NORMAL SCIENCE IN LINGUISTICS

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Introduction

Kuhn (1970) distinguished between "scientific revolutions" and "normal science". It can hardly be doubted that the Chomskyan revolution was a real revolution, but what about normal science in linguistics? Here we should notice progress being made in accounting for experimental evidence by theories grounded in the basic framework, and the demise of other theories as they are falsified by certain evidence. In what follows I outline a classic case of what could be normal science in action in Chomskyan linguistics.

The Normal Soience

In 1971 Joan Bresnan published an article entitled "Sentence Stress and Syntactic Transformations" (see bibliography). Her aim in this was to show that if a form of the Nuclear Stress Rule of Chomsky and Halle (1968) was positioned in a grammar so as to apply after all the syntactic transformations on each transformational cycle, then many facts about sentence stress would be correctly predicted.

The rule adopted by Bresnan is as follows (Bresnan, 1971, p257):

$$\overset{\downarrow}{V} \rightarrow 1 \,/\, [X\overset{\downarrow}{V}Y\_\_\_\_Z]$$

In the original formulation, Chomsky and Halle required that this rule apply in the phonological cycle after all rules which affect the stress on individual lexical items. Conditions on its application are that Z contains no $\overset{\downarrow}{V}$, and that A ranges over the major categories such as NP, VP and S. It is also assumed that whenever a primary stress is assigned in a cycle, than all other stresses within the scope of that cycle are reduced by one.

Given all this, the Nuclear Stress Rule will provide sentence stress patterns such as the following (Bresnan, 1971, p258):

$[_s$ [Mary]	$[_{vp}$[teaches]	[engineering] $]_{vp}]_s$	
1	1	1	(word stress)
	2	1	(1st cycle)
2	3	1	(2nd cycle)

to use Bresnan's very convenient notation.

After word stresses are done, the Nuclear Stress Rule will reassign primary stress to "engineering" on the first cycle, over VP. This has no effect on the word "engineering", obviously, but according to the general principle, the stress on "teaches" drops to level 2. In the second cycle, over S, "engineering" again receives a primary stress while that on teaches falls to 3, and that on "Mary", which was outside the scope of the first cycle, drops to 2. This accounts for the prevalent English [231] pattern of sentence stress in simple SVO sentences.

There are plenty of exceptions to this pattern, however, as Bresnan notes. A final anaphoric pronoun does not take primary stress, unless this stress is contrastive. Thus we have "Mary teaches it" and not "Mary teaches it". However, since anaphoric pronouns have various syntactic peculiarities, Bresnan is satisfied to leave them out of account, leaving their stress patterns to future discoveries (1971, p258).

Bresnan picks up other classes of exceptions, however. I give some of the examples here, taken from her 1971 pp258 and 259.

(1) Helen left directions for George to follow
(2) Helen left directions for George to follow
(3) Mary liked the proposal that George leave
(4) Mary liked the proposal that George left
(5) John asked what Helen had written
(6) John asked what books Helen had written
(7) George found someone he'd like you to meet
(8) George found friends he'd like you to meet

All of the even numbered examples there are exceptions to the Nuclear Stress Rule as formulated by Chomsky and Halle. Bresnan now suggests that these exceptions can be explained by the apparently simple process of relocating the Nuclear Stress Rule in the syntactic cycle, "ordered after all the syntactic transformations on each syntactic cycle" (1971 p259).

There is an immediate problem in doing this, however. The

Chomskyan system of generative grammar that Bresnan was working in allowed the transformational cycle to apply to the categories S and NP, but not to VP. Fortunately, though, as Bresnan notes in her 1971, footnote 2, p257, Chomsky and Halle had themselves suggested a rule which would alter any [221] stress pattern to [231]. If this rule is invoked, and the Nuclear Stress Rule is not applied to VP, the following will happen to "Mary teaches engineering":

$[_s$ [Mary]	$[_{vp}$[teaches]	[engineering]	$]_{vp}]_s$	
1	1	1		(word stress)
2	2	1		(1st cycle)
2	3	1		([221]-[213]rule)

Now the only cycle, over S, will give the pattern [221], but this becomes [231] with the new rule. This removes the obstacle to placing the Nuclear Stress Rule in the syntactic cycle.

Now let us see what becomes of the previously anomalous examples (2), (4), (6) and (8), using Bresnan's diagrams once more.

$[_s$ Helen	left	$[_{NP}$directions	$[_s$for	George	to follow	directions$]_s]_{NP}]_s$
w. 1	1	1		1	1	1
n.				2	2	1
s.						∅
n.		1		3	3	
n. 2	2	1		4	4	

Here I use the notation "w" to mean "Word stress assigament", "n" to mean "Nuclear Stress Rule" , and "s" to mean "syntactic rules". The important syntactic effect here is the deletion of the item "directions" in the second cycle. The lines indicate the ends of the

various cycles.

$[_S$ Mary liked $[_{NP}$the proposal$[_S$that George left the proposal$]_S]_{NP}]_S$

	Mary	liked	proposal	George	left	proposal
w.	1	1	1	1	1	1
n.				2	2	1
s.						∅
n.			1	3	3	
n.	2	2	1	4	4	

$[_S$John asked$[_{\bar{S}}$COMP $[_S$Helen had written some books$]_S]_{\bar{S}}]_S$

	John	asked	COMP	Helen	written	books
w.	1	1		1	1	1
n.				2	2	1
s.			some books +WH			∅
n.			1	3	3	
n.	2	2	1	4	4	

The syntax is a little more complicated in this example. Bresnan is using a system in which a COMP node is replaced by the item "some books", while "some" itself receives its WH form "what".

$[_S$George found$[_{NP}$some friends$[_S$he would like to meet some friends$]_S]_{NP}]_S$

	George	found	friends	like	meet	some	friends
w.	1	1	1	1	1		1
n.				2	2		1
s.						∅	∅
n.			1	3	3		
n.	2	2	1	4	4		

Here there are anaphoric pronouns "he" and "you" which do not receive stress.

The "ordinary" cases (1), (3) and (5) go through without difficulty:

[$_s$ Helen left [$_{NP}$directions [$_s$for Gerorge to follow]$_s$]$_{NP}$]$_s$
w. 1 1 1 1 1
n. 2 1
n. 2 3 1
n. 2 2 3 4 1

[$_s$Mary liked [$_{NP}$the proposal [$_s$that George leave]$_s$]$_{NP}$]$_s$
w. 1 1 1 1 1
n. 2 1
n. 2 3 1
n. 2 2 3 4 1

[$_s$ John asked [$_s$COMP [$_s$Helen had written something]$_s$]$_s$]$_s$
w. 1 1 1 1
n. 2 1
something
w. " +WH Ø
n. 3 1
n. 2 2 4 1

Example "(7) also goes through, if stress is somehow kept off the pronominal object:

[$_s$ George found [$_{NP}$someone [$_s$he would like to meet someone]$_s$]$_{NP}$]$_s$
w. 1 1 1 1
n. 2 1
s. Ø
n. 3 1
n. 2 2 4 1

Thus far, Bresnan has produced a satisfying piece of normal science: she has shown how a simple modification of the framework of transformational grammar makes certain predictions which could not have been made before. She goes on, more speculatively, to show how her discovery about sentence stress, if accepted, could be used to

throw light on other syntactic puzzles (1971, p263 et seq). Thus it might be possible to determine whether sentences like "it is tough for students to solve this problem" contain an underlying sentence, "for students to solve this problem" or an underlying prepositional phrase "for students" and a verb phrase "to solve this problem". If there is an underlying sentence, then clearly there will be a transformational cycle which there will not be otherwise. This could make a difference to the sentence stress under Bresnan's analysis.

Bresnan's analysis of sentence stress will only work if the transformational cycle applies to NP's as well as S's. This had been suggested by Chomsky himself in his (1970). It could not be a part of generative semantics, however, where it was essential that nominalizations like "the destruction of the city" be related to sentences like "the city was destroyed" because of the semantic connection.

I do not think that this fact in itself would have been an obstacle to the acceptance of Bresnan's analysis within the generative semantic framework. Nominalizations like "the destruction of the city" are associated with sentences anyway, as seen in the last paragraph. From a logical point of view, certain noun phrases - denoting phrases - had been associated with sentences since the work of Bertrand Russell (1905). The idea could be extended to noun phrases in general, as indicated in Russell (1912) and later to be taken up by Lakoff (1972b). No doubt the Nuclear Stress Rule could find a place among whatever transformations were required by this generative semantic view of noun phrases.

Unfortunately Bresnan drops a bombshell later in her article, declaring, in emphatic capital letters, that "it is a consequence of the ordering hypothesis presented here, together with the principle of the phonological cycle, that the lexicalist hypothesis is correct and that deep structure exists." (1971, p270). Deep structure did not exist, according to the generative semanticists, so Bresnan is making a full frontal assault on one of their basic tenets.

According to the lexicalist hypothesis, lexical items are inserted into tree structures at a particular level of "deep structure". Now if the Nuclear Stress Rule is poised to apply at the end of the first transformational cycle, then word stress must already have been assigned at some previous point in a derivation, either in or before the first cycle. This would represent a level of deep structure, and this argument is the reason for Bresnan's bold statement. The argument receives some support from the fact that certain suffixes, such as *-ing* in English, which according to the classical transformational theory are affixed by transformational rules, do not cause any change in word stress. On the other hand, certain (generally non-productive) suffixes like *-ation* do change word stress, as may be seen by comparing the items "derive", "deriving" and "derivation". Chomsky had already argued in his (1970) that words like "derivation" are formed by lexical, not syntactic rules. The result is just what Bresnan's hypothesis would predict.

If one did not wish to accept Bresnan's treatment of the Nuclear Stress Rule and its lexical consequences, the only way out would seem to be to reject the principle of the phonological cycle. Sentence stress

would have to be decided before word stress, and during a derivation it would be "carried" by non-terminal symbols, until at length it could be attached to a terminal symbol, a lexical item at the tip of a branch.

Bresnan herself discusses this possibility on pp270-271 of her (1971). She rejects it with the following argument (p271):

> "This proposal implies that prosodic stress does not depend in any way on lexical information, but only on syntactic configurations. Yet, as we have seen, the Nuclear Stress Rule must 'know' whether it is applying to a pronoun or to a fully specified lexical noun phrase, if the systematic difference between such pairs of examples as these is to be explained:"

And the examples Bresnan gives are the following (again p271):

> Helen detests misógynists
> Helen detésts them
> The parable shows [what súffering] men can create
> The parable shows what [suffering men] can creáte

But Bresnan is being a little disingenuous in this argument. Of course the Nuclear Stress Rule must know whether it is going to apply to a pronoun or something else, but this can surely be determined in the derivation *before* it gets as far as inserting actual lexical items, if that is the way we want to arrange it. Stress information could perfectly well be carried down from non-terminal nodes to terminal

ones. The details might get complicated, but surely a competent generative semanticist could have worked out at least an outline of the way sentence stress could be handled in a generative semantic framework, and meshed with a modified phonological cycle.

The Challenge

Indeed a generative semanticist did reply promptly enough to Bresnan's paper, namely George Lakoff (1972a). Bresnan in turn come back with a rejoinder (1972), and it is probably easier to consider this second paper of hers together with Lakoff's 1972a. Actually Bresnan was also replying to criticisms from Berman and Szamosi (1972), but since their paper does not relate to the conflict between generative and interpretive semantics, I will not consider it further here.

Strangely enough, Lakoff's criticism begins with a complete misunderstanding of the ordering hypothesis in Bresnan's argument. Of course, Bresnan (1971) had stated her ordering hypothesis in such a way as to make it seem as simple and natural as possible, that the Nuclear Stress Rule should apply "after all the syntactic transformations on each transformational cycle" (p259). Lakoff (1972a) takes this to mean that the Nuclear Stress Rule is cyclic, and on this basis produces counterexamples such as

Away ran Fido.

According to all varieties of transformational grammar, this sentence is derived from "Fido ran away" by a postcyclic rule which fronts the adverb. Now if the Nuclear Stress Rule was simply cyclic, then of course the adverb fronting rule, being postcyclic, would apply after it, and turn "Fido ran away" into the unacceptable "Away ran Fido".

This is Lakoff's objection, but astonishingly enough, Bresnan had already mentioned that example on page 276 of her 1971. Could Lakoff really have supposed that she had overlooked such an obvious point? Bresnan's simple seeming ordering does have the somewhat odd consequence, which perhaps she should have stated more explicitly, that on the last cycle the Nuclear Stress rule will apply after all the syntactic "postcyclic" rules. This would indeed prevent

Away ran Fido

but does it really represent a "natural" rule ordering? Unfortunately rule ordering has almost always been fudged by transformational grammarians, with all oddities glossed over by cunningly chosen words. The one attempt that I am aware of to establish an explicit method of registering rule order, that of Ginsburg and Partee (1969), seems never to have been used since its original conception.

After that abortive criticism, Lakoff produces the generative semantic trick of rule ordering, the global rule. He suggests that the Nuclear Stress Rule is one such, and this is the backbone of his paper, as indicated by its title. The notion of "global rule" can be made to appear simple and natural by pointing out that just as the usual transformational rule relates adjacent tree structures in a derivation, so the global rule relates structures that are in different places in the same derivation. This point is made very clearly in Lakoff (1971).

In general, it is difficult to see how a postcyclic global rule, such as Lakoff envisages, could be distinguished from a cyclic one, especially when the global rule can have a "cycling environment", a

phrase of Lakoff's mocked by Bresnan (1972, pp338, 339). Indeed Bresnan has no difficulty in demolishing all of Lakoff's arguments: everything that Lakoff claims for the global rule can perfectly well be done by the "postcyclic" one, while difficulties for the "postcyclic" rule are difficulties for the global rule also.

In fact Lakoff (1972) played right into Bresnan's hands with his suggestion that the Nuclear Stress Rule is global. In comparing Lakoff's approach to her own, Bresnan (1972, p333) writes:

"This gives us two ordering possibilities on any given transformational domain:

A	B
transformations	word-stress
word-stress	transformations
prosodic rule	prosodic rules

The principle of cyclic ordering suggests that B is the correct alternative: first process the parts, then the whole. Hypothesis A would require first transforming the structure X, then stressing the words dominated by X, and then applying prosodic rules to X. Thus, if we wish to preserve the general cyclic principle of rule application, we must choose B".

Hypothesis A, of course, is the one chosen by Lakoff. Under it the Nuclear Stress Rule can remain where it used to be, among the prosodic rules, yet, because of its global nature, it can be affected by what happens among the transformations. As required by generative

semantics, words can appear as the result of transformational processes and have stress assigned to them afterwards. Given global rules, hypothesis A is the most obvious way of doing what Bresnan did while avoiding its awful lexicalist consequence. But it does not work, as Bresnan amply demonstrated.

I hinted above at an alternative strategy which might have been used to save the generative semantic position. It could be put as a further hypothesis C:

transformations
prosodic rules
word-stress

In this case, we would be moving from the whole to the parts, a reversal of Bresnan's hypothesis B, and thus no less plausible. Fortunately, perhaps, for her, Bresnan did not have to consider hypothesis C in her reply to Lakoff.

No doubt it was its reliance on weak logical languages that led to the demise of the generative semantic effort, rather then the sentence stress matter, but that *débâcle* certainly cannot have helped.

The demise was pretty complete, however: it is interesting to see that in a very up to date book on phonology, (Durand, 1990), both Bresnan (1971) and Bresnan (1972) are referred to in the bibliography, but there is no mention of Lakoff (1972). The reply turned out to be a lot more durable then the query which gave rise to it.

Some Analogies

There are of course plenty of examples of competing theories in the history of science, culminating in the survival of just one of the theories. Some of these cases might provide analogies to throw light on the interaction between interpretive semantics (the lexicalist hypothesis) and generative semantics.

A classic one that comes to mind is the eighteenth century clash between the phlogiston theory and the then new theory of gases. A summary and some relevant references can be found in Hogben (1938). According to the phlogiston theory, a burning material releases phlogiston, which is essentially heat. The theory of gases held that a burning material absorbs oxygen from the air in a chemical reaction. The phlogiston theory collapsed largely because the ashes of burned masses of metal weigh more than the original metal, suggesting that phlogiston has a negative mass, a rather strange concept. On the other hand, the ashes of a burnt piece of paper weigh rather less than the original sheet, so the overall situation us not at all simple. It took a good deal of argument and experiment before the gas theory was finally accepted.

Another case is that of the continuum versus the atomic theory of matter. It is surprising to realise that this dispute was not resolved until the first decade of this century, when Einstein's work on the photoelectric effect and the Brownian motion finally provided indisputable evidence for the atomic theory and against the continuum, which had been forcibly argued for by the great physicist and

philosopher Ernst Mach. (See Gribbin and White, 1993.)

A somewhat different dispute, where analogies might also be sought, was that of "polywater" in the 1970's (see Allen, 1973). Polywater was supposed to be a viscous form of pure water, which some experimenters claimed to have detected under certain conditions. Some theorists came up with a model, based on standard quantum theory, of complex molecular forms which water might take up and which might give it the properties claimed for polywater. Other scientists, however, pointed out that even infinitesimal quantities of impurities in the water could affect the outcome of the polywater experiments, and that there was nothing that needed to be explained by the assumption of any new form of water. This view eventually won, but of course the theoretical model of polywater remains an untested possibility.

A much more recent case of a similar kind was that of "cold fusion" (see Close, 1990). Various groups of experimenters claimed to have induced nuclear fusion in a rather simple electrochemical apparatus using palladium electrodes. Others were sceptical, on the grounds of the enormous amount of energy required to bring simple nuclei close enough together for fusion. The sceptics seem to have been proved right by now, although, as in the case of polywater, there is a theoretical model of how cold fusion might actually come about.

Although there are plenty of analogies here with the case of interpretive versus generative semantics, there is also one important difference. In all the cases discussed above, there is experimental

evidence which eventually proves conclusive. It is not at all clear that this could be so for the linguistic theories.

A closer analogy here might be that of competing theories of fundamental physics, such as superstring theory versus twistor theory (see Peat, 1988). Here we have extremely abstract theories whose relation to each other and to the evidence is complex. It is difficult to ascertain which one explains the evidence better.

In the linguistic case also, we have abstract theories and a huge amount of potential evidence in the form of "intuitions". It is also interesting to note that Cooper and Parsons (1976) could show quite easily how a Montague grammar could be expressed in the form of either a generative semantic type grammar or an interpretive semantic one. It leads one to wonder whether any generative semantic grammar could be translated into interpretive from, and vice versa. This is a speculation which I hope to take up again in some future paper.

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