considered.[47]

(46) See Baker, *op.cit*, on the role of both Case and agreement in this connection.

(47) Such properties had to be stipulated on the assumptions of Chomsky and H. Lasnik, "Filters and Control", *LI* 8.3, 1977, but perhaps they are dispensable along the lines just sketched. For these reasons alone, it seems doubtful that what adjoins to the expletive is a small clause of which it is the subject; thus what I assume adjoins is *a man*, not the small clause [*a man in the room*], in (40i). There are other reasons for supposing this to be true. Kayne observes (see his note 6) that the assumption is required for his explanation

It also follows that at S-structure, an expletive *E* and its associate *A* must satisfy all LF chain conditions, since there is a chain ([A-E],...,t_A]) at LF. Given the chain condition holding at LF, it must be that at S-structure, the expletive *E* is in a Case-marked position and the associate *A* in a theta position.[48] Furthermore, if we assume that binding theory holds at LF, then at S-structure, *A* and *E* must be in a relation that satisfies binding theory condition (A), since at LF an antecedent-trace relation holds of their S-structure positions. Similarly, ECP, a chain condition at LF, will have to hold of the expletive-associate pair at S-structure. These consequences are largely descriptively accurate, as illustrated in (44):[49]

(44) (i) * *there* seems that *a man* is in the room (ECP violation)
(ii) * *there* seems that John saw *a man* (violation of binding theory condition (A))

Similarly, other conditions on movement must be satisfied. Compare the examples of (45):

(45) (i) * *there* was thought that [pictures of *a man* were on sale]
(ii) *we* thought that [pictures of *each other* were on sale]
(iii) * *a man* was thought that [pictures of *t* were on sale]

The italicized elements are properly related in (ii), but not in (i) or (iii). The problem with (i) is not binding theory, as (ii) shows, but rather a condition on movement (ECP), as we see from (iii).

Such properties of expletives now follow from FI, without further stipulation. Note that it also follows that binding theory must apply at LF; whether or not it also applies elsewhere (including S-structure) is a separate question.

Another consequence has to do with binding theory Condition (C), which requires that an r-expression, such as the associate of an expletive, be unbound. A long-standing question has been why there is no Condition (C) violation in the case of an expletive and its related associate. But we now assume that the two simply have different indices.[50] There is, therefore, no need to complicate the binding theory to exclude this case, as in a number of proposals over the past years.

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of the lack of participle-object agreement with object raising in expletive constructions. Consider, furthermore, such expressions as *"there seems to be several men sick", excluded by lack of agreement between *several men* and *seems*. But the phrase ["several men sick"] can be singular, as in "[several men sick] is a sign that the water is polluted", and a range of similar cases discussed by Kenneth Safir, though many questions remain unsettled. On the possibility of non-agreement between the verb and its associate, see Burzio, *op.cit.*, pp. 132-3. Note that nothing requires that the two kinds of expletives be morphologically distinct.

(48) We assume that Case distributes from a category to its immediate constituents, a process that is often morphologically overt, thus from the category of the complex element [*A-E*] to the adjoined element *A*, heading the chain A_i,..., t_A. Recall that *A* adjoined to *E* does head such a chain, by earlier assumptions.

(49) Note that these examples could be accounted for by stipulations on the distribution of expletives, as in Chomsky and Lasnik, *op.cit*, but we are now exploring the possibility, which seems plausible, that these are dispensable.

(50) Or no linking, in James Higginbotham's sense. Note that we cannot assume the expletive to be unindexed —thus it might have raised, leaving an indexed trace.

Certain problems of scope of the kind discussed particularly by Edwin Williams also are overcome. Consider the sentences (46):

(46) (i) I haven't met many linguistics students
(ii) there aren't many linguistics students here

Sentence (i) has a scopal ambiguity, but in (ii) *many* unambiguously has narrow scope. The LF representation of (ii) is (47):

(47) $[_{NP}$ [there$[_{A}$many linguistics students]] are not t_A here]

If *many linguistics students* were literally to replace *there,* it would be expected to have scope over *not,* but in (47), no relation is established between the two, and the scope of *many* can be assumed to be narrow, as in "pictures of many students aren't here".[51]

6.4. Further Questions Concerning LF-raising

There is one major exception to the generalization that the expletive *E* and its associate *A* are in a binding theory (condition (A)) relation at S-structure, namely raising constructions such as (48):

(48) * *there* seems [*a man* to be in the room]

Here the expletive-associate pair satisfies all chain conditions, but the expression is ungrammatical.

A natural explanation of these facts is provided by Adriana Belletti's theory of partitive Case assignment.[52] Taking partitive Case to be oblique, therefore theta-related in accord with the uniformity condition on Case assignment,[53] partitive Case will not be assigned to the associate in (48) but will be properly assigned at S-structure to the associate of the expletive after unaccusatives and, we must assume, copula, as in "there arrived a man", "there is a man in the room". Assume as before that Case must be assigned at S-structure, given that it appears at PF and is relevant at LF. Then (48) is *, since an S-structure condition is violated. Note that even with these assumptions, it still follows that *there* must be in a Case-marked position, by the chain condition, which requires that an LF chain be headed by a Case-marked position.[54]

(51) To account for scopal properties appropriately, more elaborate assumptions are required, taking into account the position of both the head and the terminal position of the associate chain $(A,..., t)$. In a raising construction such as "there appear (not) to have been many linguistics students here", we have to ensure that the scope of *many* falls within that of *appear* and *not;* no relation is determined by the proposed LF-representation, but such a relation would be established in the correct way if the position of the trace is considered, given that the head of the chain has no relation to the other relevant elements. Just what is entailed by a wider range of considerations remains to be determined.

(52) See Belletti, "The Case of Unaccusatives", *LI* 19.1, 1-34 (1988).

(53) On this condition, see *Knowledge of Language.*

(54) Similar remarks hold of "quirky Case", assigned at D-structure under the uniformity condition, but realized in a Case-marked position at S-structure.

If this line of argument is correct, there cannot be a process of Case-transmission, for that process would allow (48) to satisfy the Case Filter. Rather, Case must be assigned at S-structure directly by some Case-marker or other device.[55] Howard Lasnik observes that similar conclusions follow from such examples as (49):

(49) (i) I consider [there to be a solution]
(ii) *I consider [there a solution] (analogous to "I consider John intelligent")

In (49i), it must be that *be* assigns Case directly to *a solution; there* also receives Case (from *consider*), so that the chain condition is satisfied after LF-raising. There is, it seems, no S-structure process transmitting Case from the expletive *there* to its associate, the phrase *a solution* in these examples.

Kenneth Safir observes that we have such pairs as (50):[56]

(50) (i) [$_{wh}$ how many men] did John say that[there were t_{wh} in the room]
(ii) *[$_{wh}$ how many men] did John say that [t_{wh} were in the room]

Sentence (ii) is a standard ECP violation; the trace t_{wh} is in a position that is not gamma-marked, in the Lasnik-Saito sense. The question then arises why this is not also true of (i), if the trace t_{wh}, the associate of the expletive *there*, is raised by LF movement to the position of *there.* The Lasnik-Saito theory provides an explanation, whether we assume LF-substitution or, as above, LF-adjunction. In either case, the trace t_{wh} is gamma-marked by the process of *wh*-movement in overt syntax, and retains this property when it raises to the position of the expletive, so there is no ECP violation. Similar observations hold with regard to Luigi Rizzi's analysis of *wh*-extraction of subjects in Italian: the subject first extraposes, leaving expletive *pro* subject, and then undergoes normal *wh*-movement leaving a trace *t,* gamma-marked in overt syntax and then raising at LF to the position of the expletive.

The notion of LF-adjunction eliminates much of the motivation for Case-transmission theories of expletive-associate relations, and these approaches are still more dubious in the light of the observations just reviewed.[57] Nevertheless, there is evidence supporting Case-transmission.

An indirect though plausible argument for Case-transmission is developed by Hilda Koopman in a comparative study of the West African language Bambara and languages of the French-English type.[58] Koopman postulates a parametric difference between languages that have Case chains ([+CC]) and those that do not ([-CC]). Bambara is [-CC] and English-French, [+CC]. She considers three kinds of Case chains:

(55) See Jean-Yves Pollock, "On Case and Impersonal Constructions", in Robert May and Jan Koster, eds., *Levels of Syntactic Representation* (Dordrecht: Foris, 1981), for arguments against Case transmission. For additional argument, see Kayne, *op.cit.*

(56) For discussion of these and the preceding examples, see Ur Shlonsky, *Null and Displaced Subjects*, Phd Dissertation, MIT, 1987.

(57) See also references of note 55.

(58) Koopman, "On the Absence of Case Chains in Bambara".

(51) (i) (V,..., *t*), where V is a Case-assigner.
(ii) (*O*,..., *t*), where *O* is an operator and *t* the variable it binds
(iii) (*E*,..., NP), where *E* is an expletive and NP its associate

Case (i) results from V-raising. In a [+CC] language, the trace of V will assign the Case "transmitted" from V through the chain. In a [-CC] language, lacking Case chains, the trace will be unable to assign Case, and raising of transitive verbs will therefore be impossible.

Case (ii) is standard operator-movement. Typically, the trace must be in a Case-marked position, and, Koopman assumes, the operator must inherit Case from it to satisfy the Case Filter. This will be possible in a [+CC] language, impossible in a [-CC] language, which will therefore lack overt operator-movement.

Case (iii) is the expletive-associate relation. In a [+CC] language, Case can be transmitted from *E* to NP, as in standard Case-transmission theories, and the Case Filter is therefore satisfied. In a [-CC] language, there can be no expletives, for Case-transmission will be impossible, Case-chains not being permitted.

Koopman observes that in all respects, English-French are of the [+CC] variety, while Bambara is of the [-CC] variety. Omitting details, we find in Bambara the following properties. Consider Case chains of type (i). A verb that does not assign Case raises to I, but a verb that assigns Case remains in place, with a dummy element inserted to bear the affix; the explanation is that the trace could not assign Case if the verb were to raise. In causative-formation, an intransitive verb raises to form a complex V-causative construction in the familiar way, but this is impossible for a transitive verb, which allows causative only if the external argument is suppressed, as if prior passivization had taken place. These properties follow on the assumption that the trace of a transitive verb cannot assign Case; since the complex verb assigns its sole Case to the obligatory object, the subject cannot appear.

With regard to property (ii) of (51), Bambara has only *wh* in-situ, as predicted. As for (iii), there are no overt expletives; rather the associate raises overtly to subject position, again as predicted.

We thus have an indirect argument in favor of Case-transmission, absent as a device just when Case-chains generally are not permitted.

Can we reinterpret these data so as to resolve the conflict between the argument for Case-transmission and the evidence against such a process? Suppose we reinterpret Koopman's parameter in the following way, in accord with the plausible and generally applicable principle that parameters are lexical, i.e., stateable in terms of X^0 elements and X^0 categories only. We then consider the property [C], which an X^0 element may or may not have: A [+C] element can enter into Case relations, either assigning or receiving Case; a [-C] element cannot. Suppose further that X^0 elements with lexical content are always [+C], but that languages can differ as to whether other X^0 elements are [+C] or [-C]. The parameter is restricted to functional elements, in accordance with the plausible condition discussed earlier. French-English are [+C], meaning that all X^0 elements may enter into Case relations; Bambara is [-C], meaning that only a lexical X^0 enters into such relations.

Turning to the three properties, (i) follows directly: in Bambara, the trace of V, being [-C], cannot assign Case. As for (ii), the trace of the operator cannot receive Case in Bambara, being [-C], so that we have a typical violation of the Case Filter (or the visibility requirement from which it derives), with a variable heading a (perhaps one-membered) chain that violates the chain condition, since it lacks Case. Note that we need not assume that the operator requires Case, an otherwise unmotivated assumption, particularly unnatural for empty operators.

The property that concerns us directly is (iii). Since Bambara is [-C], an expletive cannot receive Case. If the language had expletives, then LF-raising (which Koopman assumes) would form a chain headed by an element in a non-Case-marked position, violating the chain condition. Consequently, there can be no expletives, and overt raising is required.

There seems, then, to be no strong argument for Case transmission, if this line of argument is viable.[59] We do, however, have evidence for a narrowly specified parametric difference involving Case theory, with a range of interesting consequences. I am not aware of other convincing evidence for Case transmission, so it may be that the property can be eliminated from UG, in favor of LF-movement, driven by FI.

7. Some Conclusions on Language Design

Summarizing, we have found evidence to support the basic assumptions on language design sketched in section 1, the more specific assumptions concerning the separate syntactic status of Tense and Agreement elements, and those of subsequent discussion. There is varied evidence suggesting that both derivations and representations are subject to a certain form of "least effort" condition and are required to be minimal in a fairly well-defined sense, with no superfluous steps in derivations and no superfluous symbols in representations. Proceeding in the way indicated, we may hope to raise these "least effort" guidelines to general principles of UG. Notice that while these principles have a kind of naturalness and generality lacking in the specific principles of UG such as ECP, binding theory, and so on, nevertheless their formulation is, in detail, specific to the language faculty.

As discussed elsewhere,[60] these properties of UG, if indeed they are real, are rather surprising in a number of respects. For one thing, they are the kinds of properties that yield computational difficulties, since structural descriptions have to meet "global" conditions. From the point of view of parsing, suppose that we have a process recovering an S-structure *s* from the PF representation *p*. Then to determine the status of *s*, we have to carry out a number of operations. We have to determine whether *s* is derived from a properly formed D-structure *d* licensed by the lexicon, and whether the derivation from *d* through *s* to the LF representation *l* is minimal in the required sense, less costly than any other derivation from *d*. Furthermore, we have to determine whether *l* satisfies the conditions of external licensing, FI, and other properties of LF. In general, these computations may be nontrivial. In these respects,

(59) Koopman considers other possible Case chains, but the evidence is less convincing.

(60) See my paper "Prospects for the Study of Language and Mind", ms, MIT, 1988.

language design appears to be problematic from considerations of use. The basic assumption that the fundamental levels are those that satisfy the external licensing conditions at the "interface" with other systems already illustrates these properties, and the "least effort" conditions, while natural and plausible in terms of empirical consequences, provide further illustration. The discrepancies between natural language design and the structure of formal systems constructed for computational efficiency may also be relevant here, as well as other properties of natural language, such as the existence of empty categories, which might also be expected to yield parsing problems. Note that one cannot easily motivate the conditions on economy of representation in terms of processing considerations, since they hold at LF, and only derivatively at S-structure. Nor does there appear to be any argument that the particular properties of language design are necessary for language-like systems. These are contingent properties of natural language.

There are "computational tricks" that permit easy determination of the grammatical properties of an S-structure representation in a large class of cases, broad enough to allow for language to be usable in practice. But language design as such appears to be in many respects "dysfunctional", yielding properties that are not well adapted to the functions language is called upon to perform. There is no real paradox here; there is no reason to suppose, *a priori*, that the general design of language is conducive to efficient use. Rather, what we seem to discover are some intriguing and unexpected features of language design, not unlike those that have been discovered throughout the inquiry into the nature of language, though unusual among biological systems of the natural world.