ASPECTS OF "ASPECTS"

A discussion of some of the psychological implications of the notion of deep structure.

M.B. Paterson
University of Auckland

The surface structure-deep structure distinction forms an integral part of the transformational syntactic theory of Noam Chomsky. This theory arose as an apporach to the problem of writing descriptive grammars of languages, and has now revolutionised linguistic thought.

Introduced in *Syntactic Structures* (1957), and rather more explictly presented in *Aspects of the Theory of Syntax* (1965), Chomsky's concept of deep versus surface structure is also now largely embodied in the considerations of most contemporary psycholinguistics. It is with the psychological implications of this concept that I am chiefly concerned here.

Surface structure corresponds to the overtly manifested syntactic structures available to the native speaker, and corresponds to a determinant of the phonetic interpretation of a sentence. The transformational grammar expresses these structures in the shorthand of phrase (P) markers, incorporating 'rewrite rules'. In this way, the sentence: *'The flower is blue'* can be represented:

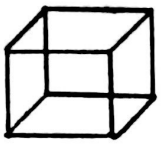
1. S → NP + VP
2. NP → Art. + N
3. VP → *is* + Adj
4. Art → *The*
5. N → *flower*
6. Adj. → *blue*

If, however, we can also rewrite N as: *house, cloth, ball, bird,* etc.; and Adj as *yellow, pretty, unusual, big,* etc., the possible number of utterances that can be generated by the above P marker vastly increases (to 25 in the above instance). In this way the phrase structure component of a language can be adequately stated. This generative aspect is central to transformational theory.

There is, however, another component of syntactic description. This is the transformational component, which constitutes a set of rules which operates on the P markers of the phrase structure component. The operation of these rules brings about various processes of substitution, deletion, addition, or permutation affecting the P markers to which they are applied, giving rise to new, or 'derived' P markers. Thus, through transformation: *'There is more than one way to skin a cat'* may become *'A cat may be skinned in more than one way'*. Such transformations, then, give rise to new P markers, or surface structure.

When these transformations occur, however, a constant may be observed. Basically it is this constant which Chomsky terms deep structure, and may be considered as the determinant of semantic interpretation. Deep structure is seldom generated physically, being essentially mentalistic in origin and effect, and representing the essential grammatical categories and the relational concepts of subject and predicate, main verb and object, and modifier and head of a phrase. This concept is basically that presented in *Aspects of the Theory of Syntax*, and constitutes a development of Chomsky's earlier (1957) consideration of deep structure, as being represented by a series of P markers, inter-related through a series of transformational rules, although the latter is embodied in the former.

The deep structure construct is proving very useful in certain areas of linguistic description. A single deep structure may often take the form of any of several surface structure representations, of which a visual analogy may be: A a Or, a single surface structure may be the medium for the representation of more than one deep structure, resulting in ambiguity. A visual analogy of this may be the well-known Nekker Cube:



Chomsky's transformational theory makes way for the explanation of such ambiguities in terms of deep structure, and at this point criticisms that were leveled at the Gestalt psychologists begin to be refuted, to some extent at least, when they are also directed at transformational theory. Chomsky's claim that a descriptively adequate grammar should formally characterize the native speaker's (tacit) knowledge of his language has often been misinterpreted as a claim that it should describe performance.

In 1961 *(On the Notion "Rule of Grammar")*, Chomsky stated that 'the attempt to develop a reasonable account of the speaker [performance] has, I believe, been hampered by the prevalent and utterly mistaken view that a generative grammar in itself provides, or is in any way related in some obvious way to a model for the speaker'. Intuitively, however, one feels that transformational rules must be involved in some way in the production and understanding of utterances and today it would appear that a number of psycholinguists are now considering a transformational model of language performance. This is not to say, however, that the differences to be expected between a model of the language and a model of the speaker are being ignored. Theorists in fact manipulate the language/user distinction to fit their particular biases.

It is being minimally charitable, however, to admit that the transformational grammarian's model does open to attack avenues of psychological research that were certainly not possible with the earlier Bloomfieldian-type descriptive model of language.

The major experimental studies concerned with assessing the psychological reality of deep and surface structure may be regarded as falling into four general categories. The first such category includes those experiments aimed at the demonstration of transformational relationships between surface structures and their underlying (deep) forms: e.g. Miller, McKean & Slobin, 1962; Miller & McKean, 1964; McMahon 1963; Mehler, 1963. The second category includes experiments concerned with the relationships existing between aspects of the structural description of various sentence types, and their storage requirements: e.g. Savin & Perchonock, 1965; Miller, 1962; Gough, 1965. A third

category may be considered to deal with the effects of deep structure upon perception: e.g. Mehler & Carey, 1966. The fourth category includes the few studies done with regard to the effects of deep structure upon recall: e.g. Blumenthal, 1965; Blumenthal & Boakes, 1965.

A reasonably representative sample of these studies, I feel, are the experiments of Mehler, 1964; Savin & Perchonock, 1965; and Mehler & Carey, 1966, and these will be briefly outlined and discussed here.

Mehler's (1964) experiment, it should be noted, was carried out before the 1965 publication of Chomsky's '*Aspects of the Theory of Syntax*' and was thus based on the assumption that the *simple, active, affirmative, declarative* (SAAD) sentence served as the transformational derivative from which other sentence types were produced. Thus *questions* (Q) *negatives* (N), and *passives* (P) were regarded as being optional transformations of the derivational SAAD base form. While this may 'date' this experiment, and for that matter the experiment of Savin & Perchonock (1965), it does not necessarily negate the relevance of the results that were obtained.

Mehler's study examined the effects of the differences between SAAD, P, Q and N sentence types on recall. He used eight lists of eight sentences each; each list containing one of the eight syntactic types: SAAD, P, Q, N, PQ, NQ and PQN. Each sentence on a given list was derived from semantically independant SAAD's. Five presentations of a given list were made to each of ten subjects, the subject being required to recall the sentences of a set (as accurately as possible) after each presentation.

The results indicated that the SAAD sentence form was a great deal easier to recall, and hence more readily learned, than any of the other forms. Those sentences involving only one transformation from the 'base' form were the next most readily learned, while those with multiple transformations were the most difficult to acquire. Perhaps more important and suggestive, however, was the nature of the errors that were found to occur during recall. Of 648 errors, 400 occurred in which the incorrectly recalled form was simpler than the correct form (ie. more closely approximating the SAAD sentence type). This evidence was interpreted as favouring a '*coding hypothesis*' theory of storage, which proposes that the sentence is represented in memory by a body of information minimal to the characterisation of the semantic component, plus a minimal set of instructions concerning the requisite transformations for the reproduction of the original surface structure. The ease with which the SAAD sentences were learned inferred that they most closely approximated the simple underlying form.

Using the same method of presentation, Mehler also tested the effect of the expansion of auxiliaries on recall. For example: sentences such as the following were presented:

The boy hit the ball

The boy has hit the ball.

The boy could have hit the ball.

The boy could have been hitting the ball.

In this case, it was found that the expansion of auxiliaries had no significant effect upon the ease of recall. Also there was no discernable trend towards the simplification or complication of the auxiliaries amongst erroneously recalled sentences.

Savin and Perchonock (1965), carried out an experiment aimed at the quantitative analysis of the relationsips between storage requirements and the structural characteristics of a variety of sentence types. Subjects were required to recall a sentence plus as many of unrelated ensuing words as they could. Storage requirements were measured as an inverse quantity to the number of additional unrelated words correctly recalled. The same sentence types as those used by Mehler (1964) were used, and *emphatic* (E-stressed auxiliary) and *'who question'* (Wh) forms were added. Using this method, Savin and Perchonock discovered constant and additive storage values associated with each of the given derived forms, the SAAD form requiring least storage 'space' of any of the forms used. Mean numbers of additional words recalled for the sentence types studied were as follows:

0 Transformations assumed:	SAAD	:	5.27
1 Transformation assumed:	Wh	:	4.78
	Q	:	4.67
	P	"	4.55
	N	:	4.44
	Qneg.	:	4.39
	E.	:	4.30
2 Transformations assumed:	PQneg.	:	4.02
	PQ	:	3.85
	EP	:	3.74
	NP	:	3.48

These results would seem to suggest an explanation of sentence production and perception in terms of a semantic component and independent but associated transformational strategies.

A rather different approach, following Chomsky's (1965) publication of *'Aspects of the Theory of Grammar'*, was that of Mehler and Carey (1966), which sought to examine the effects of deep structure on perception.

Mehler and Carey constructed two sets of sentences that differed only with regard to their deep structure, and a further two sets of sentences that differed in both surface and deep structures. Sentences were presented under noise, and the subjects were required to recognise each sentence. A given sentence received a 'recognition score' when it followed a homogeneous set of similar sentence types. In this way, subjects were first given some expectation of a particular deep or surface structure, the effects of which were studied with regard to the ensuing test sentence, which might or might not be congruous with the established expectation.

Scores were better (ie. high recognition scores) for those sentences which were congruent with the set that they followed. The difference was significant for one of the two comparisons of deep structure, and for both of the comparisons of surface structure. An analysis of the errors that were made by the subjects showed that words compatible with the syntactic set were selected more frequently than were phonetically similar substitutions. While these results are not as conclusive as might be desired, they do infer that surface structure may have a more profound effect perceptually than deep structure.

The experiments outlined above, and others thus far published, are essentially only introductory to the psychological consideration of transformational grammar as a possible model for the language user. While they do appear to indicate a certain relevance of syntactic structures to psychological processes, they do not contribute towards a general theory, something that is badly needed in contemporary psycholinguistics. The transformational model remains, despite Chomsky's apparently increasing interest in the psychological implications of his work, only a theory of a code. It seems highly questionable that there is any possibility of drawing more than very broad psychological correlates with the concepts involved in the transformational model of Chomsky, whose psychological views should not be over-estimated. This is not to say, however, that I do not feel there is a place in the study of psycholinguistics for this model, but rather that it should be approached critically, and that the concepts which stand be incorporated into a psychologically biased theory of verbal performance. Some such concepts would appear to be already emerging.

The studies described here do all tend to indicate that the hearer makes some distinction, if at present rather obscure, between surface structure and those syntactic interrelations that cannot be marked by the simpler grammatical descriptions. To what extent these covert syntactic inter-relations, to which a subject can be shown to be sensitive, correlate with the transformational grammarian's concept of deep structure is still a controversial matter.

Many factors relevant to this problem have not yet been adequately studied, and the semantic factor is probably the most outstanding among them. After all, the whole of language is essentially concerned with the passing of information, and is nothing without meaning.

Perhaps studies biased in this direction might lead to a model based upon the availability of meaning within the syntactic framework. In persuasive communication, for example, the modulation of the availability of meaning is an important factor. Some information will be presented boldly, and other information will be presented rather more obscurely. Syntactic manipulation makes this possible, but such manipulation is not necessarily always grammatical. Syntactic theory is itself incapable of explaining the occurrence of such behaviourally acceptable, but syntactically ungrammatical utterances.

Another factor that may have been a little overlooked is the fact that although verbal behaviour is still highly unpredictable, it is nevertheless essentially context and purpose bound. If the hearer is aware in some way of a particular context or purpose, utterances incompatible with the resulting expectancy will probably seem confusing. In that the nearest giant panda is probably that in the Peking People's Zoo is semantic- out of context with regards to this article, (I most sincerely hope), this sentence has probably struck the reader as being a little confusing. If with regard to syntactic con-

text, it can be accepted that the SAAD type sentence is generally least context-bound, whereas P,Q,N sentence types are rather more restricted in this way, it may be possible to explain the results of Mehler (1963); Miller, McKean and Slobin (1962); etc., in terms of the context compatability of the sentence types involved. The results of Mehler and Carey (1966) may be construed as favouring such an interpretation, unlikely though such an interpretation may sound.

Presumably the semantic component of an utterance leads to the formation of associations with pre-existing concepts, or the elicitation of partial perceptual responses related to the semantic content (depending on one's psychological bias). Such an event could possibly be considered to represent a psychologist's concept of deep structure, in relation to either the speaker or the hearer. A transformational grammarian's operational definition of deep structure, on the other hand, is 'the structural relations expressed by the early phrase structure rules of a grammar, before transformational rules operate on them.' To what extent these two concepts can be regarded as being compatible is an open question.

Some linguists have denied the relevance of psychological variables to their study. It would seem useful to know, however, not only the formal rules of language which the speaker tacitly knows but also the extent to which the speakers of a language actually obey the rules in normal verbalisation. Such information cannot but involve cognitive factors. The day might also come when psychologists can contribute towards the linguist's grammatical theories. At any rate, it would appear that transformational grammar theory is not, at present, entirely adequate, and that, for the psychologist, a certain amount of redefinition and reinterpretation of transformational theory will have to occur before its full potential can be ascertained.

ACKNOWLEDGEMENTS

I should like to thank Dr. M.C. Corballis of the Department of Psychology, and Dr. A.K. Pawley of the Department of Anthropology for their comments and assistance.

BIBLIOGRAPHY

Chomsky N., 1957. *Syntactic Structures.* The Hague, Mouton & Co.

Chomsky N., 1961. "On the notion 'Rule of Grammar' ". *The Structure of Language* (Eds.) Fodor J. & J. Katz. New Jersey, Prentice-Hall: 119-136.

Chomsky N., 1965. *Aspects of the Theory of Syntax.* Cambridge, Massachusetts, M.I.T. Press.

Garrett M. & J. Fodor., 1968. "Psychological Theories and Linguistic Constructs". *Verbal Behaviour and General Behaviour Theory* (Eds.) Dixon T. & D. Horton. New Jersey, Prentice-Hall: 451 - 477.

Mehler J. & P. Carey., 1967. "The Role of Surface and Base Structures in the Perception of Sentences." *J. of Verbal Learning & Verbal Behaviour, 6:* 335 - 338.

Osgood C., 1968. "Towards a Wedding of Insufficiencies." *Verbal Behaviour and General Behaviour Theory* (Eds.) Dixon T. & D. Horton. New Jersey, Prentice-Hall: 495 - 519.

Savin H. & E. Perchonock., 1965. "Grammatical Structures and Immediate Recall of English Sentences." *J. of Verbal Learning & Verbal Behaviour, 4:* 348 - 353.