Free Word Order and Phrase Structure Rules

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A number of recent publications have defended the view that description in terms of phrase structure (with or without trans- formations as well) is right for some languages but not for others (see e.g. Hale 1981 and references cited there). The non-phrase- structure languages are discussed in terms of such distinctions as "fixed word-order" vs. "free word-order," "configurational" vs. "nonconfigurational," and "X-bar" vs. "W-star" languages.

A proposal that represents languages as being radically differentiated from one another with respect to such a fundamental property as the possession of constituent structure is too pessimistic (i.e. too weak) to be adopted in the absence of com- pelling justification. A universal linguistic theory should aim to treat superficially different languages in terms of exactly the same theoretical constructs, bringing out underlying similarities in syntactic structure. I would therefore want to argue for a rejection of such distinctions as those just mentioned. This is not an overly controversial position. Hale (1981) contains a Postscript that to a substantial extent retracts the suggestions in its main text (and in Hale, Jeanne and Platero (1977)) concerning the latter distinc- tion, and both Lapointe (1981, 33-34) and Stowell (1981, 78-80) offer metatheoretical arguments against Hale's version of what I shall refer to as the bifurcationist view.

However, the alternatives that Lapointe and Stowell defend are comparatively baroque theories as compared to the theory of

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context-free phrase structure grammar (CF-PSG), which I shall be
elaborating upon in this paper. I shall propose a theory that is
weakly and strongly equivalent to CF-PSG, and I shall show that it
provides for an elegant account of free order among sister constitu-
ents and captures hitherto uncaptured generalizations about constituent
ordering. I shall also show that the theory can provide in an appro-
priately constrained way for free reordering of words across con-
stituent boundaries, and I shall argue that the more powerful theories
that have been rather speculatively explored in some recent work are
not securely motivated.

The key concept in each of the theoretical innovations I shall
introduce is the notion of a <u>metagrammar</u>. A metagrammar is basically
just a device that generates a grammar.[1] It is not in fact novel to
employ a metagrammar in description of natural languages. Any rule-
collapsing convention, like writing (1) as an abbreviation for the set
of rules obtainable by instantiating the variables as categories, is
an example of using a metagrammar.

(1)   X' $\longrightarrow$ X   (Y")

The symbols 'X' and 'Y' in (1) do not appear in syntactic representa-
tions or in actual grammatical rules. It is the statements formed by
instantiating the variables in (1) that are actually interpretable in
terms of admitting trees (or generating strings). But (1) can be seen
as a metagrammar that generates a finite set of rules under a fairly
obvious set of principles of interpretation. The generalization
across categories that (1) captures is captured at the level of
metagrammar.

The technique for capturing facts of free reordering that I
shall propose is an example of a much more interesting generalization
that can be captured metagrammatically. It derives from work done in
collaboration with Gerald Gazdar, described in more detail in Gazdar
and Pullum (in press).

Consider a grammar that permits a node labeled A to have
daughters labeled B, C, and D (in any linear order), and permits
nothing else. Such a grammar needs a set of rules like that shown
in (2).

(2)   {A $\longrightarrow$ BCD,   A $\longrightarrow$ BDC,   A $\longrightarrow$ CBD,
        A $\longrightarrow$ CDB,   A $\longrightarrow$ DCB,   A $\longrightarrow$ DBC}

We can express this grammar much more simply by stating it via a
metagrammar that treats <u>immediate</u> <u>dominance</u> (henceforth ID) and
<u>linear</u> <u>precedence</u> (henceforth LP) <u>separately</u>. The idea of separating
the assignment of ID and LP relations is not new at all, of course.
There is a very large literature--too large to review here--that
explores the consequences of such a move in the grammar itself. But
Gazdar and I do not separate ID assignment from LP assignment in the
grammar. We do not employ any rules other than ordinary CF-PSG
rules, nor do we posit any nonlinear level of syntactic representa-
tion.[2] We shall specify a grammar by stating a metagrammar

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consisting of a pair of sets: a set of ID statements in the form
'N1 —→ N2, ..., Nk' (meaning 'N1 can dominate N2, ..., Nk') and a
set of LP statements in the form 'N1 ≺ N2' (meaning 'if any rule
introduces N1 and N2, N1 linearly precedes N2'. The grammar stated
by such a metagrammar is the set of all CF-PS rules that are compat-
ible with <u>at least one</u> ID statement and with <u>all</u> LP statements. Thus,
the grammar in (2) would be specified by means of the metagrammar
shown in (3).

(3)a. $\{A \longrightarrow B, C, D\}$ b. $\emptyset$

In this case the set of ID rules is a singleton, and the set of LP
statements is the empty set. Because this metagrammar contains no LP
statements, it imposes no restrictions on linear order among sister
constituents, and hence determines the grammar in (2). Suppose we now
add to (3) an LP statement requiring that any instance(s) of D intro-
duced by a rule R must precede any instance(s) of C introduced by R.
This gives us the (slightly more complex) metagrammar shown in (4),
which determines the grammar shown in (5).

(4)a. $\{A \longrightarrow B, C, D\}$ b. $\{D \prec C\}$

(5) $\{A \longrightarrow BDC, A \longrightarrow DBC, A \longrightarrow DCB\}$

By adding a single LP statement to the metagrammar, we halve the con-
stituent order freedom. This captures the analytical intuition, often
hinted at in the literature, that fixing constituent order "costs" in
the same way that having special NP case-marking rules or verb agree-
ment rules does. To limit the grammar in (2) right down to only
allowing a single order for B, C, and D, say the order DCB, we have to
add a further LP statement, namely 'C ≺ B', making the metagrammar
lengthier and thus more 'costly' to state, in the same way that, for
instance, a statement requiring the feature [ACCUSATIVE] on every N"
introduced by a V' expansion rule would complicate the metagrammar.[3]
Writing the conjunction of 'D ≺ C' and 'C ≺ B' as 'D ≺ C ≺ B', we have
the metagrammar in (6). It determines the grammar in (7).

(6)a. $\{A \longrightarrow B, C, D\}$ b. $\{D \prec C \prec B\}$

(7) $\{A \longrightarrow DCB\}$

   Writing LP statements in this form imposes a stringent and
rather interesting restriction on the grammar: there must exist a
single partial ordering of the nonterminal vocabulary which defines
the correct orders for pairs of sister constituents regardless of what
category they are daughters of. For an example, consider the relative
order of prepositional phrases (P") and subordinate clauses (which we
shall assume are labeled V") in English phrases. Noun phrases (e.g.
<u>our</u> <u>appeal</u> <u>to</u> <u>him</u> <u>for</u> <u>something</u> <u>to</u> <u>be</u> <u>done</u>), verb phrases (e.g.
<u>appealed</u> <u>to</u> <u>him</u> <u>for</u> <u>something</u> <u>to</u> <u>be</u> <u>done</u>) and adjective phrases (e.g.
<u>lucky</u> <u>for</u> <u>you</u> <u>that</u> <u>you</u> <u>weren't</u> <u>killed</u>) could be argued to contain P"

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and V" constituents as sisters. (The AP case is moot, but it will serve our illustrative purpose.) In each case, the P" precedes the V". We can describe this by giving an LP statement of the form P" V". But if English had clauses before PP's in VP's and after PP's in NP's, we could not state the facts at all using this re-stricted format for LP statements. We are therefore predicting that the grammars of natural languages will have the property that Gazdar and I call the Exhaustive Constant Partial Ordering (ECPO) property, defined in (8).

(8) Let G be a grammar and let A, B, and C be arbitrary non-terminals of G. G has the ECPO property if and only if the following condition is met:

If A expands as   ...B...C... but does
not expand as   ...C...B..., then no
category expands as   ...C...B...

Thus if a grammar has the ECPO property, linear precedence restric-tions holding in one rule hold in all other rules too. Investigation of a representative sample of PS rules for English (see Gazdar and Pullum, forthcoming) has shown that this statistically unlikely property is found in a number of phrase types in English.[4] It is also found in a larger set of PS rules for English by Sag (1982), and in the set of rules that have to be postulated for the verb phrase in Makua as described by Stucky (1981). Stucky specifies this set by means of a set of reordering metarules,[5] but a simpler and more con-cise grammar is available in terms of the format proposed here.

Additional generalizations about linear order can be captured if we adopt a revised conception of the notion 'head'. In most earlier PS and TG work, the notion 'head' is treated as a notion definable in terms of properties of trees (see e.g. Williams (1981), Gazdar, Pullum and Sag (1981)). A different possibility is suggested in Hellan (1977). 'Head' could be treated as a primitive notion, represented in phrase structure rules by means of a copying variable, say 'H'. For example, the rule shown in (9a), where we forego the usual abbreviations and show feature composition in full for V' and V, could be written as (9b), a general (and universal) convention providing the information that the head of a V' will belong to the category V and will share all morphosyntactic feature values with it.

(9)a. [+V, -N, +III, -PLUR, -FEM]' $\longrightarrow$

     [+V, -N, +III, -PLUR, -FEM]   N"   P"

  b. [+V, -N, +III, -PLUR, -FEM]' $\longrightarrow$ H   N"   P"

The advantage this brings in the statement of constituent order is that it is now unnecessary to list statements like V < N", P < N", V < P", P < P", A < P", N < P", and so on. The single LP statement shown in (10) captures all the basic facts about order of constituents in rules introducing lexical heads.[6]

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(10)   H $<$ N" $<$ P" $<$ V"

The format for grammar definition proposed here, which Gazdar and I call ID/LP format, shows simultaneous advantages for the description of languages like English with fairly fixed constituent order and languages like Makua with considerable freedom of constituent order. This speaks against the bifurcationist view mentioned earlier. We can now account for both limited and far-reaching variability in ordering of sister constituents in a very simple way, without using either the scrambling transformations of Ross (1967) and subsequent TG work or the reordering metarules of Stucky (1981).

But what we have not allowed for with the mechanisms so far described is scrambling which takes an item outside of the constituent it syntactically belongs to. It is important that permitting scrambling across the boundaries of recursive constituents does not necessarily preserve weak generative capacity. For instance, the system we have been discussing so far restricts us to CF-PSG's, and thus to context-free languages (CFL's). If we permit movement out of constituents by transformation, we can immediately describe languages that are not context-free, as Bach (1981) has noted (see Gazdar, Pullum, Sag, and Wasow, forthcoming, section 1, for discussion). It is not clear that such an enrichment of linguistic theory is necessitated by the facts of any language. So far, every published argument that some human language is not a CFL has turned out to be invalid (Pullum and Gazdar, in press). There is thus every reason to think that a CFL-inducing theory of grammar will suffice for the description of human languages. We should be sceptical of a theory that takes a laxer view.

One well-known case for positing scrambling rules in grammars is to be found in Ross (1967, chapter 3). Ross considers word order in Latin, citing an example from a famous ode by Horace:

(11)   Latin

Quis	multa	gracilis	te	puer	in	rosa	perfusus	liquidis
what	many-a	slender	you	boy	on	rose	drenched	liquid
m sg	f sg	m sg	sg	m sg		f sg	m sg	abl pl

urget	odoribus	grato,	Pyrrha,	sub	antro?
makes-love-to	with-scents	delightful	Pyrrha	in	a-cave
3 sg	abl pl	n sg abl			n sg abl

'What slender boy, drenched with perfumes, is making love to you, Pyrrha, on a heap of roses, in a delightful cave?'

Taking this as typical for Latin poetry, Ross formulated a transformation called "Scrambling" which moves any NP, VP, N, V, A, or Adv to anywhere in its clause (Ross 1967, 42, (3.48)). Horace, of course, is noted for stretching tendencies in the living Latin language beyond all grammatical limits in order to achieve special poetic effects. It is reasonable to doubt that the syntax of Horace's odes falls within the bounds set by universal linguistic theory. Thus Ross's theory of scrambling, and the associated proposal to include a "stylistic

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component" in the grammar, had no acceptable empirical motivation when it was proposed. Yet Ross very perceptively included in the specification of his scrambling rule a very plausible condition: constituents are allowed to scramble within, but not out of, their clauses. This suggests an important distinction.

Chomsky (1965, 126) claims that "there is no known language" in which "each permutation of the words of each sentence give[s] a grammatical...paraphrase of the original."[7] I think Chomsky is correct in this claim. But since 1965, Dixon (1972) and Hale (1981 etc.) have publicized the extraordinary word-order freedom of certain Pama-Nyungan languages of Australia, putting Chomsky's claim in some doubt. There is no doubt that if we could find a language of the sort Chomsky expresses scepticism about, we could show that CF-PSG theories, including the theory implicit in the ID/LP format proposal sketched above, are inadequate. But I do not believe anything of the sort has yet been shown, despite the invaluable work Dixon and Hale have done in opening up the Pama-Nyungan languages to the scrutiny of the linguistic community.

To begin with, note that the wildness of word order in Pama-Nyungan (or any other group of languages) can be overestimated if first impressions are allowed to predominate. For example, the following Ngarluma sentence from Simpson (1980) looks at first glance like an example of scrambling of words clear out of a relative clause.

(12)   Ngarluma
ngayi jimpayika-rnakurla-ku marrparnta-nha-pa yarnta-yi nyintala-ku
I   lost   found   watch   you
'I found the watch you lost.'

But as Mürvet Enç has pointed out to me, it can be translated word for word, without any change in word order, into Turkish, generally thought of as a straightforward, conservative, SOV language.

(13)   Turkish
         ben kaybed-il-en-i   buldum   saatini senin
         I   lose-PASS-PART-ACC find-PAST watch   your
         'I found the watch you lost'
         (literally, 'I found what was lost, your watch')

The Turkish form kaybedileni is a passive participle; but so is the Ngarluma form jimpayika-rnakurla-ku, which Simpson glosses more fully as 'lose-PASS+PART-ACC', exactly like the Turkish form. The analogy is striking, to say the least. I am not suggesting that the Ngarluma sentence and the Turkish one have identical syntactic structures, but I do think it would be wrong to take (12) as indicative of a need for powerful word-scrambling machinery, or a new non-phrase-structure theory of grammar, before exploring thoroughly the possibility that such sentences could be structurally described in much more familiar terms.

Yet various workers have indeed opted for theory-expansive moves in the face of Pama-Nyungan data. For instance, Lapointe (1981,

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33-34), after voicing a number of cogent criticisms of Hale's general approach, seems to embrace the bifurcationist view just as Hale does, though he expresses the bifurcation in a different way. To justify his adoption of the bifurcationist view, Lapointe cites the work of Dixon on Dyirbal, quoting Dixon's most striking example of word scrambling:

(14) Dyirbal

a.	bayi	wangal	bangul	yaRangu	bulganu	banggun	jugumbiRu	buran
	ABS	boomerang	GEN	man	big	ERG	woman	saw
		ABS		GEN	GEN		ERG	
b.	bayi	yaRangu	jugumbiRu	buran	wangal	banggun	bangul	bulganu
	ABS	man	woman	saw	boomerang	ERG	GEN	big
		GEN	ERG		ABS			

'The woman saw the big man's boomerang.'

Suppose we take Dixon's word about (14b) and similar strings being accepted by Dyirbal speakers, and also about this kind of scrambling being found in other Pama-Nyungan languages such as Warlpiri (cf. Hale (1981)). A theoretical argument can still be given against drawing theory-expansive theoretical conclusions from such data. It is not the case that phrase structure description must fail for a language that appears to exhibit word-level scrambling.

Consider a simplified situation — that of a language that has NP's consisting of a noun and a determiner showing agreement with it, and allows the determiner and the noun to separate within VP and scramble separately in any direction. To deal with this situation, we can use a CF-PSG that can be elegantly specified by means of a metarule. A metarule (see note 5) is a metagrammatical device for extending a repertoire of rules in a systematic way. Metarules have been stated in previous work (cf. Gazdar, forthcoming; Gazdar, Pullum and Sag (1981)) in the form $A \Longrightarrow B$, where A and B are schemata that have phrase structure rules as their instantiations. I shall modify that conception here by making the assumption that metarules operate on ID statements.[8] The metarule needed to scramble NP constituents in the VP is shown in (15).

$$(15) \quad \{ VP \longrightarrow NP[F], \; X \} \Longrightarrow \{ VP \longrightarrow Det[F], \; N[F], \; X \}$$

For every ID statement that allows VP to dominate an NP with the agreement feature-set [F] and some additional material X, this metarule provides another that allows VP to dominate a Det and a N both having the agreement feature set [F], plus the additional material X. So, for example, if the grammar contains an ID statement of the form shown in (16a) then it will also contain an ID statement of the form shown in (16b), by virtue of the metarule in (15).

(16)a.   VP $\longrightarrow$ H, NP[acc], NP[dat]
     b.   VP $\longrightarrow$ H, Det[acc], N[acc], NP[dat]

Scrambled word order now follows in the usual way: if we simply fail to add any LP statements, any order of verb, accusative determiner, accusative noun, and dative noun phrase is permitted by the grammar.

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What a metarule like (15) does is to liberate a constituent of
one phrase so that it can become a constituent of the immediately
dominating phrase. Liberation metarules of the sort illustrated very
simply here can interact with one another to produce large sets of
rules that allow for considerable possibilities of scrambling at the
word level. An example like Dixon's (14b) above could readily be de-
scribed given a liberation metarule for NP's in S that freed attributive
adjectives and genitive modifiers as well as determiners (or whatever
items like <u>bayi</u> etc. are).[9]
There are interesting limits to what liberation metarules can do,
however. The most significant of these is that a finite system of meta-
rules yielding a finite output set of rules cannot liberate a constitu-
ent of a recursive category into a higher recursive category. A
constituent of a subordinate clause, for example, cannot be made an
immediate constituent of some higher clause. And interestingly, this
predicts one characteristic of the alleged word-level-scrambling
languages that is generally agreed upon in the literature: their
scrambling is not in fact total, for it never intersperses the elements
of one clause with those of a superordinate or subordinate clause.
Thus, when Dixon asserts that words in Dyirbal "are not only free
within phrases, they can occur in any order in a sentence" (1972, 291),
he nevertheless acknowledges that this is subject to the restriction
that "a word dominated by a lower sentence-node must generally occur
before the verb of [a sentence that dominates it]."[10] If there is any
scrambling of subordinate clause material across matrix clause mate-
rial, therefore, it must be leftward; and in fact Dixon provides no
evidence that it occurs at all.[11] I conjecture that there is in fact
no trans-clausal scrambling in Australian languages or any others (so
that the restriction originally placed on scrambling rules by Ross is
indeed correct). More generally, I claim that no constituent of a
recursive category (one that can immediately dominate itself) can
scramble out of that category. For instance, I predict that although
the words of a sentence meaning 'The woman saw the big man's boomerang'
can scramble in Dyirbal, the words of a sentence meaning 'The woman
saw the big man's ugly brother's boomerang' could not scramble in a way
that broke up the nested genitive NP's.
I claim that this restriction obtains not because of some func-
tional pressure to avoid ambiguity, but because the metagrammar is a
set of statements specifying a <u>finite</u> set of CF-PSG rules.[12] If a
constituent of a recursive category could scrmable up into a containing
category, there would be no limit to the number of daughters a particu-
lar recursive category might have, and hence no longest constituent
type; but the requirement that grammars be finite sets of rules
guarantees that there is a finite bound on rule length.
The evidence needs to be examined very carefully to test the
claim I have made. It is quite possible that there is relevant evi-
dence I have overlooked or misinterpreted--though it is also very
likely that some apparent counterexamples to my claim will in reality
be not relevant to it. In particular, it will be necessary to identify
cases of "extraction" (i.e. the kind of phenomena that Gazdar (1981)
treats in terms of the derived category system) and cases of clause

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union (where the elements of two logical clauses are syntactically amalgamated into one) on independent grounds before we can be sure that a given case of word positioning involves the violation of a clause boundary.

Much remains to be considered. I have not, in particular, said anything about how, or even whether, a semantics could be provided for a grammar involving liberation metarules.[13] This is a matter to be discussed elsewhere. I have attempted only to achieve a very modest goal: to point out that word scrambling that crosses constituent boundaries is not necessarily a phenomenon that invalidates CF-PSG description, especially since natural languages appear to manifest word scrambling only within limits that guarantee context-freeness of the resultant language. If I am correct, then it is at least possible in principle that word order freedom in Australian languages, and in all human languages, can be correctly accounted for in terms of a CF-PSG defined by a metagrammar in ID/LP format.

FOOTNOTES

[1]Langendoen's term hypergrammar (see Langendoen 1976) has a very similar significance, but I shall use the term metagrammar in a rather more general way.

[2]For a hint of this idea that is not followed up, see Lapointe (1980, 183-184, fn. 29).

[3]This analogy may have more to it than meets the eye in the light of the interesting work of Sag and Klein (forthcoming) on general metagrammatical procedures for assignment of contextually determined syntactic features.

A grammar having no case-marking or verb agreement rules and not having any word order constraints either would on this account be less 'costly' than any other type. Such languages have been reported in the literature—see e.g. Hope 1973 on Lisu—but we would not expect them to be common, since, ceteris paribus, they would seem to be prone to rather severe ambiguity within the simple clause.

[4]Stowell (1981, 81-82) appears to recognize that the expansions for V' in English have this property, but does not come to any conclusion comparable to ours. In general, we believe that what we are proposing here answers the critique of phrase structure rules that Stowell develops.

[5]A metarule is a metagrammatical statement that augments a set of PS rules on the basis of some function applying to a subset of the rules already there. See Gazdar, in press, for discussion and examples.

[6]Additional empirical predictions are made, too. For example, (10) claims that any adjective allowing N" complements in A' will

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precede its N" complement. Maling (1981) argues that _near_ is such an adjective. If it is, the foregoing claim is borne out by phrases like _nearer_ the _bed_. A further prediction is that if any adjective allowed a P" together with an N", the N" would precede the P".

[7]Cf. also Stockwell et al. (1977), p. 1), asking students: "Why would a language that allowed sentences to be formed by stringing words together in random order be useless for ordinary human communication?" It is amusing that Hale's "W* grammar," endorsed by Chomsky in later work, basically says that sentences in the languages it describes _are_ put together by stringing words together randomly.

[8]If metarules can tamper with rules that incorporate information about LP relations, it is fairly obvious that having the basic part of the grammar in ID/LP format makes no claims at all about constituent order across construction types. Although the basic rule set might have the ECPO property, the operation of metarules could introduce rules that nullified the ECPO-ness of the complete grammar.

[9]Notice that some already published analyses employ liberation metarules, in effect. The analysis of VSO constituent order in S by means of a metarule wrapping a VP around a subject NP, suggested by Gazdar and Sag (1981), is an example of a metarule liberating V and other VP constituents into S.

[10]Dixon's text here has an error: "is dominated by" for "dominates."

[11]He does cite at this point an example that glosses roughly as 'the man to-climb[-it] runs[-to-it]', but it is not clear to me that this bears on the relevant question in any way.

[12]There is a treatment of coordination that is compatible with this claim; see Gazdar, forthcoming.

[13]See Simpson and Bresnan 1982 for a preliminary study of the interesting question of how to deal with the syntax and semantics of anaphora and control in a language like Warlpiri.

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ACKNOWLEDGMENTS