

SENTENCE STRUCTURE
AND THE READING PROCESS

JANUA LINGUARUM

STUDIA MEMORIAE
NICOLAI VAN WIJK DEDICATA

edenda curat

C. H. VAN SCHOONEVELD
INDIANA UNIVERSITY

SERIES MINOR

69



1968
MOUTON
THE HAGUE • PARIS

SENTENCE STRUCTURE AND THE READING PROCESS

by

I. M. SCHLESINGER

THE HEBREW UNIVERSITY, JERUSALEM

AND

THE ISRAEL INSTITUTE OF APPLIED SOCIAL RESEARCH



1968

MOUTON

THE HAGUE • PARIS

© Copyright 1968 in The Netherlands.
Mouton & Co. N.V., Publishers, The Hague.

No part of this book may be translated or reproduced in any form, by print, photoprint, microfilm, or any other means, without written permission from the publishers.

LIBRARY OF CONGRESS CATALOG CARD NUMBER: 68-23200

Printed in The Netherlands by Mouton & Co., Printers, The Hague.

To my wife

PREFACE

This study is a revision of a doctoral dissertation submitted to the Senate of the Hebrew University, Jerusalem, in 1964. Most sections have been rewritten and reviews of the literature (especially that in Chapter Three) have been brought up to date till about the middle of 1965. Some sections of lesser interest have been omitted, and descriptions of experimental procedures have been shortened (more detailed descriptions being available in mimeographed form). Every effort has been made to present these descriptions in non-technical language, with an eye on readers with no background of psychological training.

I am very much indebted to my thesis advisers, Professors S. Kugelmass and Y. Bar-Hillel of the Hebrew University, Jerusalem, for all the help they have given me. But for their unfailing patience and forbearing and their continuous encouragement this work would not have reached completion.

My interest in psycholinguistic problems dates back from Professor Bar-Hillel's lectures at the Hebrew University in 1954. Since beginning work on this thesis, in 1960, I have had the benefit of long hours of talks with Professor Bar-Hillel. Besides having been an invaluable experience, these talks have helped me in clarifying many of the problems with which my work has been beset. Thus Professor Bar-Hillel's thinking has influenced, directly or indirectly, almost every part of this study. Finally, it is due to Professor Bar-Hillel's initiative that this work has been published. For all this, I wish to express my gratitude to him.

While this study owes much to Professor Bar-Hillel, the entire

responsibility for its shortcomings – of which I am well aware – lies with myself. In part, these shortcomings may be due to the fact that the experiments reported here are among the first to be conducted in this area; I was, therefore, deprived of the opportunity to benefit from the experience of others. In fact, at the time this work was begun, in 1960, not a single psychological study had been published, to my knowledge, in which the influence of a syntactic variable was investigated directly; I was not then aware of the important research which was being conducted elsewhere at about the same time as my own, in the same area and often along similar lines. To the extent that relevant studies have, in the meantime, become available to me, they have been reported here.

On the other hand, I have had the benefit of discussions with persons working in various areas. Of the staff of the Hebrew University I would like to mention the late Professor Irene Garbell, and Professors Haim Blanc, Moshe Goshen-Gottstein, Louis Guttman, Daniel Kahaneman, Chaim Rabin, and E. Shamir, to whom I am indebted for stimulating discussions and for their readiness to help me in many ways. The experiments reported in Chapter Six were stimulated by comments of Professor Noam Chomsky on a short report I had written. By providing me with information about their unpublished work, the researchers mentioned in Chapter Three have made it possible to bring the discussion up-to-date. I want to take this opportunity to thank all these persons for their kindness.

The conscientious work of students of the Psychology Department of the Hebrew University who assisted me in this study is also gratefully acknowledged. Special mention deserve Mr. Ben-yamin Beth-Halachmi, Mr. Asher Coriat, Mrs. Dalia Etzion, and Mr. David Seidel who carried out several of the experiments and helped with the analysis of results, and Mrs. Rachel Melkman whose able help with the experiments reported in sections 2.2.5 and 5.4.1 was more in the nature of collaboration than mere technical assistance.

Work reported in this study was supported in part by research

grants from the following sources: the U.S. Office of Naval Research, Information Systems Branch, Contract No. 62558-4695, NR-049-130; the Rena and Walter Burke Foundation (through the Hebrew University, Jerusalem); and the General Federation of Labour in Israel.

Jerusalem, Israel
July, 1966

I. M. SCHLESINGER

CONTENTS

Preface	7
1. Introduction	11
1.1. Previous Psychological Research on the Influence of Sentence Structure	11
1.2. The Scope of this Study and its Theoretical Ori- entation.	17
1.3. A Problem in the Interpretation of Research Results	19
1.4. Research Methodology of this Study	21
2. The Syntactic Constituent as Unit of Decoding	24
2.1. Previous Research	24
2.2. Syntactic Constituents and the Eye-Voice Span . . .	27
2.2.1. Previous Findings on the Eye-Voice Span . . .	27
2.2.2. The Hypothesis	29
2.2.3. First Experiment: Method	30
2.2.4. First Experiment: Results	31
2.2.5. Second Experiment: Method	38
2.2.6. Second Experiment: Results	40
2.3. Summary and Conclusions	42
3. Effects of Grammatical Transformations	44
3.1. Understanding Transformations	45
3.1.1. Evaluation Tasks	45
3.1.2. Reading Task	49

3.2. The Construction of Transformations	51
3.2.1. Anagram Task	51
3.2.2. Matching Task	54
3.3. The Recall of Transformations	56
3.3.1. Transformations and Memory Capacity . .	57
3.3.2. The Direction of Errors	58
3.4. The Recognition of Transformations	63
3.4.1. The Direction of Errors in Recognition . . .	64
3.4.2. Errors of Recognition and the Number of Transformations	67
3.5. The Evidence from Language Development	68
3.6. Summary and Conclusions	69
4. The Effect of Sentence Length	71
4.1. Some Correlates of Sentence Length	71
4.1.1. Sentence Length and Sentence Structure . . .	71
4.1.2. Sentence Length and Redundancy	72
4.1.3. Sentence Length and the Reading Process . .	74
4.2. Reading Rate and Comprehension as a Function of Sentence Length	75
4.2.1. Method	75
4.2.2. Results	77
4.3. Conclusion and Practical Considerations	78
5. The Effect of Syntactic Complexity	81
5.1. Yngve's Model.	81
5.1.1. Description of the Model	82
5.1.2. Yngve's Mechanism and the Human Encoder .	85
5.1.3. Testing the Model: Depth and Nesting . . .	87
5.1.4. Testing the Model by Means of a Language	89
5.1.5. Yngve's Mechanism as a Model of the Decoder	92
5.1.6. The Distinction Between Grammatical and Semantic Decoding	93

CONTENTS	13
5.2. A Hypothesis Based on Chomsky's Theory	95
5.2.1. The Relationship of Chomsky's Theory to a Behavioral Theory	95
5.2.2. The Syntactic Decoding Hypothesis	96
5.2.3. Ways of Testing the Hypothesis and Previous Research	98
5.3. The Effect of Nesting in Ordinary Reading Situations	100
5.3.1. First Experiment: Method	101
5.3.2. First Experiment: Results	103
5.3.3. Second Experiment: Method	104
5.3.4. Second Experiment: Results	105
5.3.5. Conclusions and Practical Considerations . .	106
5.4. Testing the Syntactic Decoding Hypothesis	110
5.4.1. Method	111
5.4.2. Results	114
5.4.3. Additional Findings.	117
5.5. Summary	119
6. Syntactic and Semantic Decoding	121
6.1. The Postulate of the Separability of Grammar and Semantics	121
6.2. The Semantic-Syntactic Decoding Process	122
6.2.1. Description of the Process	122
6.2.2. Previous Findings in the Light of the Semantic- Syntactic Decoding Process	124
6.2.3. The Redundancy of Syntactic Structure . . .	127
6.2.4. The Encoding of Nested Sentences	128
6.3. Experimental Verification of the Semantic-Syntactic Decoding Process	129
6.3.1. Predictions	129
6.3.2. First Experiment: Method	132
6.3.3. First Experiment: Results	133
6.3.4. Second Experiment: Method	135
6.3.5. Second Experiment: Results	136

6.3.6. Observations Pertaining to the Nature of Syntactic Decoding	139
6.4. Summary and Conclusions	140
7. Sentences Beginning with Semantically Indeterminate Words	142
7.1. Problem.	142
7.2. An Experiment with Pronouns Standing before the Nouns to which They Refer	144
7.2.1. Method	144
7.2.2. Results	145
7.3. Summary	146
8. Suggestions for Future Research in Readability	148
8.1. Some Remarks about Research Methodology	148
8.1.1. The Experimental Approach	148
8.1.2. Readability and the Reading Process	149
8.1.3. Reading Rate	150
8.1.4. Comprehension and Recall Tests	150
8.1.5. The "Cloze" Procedure	152
8.1.6. Efficiency of Eye-Movements.	155
8.1.7. Judgments of Readability	156
8.1.8. Measurement of Effort	156
8.2. A Framework for Research	157
References	162

INTRODUCTION

The question how syntactic structure affects the ease of reading is obviously of the greatest importance to teachers, writers, editors, in short – to anyone interested in written communication. The present study is an attempt to deal with this problem experimentally. It is one of the first attempts of its kind, for, in spite of the obvious importance of the problem, empirical research on it is almost non-existent, as we shall see presently.

1.1. PREVIOUS PSYCHOLOGICAL RESEARCH ON THE INFLUENCE OF SENTENCE STRUCTURE

The problem of the influence of sentence structure falls in the province of so-called *readability* research. Work done in this field has been lacking in theoretical orientation; the aim of readability studies has been an applied one – to develop a yardstick by means of which the reading ease¹ of a given text can be conveniently measured. On the basis of correlational studies, formulas were devised which answered this practical need (see Chall's (1958) useful review of these studies). Syntactic structure is, of course, generally admitted to be one of the determinants of readability; however, the only variable to appear in the formulas, which has anything to do with sentence structure, is sentence length. Now, sentence length may perhaps be only a symptom of reading ease,

¹ The term "readability" is often taken to refer also to the amount of interest a given text arouses in the reader (cf. Chall, 1958, pp. 4-7; Klare *et al.*, 1955; Schramm, 1947). But here and in the following the term will not be used in this way, since we will be concerned only with reading ease and difficulty.

reflecting some underlying factor connected with the *complexity* of sentence structure. This is recognized by researchers in this field who give the practical advice to write "simple sentences", so as to ensure comprehension and ease of reading. But what simplicity or, by contrast, "complexity" consist of is not made explicit: here one trusts the judgment of the writer.

This neglect of research pertaining to the relationships obtaining between syntactic variables and readability is paralleled by a general neglect of these variables in psycholinguistic research. Most psychological studies on linguistic variables are concerned with words; psychologists seem to hesitate to come to grips with larger and more complex units. This is perhaps understandable in view of the great difficulties attendant on research with such units (difficulties which will become evident in the following chapters); but as long as syntactic variables are ignored, no understanding of language behavior can be achieved.

The theoretical writings of psychologists bear ample evidence of the fact that the psychological importance of sentence structure is recognized (e.g., Osgood and Sebeok, 1954; Osgood, 1957; Miller *et al.*, 1960). In their research, however, psychologists have usually contented themselves with approaching the problem of sentence structure, if at all, indirectly, for instance via word class (e.g., Aborn *et al.*, 1959). Studies in which sentence structure figures indirectly are those which attempt to relate recall of words to transitional probabilities of the text (Postman and Adams, 1960; Tulving and Patkau, 1962), and intelligibility of words to their position in the sentence (Rubenstein and Pickett, 1958). Mention should also be made of studies concerned with the "psychological reality" of the parts of speech (Barik and Fillenbaum, 1961; Barik and Lambert, 1960; Glanzer, 1962).

A new impetus to psychological work on sentence structure has been given by recent developments in theoretical linguistics. The most prominent single influence here has been the work of Noam Chomsky. Some years after the appearance of his "*Syntactic Structures*" (1957) studies began to be published which dealt with the behavioral consequences of syntactic structure in a more direct

manner, investigating its influence on intelligibility (Miller and Isard, 1963; Marks and Miller, 1964), and on learning and recall (Epstein, 1961, 1962, 1963). In line with Chomsky's (1962) remarks regarding the relationship between grammatical models and language learning, a new approach is being taken to the study of language development (e.g., Menyuk 1963a, 1963b; see also Ervin and Miller's review, 1963). Other studies prompted by Chomsky's work will be mentioned in the following chapters.

1.2. THE SCOPE OF THIS STUDY AND ITS THEORETICAL ORIENTATION

Like some of the psycholinguistic work mentioned in the previous section, this study leans heavily on grammatical models developed in modern theoretical linguistics. On the basis of these models, psychological hypotheses will be formulated and an attempt will be made to test these empirically. Specifically, our investigations will deal with:

- (a) the psychological reality of the syntactical constituent (chapter 2),
- (b) the effect of grammatical transformations on decoding and encoding behavior (chapter 3), and
- (c) the effect of sentence complexity as defined in the work of Yngve (1960) and Chomsky (1957) on the ease of reading (chapters 5 and 6).

In addition to these, experiments are reported on other syntactic variables – sentence length (chapter 4) and the location of the subject (chapter 7).

There is perhaps no need to point out that the linguistic theories which serve as the starting point of our investigations do not make any psychological statements, and can therefore not be put to test by psychological experiments. This study is based on the assumption that certain aspects of decoding and encoding behavior can be explained in the light of linguistic theories. Our basic tenet is that *the human user of language incorporates a device which operates*

along the lines of a grammar proposed by theoretical linguists, such as a Chomskyan grammar. This proposition is not an integral part of any linguistic theory.

The nature of this statement is such that no empirical study can ever refute it; it is not stated in operational terms. It may be looked upon as a *metahypothesis* which gives rise to certain specific *research hypotheses*. One of our research hypotheses, for example, states that self-embedded sentences will be more difficult to read than those which are not self-embedded (5.2.2), and this hypothesis is based on Chomsky's discussion of self-embedding (5.2.1). If this particular research hypothesis fails to be confirmed by an empirical test, the above metahypothesis will in no way be disparaged thereby (and, of course, Chomsky's theory will not be disparaged thereby, as has been pointed out above). This is so, because we can easily formulate a new research hypothesis, which may even be incompatible with the former one, and which is based on the *same* metahypothesis. For instance, one might hypothesize that self-embedding affects not reading ease as measured by reading rate, but as measured by some other criterion, or that it does not affect the reading process at all unless carried to a certain degree, or that it influences only the reading of sentences of a certain kind, and so on. None of these hypotheses can be strictly derived from the metahypothesis, but all are somehow based on it. The value of the metahypothesis lies in that it guides us in the formulation of empirically verifiable research hypotheses; it can not be empirically confirmed but only shown to be fruitful in this respect. The present study, then, is an exploration of the fruitfulness of the above metahypothetical statement.

Although no linguistic controversies can be settled by it, this study should prove of interest to the linguist. Ultimately, a comprehensive theory of language must concern itself with the linguistic processes of the user of language. The question of whether or not a description of the latter on the basis of a given linguistic model is possible, concerns, therefore, linguistics no less than psychology.