AN INVESTIGATION OF THE EFFECTS OF INCREASED MESSAGE TRANSFORMATIONAL COMPLEXITY ON THE COMPREHENSION OF SPOKEN ENGLISH MESSAGES

Thesis for the Degree of M. A.
MICHIGAN STATE UNIVERSITY
Richard R. Reagan
1973

THESIS

ABSTRACT

AN INVESTIGATION OF THE EFFECTS
OF INCREASED MESSAGE TRANSFORMATIONAL COMPLEXITY
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by Richard R. Reagan

Research suggests that the amount of difficulty a person has in processing and comprehending a sentence is inversely related to the number of transformational rules in its derivational history. It has not been demonstrated, however, that a similar relationship exists when a message consisting of several sentences is used as the primary unit of analysis. Therefore, the purpose of the present study was to investigate the relationship between the overall transformational complexity of a message and receivers' comprehension of it.

The study involved five existing intact groups consisting of twenty (20) subjects each. One of these groups was a "base line measures" group and the other four were treatment groups.

Subjects in the treatment groups were required to listen to one of four versions of the same message. The four stimulus versions were exact meaningful paraphrases of one another and each contained an identical number of sentences. The versions differed in overall transformational complexity by specified amounts.

Each group of subjects first listened to a tape-recorded presentation of one of the message versions. Immediately afterward, each subject took a Cloze Procedure test designed to measure his comprehension of that version.

It was hypothesized that the group that heard the least complex version would have the highest Cloze Comprehension Mean while the group that heard the most complex version would have the lowest Cloze Comprehension Mean. The Cloze Comprehension Means of the remaining two groups were expected to fall in between the extremes.

Two modes of data analysis were employed, one descriptive and the other inferential.

The results of the descriptive analysis indicated that as the overall transformational complexity of the versions increased, the Cloze Comprehension Means of the groups who heard them decreased. This particular finding suggests that

the hypothesized inverse relationship between Message Transformational Complexity and Receiver Message Comprehension was indeed present. Results of the statistical analyses failed to support the main hypothesis. There is evidence to suggest that this failure may have been due, in large part, to two factors: small sample size and large within group variability; and to the effects of three main sociological variables which were not controlled for: the socio-economic status of subjects' families, subjects' mother's educational level and the use of a foreign language in the home of subjects.

Taken together, these results suggest that although Message Transformational Complexity and Receiver Message Comprehension appear to be inversely related at the descriptive level, several methodological and design inadequacies of the study itself may well have made statistical verification of this relationship impossible.

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A THESIS

Submitted to
The Department of Communication
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

September 1973

ACKNOWLEDGEMENTS

It has been said many times, and rightly so, that an individual's scholarly ideas and research are heavily influenced by his teachers, his colleagues and his family. Happily, I am no exception because a number of people close to me have greatly influenced, shaped and guided the work represented in this thesis from its very inception. I would, therefore, like to take this opportunity to, in some small way, recognize and sincerely thank those who have helped me in countless ways as I set about to conduct the research reported in this thesis.

First, I would like to gratefully acknowledge the tremendous contributions of my guidance committee chairman, Dr. Erwin P. Bettinghaus, whose help, intellectual stimulation, criticism and continued friendship served as a constant source of inspiration and in so many ways made this entire project possible. I would also like to thank the other two members of my committee, Drs. Alfred E. Opubor and Randall P. Harrison for the advice and criticism each offered at various critical stages of my work. I am convinced that without their valuable and timely insights, this study would have been somehow lacking in a number of respects.

I am also indebted to Dr. Julia S. Falk, of the Michigan State University Department of Linguistics, African and Oriental Languages for her valuable assistance, for it was through her various courses that I was able to develop the basic understanding of the linguistic and psycholinguistic sciences necessary to undertake my research.

Numerous of my graduate student colleagues have provided valuable insights during the course of my work for which I am most grateful. Unfortunately, it is not possible to mention all of them at this time, but I would especially like to acknowledge the many contributions of Mr. Mark Milkovich who proved to be an invaluable source of methodological assistance and without whose help my data might never have been analyzed properly.

More thanks than I could possibly hope to offer in such a short space are due to my wife, Esther, whose understanding, dedication, inspiration and love sustained me when I was discouraged and gave my work true purpose and meaning.

Finally, I would like to offer my very warm and heartfelt thanks to the late Dr. Verling C. Troldahl whose wisdom, friendship and personal concern for me greatly influenced my decision to undertake post-graduate study in the field of communication and showed me in so many ways that the pursuit of knowledge could be both an exciting and rewarding career.

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INTRODUCTION

Research suggests that the amount of difficulty a person has in processing and comprehending a sentence is inversely related to the number of transformational rules in its deriviational history. It has not been demonstrated, however, that a similar relationship exists when a message consisting of several sentences is used as the basic unit of analysis. Therefore, the purpose of this study was to investigate the relationship between the overall transformational complexity of a message and receivers' comprehension of it.

In this study, four comparable groups of subjects were required to listen to one of four versions of the same message. The four stimulus versions were exact meaningful paraphrases of one another and each contained an identical number of sentences. The versions differed in overall transformational complexity by specified amounts. Each group of subjects first listened to a tape-recorded presentation of one of the message versions. Immediately afterward, each subject was administered a Cloze Procedure test designed to measure his comprehension of that version. It was hypothesized that subjects' Cloze comprehension scores would be highest in the group that heard the least complex version and lowest in the group that heard the most complex version with scores from the other two groups falling in between.

The experiment reported in this thesis may be conveniently fit under two very broad, but by no means mutually exclusive, categories, in that it is both a psycholinguistic study and a study of human communication.

The present study may be classified as psycholinguistic for two reasons. First, during the process of conceptualization and design, the author was guided by the basic tenets of Generative-Transformational linguistic theory. This particular theory of language, almost by definition, serves as the underlying theoretic base for the vast majority of research work currently being done in the field of psycholinguistics. Second, the independent variable investigated in this study, Message Transformational Complexity, is a direct and logical extension of a highly similar variable that has been the subject of much past research by experimental psycholinguists investigating the Derivational Theory of (transformational) Complexity.

Two facts support the assertion that the present study is one broadly dealing with aspects of human communication. The first of these relates to the nature of the independent and dependent variables that were investigated. While "transformational complexity" is primarily a psycholinguistic variable, in this study the psychological effects of increased transformational complexity were investigated within the context of connected message discourse. This use of the message as the primary stimulus/analysis unit places the author's experiment directly in line with the majority of past communication research which has tended to be most concerned with investigating the effects of entire messages on those who receive them. The dependent variable in the study was Receiver Message Comprehension and a quick perusal of the existing communication research literature reveals that it is the most frequently used dependent variable in message research. The second important fact is that psycholinguistic research and communication research hold much in common because they both seek to investigate relevant aspects of the process of human communication.

The communication scholar is, of course, primarily concerned with studying the psychological and sociological effects of messages on those who send and receive them, and thus is undeniably involved in investigation of the process of communication. The psycholinguist, on the other hand, typically investigates the nature of the "linguistic process" by which language users pair relevant features of meanings with relevant features of speech sounds for the purpose of communication. At first glance, this line of inquiry might seem somewhat unrelated to the work of the communication scholar but once it is made clear that the meaning-speech sound "pairing" function served by the linguistic process is an indispensable aspect of the larger process of communication via linguistic symbols, it becomes obvious that the psycholinguist is no less concerned with investigating the communication process than is the communication scholar himself. In the broadest sense, any attempt to gain insight into the nature and operation of the linguistic process has the potential to add considerably to the growing body of knowledge about the process of communication in general.

The experiment which the author has undertaken is reported in five chapters. Chapter One develops part of the rationale for the study by discussing the relationship between psycholinguistics and Generative-Transformational theory, and the relationship between psycholinguistics and the study of human communication. Chapter Two completes this rationale by concentrating on a discussion of trans-

formational rules from three related perspectives: 1) Generative-Transformational theory, 2) psycholinguistic theory and research, and 3) human communication theory. In addition, in Chapter Two the general and research hypotheses are developed, the main variables are operationalized, the measuring instrument is described, and the nature of the study is outlined. Chapter Three discusses the experimental and statistical design of the study, the technique of administration employed and the subjects tested. Chapter Four reports the findings of both descriptive and statistical analyses of the data. Chapter Five includes a discussion of the results of the study, the conclusions that may be drawn from them, and suggestions for further research.

CHAPTER I

I. Introduction

The explicit statement of Chomsky's theory of Generative-Transformational grammar in Syntactic Structures heralded the beginnings of rapid and far reaching revolutions in the related fields of linguistics and psycholinguistics.[1] Both of these revolutions have very closely followed the general pattern of paradigm development outlined by Kuhn in The Structure of Scientific Revolutions.[2] In the case of linguistics, Chomsky's theory arose to challenge and eventually repudiate the doctrines, aims and methodology of "structural linguistics" by arguing for a new definition of human language and proposing entirely new goals for the development of linguistic meta-theory. Within psycholinguistics, Chomsky's persuasive argument that language is a cognitive device of infinite creativity cast serious doubt on the usefulness of attempts to develop models of language behavior based on information theory and learning theory. Perhaps the clearest indication that Chomsky's theory has indeed had revolutionary impact lies in the fact that today, among linguists, psycholinguists and scholars from a number of other related fields, there is almost universal acceptance of the cognitive definition of language embodied within Generative-Transformational theory.[3]

Although the theoretic underpinnings of the study reported herein come primarily from psycholinguistics, there are, in addition, a number of contributions from the related fields of Generative-Transformational linguistics and communication. Because of this, it seems advisable to begin this thesis with some general remarks

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[1] Chomsky, N., Syntactic Structures, The Hague: Mouton and Company, 1957.

[2] Kuhn, T., The Structure of Scientific Revolutions, Chicago: University of Chicago Press, 1970.
Excellent reviews of the Chomskyian revolution in linguistics and psycholinguistics can be found in the following sources:
Searle, J., "Chomsky's Revolution in Linguistics", The New York Review, June 29, 1972 (MSU Communication Department Reprint).
Greene, J., Psycholinguistics: Chomsky and Psychology, Middlesex, England: Penguin Books, Ltd., 1972.

[3] Greene, J., op. cit., pp. 11.

about the field of psycholinguistics in terms of its relationship both to Generative-Transformational theory and communication theory. Toward this end, Section II of this chapter discusses the reasons for the attraction of many psycholinguists to Generative-Transformational theory, while Section III discusses the importance of the psychological investigation of language to a broader understanding of the human ability to communicate. These discussions will serve as a general introduction to the major disciplines upon which the author's study is founded.

II. Psycholinguistics and Generative-Transformational Theory

Several psycholinguists, including Johnson, Greene and Okby, have argued that although "psycholinguistics" and "the psychology of language" share the common goal of developing a theoretically sound and empirically valid model of "linguistic performance" (ie. human language behavior), they are not one and the same.[4] These authors suggest that psycholinguistics and the psychology of language may be differentiated chiefly in terms of the degree to which each relies on linguistic theories as a base upon which to begin building a detailed model of linguistic performance. As its name implies, psycholinguistics is a meld of (cognitive) psychology and linguistic science. This readily suggests that the psycholinguist sees great potential value in looking toward insights provided by linguistic theories for an analysis of language behavior. The more traditional psychologist, however, tends instead to look toward insights provided by non-linguistic theories of information and learning for such an analysis.

A further basis for differentiation may be noted in that psycholinguists have, for the most part, adopted the Generative Transformational viewpoint that the primary determiner of language behavior is "linguistic competence" which consists of those rules the language user must implicitly know in order to be able to produce and understand linguistic messages. Psychologists of language, on the other hand, have remained largely uninfluenced by this viewpoint,

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[4]Johnson, N., "Linguistic Models and Funcional Units of Language Behavior" in Rosenberg, S. (Editor), Directions in Psycholinguistics, New York: MacMillan, 1965, pp. 29-65.
Greene, J., op. cit.
Okby, M., Verbal Cues of Organizational Information in Message Decoding, The Hague: Mouton and Company, 1972.

believing instead that language behaviors are situationally determined verbal responses to stimuli that the language user has previously learned by means of operant conditioning.

Acceptance of a cognitive "rule based" definition of language means that, unlike the psychologist of language, the psycholinguist is primarily concerned with the psychological investigation of key concepts (ie. deep structure, transformational rules, surface structure, etc.) which are central to the Generative-Transformational description of linguistic competence in order to assess what role, if any, each plays in linguistic performance.

At this point, an important question presents itself. Why have psycholinguists turned specifically toward Generative-Transformational theory as a likely basis for psycholinguistic theory and research? This question can best be answered by briefly examining the state of the psychological investigation of language prior to the publication of Syntactic Structures in 1957 and noting the tremendous impact Chomsky's new ideas and arguments had on the status quo.

As has been noted above, the two most prominent influences on the psychology of language prior to the development of Generative-Transformational theory were information theory and learning theory.

Looking first at information theory, the following quotation from Greene aptly captures the influence of this particular theoretic perspective on the psychology of language.

> "... according to the technical definition of information introduced in Shannon's theory of telecommunications (Shannon and Weaver, 1949), what is important is not the content of the message but the probability that it will be transmitted. This means that the output of language users can be looked at as a set of message sequences in which each word has a definable probability of occurring. The implication is that it is these probabilities that control the individual speakers' outputs and their ability to process language."[5]

As a result of the application of information theory to the psychological investigation of language, a number of psychologists came to believe that the grammatical organization of any utterance could easily be explained solely on the basis of the statistical dependencies of each successive word.[6] Having

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[5]Greene, J., op. cit., pp. 13.
The Shannon and Weaver citation present in the above quotation is:
Shannon, C. and Weaver, W., A Mathematical Theory of Communication, Urbana, Illinois: University of Illinois Press, 1949.

[6]Haney, R., The Analysis of Meaning, unpublished paper, Michigan State University, 1970, pp. 18.

observed that high probability strings of words resemble grammatical sentences more than do low probability strings of words, many scholars concluded that a probabilistic "Markov grammar" could serve as a useful model of what the language user does when he uses language.[7] In such a model the language user's linguistic competence consists of "knowing" the probability of various words permissibly following each other, and his linguistic performance consists of actually employing this knowledge to string words together in order to produce grammatically correct sentences.[8]

Turning now to the influence of learning theory on the psychology of language, Greene has observed;

> "(that) from the point of view of learning theory, verbal responses are thought to be a sub-class of responses in general. Consequently, they can be examined by the general laws governing the establishment of connections between stimuli and responses, although there is disagreement about how complicated the stimulus-response connections may need to be in the case of complex behavior such as problem solving, thinking and language... As with information theory, the stimulus-response approach is concerned with the probability that a particular verbal response will occur, in this case due to a previous history of conditioning."[9]

Perhaps the best known S-R model of language behavior is that of Skinner which is based on operant learning theory.[10] According to Skinner, language behavior is controlled by its consequences. If its consequences are rewarding, the behavior is likely to be maintained and increase in frequency and strength; if its consequences are punishing, the behavior is likely to decrease in frequency and strength or perhaps disappear entirely.[11]

Skinner's "behavioristic" S-R theory of the language user includes no mention of internal thought processes and for this reason, meaning is excluded.

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[7]For a discussion of Markov grammars see: Chomsky, N., Syntactic Structures, Chapter 3, pp. 18-25.

[8]Terwilliger, R., Meaning and Mind: A Study in the Psychology of Language, New York: Oxford University Press, 1968, pp. 199.

[9]Greene, J., op. cit., pp. 14.

[10]Skinner, B. F., Verbal Behavior, New York: Appleton-Century-Crofts, 1957.

[11]DeVito, J., Psycholinguistics, Indianapolis: Bobbs-Merrill Company, Inc., 1971, pp. 10.

Feeling that any theory of language behavior must fully account for the psychological nature of meaning, Osgood, Suci and Tannenbaum proposed a two-stage S-R model which characterized meanings as symbolic mediatiation processes.[12]

> "These meanings are unobservable...responses to words, which represent only a part of the overt responses that would have been made to the object, and in turn stimulate appropriate responses to the word."[13]

Many scholars felt that the Representational Mediation model proposed by Osgood, Suci and Tannenbaum was definitely a "step in the right direction" for two reasons. First, the model recognized the existence and importance of internal processes in linguistic encoding and decoding. Second, it attempted to formally account for the process by which meanings are attached to linguistic symbols. Most psychologists, whether they were behaviorists or not, had felt all along that any psychological theory of langauge which viewed linguistic performance as consisting only of conditioned response habits was, at best, oversimplified and, at worst, incorrect.

The term "psycholinguistics" first came into use in the late 1940's and indicated psychologists' interest in the "structural" linguist's terminology and methods for describing the output of language users. Early psycholinguists felt that linguistic units such as phonemes, morphemes and phrases offered a more precise formulation of linguistic output than did the psychological concepts of letters, words and utterances.[14] Attempts by early psycholinguists to incorporate the terminology and methodology of structural linguistics into the psychological investigation of language comfortably co-existed with information theory and learning theory until about 1960 when Chomsky's theory was presented in detail to psychologists in Miller, Galanter and Pribram's book, Plans and the Structure of Behavior.[15]

In essence, Chomsky's theory of Generative-Transformational grammar proposed a new definition of language which focused on the "generative capacity"

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[12] Osgood, C., Suci, G., and Tannenbaum, P., The Measurement of Meaning, Urbana, Illinois: University of Illinois Press, 1957.

[13] Greene, J., op. cit., pp. 14.

[14] Loc. cit.

[15] Miller, G., Galanter, E., and Pribram, K., Plans and the Structure of Behavior, New York: Holt, Rinehart and Winston, 1960.

of human language and its users. Chomsky argued that language may be thought of as a very large but finite set of "recursive" rules which are implicitly known by the language user.[16] These rules allow him to pair relevant features of meanings with relevant features of speech sounds in order to both produce and understand a potentially infinite number of novel sentences.

The impact of Chomsky's theory on the psychology of language in the early 1960's is clearly noted in the following quotation from Greene.

> "The major change as far as psychology is concerned is that Chomsky's linguistic theory makes explicit a definition of language which appears to rule out the possibility of linguistic analysis continuing in tandem with information theory and learning theory accounts of response probabilities and conditioned word meanings. The arguments used by Chomsky and his supporters were designed to show, first, that learning theory is in principle unable to account for the speakers' ability to use language, and second, that, in any case, acquisition of stimulus-response probabilities would be a wildly uneconomical explanation of language learning. On the first count, the crucial point is Chomsky's demonstration that the number of possible grammatical sentences is potentially infinite, since it is always possible for a speaker to produce some new combination of words not spoken before. Obviously, it is theoretically impossible to calculate the probability of words occurring together in a new combination on the basis of previous frequencies of occurrence. Chomsky's famous sentence 'Colorless green ideas sleep furiously.' is an example of a sequence of words which is immediately recognizable as a grammatical sentence despite the infinitesimal probability of any of the words having occurred together before. The point he is making is that there is no theoretical limit to the number of novel sentences that can be produced; consequently a speaker's performance cannot be based on probability counts of the finite sample of sentences he happens to have experienced.
>
> The second consideration is the implausibility of the notion that, even supposing there were some artificial limit placed on the number of possible sentences, a child could learn a language by experiencing all possible sentence strings in order to become aware of the probabilities of stimulus-response associations between successive words in a sentence. Apart from the theoretical impossibility of making this calculation, it would obviously be far more efficient for a child to develop rules for producing permissible sentence sequences, including combinations of words he has never heard before, and which consequently have no calculable probability of occurring."[17]

Like the psychologists of language, early psycholinguists also found Chomsky's

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[16] To suggest that language rules are "recursive" essentially means that there is, in most cases, no theoretic limit to the number of times any one rule may be applied in the derivation of a sentence.

[17] Greene, J., op. cit., pp. 15-16.

theory at odds with the paradigm they were attempting to utilize in their psychological investigations of language, which was, of course, linguistic structuralism. The goal of descriptive linguistics as defined by prominent structuralists such as Bloomfield, Hockett and Gleason was the classification of the elements of human languages (ie. phonemes, morphemes, phrases, etc.).[18] As a result of this goal, emphasis was placed on the dissection and detailed description of static surface forms found within various languages.

Due to his belief that language is best characterized as a set of generative rules, Chomsky found himself in fundamental disagreement with the structural linguists. Rather than the mere classification of the constituents of sentences, he felt that the primary goal of linguistic science should be the description of the rules by which sentences are generated. Thus, Chomsky set about to identify some of the rules of English (his native language) and demonstrate how they might be formally stated and used in linguistic descriptions to generate grammatically well-formed sentences.

Chomsky was careful to make clear, however, that while these rules provide a useful descriptive representation of speakers' linguistic competence, they do not necessarily have either "psychological reality" or "process validity". Chomsky admonished that the descriptive rules contained within a generative grammar may not correspond in form to the psychological rules of language assumed to be part of speakers' cognitive make-up. Similarly, he warned that the way in which a generative grammar produces sentences may not correspond to the way in which the speaker does so in everyday language use. Thus, according to Chomsky, his theory of grammar is purely descriptive in nature and should not be construed as having psychological reality.

Early psycholinguists attributed much stronger psychological implications to Generative-Transformational theory than did Chomsky for the following three reasons: 1) they accepted the "rule based" definition of language which underlay Generative-Transformational grammar, 2) they accepted Chomsky's premise that the central component of any useful model of linguistic performance must, of necessity, be a theory of linguistic competence, and 3) they were aware of the fact that Chomsky's descriptive account of linguistic competence was painstakingly founded on investigations of linguistic data and thus were able to appreciate its scientific

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[18] Searle, J., op. cit., pp. 1.

sensibility and parsimony. These reasons led a number of psycholinguists to optimistically conclude that Chomsky's generative rules might be exact correlates of the cognitive rules speakers actually use in generating sentences and also that the generative process might have psychological validity.[19] In short, it was their hope that Chomsky's descriptive account of linguistic competence could be incorporated directly into a psychological model of performance without major modification.

This line of reasoning immediately suggested that before psycholinguists could begin building a model of performance, a very important two-part empirical question would have to be answered. Do the various rule systems proposed by the Generative-Transformational description of linguistic competence actually have psychological reality for language users, and if so, do the cognitive processes implied by linguistic analysis have similar realities?[20]

Clearly, the advisability of directly using the Generative-Transformational account of linguistic competence in a psychological model of performance depends critically upon an affirmative answer to the above question. As Miller and McNeill correctly point out;

> "Until he is reassured... (on this question) ... the psycholinguist will tread cautiously; he would not care to be caught explaining something that did not exist."[21]

Over the years, data have been amassed which suggest the fruitfulness of using aspects of Generative-Transformational grammar as a foundation for a psychological model of linguistic performance, but these data are far from conclusive. A great deal still remains to be done before the true usefulness of this theoretic perspective can be adequately assessed. In addition, the contributions of information theory, learning theory and a whole host of other theories obviously relevant to the psychology of language remain to be discovered and integrated into a suitable model of language behavior. In short, language behavior is still only partially understood and there remains a need for insights provided by scholars working from a variety of relevant perspectives.

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[19] Greene, J., op. cit., pp. 17.

[20] Miller, G. and McNeill, D., "Psycholinguistics", in Lindzey, G. and Aronson, E. (Editors), The Handbook of Social Psychology, Reading, Massachusetts: Addison-Wesley, 1969, 3:701.

[21] Ibid., pp. 701-702.

The discussion provided in this section has attempted to note some of the reasons why psycholinguists have been attracted to Generative-Transformational theory. These reasons are more numerous and complex than has been suggested here, but the basic attraction of psycholinguists to Chomsky's theory is a result of 1) his appealing new cognitive definition of language, 2) the many legitimate criticisms he leveled at the usefulness of analyses of language based on information theory, learning theory and structural linguistics, and 3) the attractiveness of his formulation of the rules of grammar as a possible model of the mental mechanisms actually underlying language behavior. As a result of Chomsky's influence, psychologists were forced to candidly re-evaluate their various approaches to the psychological investigation of language. Once they began doing so in earnest, the Generative-Transformational "revolution" within the psychology of language was born and rapidly gained ardent supporters.

In summary, the importance of Chomsky's theory to psycholinguists has been nicely stated by Deese, who in 1970 observed,

> "Generative theory ... contains some old truths about language and shows us some important new ones. The most significant function it has had in the last decade, however, has been to provide our ideas about language with a firm theoretical foundation. It is the best and most powerful device available for telling us what we are talking about when we are talking about language. Generative theory gives us the means of characterizing those things that are really essential to language in a precise and detailed way. It is not too much to say that no adequate account of the nature of language...(behavior)...was possible before Generative theory."[22]

III. Psycholinguistics, Language and the Study of Human Communication

Human "language" may be defined as a cognitive device consisting of a set of arbitrary and abstract symbols and the various rule systems necessary for the meaningful combination and interpretation of these symbols. Without a doubt, language is man's primary vehicle of communication. Man, of course, communicates through a variety of other means besides language (ie. gestures, facial expressions, dancing, music, etc.), but he relies most heavily on his ability to express his thoughts by creating messages that consist of meaningful sequences of verbal or written linguistic symbols. In all probability, communication would be a great deal more difficult were it not for man's remarkable ability to readily master and use systems of linguistic symbols.

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[22]Deese, J., Psycholinguistics, Boston: Allyn and Bacon, Inc., 1970, pp. 2.

Underlying language and human communication are three important rule governed relationships involving the symbols comprising any linguistic code.[23] The first relationship, termed "syntactics", is one that exists between symbols. The study of syntactics, which is the special domain of linguistics and psycholinguistics, involves the specification of the rules governing the combination of symbols to create grammatically well-formed messages. The second relationship, termed "semantics", is one that exists between symbols and the objects or abstractions to which they refer. The study of semantics involves the specification of the rules governing the meaningful correspondence between symbols and their referents. Semantics is an area of study which is of interest to a number of fields, including philosophy, psychology, linguistics, psycholinguistics and communication. The third relationship, termed "pragmatics", is one that exists between symbols and their human users. The study of pragmatics involves the specification of the rules governing the effects of symbolic messages on those communicators who send and receive them. Pragmatics is an area of study which is of particular interest to the communication scholar. Clearly these three relationships (and the rules which support them) are of crucial importance to the process of communication via linguistic symbols because they alone are responsible for determining the grammatical structure, meaning and social effects of linguistic messages.

Thus, in a very real sense, the researcher investigating any one of these three relationships is studying an aspect of the process of communication. This is particularly true of the psycholinguist seeking to empirically investigate those rules of linguistic competence which comprise the "linguistic process" and make it possible for communicators to pair relevant features of meanings with relevant features of speech sounds (or written characters) in order to establish a shared context of meaning. Without a doubt, the rule governed linguistic process is an indispensable aspect of the broader process of communication via linguistic symbols. This is true because successful communication by means of linguistic symbols would be impossible unless both source and receiver were able to associate meanings and symbols.[24]

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[23] Saporta, S., in Thayer, L. (Editor), Communication Theory and Research, Springfield, Illinois: Charles C. Thomas, 1967, pp. 4-5.

[24] Miller, G. and McNeill, D., op. cit., pp. 666-667.

The above line of reasoning strongly suggests that, in the long run, the greatest contribution of psycholinguistics to the study of human communication is likely to be the empirical determination of the finite set of cognitive rules which will broadly define the total set of linguistic messages that may be generated in human languages. This, of course, is a mammoth undertaking which specifically requires the development of a theory of "universal grammar". Many scholars believe that the development of such a theory is of extreme importance to the study of human communication. Saporta, for example, has gone so far as to argue that the explication of the cognitive rules of language which are shared by all the language users of the world is, in fact, pre-requisite to any investigation of the process of communication via linguistic symbols.[25] Basically, Saporta's point is this; one can meaningfully inquire into the processes underlying the acquisition, use and social effects of linguistic messages only after defining the constituents of the total set of such messages. Such a definition is precisely what the psycholinguist is attempting to supply. This argument clearly suggests that the communication scholar must draw heavily from the work of the psycholinguist if he is to adequately understand the primary subject matter of his science, which is, of course, the communicative message.

It must be made clear, however, that a completely developed theory of universal grammar cannot alone serve as a comprehensive theory of human communication.[26] This is true because no grammar can fully account for all the communicative abilities of human beings. There is, in short, more to the process of communication than is subsumed under the linguistic process. The following quotation from Saporta makes this point clearly.

> "The strongest requirement that could be placed on such a (communication) theory is that it prove powerful enough in principle to explain and predict human behavior, or, equivalently, that such a theory prove sufficiently rich to enable one to construct a device the output of which would be indistinguishable from the verbal behavior of a fluent speaker. However, it is clear that this is not a reasonable immediate goal. The verbal behavior of a speaker, like other forms of complex behavior, is presumably the product of the interaction of different types of psychological processes. To specify a device capable of simulating the behavior of a speaker by producing situationally appropriate verbalizations would require making explicit the laws of motivation, beliefs, etc., and their interaction--in short, almost a general theory of human behavior.

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[25] Saporta, S., op. cit., pp. 27.

[26] Ibid., pp. 15.

> But if such a goal is considered even as a long-range goal, then specification of the information made explicit by a grammar may be viewed as a reasonable intermediate goal, since specifying the response units is a prerequisite to an understanding of the factors which operate to determine the probability of their emission. That is, rather than trying to model the variables which enter into a functional account of verbal behavior, we might rather model the speaker's linguistic capacities, e. g., his ability to identify well-formed sentences, ambiguities of various sorts, synonomy, etc. And the adequate grammar that accounts for these capacities must be viewed as claiming the psychological reality of its constructs.
>
> A grammar, then, may be viewed as one essential component of a more comprehensive view of communication...(but)...characterizing a communicating member of a society is not exhausted by claiming that he has command of a grammar."[27]

The indispensability of the information provided by a theory of universal grammar to an overall theory of human communication suggests that the communication scholar must be aware of, and concerned with, the linguistic process which makes communication via linguistic symbols possible. But understanding the linguistic process is only one small part of his overall task. There are, for example, a whole host of psychological, sociological, situational and relational variables that play a crucial role in the process of communication. Each of these variables must be investigated and explained by the communication scholar who must then integrate them into a comprehensive theory of human communication. (In addition, the communication scholar must investigate those communication processes which do not use a linguistic code at all.) Indeed, the psychological investigation of language is only one area of interest to the communication scholar, but realistically it is one he cannot afford to ignore. To do so seriously distorts his overall understanding of the total process of communication by excluding an essential appreciation of those basic linguistic abilities which underly most forms of human communication.

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[27] Ibid., pp. 15-16.

CHAPTER II

I. Introduction

Over the years, transformational rules have been the subject of much investigation both within linguistics and psycholinguistics. In the case of theoretic linguistics, interest has centered around explicating those characteristics of transformations which are common to all naturally occurring human languages throughout the world. In addition, field linguists have long been concerned with the actual formalization of those rules which will describe how sentences are generated in specific languages. In the case of psycholinguistics, interest has centered around empirical attempts to determine whether or not transformational rules have some measure of psychological reality for language users.

Because the study reported in this thesis is concerned with investigating the psychological effects of the use of transformational rules on receiver message comprehension, it seems advisable to begin this chapter with a general discussion of transformations, focussing on the way in which linguists have fit them into the overall component structure of Generative-Transformational grammar, and the specific function they perform within that grammar. These two topics are discussed in Section II. The main objective of this particular discussion is to briefly explain the general organization of Generative-Transformational grammar and illustrate the role transformations play in this overall scheme. This is done in an attempt to insure that later remarks concerning transformations are not presented in isolation from the broader linguistic theory of which they are a central part.

Section III completes the author's discussion of transformations from the perspective of Generative-Transformational theory by defining them in terms of 1) the basic types of operations they may perform on pre-sentence forms, 2) the format which linguists use to formally represent them in written grammars, and 3) those properties which appear to be common to the transformations of all naturally occurring human languages. The need to provide such a comprehensive Generative-Transformational definition of transformations here is primarily due

to the fact that the psycholinguistic theory and research to be reviewed later in this chapter are rooted in this definition to the extent that it would be nearly impossible to meaningfully discuss psycholinguists' treatment of transformations without having first described them in detail from the point of view of linguistic theory.

With the necessary Generative-Transformational considerations of transformational rules completed, Section IV builds toward an operationalization of the author's study by offering the main rationale underlying it. This rationale is developed through a discussion of the following seven topics: 1) an explication of the Derivational Theory of Complexity which is the main theory psycholinguists have developed to explain the effects of transformational complexity on receivers' language processing behavior, 2) a review of the psycholinguistic/communication research which has sought to empirically test the Derivational Theory of Complexity, 3) a suggestion of the implications of the findings of these studies both for the development of effective message design strategies and the soundness of the psycholinguistic proposition that transformational rules have psychological reality for language users, 4) a review of some recent developments within experimental psycholinguistics which have caused psycholinguists to re-examine the findings of prior Derivational Theory of Complexity studies, 5) a review of the three major schools of thought that have grown out of this re-examination movement and the main objections each has raised to the basic propositions of the Derivational Theory of Complexity, 6) an overview of several design, control and measurement weaknesses that have been attributed to prior Derivational Theory of Complexity studies and the difficulties they introduce in terms of interpreting the findings of these experiments, and 7) a review of the single study that has tested the Derivational Theory of Complexity with a greatly improved experimental methodology. The discussion in Section IV admittedly covers a great deal of ground, but each of the seven topics mentioned above has been included for a very definite reason. In a very real sense, were any of the above topics to be omitted from the discussion, the reader would be left with a highly incomplete picture of the theoretic premise which underlies the author's study, the research that has tested it, and the confusion which currently surrounds the question of its validity and consequently gives rise to the need for a study such as the author

has undertaken.

Section V concludes the chapter by offering a precise operationalization of the author's study. The author provides this operationalization by 1) establishing the theoretic and research hypotheses that were tested in the experiment, 2) offering conceptual and operational definitions of the variables that were employed, 3) describing the measuring instrument that was used to index the dependent variable, and 4) presenting a general overview of the study.

II. Generative-Transformational Theory: An Overview

The basic aim of Generative-Transformational theory as developed by Chomsky in Aspects of the Theory of Syntax is to explicate all the relationships between the meaning system and the sound system of human language.[1] Chomsky has argued that in order to account for these relationships a grammar must consist of three interdependent components.[2] The most important of these is the "syntactic component" which generates and describes the internal structure of the infinite number of sentences possible in a given language. Another of these components is the "semantic component" which describes the meaning structure of sentences. The final component is the "phonological component" which describes the sound structure of sentences. Each of these components is necessary for the generation and interpretation of sentences, but not all share equal importance. Searle has summarized Chomsky's position regarding the relationship between these components as follows:

> "The heart of the grammar is the syntax, the phonology and semantics are purely 'interpretive', in the sense that they describe the sound and the meaning of sentences produced by the syntax but do not generate any sentences themselves."[3]

In this light, it is not hard to see why Chomsky has characterized the

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[1] Searle, J., "Chomsky's Revolution in Linguistics", The New York Review, June 29, 1972 (MSU Communication Department Reprint), pp. 6.
Chomsky, N., Aspects of the Theory of Syntax, Cambridge, Massachusetts: the MIT Press, 1965.

[2] Searle, J., op. cit., pp. 7.

[3] Loc. cit.

syntactic component as being the most important aspect of the grammar and why he set about to fully explicate it first.

The first task of Chomsky's syntactic component is to account for the speaker's linguistic "intuitions" about the structure of sentences. These intuitions, which stem from the speaker's linguistic competence, are of several types, including: 1) the ability to identify the grammatical relationships among the constituents of a given sentence, 2) the ability to distinguish grammatical sentences from ungrammatical ones, 3) the ability to recognize sentences which are paraphrases of one another, and 4) the ability to recognize syntactic ambiguity.[4] Chomsky represents the basis for these intuitions with rules which he has termed "phrase-structure rules".[5]

Chomsky's conception of a grammar based on phrase-structure rules can be illustrated by offering the following set of simple English rules.[6]

1. Sentence $\longrightarrow$ NP + VP
2. NP $\longrightarrow$ Article + Noun
3. VP $\longrightarrow$ Verb + NP
4. Article $\longrightarrow$ "The"
5. Noun $\longrightarrow$ {"Man", "Ball"}
6. Verb $\longrightarrow$ {"Hit", "Took"}

The above set of rules will, of course, generate only a very small number of English sentences, but it is adequate for the purposes of illustration. All rules are of the form X $\longrightarrow$ Y, which means, "rewrite X as Y". Rules 5 and 6 employ brackets which means that one and only one element from the bracket is to be selected in any one application of the rule. Lyons has offered the following procedure for applying the rules.

> "... we start with the element Sentence and apply Rule 1; this yields a string (ie. a sequence of symbols: "string" is a technical term) NP + VP. We inspect this string to see whether any of the elements occurring in it can be rewritten by means of Rules 1-6. It will seem that either Rule 2 or Rule 3 can be applied at this point: it does not matter which we select. Applying Rule 3, we get the string VP $\longrightarrow$ Verb + NP. We can now apply

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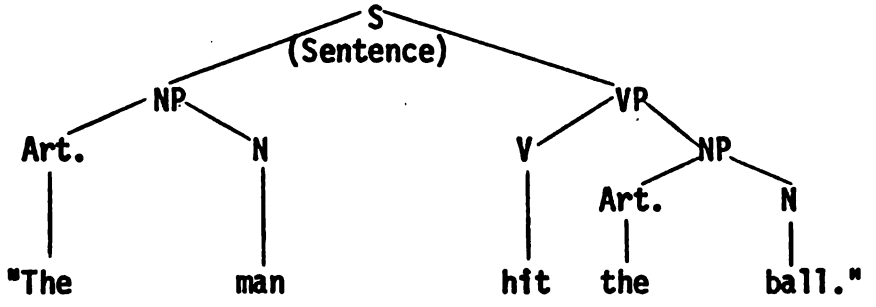
[4]Slobin, D., Psycholinguistics, Glenview, Illinois: Scott, Foresman and Company, 1971, pp. 4-6.

[5]For an excellent discussion of Phrase-Structure Rules see: Chomsky, N., Syntactic Structures, The Hague: Mouton and Company, 1957, Chapter 4, pp. 26-33.

[6]Lyons, J., Noam Chomsky, New York: The Viking Press, 1970, pp. 29-32.

> Rule 2 twice, followed by Rules 4 and 5 twice, and Rule 6 once (in any order except that Rule 2 must precede Rules 4 and 5 and Rule 3 must precede Rule 6 and one of the applications of Rule 2). The terminal string generated by the rules (assuming that 'Man', 'Hit', and 'Ball' are selected at the appropriate points) is 'The + man + hit + the + ball.'; and it takes nine steps to generate this string of words."[7]

By means of a branching tree diagram termed a "phrase marker", the step by step manner in which the above sentence was generated can be graphically represented.[8]



The above phrase marker is a hierarchical representation of the internal syntactic structure of the sentence 'The man hit the ball.'. This phrase marker provides an explicit "structural description" of the sentence which clearly identifies all its constituent groupings. For example, the subject of the above sentence is the NP immediately dominated by S, the predicate is the VP immediately dominated by S and the object is the NP immediately dominated by the VP.

It is important to note that in order to derive the words which will actually constitute a given sentence, in addition to the phrase-structure rules, information from the "lexicon" is also needed. The lexicon is a special type of dictionary which contains information about the meaning, pronunciation and syntactic function of each word in a language. The lexicon is considered to be part of the syntactic component and together with the phrase-structure rules constitutes the "base" portion of the grammar. The way in which information from the lexicon enters into the generation of sentences is not represented in the above example because it is not directly relevant to the discussion at hand.

Although phrase-structure rules are necessary for the generation of any

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[7] Ibid., pp. 32-34.

[8] Loc. cit.

sentence, they will not permit the generation of all the possible grammatical sentences of a given language. In the following quotation, Haney has noted three of the most important types of sentences that phrase-structure rules cannot generate.

> "... (using phrase-structure rules alone), it is not possible to 1) insure the correct production of new sentences by conjunction, 2) assign rules to guarantee the production of sentences with the correct concord of noun and verb and the proper selection and combination of auxiliaries, or 3) guarantee the formation of passive from active ones without allowing ungrammatical sentences to result."[9]

By Chomsky's own insistance, a grammar must be able to do everything a language user can. Since language users can create the kinds of sentences Haney has outlined above and phrase-structure rules cannot, it is clear that such rules are incapable of alone comprising the syntactic component of the grammar.

In order to render the syntactic component of the grammar sufficiently "powerful" to generate all possible kinds of sentences, Chomsky has introduced into it a new type of rule known as "transformations". These rules operate on the output of the base portion of the grammar (termed a "deep structure") and sequentially convert or transform it into a grammatically correct terminal string (termed a "surface structure").

Two new terms have been introduced and before going further they must be defined and explained. Generative-Transformational theory stipulates that the derivational history of a sentence contains two very important levels of structure. The first of these levels is termed deep structure and is the level which specifies: 1) the "semantic representation" or meaning of each word in the sentence, and 2) the grammatical relationships that exist between the constituents of the sentence. The second of these levels (less abstract than deep structure) is termed surface structure, and is the level in which the eventual physical form of the sentence is specified. These two levels are linked by transformational rules which in effect, substitute, add, delete or permute parts of deep structures to yield grammatical surface structures.

Postulating these two separate levels of sentence structure aids greatly in accounting for the fact that two sentences like the following have identical

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[9]Haney, R., The Analysis of Meaning, unpublished paper, Michigan State University, 1970, pp. 26-27.

syntactic surface forms but very different meanings.

(1) "John is easy to please."

(2) "John is eager to please."

The deep structure of (1) would indicate that "John" is intended to be the object of the action (ie. John is pleased by someone). The deep structure of (2) would indicate that "John" is intended to be the subject of the action (ie. John pleases someone). While these two interpretations are not entirely obvious from a cursory examination of the surface structures of (1) and (2), they are explicitly noted in the grammatical relationships among constituents expressed in the respective deep structures.[10]

A great deal more could be said regarding the general principles of Generative-Transformational theory, but the interests of brevity will permit only a brief description of the way in which the total grammar is organized.[11]

The "generative capacity" of the grammar is embodied in the syntactic component while the "interpretative capacity" of the grammar is embodied in the semantic and phonological components. The "base" portion of the syntactic component consists of the phrase-structure rules and the lexicon and is responsible for the generation of abstract deep structures. These deep structures serve as the input to the transformational portion of the syntactic component. The transformational rules sequentially convert abstract deep structures into grammatically correct surface structures.

Deep structures are also the input to the interpretative semantic component. This component consists of various types of semantic rules and functions to provide an overall meaningful interpretation for each deep structure based on the inherent semantic properties of all its lexical items considered together and the syntactic organization of these items.

The interpretative phonological component operates analogously to the semantic component. Surface structures are the input to this component which consists of various types of phonological rules and functions to provide an overall

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[10] Devito, J., Psycholinguistics, Indianapolis: Bobbs-Merrill Company, Inc., 1971, pp. 23.

[11] The remarks which follow are based on Paul Postal's discussion of the organization of the grammar which appears in the epilogue of Jacobs, R. and Rosenbaum, P., English Transformational Grammar, Waltham, Massachusetts: Blaisdell Publishing Company, 1968, pp. 267-289.

(speech) sound interpretation for each surface structure based on the inherent phonological properties of all its lexical items considered together and the syntactic organization of these items.

The combined operation of these three components of the grammar constitute the Generative-Transformational view of the way in which sentences are generated in all human languages. Together these components provide a description of the total set of competence rules responsible for the derivation of highly abstract pre-sentence forms and the evolution of these forms into grammatically correct surface structures ready for actual acoustic production by a speaker.

III. Transformational Rules: Generative-Transformational Perspectives

Transformational rules play a most important role in the Generative-Transformational conception of the way in which sentences are generated in any language. In the terminology of the linguist, they add "power" to the grammar by making it possible to generate those grammatical sentences which phrase-structure rules cannot. The inclusion of transformational rules also makes the grammar more parsimonious in that they permit the generation of a number of different kinds of sentences more conveniently and with fewer rules than do phrase-structure rules.[12] Thus, it is the power and parsimony that transformational rules add to the grammar which make them an indispensable component of Generative-Transformational theory.

Linguists differ with respect to the names they give to the various types of basic operations which transformations may perform on pre-sentence forms, but essentially there are four. They are: 1) substitution, 2) addition, 3) deletion, and 4) permutation.

As an example of the transformational operation of substitution, consider the following deep structure:

(3) * "I kicked I." (an asterisk indicates an ungrammatical sentence or pre-sentence form)

The above deep structure is ungrammatical as it now stands, but a transformation called the Reflexive Transformation will substitute the appropriate

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[12] The advantages of a grammar based both on phrase-structure and transformational rules are outlined in detail in: Chomsky, N., Syntactic Structures, Chapters 5-8, pp. 34-84.

reflexive pronoun (in this case the pronoun "myself") for the second occurrence of the personal pronoun "I". Application of the Reflexive Transformation to the above deep structure will result in the following surface form:

(4) "I kicked myself."

The transformational operation of addition can be illustrated by considering the following "intermediate structure"[13]:

(5) "I know Bill left home."

By a transformation called the "That" Insertion Transformation, it is possible to add the word "that" between the main verb and the subject of an embedded sentence (in the above case, "Bill left home." is an embedded sentence).[14]

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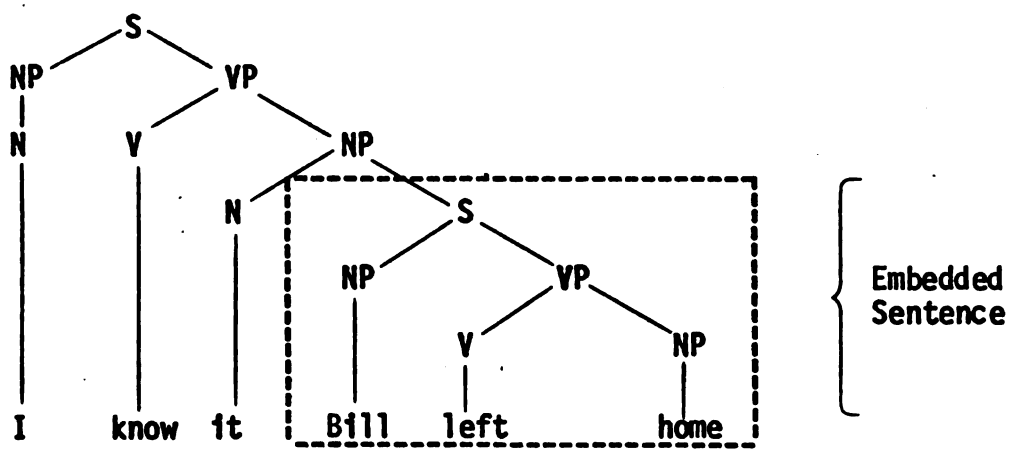
[13]Starting with a deep structure, each time a single transformational rule is applied, a new structure called an intermediate structure is produced. The derivational history of any sentence would look something like the following:

Deep Structure
Transformation 1 applies to produce
Intermediate Structure 1
Transformation 2 applies to produce
Intermediate Structure 2
Transformation 3 applies to produce
Intermediate Structure 3
⋮
Transformation n applies to produce
Surface Structure

Thus, intermediate structures are produced by the application of transformational rules and they stand in between the deep and surface structures of a sentence.

Diagram from: Falk, J., Linguistics and Language, Lexington, Massachusetts: Xerox College Publishing, 1973, pp. 164, figure 14.1.

[14]The abbreviated deep structure of this sentence (in tree diagram form) would be:



When the "That" Insertion Transformation is applied to the above intermediate structure, the following surface form is produced:

(6) "I know that Bill left home."

The transformational operation of deletion can be illustrated by considering the following intermediate structure:

(7) "The men were hesitant to come out because they were afraid to come out."

This sentence is grammatical but a little awkward. By applying a transformation called the Identical Verb Phrase Deletion Transformation, the second occurrence of the same verb phrase can be completely eliminated (in this case the identical verb phrase is "come out"). Application of the Identical Verb Phrase Deletion Transformation will convert the above intermediate structure into the following surface form:

(8) "The men were hesitant to come out because they were afraid to."

The final type of transformational operation, permutation, can be demonstrated by considering the following intermediate structure:

(9) "Dave looked up the number."

A transformation called the Particle Movement Transformation will permit a verb particle (such as the particle "up") to be moved from a position beside its verb to a place after the appropriate noun phrase (in this case the appropriate noun phrase is "the number"). Applying the Particle Movement Transformation to the above intermediate structure will yield the following surface form:

(10) "Dave looked the number up."

The linguist, concerned with providing a description of the way in which a particular language works, wishes to capture within his grammar those transformations which are required to generate grammatical sentences in that language. His goal is to make his grammar both "formal" and "explicit". This means that the transformational rules included within his grammar must be clearly stated so as to indicate both the syntactic environment in which they operate and the change they produce in syntactic structures.

As an example, consider the formalized representation of the Particle Movement Transformation:

S.D.	Verb	Particle	NP	
	1	2	3	$\Longrightarrow$
S.C.	1	3	2	

The first line of this rule "statement" indicates the type

of structure to which the Particle Movement Transformation applies. This line is called the "Structural Description" (abbreviated S.D.). According to the above S.D., the Particle Movement Transformation can be employed when there is a verb followed by a particle followed by a noun phrase. This structure may come at the beginning, middle, or end of a sentence and other parts of the sentence do not matter. Whenever the above configuration of constituents is present, the Particle Movement Transformation can optionally apply. The second line of the representation numerically identifies the constituents and their order before the transformation applies. The arrow is a transformation arrow which indicates that the order of the constituents has been changed by the application of the transformation. The third line of the transformational representation is called the "Structural Change" (abbreviated S.C.). It specifies what change the operation of the transformation has produced in the original structure. In the case of the above example, the Particle Movement Transformation shifts the particle from its original position to a spot at the immediate right of the noun phrase.[15]

Actually there are many formats for formally representing transformational rules, but the one described above is widely used and is one of the less complicated schemes available.

According to Generative-Transformational theory, there are four basic properties shared by all transformational rules. These properties are not restricted to the transformational rules of English, but rather apply to the transformations of all naturally occurring human languages.

1. Transformational rules are generalizations.

The task of the linguist in writing a descriptive grammar for a particular language is to discover and formalize all of those syntactic, semantic and phonological rules which a native speaker must know in order to use that language. The linguist strives to make these rules as general as possible. That is to say, he states each rule in such a way so as to allow it to apply in as many situations as possible. The rules which the linguist includes in his grammar are derived from a close and detailed investigation of the language in which he is interested. This firm reliance on linguistic data insures that the rules written by the linguist are accurate reflections of speakers' knowledge. It also insures

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[15]Falk, J., op. cit., pp. 183-185.

that the linguist's rules do not permit things to occur which never happen within that language.[16] In essence, the linguist attempts to completely describe the rule system of a language using general statements of the broadest possible applicability.

To demonstrate how this criterion of generality might apply to the writing of transformational rules, suppose that a linguist interested in writing a grammar for English noticed that native speakers were able to transform active sentences like the following:

(11) "The men ate the cakes."

into passive sentences such as:

(12) "The cakes were eaten by the men."

If the linguist were to observe a large number of such active-passive sentence relationships, he might be tempted to write a transformational rule much like the following:

Art.	Noun	Verb	Art.	Noun	
1	2	3	4	5	$\Rightarrow$
4	5 be	3+en by	1	2	

Such a transformation accounts for many active-passive relationships, but not all of them. For example, it does not account for the following two active-passive sentence relationships:

1< (13) "John ate the cakes."
1< (14) "The cakes were eaten by John."
2< (15) "The old man ate the cakes."
2< (16) "The cakes were eaten by the old man."

Because the above two active-passive relationships cannot be accounted for by the transformational rule proposed earlier, it must be revised and made more general. Once it is realized that a noun phrase may consist of a noun by itself, a noun preceded by an article, or a noun preceded by an adjective and an article, a new and more general formalization of the Passive Transformation can be written.

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[16] Basically, this reliance on linguistic data prevents the writing of ad hoc rules which have no empirical foundation. For example, no grammar for a language would include a rule forcing the first and last words of a sentence to arbitrarily exchange places unless speakers of that language behaved as though they knew and used such a rule.

Such a transformation could be stated as follows:

NP_1	Verb	NP_2	
1	2	3	$\Rightarrow$
3 be	2+en by	1	

This statement of the Passive Transformation is general enough to account for a more complete range of English active-passive sentence relationships and would be preferred.

2. Transformational rules may only substitute, add, delete or permute elements.

The basic transformational operations outlined earlier are universal to all languages. According to Generative-Transformational theory, no transformation may perform operations which do not fit under one of the above headings.

3. Transformational rules are often ordered with respect to one another.

Frequently, several transformations are required to generate a given surface structure. On many occasions the order in which these transformations are applied makes no difference. For example, consider the following surface structure:

(17) "I know that Ralph called the girl up."

In generating this sentence, both the "That" Insertion and the Particle Movement Transformations have been applied, but clearly it does not matter which one is employed first. A person could begin with either transformation and still end up with surface structure (17).

There are occasions, however, in which the order that transformational rules are applied is of crucial importance. The necessity of proper transformation ordering can easily be illustrated with an example involving two transformations which must be ordered with respect to each other. Consider the following deep structure:

(18) * "You wash you!"

The grammatical surface form for the above deep structure is:

(19) "Wash yourself!"

In order to generate the above surface structure, two transformations are needed, one to introduce the reflexive pronoun "yourself" and a second to delete the "you" in subject position. The Reflexive Transformation was discussed earlier and at that time it was noted that it serves to substitute the second occurrence of a personal pronoun with a reflexive pronoun. If this transformation were applied first, the following intermediate structure would be generated:

(20) "You wash yourself!"

Next, application of the transformation which deletes the subject "you" of an imperative sentence, will generate the surface structure shown in (19), which is grammatical. If, however, the "You" Deletion Transformation were applied first, the Reflexive Transformation could not then be applied because there would no longer be two identical personal pronouns in the same sentence. This would mean that the ungrammatical sentence:

(21) *"Wash you!"

would be produced. From this example, it is clear that the Reflexive Transformation must be ordered so as to precede the "You" Deletion Transformation.

4. Transformational rules are (usually) meaning preserving.

The reason why transformational rules are said to be meaning preserving is not hard to see once two important notions from Generative-Transformational theory are re-emphasized. The first notion is that all information relating to the meaning of a sentence is completely specified in its deep structure (ie. all meaningful lexical items are present and the grammatical relations among subject, predicate, object and the like are noted). The second notion is that transformations operate on deep structures and their derivitives. Thus, transformational rules are employed after meaning has been specified within any given sentence and for this reason, Generative-Transformational theory stipulates that they may not alter meaning. A quick review of the example sentences considered when noting the basic operations which transformations may perform will verify the fact that those transformations cited do not change meaning in any way.

It has recently been discovered, however, that the meaning preserving property of transformational rules does not hold true in all cases. Consider the following two sentences:

(22) "Many men read few books." (active)

(23) "Few books are read by many men." (passive)

Most native speakers of English would agree that when (22) is passivized its interpretation is changed somewhat. Apparently, when quantifiers (such as "few" and "many") are used in a sentence, application of the Passive Transformation does change meaning. There are other examples of situations in which the application of a particular transformational rule alters meaning, and linguists are currently attempting to identify these situations and account for them within their theory. Without going into detail concerning the types of changes in

Generative-Transformational theory necessitated by the discovery of non-meaning preserving transformations, let it suffice to say that in most cases transformational rules are meaning preserving.

There are a great many more things that could be said about the nature of transformational rules as they are conceptualized and defined in Generative-Transformational theory, but in the interests of brevity the discussion will now turn to a more psycholinguistic and communication oriented consideration of them in order to indicate how they relate to the present study.

IV. Transformational Rules: Psycholinguistic and Communication Perspectives

In the sixteen years since the publication of Syntactic Structures, several experimental psycholinguists have investigated individuals' language processing behavior in an attempt to shed light on the advisability of incorporating the descriptive transformational rules developed by linguists into a psychological model of linguistic performance. To date, most research along these lines has attempted only to empirically validate the psychological reality of transformations and determine what evidence exists to suggest that they are serially applied by language users. Very little has been done thus far in terms of explicating the precise psychological nature of transformations or attempting to fit them into a broader model of linguistic performance.

It may seem strange that the first psycholinguists to empirically investigate Generative-Transformational grammar chose to begin with the transformational component instead of what appeared to be the more thoroughly developed phrase-structure portion of the base.[17] This choice had much to do with the fact that psycholinguists felt the Generative-Transformational account of the transformational component made the most intuitive sense, and was, therefore, the likeliest candidate for direct incorporation into a psychological model of linguistic performance. Psycholinguists' main objection to Chomsky's account of the operation of the phrase-structure portion of the base is clearly noted in the following

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[17]The reason why psycholinguists concluded that phrase-structure rules were more thorougly developed than transformations had much to do with the historical fact that when they first became interested in Generative-Transformational grammar, the only major treatise available to them was Chomsky's Syntactic Structures. In this particular book, Chomsky developed an extensive list of English phrase-structure rules but offered only a very few example transformations. When psycholinguists looked at Syntactic Structures, the mere fact that Chomsky proposed more phrase-structure rules than transformations prompted them to conclude that the phrase-structure portion of the base was the best developed aspect of the overall grammar.

quotation from Greene.

> "... it seemed most implausible that people produce sentences by starting with an abstract axion S, then proceeding to rewrite it as VP and NP and so on, inserting the actual words only at the end of the process. Such a series of operations runs counter to every intuition that people start with 'what they want to say' and only then generate an appropriate sentence to express it."[18]

Psycholinguists were also encouraged to begin with an examination of the transformational component because they suspected that it could be investigated more easily than the phrase-structure portion of the base. This suspicion was a direct result of psycholinguists' conviction that, in comparison to phrase-structure rules, transformations are less cognitively abstract and therefore, more susceptible to empirical investigation. This may or may not be the case, but even if it were true, the task of empirically establishing the psychological reality of the transformational component of linguistic competence is not easy. This is so because it is impossible for the psycholinguist to observe a speaker making direct use of his linguistic knowledge. What is observable to him is the speaker's language behavior which reflects not only the use of linguistic rules but also the combined influences of a whole host of individual performance variables (such as memory span, fatigue, anxiety and attention span) which often interfere with and obscure linguistic competence. This suggests that the only viable research strategy available to the psycholinguist is to minimize potentially confounding performance factors as much as possible in the experimental tasks he asks subjects to perform. In so doing, the psycholinguist helps to insure that the behaviors he observes are more accurate reflections of linguistic competence than might otherwise be discernable. However, since it is not possible to systematically eliminate the influences of all potentially confounding performance factors from any single experimental task, the psycholinguist must live with the uncomfortable realization that the inferences he can draw concerning the psychological nature of linguistic competence are limited, and inherently tenuous. But by the same token, the psycholinguist can rest assured that his investigations (and the inferences he draws from them) are extremely valuable. This is so because such investigations do provide useful empirical data, on the basis of which, preliminary judgements can be made con-

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[18]Greene, J., Psycholinguistics: Chomsky and Psychology, Middlesex, England: Penguin Books, Ltd., 1972, pp. 108.

cerning the suitability of certain portions of the Generative-Transformational theory of linguistic competence as central components in a model of linguistic performance. The alternative to basing these judgements on empirical evidence is, of course, to found them on human intuition alone. While it is true that the use of intuition is a necessary aspect of the experimental psycholinguist's approach to science, the fact that he is an empiricist dictates that he seek "data based" support for his intuitions about human language.

Thus, with the above mentioned ideas clearly in mind, psycholinguists in the early 1960's set about to design a variety of experimental tasks which would cause subjects to make use of specific descriptive transformational rules while engaged in language processing in a controlled laboratory environment. It was expected that subjects' behavior would yield clues as to the psychological presence or absence of the rules they were called upon to employ.

There was, of course, a theoretic proposition underlying the early transformational studies which Williams has briefly summarized as follows:

> "... the more linguistic (ie. transformational) rules that the user (has) to use in a given situation, the greater (will) be the demands on his language-processing behavior."[19]

This thesis has been termed the "Derivational Theory of Complexity" and suggests that the more transformations a person is called upon to employ in encoding or decoding a sentence, any or all of the following things may happen to his ability to process it: 1) he may take a longer period of time to encode or decode a transformationally complex sentence than a simpler one, 2) he may make more errors in correctly processing a complex sentence than a simpler one, 3) he may be able to recall fewer details from a complex sentence than from a simpler one, or 4) he may comprehend a complex sentence less well than a simpler one.[20]

The psycholinguists who first developed and tested the Derivational Theory of Complexity based their work on two important assumptions. Both were empirical questions but neither was researched until after work had begun on the Derivational Theory of Complexity.

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[19]Williams, F., Language and Speech: Introductory Perspectives, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972, pp. 92.

[20]Ibid., pp. 92-94.

The first assumption was that sentence processing, in accordance with the predictions of Generative-Transformational theory, takes place on two separate cognitive levels. This assumption translates into the following research question; do the linguistic levels of deep and surface structure have "functional" psychological reality for language users? The answer to this question has an extremely important implication for the psychological investigation of transformations. Specifically, Generative-Transformational theory stipulates that the function of transformational rules is to link deep and surface structures. If it were demonstrated that these two separate levels of cognitive structure do not exist in the minds of language users, the psychological need for and reality of transformational rules would be seriously called into question. It follows from this line of reasoning that the need to even bother looking for psychological evidence of the existence of transformations depends greatly on whether the above question can be answered affirmatively. Slobin has provided a review of two related experiments, the results of which support the notion that two separate levels of functional cognitive linguistic structure do indeed exist.[21]

> "Arthur Blumenthal, at Harvard, has devised a technique of 'prompted recall' to assess which parts of the deep structure of a sentence are most salient. In one experiment (1967) subjects were required to remember lists of two types of passive sentences:
> (1) 'Gloves were made by tailors.'
> (2) 'Gloves were made by hand.'
> These two sentences have the same surface structure, but very different deep structures. Underlying (1) is an assertion that tailors make gloves; underlying (2) is an assertion that somebody makes gloves, and that this process is done by hand.
>
> Blumenthal aided subjects in recalling sentences by giving them the final noun ('tailors' or 'hand') as a prompt. He found that nouns corresponding to the underlying subject ('tailors') were much more successful memory aids than nouns like 'hand' which are not part of the underlying structure, but come from an adverbial phrase ('by hand') tacked onto that structure. The initial noun 'gloves', functions equally well as a prompt for both kinds of sentences.
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> In a later experiment, Blumenthal and Boakes (1967) used sentences like 'John is eager to please.' and 'John is easy to please.', in which

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[21] Slobin, D., op. cit., pp. 30-31.
The studies reviewed by Slobin are:
Blumenthal, A., "Prompted Recall of Sentences", Journal of Verbal Learning and Verbal Behavior, 1967, 6:203-206.
Blumenthal, A. and Boakes, R., "Prompted Recall of Sentences", Journal of Verbal Learning and Verbal Behavior, 1967, 6:674-676.

> the final word functions as either logical subject or logical object. Using the initial word as a prompt for the recall of sentences such as these, they found that 'words functioning as logical subjects were significantly more effective prompts than words functioning as logical objects'. The difference in recall must be attributed to the differing functions which the prompt words perform in the underlying structures of these sentences, since they seem to have no significant differences in terms of their surface positions. These experiments make it quite clear that sentence processing must take place on two levels, as described in ... (Generative-Transformational) ... linguistic theory."[22]

The second important assumption made by those who first developed the Derivational Theory of Complexity was that, when engaged in "normal" language processing, language users process syntactic and semantic information separately. Clearly, if this were not the case, it would be extremely difficult to test the Derivational Theory of Complexity at all. This is so because, in experimental situations, the psycholinguist could not easily isolate the behavioral indices of syntactic variables from those of semantic ones. It would, of course, be theoretically possible to separate syntactic and semantic variables by devising experimental tasks which ask subjects to process meaningless or nonsense material. Such a procedure would most definitely control out semantic factors but it would serve to create a situation bearing little resemblance to normal communication/language processing. This extensive artificiality would serve to render the results of experiments using such experimental tasks very ambiguous and highly suspect.

A recent experiment conducted by Sachs has generated data which suggest that language users do indeed process and remember syntactic and semantic information separately.[23] Slobin has provided the following account of the Sachs experiment.

> "Her subjects listened to 28 passages of connected discourse. After each passage the subject was given a test sentence which was either identical to a sentence he had heard in the passage, or had been changed in either form or meaning. There were three delay intervals between the original sentence and the test sentence: no delay, 80 syllables (about 27 seconds), and 160 syllables (about 46 seconds). The subject never knew what sentence he would be tested on. The following are examples of the changes used in

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[22]Slobin, D., op. cit., pp. 30-31.

[23]Sachs, J., "Recognition Memory for Syntactic and Semantic Aspects of Connected Discourse", Perception and Psychophysics, 1967, 2:437-442.

the experiment:

Original sentence: He sent a letter about it to Galileo, the great Italian scientist.

Semantic change: Galileo, the great Italian scientist, sent him a letter about it.

Active to passive change: A letter about it was sent to Galileo, the great Italian scientist.

Formal change: He sent Galileo, the great Italian scientist, a letter about it.

When the test sentence was heard with no intervening delay, subjects were able to recognize both semantic and syntactic changes. After only 80 syllables (about 27 seconds) of delay, subjects' recognition of syntactic changes (active-passive and other formal changes) was close to chance, while their recognition of semantic changes remained strong even after 160 syllables (about 46 seconds)... It is clear that the formal structure of sentences is stored for only a brief period of time. A small change in wording which is relevant to meaning, however, is easily detected. For example, subjects recognized the following change in meaning with ease after 80 syllables of interpolated material: 'There he met an archaeologist, Howard Carter, who urged him to join in the search for the tomb of King Tut,' changed to: 'There he met an archaeologist, Howard Carter, and urged him to join in the search for the tomb of King Tut.' However, the following formal change in the original sentence was almost never noted: 'There he met an archaeologist, Howard Carter, who urged that he join in the search for the tomb of King Tut.'..."[24]

The fact that Sachs' subjects were able to remember semantic changes for longer periods of time than syntactic changes strongly suggests that these two types of information are processed and stored in memory differently. Syntactic information appears to be processed in a way intended to facilitate its rather transient storage in short term memory. Semantic information, on the other hand, appears to be processed in a way intended to facilitate its more permanent retention in long term memory. The numerous differences that are thought to exist between short and long term memory would seem to overrule the possibility of an identical processing strategy being used to prepare information for storage in both of them.

All in all, Sachs' findings that syntactic information (presumably including transformations) and semantic information are processed separately lend considerable support to the assumption that the Derivational Theory of Complexity is indeed an empirically testable hypothesis.

The Derivational Theory of Complexity was first proposed in the early 1960's, and since that time many studies have sought to empirically test it. These

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[24]Slobin, D., op. cit., pp. 31-32.

studies are clearly psycholinguistic in nature for the simple reason that they are concerned with investigating an aspect of the cognitive linguistic process. By definition, any study which sets out to do this should be classified as psycholinguistic. But in a somewhat broader sense, these experiments are also studies of human communication. The basic reason why this is true has already been explored in the previous chapter (see pages 12-15) and no further elaboration seems necessary at this time. The basic aim of the discussion in this paragraph is simply to remind the reader that the Derivational Theory of Complexity studies to be reviewed in the pages which follow are, in many ways, a mixture both of psycholinguistic and communication research.

The first experiment designed expressly to test the Derivational Theory of Complexity was conducted by Miller, McKean and Slobin.[25] These researchers attempted to demonstrate that the relative difficulty of producing certain systematic syntactic changes in sentences (as indexed by the amount of time subjects took to make such changes) could be predicted as a function of their transformational complexity.[26]

Subjects taking part in the Miller, et al. experiment were presented with several sets of test stimuli, each consisting of two columns of sentences. In each trial, subjects were asked to match sentences in one column with designated transformationally altered counterparts in the other column. Counterpart sentences appearing in the two columns differed by either one or two transformations each. For example, a sentence in one column might be a simple-active-affirmative-declarative "kernel sentence" like the following:

(24) "Jane liked the old woman."

In the other column, (24) with one transformation added might be:

(25) "The old woman was liked by Jane." (Passive Transformation added)

or with two transformations added:

(26) "The old woman was not liked by Jane." (Passive and Negative Transformations added)

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[25]This particular study is reported in:
Miller, G., "Some Psychological Studies of Grammar", American Psychologist, 1962, 17:748-762.

[26]Fodor, J. and Garrett, M., "Some Reflections on Competence and Performance", in Lyons J. and Wales, R. (Editors), Psycholinguistic Papers: The Proceedings of the 1966 Edinburgh Conference, Edinburgh: Edinburgh University Press, 1966, pp. 143.

Each trial tested a specific operation or set of operations (ie. Kernel $\longrightarrow$ Passive or Kernel $\longrightarrow$ Passive-Negative) and subjects were told ahead of time exactly what operations they were to carry out.

Miller, et al. estimated the time needed to search for correct matches by asking subjects to locate untransformed versions of sentences in a scrambled list of sentences (ie. Kernel $\longrightarrow$ Kernel or Passive $\longrightarrow$ Passive). This provided a measure of "base search time" which the researchers later separated from the amount of time subjects took to make required transformational operations.

> "It was assumed that differences in the time taken to perform these matches would reflect differences in the time taken to perform the various transformational operations. That is, given a ... (kernel sentence) ..., to find its match in the other list subjects must perform the required transformation(s) and then look for a sentence which matched the result of the transformation(s).
>
> Of the relationships among the types of sentences studied by Miller et al., two were considered to require two operations, and four, only one operation. For instance, where a P (Passive) sentence was required (or given), and an N (Negative) sentence given (or required), it was assumed that one 'undid' the work of the negative transformation and then applied the passive. But for the same initial condition (given an N sentence) where a PN sentence was required, subjects were assumed to apply the passive while not being required to 'undo' the result of the negative transformation. On this view, it would be predicted that the result of the experiment should find Kernel $\longrightarrow$ (N or P) and PN $\longrightarrow$ (N or P) comparable while Kernel $\longrightarrow$ PN and N $\longrightarrow$ P should both be more difficult (although comparable to each other). In fact the order in the results was just that:
>
> | | | | |
> |---|---|---|---|
> | Kernel | $\longleftrightarrow$ | N | 1.1 seconds more than base search time |
> | Kernel | $\longleftrightarrow$ | P | 1.4 |
> | P | $\longleftrightarrow$ | PN | 1.7 |
> | N | $\longleftrightarrow$ | PN | 1.9 |
> | Kernel | $\longleftrightarrow$ | PN | 2.7 |
> | N | $\longleftrightarrow$ | P | 3.5 |
>
> ... Further there was the suggestion that these operations produced a linearly additive perceptual complication (sentences involving both negative and passive transformation required a time approximately equal to the sum of the average time required for negatives and passives applied separately)."[27]

The results of the Miller, et al. study strongly suggest that the transformational operations subjects were called upon to perform do indeed have psychological reality, and further, that they are applied in a serial fashion, as Generative-Transformational theory suggests.

Miller and his associates were somewhat dissatisfied with the rather imprecise way in which they had measured the amount of time subjects took to complete trans-

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[27] Ibid., pp. 144.

formational operations. Therefore, they replicated their original experiment; this time presenting test sentences to subjects on a tachistoscope.[28]

> "When S (subject) had performed the required transformation of the sentence, he pressed a button which presented a search list (and stopped a timer which had started on presentation of the sentence). In this technique the search time is separated from the presumed processing time and is employed only to provide a check on the accuracy of the task performance. An independent measure (S's subjective estimation) of the transformation time is thereby obtained, and variance introduced by the search is eliminated. The results here were comparable to those with the pencil and paper method, but there was some rearrangement within the two 'equivalence' sets (ie. among those sentences requiring two operations vs. those requiring one operation). In the Miller and McKean results, applying the negative transformation to a passive sentence is easier than applying the passive to kernel (ie. P $\longrightarrow$ PN is easier than Kernel $\longrightarrow$ P). This makes the Miller and McKean results more uniform than those of Miller et al.; for application of a single transform, the negative is easier than the passive, and of each of the two applications of the two transformations, the one involving transform from kernel is the easier of the pair (ie. Kernel $\longrightarrow$ N is easier than P $\longrightarrow$ PN, and Kernel $\longrightarrow$ P is easier than N $\longrightarrow$ PN, and Kernel $\longrightarrow$ PN is easier than N $\longrightarrow$ P). Negative transforms are easier than passive transforms, and kernel forms are easier to handle than any other."[29]

Another experiment which sought to measure the effects of transformational complexity on the time required for sentence processing was conducted by Marshall.[30] In this experiment, Marshall presented subjects with sentences having scrambled word orders and asked them to rearrange the sentences into their original grammatical form. The test sentences differed in degree of transformational complexity.

Marshall found that subjects took longer to unscramble those sentences which had the most transformations in their derivational histories. Apparently, in order to unscramble a given sentence into its grammatical form, subjects had to make use of those transformations required to generate it. These results are in keeping with those of Miller, et al., and Miller-McKean and clearly suggest the psychological reality of transformational rules.

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[28]Miller, G. and McKean, K., "A Chronometric Study of Some Relations Between Sentences", Quarterly Journal of Experimental Psychology, 1964, 16: 297-308.

[29]Fodor, J. and Garrett, M., op. cit., pp. 146.

[30]Marshall, J., "Behavioural Concomitants of Linguistic Complexity", Report of the Medical Research Council: Psycholinguistic Research Unit, New York: Oxford University Press, 1964.

An important test of the Derivational Theory of Complexity which produced findings similar to those of Miller, et al., Miller-McKean and Marshall was conducted by Mehler who investigated the effects of transformational complexity on subjects' ability to successfully recall sentences.[31]

> "Mehler assumed that S (subject) recalled the sentences using a strategy in which the underlying form of the sentence is stored independently of the transformations which determine the sentence's syntactic form; that is, the sentence is assumed to be represented in memory, not in its surface form, but in some form minimally necessary to specify semantic content and with a set of transformational instructions for deriving the final syntactic form. The minimal grammatical information required for semantic interpretation is represented by the deep structure of the sentence. Since kernel forms have the minimal number of syntactic 'footnotes' (ie. since they resemble deep structures more closely than other types of sentences), they should be the most easily and accurately remembered.
>
> In these results, the sentences were ordered roughly as they were in the Miller and McKean study; the order of correct recall was similar to that for ease of transformation. Kernels were much the best for accurate recall; those cases with only one transformation were next, followed by those with multiple transformations. This indicates that ... length of derivation is related to ease of recall."[32]

As part of a later experiment aimed primarily at discovering whether syntactic and semantic information are processed separately, Mehler and Miller replicated the study outlined above.[33] The findings of this replication study do not differ appreciably from those of the original.

A series of three related experiments conducted by Coleman also produced results which support the Derivational Theory of Complexity.[34] In these experiments, subjects were presented with a series of sentences which they were asked

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[31]Mehler, J., "Some Effects of Grammatical Transformations on the Recall of English Sentences", Journal of Verbal Learning and Verbal Behavior, 1963, 2:346-351.

[32]Fodor, J. and Garrett, M., op. cit., pp. 146.

[33]Mehler, J. and Miller, G., "Retroactive Inference in the Recall of English Sentences", British Journal of Psychology, 1964, 55:292-302.

[34]Coleman, E., "The Comprehensibility of Several Grammatical Transformations", Journal of Applied Psychology, 1964, 48:186-190.
_____, "Learning of Prose Written in Four Grammatical Transformations", Journal of Applied Psychology, 1965, 49:332-341.
_____, "Responses to a Scale of Grammaticalness", Journal of Verbal Learning and Verbal Behavior, 1965, 4:521-527.

to memorize and repeat verbatim. Subjects were allowed to review any sentence as many times as was necessary for successful memorization and subsequent verbal repetition. Some of the sentences presented to subjects were in their simple-active form, while others had been made more complex by the addition of one or more of the following transformational operations: 1) the Nominalization Transformation, 2) the Passive Transformation, or 3) the Adjective Clause Construction Transformation.

The results of these three experiments, taken as a whole, showed that subjects were able to memorize the simpler sentences faster (ie. after fewer exposures) than their more transformationally complex counterparts, even though, in some cases, the simpler sentences were longer.

An experiment conducted by Coleman and Blumenfeld measured the effects of transformational complexity on subjects' ability to comprehend sentences.[35] Subjects were presented with a series of sentences and afterward given a Cloze Procedure test designed to index their comprehension of these sentences.[36] Some of the sentences presented to subjects were in their simple-active form while others had been made more transformationally complex by the application of Nominalization operations.

Coleman and Blumenfeld found that the highest mean comprehension Cloze scores were obtained for the simple-active sentences. These results concur with the predictions of the Derivational Theory of Complexity.

A particularly ingenious test of the Derivational Theory of Complexity was conducted by Savin and Perchonock in which they attempted to relate the memory storage requirements of sentences to their derivational histories.[37] Deese has offered the following account of the Savin-Perchonock experiment.

> "There is, as most students of psychology know, a fixed memory span. For the average adult it is about eight items long. That is to say, the average

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[35]Coleman, E. and Blumenfeld, J., "Cloze Scores of Nominalization and their Grammatical Transformations Using Active Verbs", Psychological Reports, 1963, 13:651-654.

[36]Cloze Procedure is essentially a paper and pencil exercise which calls upon subjects to supply correct missing words in the text of a message that has had every fifth word systematically deleted. Cloze Procedure is discussed in detail later in this chapter.

[37]Savin, H. and Perchonock, E., "Grammatical Structure and the Immediate Recall of English Sentences", Journal of Verbal Learning and Verbal Behavior, 1965, 4:348-353.

> adult can recall after presentation, about eight unrelated items, such as randomly selected numbers or randomly selected words. If a person hears more than eight items, inevitably some items will not be recalled (unless, of course, the items are organized into some kind of structure, such as a sentence). In this experiment, the S's heard a sentence followed by a string of eight unrelated words. The S's were supposed to recall the sentence and then recall as many words as possible. In order to remember the sentence, the S's would have to forget some of the words. The sentences differed in ... complexity ..., and the investigators assumed that the more complicated sentences would cause more words to be forgotten. Thus the number of words recalled was an indirect measure of the influence of ... complexity upon immediate memory span."[38]

In addition to those transformations used in previous studies, Savin and Perchonock included a number of new ones in their experiment (ie. the Interrogative Transformation, the Wh-Question Transformation and the Emphatic Transformation). By including a broader range of transformational operations in their experiment, Savin and Perchonock were able to provide a highly comprehensive test of the Derivational Theory of Complexity. The results of their experiment are reported below in Table One.

TABLE ONE[39]

Mean Number of Words Recalled After Each of the Sentence Types in the Savin-Perchonock Experiment

Sentence Type	Example	Mean Number of Words Recalled
Kernel	"The boy has hit the ball."	5.27
Wh-Question	"What has the boy hit?"	4.78
Question	"Has the boy hit the ball?"	4.67
Passive	"The ball has been hit by the boy."	4.55
Negative	"The boy has not hit the ball."	4.44
Negative Question	"Has the boy not hit the ball?"	4.39
Emphatic	"The boy <u>has</u> hit the ball!"	4.30
Negative Passive	"The ball has not been hit by the boy."	3.48
Passive Question	"Has the ball been hit by the boy?"	4.02
Negative Passive Question	"Has the ball not been hit by the boy?"	3.85
Emphatic Passive	"The ball <u>has</u> been hit by the boy!"	3.74

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[38]Deese, J., <u>Psycholinguistics</u>, Boston: Allyn and Bacon, Inc., 1970, pp. 40

[39]Slobin, D., <u>op. cit.</u>, Table One, pp. 29.

The results shown in Table One clearly indicate that simple sentences such as kernels produced the least memory interference. More complicated sentence types, such as questions, passives, negatives, and those with multiple transformational requirements produced significantly more memory interference than did the simpler ones. The degree of memory interference any given sentence created appears to be directly related to the number of transformations required to make it grammatical. According to Deese;

> "... this experiment provided most impressive evidence for the view that in order to operate upon sentences in such a way as to understand them in any way whatever, it is necessary to perform the operations required to derive the sentences... Furthermore, the results of the experiment by Savin and Perchonock showed that such things as sentence length (a factor of no linguistic importance but conceivably of importance to performance) were much less influencial than deep structure."[40]

Savin has since replicated the above experiment with minor modifications in the experimental design and test sentences.[41] His results support earlier findings and uphold the Derivational Theory of Complexity.

Another possible way of manipulating the transformational complexity of a sentence is to add "embedded" clause constructions to it. For example, a simple sentence like the following:

(27) "The old man left."

can be made more complex by using the Relative Clause Transformation to introduce a relative clause into it. Application of this transformation will yield the following surface structure:

(28) "The man who is old left." (relative clause underscored)

Miller and Isard conducted an experiment in which they attempted to demonstrate that sentences with several embedded clauses are more difficult to memorize than ones with fewer, or no such clauses.[42] For this experiment, sentences were constructed which had the same number of words but were arranged in different

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[40] Deese, J., op. cit., pp. 41.

[41] This particular study is reviewed in:
Chomsky, N., "Language and the Mind", in Readings in Psychology Today, Delmar, California: CRM Books, 1969, pp. 285-286.

[42] Miller, G. and Isard, S., "Some Perceptual Consequences of Linguistic Rules", Journal of Verbal Learning and Verbal Behavior, 1963, 2:217-228.

orders to contain either zero, one, two, three or four embedded clauses. For example, a sentence with multiple embedded clauses is the following:

(29) "The race that the car that the people whom the obviously not very well dressed man called sold won was held last summer."

The presence of each embedded clause in Miller and Isard's test sentences was a direct result of the application of particular transformational rules; therefore, as the number of embedded clauses within a sentence increased, so did its transformational complexity. Thus, in their experiment, Miller and Isard, indirectly, but nevertheless definitely, tested the Derivational Theory of Complexity.

In their experiment;

> "Listeners were required to memorize ... sentences and the accuracy of their recall was scored for five successive free-recall trials. As expected, the more deeply embedded (ie. transformationally complex) sentences were the most difficult to memorize. Miller and Isard concluded that no one had difficulty with a single self-embedding, some people had difficulty with two, and everyone had difficulty with three or more. The source of the trouble seemed to be the limited amount of memory available for the task of unscrambling the syntax."[43]

In a later experiment, Phillips and Miller replicated the above study with some modifications.[44] The major point of difference between the two studies is that in the replication, the dependent variable was subjects' ability to comprehend embedded sentences, whereas, in the original study it had been their ability to memorize such sentences. As expected, Phillips and Miller's results showed that subjects had the most trouble comprehending sentences with multiple embedded clauses.

Taken together, the above two studies of embedded clause complexity add further support to the Derivational Theory of Complexity by showing, once again, that performance abilities related to sentence processing are indeed affected by the number of transformational rules in the derivational histories of sentences.

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[43]Miller, G. and McNeill, D., "Psycholinguistics", in Lindzey, G. and Aronson, E. (Editors), The Handbook of Social Psychology, Reading, Massachusetts: Addison-Wesley, 1969, 3:708.

[44]Phillips, J. and Miller, G., An Experimental Method to Investigate Sentence Comprehension, unpublished paper.

The overall findings of the studies reviewed to this point constitute the majority of the empirical support for the Derivational Theory of Complexity. Perhaps the theory's strongest support comes from those experiments which found that as the transformational complexity of a sentence increases, so does the time required for subjects to carry out those cognitive operations necessary to derive its deep structural meaning. Other findings offer support for the Derivational Theory of Complexity by demonstrating that transformations take up short term memory space and that as the transformational complexity of a sentence increases, receivers' ability to successfully recall and comprehend it will tend to decrease.

When viewed as a whole, the findings of the above transformational studies have important implications both for human communication and psycholinguistics.

Looking first at communication, the findings of these studies clearly suggest that syntactic complexity plays an important role in developing effective message design strategies.

In order to be successful, human communication depends fully on the ability of source and receiver to derive a shared context of meaning as a direct result of the exchange of messages. Arriving at such a shared context of meaning becomes easier when the total cognitive "effort" involved in message processing is minimized as much as possible for those persons participating in the communicative act.[45] This is true because as the total message processing effort is reduced, communicators become better able to concentrate on crucial aspects of message meaning.

Surely, the greatest share of the responsibility for reducing this total message processing effort rests with the source because it is he who must select and syntactically arrange the symbols which constitute his message. In attempting to significantly reduce this message processing effort, there are probably a number of useful strategies available to the source, but, as the results of the transformational studies suggest, one of them is to design linguistic messages which call upon the receiver to use as few syntactic opera-

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[45]Darnell, D., The Relation Between Sentence Order and the Comprehension of Written English, unpublished M. A. Thesis, Michigan State University, 1960, pp. IV-VI.

tions as possible in decoding deep structure meanings. Employing this strategy should help to insure that the receiver will be better able to correctly process, recall, and most importantly, comprehend the source's message because he will have more time and memory space available to concentrate on decoding the meaning of the message he has received.

Clearly though, the above strategy is most useful to the writer or speech maker who has more time to ponder his message and can, therefore, consciously work toward designing one that has both syntactic simplicity and clarity of meaning. In everyday conversation, however, the communicator often does not have the time to engage in careful message planning and must, of necessity, concentrate on meaning rather than syntax. The difficulty of meticulously scrutinizing the syntax of spontaneous messages notwithstanding, there are two important ways in which a knowledge of the effects of syntactic complexity on receiver message processing abilities can benefit the average communicator in everyday situations. First, such a knowledge should make him aware of the advisability of attempting to develop as simple a syntactic style of expression as possible in the interests of increased message clarity and more effective communication. Second, such a knowledge brings into focus the fact that some communication breakdowns are the direct result of overly complex message syntax. Knowledge of this fact should indicate to the communicator that this particular type of breakdown is most appropriately attributable to the source and not, as he might suppose, to the receiver.

In all fairness, it must be pointed out that the ideas just presented are by no means brand new. Rhetoricians and those investigating message "readability" have argued in favor of simplistic message styles for many years, but it was not until the studies of the Derivational Theory of Complexity were begun that a clearer picture of the potentially adverse effects of syntactic complexity on receiver comprehension and understanding became established on the basis of empirical tests.[46]

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[46]One particularly good discussion of grammatical style from a rhetorical point of view may be found in:

Wilson, J. and Arnold, C., Public Speaking as a Liberal Art, Boston: Allyn and Bacon, Inc., Second Edition, 1968.

Many scholars have proposed mathematical yardsticks of "readability" but the most notable of these was developed by Rudolph Flesch. For a brief discussion of his technique, see:

Flesch, R., "A New Readability Yardstick", Journal of Applied Psychology, 1948, 32:221-233.

Turning now to psycholinguistics, the findings of the Derivational Theory of Complexity studies were immediately heralded as implying very strong support for the following three notions: 1) that in order to derive the meaning of sentences, language users must resolve them to their deep structural level, 2) that the transformational component of linguistic competence has some measure of psychological reality for language users, and 3) that transformational rules are serially applied by language users. On the basis of the above noted findings, it was believed that the transformational component of linguistic competence could be directly incorporated into an eventual model of linguistic performance. This belief was destined to be rather short-lived, however, because at that particular time a number of developments were beginning to crop up within experimental psycholinguistics which caused some psycholinguists to wonder whether the mechanisms underlying language behavior could really be best represented by the descriptive rules of Generative-Transformational theory. By far the most disquieting of these developments were several experiments which tried, but failed, to conclusively demonstrate that the Generative-Transformational rules of phonology and phrase-structure could easily be fit into a model of performance.[47] Due to the fact that these two rule systems were thought to be much like transformations with respect to their cognitive nature, the failure of these experiments forced psycholinguists to re-examine both the Derivational Theory of Complexity and the findings of the experiments that had investigated it.

Within this re-examination movement, three distinct but related schools of thought can be identified. Common to all three are the following two premises. First, the cognitive mechanisms responsible for language behavior are highly complex and abstract. Second, in one way or another, the Derivational Theory of Complexity paints too simple a picture of these mechanisms and the way in which they work. The two major points of difference between the positions taken up by these three schools of thought are: 1) the type of inadequacies each attributed to the Derivational Theory of Complexity, and 2) the remedies each subsequently proposed to rectify them.

The basic positions taken up by these three schools of thought and the

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[47]Several of the studies dealing with Generative-Transformational phonology and phrase-structure are mentioned in: Haney, R., Analysis of Meaning, pp. 15-33.

types of research initiated by each are discussed below. This discussion is provided in order to clarify the current status of the Derivational Theory of Complexity and show the need for a study such as the author has undertaken.

1) One group of psycholinguists found themselves willing to accept the published conclusions of the Derivational Theory of Complexity studies at face value, but argued that these experiments left one very important question unanswered which they felt had to be resolved before meaningful performance modelling could begin. These psycholinguists made it clear that when they asked the following question; "now that we have reason to suspect that language users have as part of their cognitive language system a Passive Transformation for example, exactly what mental operations do they execute in passivizing a sentence?"; they had no answer because the Derivational Theory of Complexity studies failed to specify both the precise psychological nature of transformations and the cognitive processes underlying their use. This particular group of psycholinguists, admittedly influenced by those psychologists arguing in favor of a neurophysiological account of the processes underlying human cognition, concluded that the Derivational Theory of Complexity research did not tell them very much and, in fact, begged the most salient question. In essence, these psycholinguists argued for the abandonment of efforts to infer about the nature of the cognitive linguistic process from observations of overt language behavior in favor of a direct neurophysiological examination of the mechanisms constituting this process. Psycholinguists who accepted this line of reasoning maintained that in order to be useful, any general account of the linguistic process must be phrased in terms of the actual neural events taking place in the brains and nervous systems of language users. Implicitly, these psycholinguists called for a restatement of the Derivational Theory of Complexity in neurophysiological terms.

Although the task of mapping the neural pathways involved in language perception and processing has hardly begun, two fruitful attempts to utilize the above approach to the study of language and language behavior readily come to mind. The first is the research work of Lenneberg and his associates who are currently studying the neurophysiological and genetic bases for child language acquisition as well as certain varieties of sex-linked language abnormalities.[48]

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[48]The general nature of Lenneberg's work is outlined in:
Lenneberg, E., Biological Foundations of Language, New York: John Wiley and Sons, 1967.

The second is Terwilliger's reformulation of Taylor's neural based "engram theory" to account for the cognitive development of symbolic meanings.[49] In essence, Terwilliger has offered a thoughtful, yet highly speculative, account of the types of neurophysiological patterns that develop as a result of the establishment of a "network of meanings" in the human mind.

Clearly, such a neurophysiological approach has great potential merit but realistically it will be years before the neurophysiological sciences advance far enough to provide psycholinguists with a thorough explication of the mechanisms underlying language behavior (if indeed this can be done at all). In this light, one can only speculate as to what psycholinguists are to do in the mean time.

2) While a handful of psycholinguists flatly rejected the usefulness of trying to infer about the cognitive linguistic process from the observation of overt language behavior, many others did not agree with this point of view and continued to do what might best be called "behavioral" psycholinguistic research.

One such group of psycholinguists, that was strongly influenced by Chomsky's insistence that his descriptive grammar is not a model of actual performance, took up a somewhat deviant theoretic position and argued that transformational rules do not have psychological reality. This group of psycholinguists was particularly distressed over the unsuccessful outcome of the experiments on phonological and phrase-structure rules mentioned earlier. Because of this, they suggested that although notions borrowed from Generative-Transformational grammar are useful in conceptualizing and defining language in the abstract, existing research makes it clear that there is no reason to suspect that the cognitive mechanisms underlying language behavior should resemble descriptive "rules" in any way. They discounted the body of findings which supported the psychological existence of transformations by arguing that the experiments which had generated these findings contained a number of experimental design "weaknesses".[50] It was their position that these weaknesses were serious

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[49] A good discussion of Terwilliger's reformulation of the engram theory is contained in:
Terwilliger, R., Meaning and Mind: A Study in the Psychology of Language, New York: Oxford University Press, 1968, pp. 163-223.

[50] The discussion of these design weaknesses will be postponed until later in this section.

enough to render the findings of the Derivational Theory of Complexity studies highly questionable. As a direct result of the above line of reasoning, a few psycholinguists abandoned the Derivational Theory of Complexity entirely in favor of an hypothesis which proposed that language users decipher deep structural sentence meaning on the basis of "clues" derived directly from surface structure.

This particular hypothesis was developed largely by Fodor and Garrett who tested it in a series of experiments aimed at showing 1) that sentence comprehension involves the language user's discovery procedures in resolving deep structure from clues in surface structure, and not the operation of syntactic rules of grammar, and 2) that the amount of difficulty a person will experience in decoding a given sentence is a function of the degree to which the arrangement of elements in its surface structure provide clear clues as to the elements and relationships present in its deep structure, and not the number of transformations which separate the two levels.[51]

> "Fodor and Garrett (1967) reasoned that relative pronouns in self-embedded sentences, such as 'The man whom the dog bit died.', provide a surface structure clue as to the deep structure relationships. Here this relationship is that of the sentential patterns of 'man died' and 'dog bit man'. Presumably, 'whom' helps to clarify that the man is the subject of one sentence and the object of another. Without the relative pronoun the sentence is still grammatical but may be more difficult to understand: 'The man the dog bit died.' This difficulty is magnified even more in sentences having two embedded clauses:
>
> 'The tiger the lion the gorilla chased killed was ferocious.'
>
> (compared with)
>
> 'The tiger which the lion that the gorilla chased killed was ferocious.'
>
> In one experiment, the researchers had persons attempt to restate such sentences immediately after hearing them. Responses were scored in terms of latency (how soon the response was given) and in terms of the number of subject-object relations which were correctly restated. As predicted, persons were better able to restate sentences containing relative pronouns than those without them. Although this finding was supportive of the idea that the relative pronouns served as surface feature clues of deep structural relations, ... alternative explanations could be offered. One was that the pronouns simply gave the subjects a kind of 'break' between the sentence segments and thus facilitated their perception of the individual units ... However, in a second experiment brief segments of blank tape inserted between the segments did not serve to increase the rate of correct restate-

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[51] Williams, F., op. cit., pp. 96-98.
The particular studies cited are reported in:
Fodor, J. and Garrett, M., "Some Syntactic Determinants of Sentential Complexity", Perception and Psychophysics, 1967, 2:289-296.

ments over the pronoun-less versions. This denied the alternative explanation concerning segmentation."[52]

On the basis of the above findings, Fodor and Garrett concluded that their "surface structure clues" hypothesis was supported. There is, however, a problem with this conclusion. Specifically, Fodor and Garrett fail to indicate the precise way in which a sentence processing strategy based on the direct deduction of deep structural meaning from surface structure clues differs ostensibly from one based on the use of these very same clues to deduce those transformations required to resolve a sentence to its deep structure. This latter strategy seems entirely feasible and in the absence of any substantial argument to the contrary, one can easily propose that in the pronoun-less versions, the deletion of each pronoun can be accounted for by the operation of a specific transformational rule (ie. the Relative Pronoun Deletion Transformation). On this basis, it becomes possible to reinterpret Fodor and Garrett's findings by suggesting that the pronoun-less versions proved harder to quickly restate because they were more transformationally complex than their counterparts containing pronouns (ie. both types of sentences required transformations to add pronouns but the pronoun-less sentences also required transformations to later delete them). Clearly, this proposed reinterpretation conforms perfectly with predictions based on the Derivational Theory of Complexity and, in addition, is solidly supported by findings of the studies conducted by Miller-Isard and Phillips-Miller, which were mentioned earlier (see pages 42-44).

Although Fodor and Garrett failed to definitively refute the Derivational Theory of Complexity, their contribution is significant because they have pointed out that other kinds of activities besides transformational decoding may well be involved in processing grammatical information.

In response to the work of Fodor and Garrett, some psycholinguists have proposed that actual sentence processing might realistically involve the simultaneous use of both transformational clues and direct deep structure clues. The outgrowth of this line of reasoning has been preliminary attempts to develop an "information processing" type model of linguistic performance which retains the notion that cognitive linguistic rules form the underlying basis for language

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[52]Williams, F., op. cit., pp. 97-98.

behavior.[53]

3) the vast majority of psycholinguists did not question the findings of the Derivational Theory of Complexity studies until three potentially serious "weaknesses" in their experimental/measurement designs were brought to light.

The first of these weaknesses went unnoticed until the findings of four highly similar studies were published.[54] These four experiments differed from prior Derivational Theory of Complexity studies in that they set out to compare the amount of time subjects took to process negative and passive sentences that were either true or false. Greene has summarized the general nature of the experimental task used in all four studies as follows:

> "(In these experiments) ... subjects ... (were) presented with statements such as 'The girl is hitting the boy.', which they had to judge as true or false in relation to a pictured situation which might or might not show a girl hitting a boy. The statements were in the form of active affirmative (AA), negative (AN), passive (PA) and passive negative sentences (PN)."[55]

Considered as a whole, the findings of these studies showed:

> "(that) ... kernels are the easiest to deal with, sentences with single transformations next, while passive negative sentences take the longest to evaluate. These findings again support the idea that response times are a function of the number of transformational operations (involved in sentence processing)."[56]

Overall, the results of these studies, once again, supported the Derivational Theory of Complexity. However, one additional finding that came out of them served to alert psycholinguists as to the possible existence of a "confounding factor" which may have been present in two of the earlier Derivational Theory of Complexity studies. This particular finding was:

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[53] An excellent overview of the current work being done on information processing/transformation models of language behavior is available in: Greene, J., Psycholinguistics: Chomsky and Psychology, pp. 121-130.

[54] The studies referred to above are:
McMahon, L., Grammatical Analysis as Part of Understanding a Sentence, unpublished Doctoral dissertation, Harvard University, 1963.
Gough, P., "Grammatical Transformation and Speed of Understanding", Journal of Verbal Learning and Verbal Behavior, 1965, 4:107-111.
_____, "The Verification of Sentences: The Effects of Delay of Evidence and Sentence Length", Journal of Verbal Learning and Verbal Behavior, 1966, 5:492-496.
Slobin, D., "Grammatical Transformations and Sentence Comprehension in Childhood and Adulthood", Journal of Verbal Learning and Verbal Behavior, 1966, 5:219-227.

[55] Greene, J., op. cit., pp. 113.

[56] Ibid., pp. 114.

> "(that) the times for negatives and passives did not have a constant value but varied in relation to whether the sentences were true or false. Thus, whereas AA and PA sentences tended to be considerably easier than false AA's and PA's, with AN and PN sentences the trend was in the opposite direction with false negatives taking the same or less time than true negatives."[57]

The most obvious conclusion to be drawn from this finding is that semantic considerations, in some way, play an important role in sentence processing when questions of truth value are involved.[58] While this particular finding did nothing to refute the Derivational Theory of Complexity in and of itself, it did cause psycholinguists to critically review the Miller, et al. and Miller-McKean studies of "sentence processing time", mentioned earlier (see pages 36-38). This review was undertaken in an attempt to determine if confounding semantic factors had inadvertently managed to slip into these experiments. When the test sentences used in these two experiments were carefully scrutinized, it was discovered that, in most instances, affirmative sentences like:

(30) "John is here."

had been directly compared with negative ones, such as:

(31) "John is not here."

Clearly, the above two sentences differ in transformational complexity but, more importantly, they also differ in meaning.[59] This being the case, it is not unreasonable to suggest that subjects may have taken longer periods of time to process the semantic change between sentences rather than the additional transformational operations involved. That this may have happened in the Miller, et al. and Miller-McKean studies would not present itself as a serious problem were it not for the fact that during measurement, the experimenters failed to record the time subjects needed to process each of these two types of changes separately.[60]

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[57] Loc. cit.

[58] Fodor, J. and Garrett, M., "Some Reflections on Competence and Performance", in Lyons, J. and Wales, R. (Editors), Psycholinguistic Papers: The Proceedings of the 1966 Edinburgh Conference, Edinburgh: Edinburgh University Press, 1966, pp. 145-146.

[59] Ibid., pp. 148.

[60] At first glance, it might appear as though the "base search time" measures obtained in the above experiments successfully isolated and indexed the amount of time subjects took to process semantic shifts between comparison sentences. Once it is recalled that these measures indexed only the amount of time subjects took to search the sentence lists for correct matches, and that they were obtained while subjects searched for sentences that did not differ in meaning (ie. Kernel $\longrightarrow$ Kernel), it becomes clear that they in no way served to separate semantic and syntactic processing times.

In retrospect, it is quite probable that the measures of "sentence processing time" obtained in both Miller experiments are conglomerates of the time subjects took to make necessary transformational operations and the time they took to decipher changes in sentence meaning. For this reason, it is not at all clear whether the results obtained should have been attributed to increased transformational complexity or to shifts in sentence meaning.

One possible way to circumvent the above mentioned problem would, of course, be to re-examine the Miller, et al. and Miller-McKean data, using in this analysis only those sentence comparisons that did not involve changes in meaning. Unfortunately, all but a very few of the comparisons tested by these experimenters included the troublesome affirmative-negative shifts. There were, in fact, so few uncontaminated sentence comparisons available that no one has bothered to isolate and re-examine them.

When psycholinguists completed their critical review of the above two studies, they were somewhat reluctantly forced to conclude that the dependent measures and thus the findings were far too contaminated to be at all conclusive.[61]

Although many of the "sentence recall" studies (such as those conducted by Mehler, Mehler-Miller, Savin-Perchonock, and others) by all rights should have been criticized on exactly the same grounds as the Miller, et al. and Miller-McKean experiments, they were not, and instead came under attack for an entirely different reason.[62]

The basic weakness uncovered in the "sentence recall" studies was directly related to the following two design "features" which were included in all such experiments: 1) subjects were called upon to display their transformational behavior in some sort of rote sentence memorization task, and 2) as a matter of course during preliminary instructions, subjects were always informed as to the exact nature of the experimental task in which they were about to participate. Once brought out in the open, many psycholinguists suggested that these design features had no doubt combined to make the experimental tasks used in most of

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[61]This line of reasoning is very clearly developed in:
Rommetveit, R., Words, Meaning and Messages, New York: Academic Press, 1968, pp. 209.

[62]The reason why the "sentence recall" studies rightly deserved similar criticism is because like the Miller, et al. and Miller-McKean experiments, their data too was based on an alarmingly large number of affirmative-negative sentence comparisons.

these studies highly artificial communication/language processing situations. It was subsequently proposed, that in such situations, subjects may not have employed transformational rules to associate deep structural meanings with sequences of written or spoken linguistic symbols.[63] It was reasoned that if subjects knew ahead of time the precise nature of the upcoming experimental task (ie. the memorization of sentences), they may have adopted a highly atypical sentence processing strategy for dealing with it. They may have, for example, consciously tried to memorize sentences without actually attempting to resolve their meaning as they would undoubtedly do in normal communication. Were this the case, it would mean that the "sentence recall" studies very probably indexed something entirely different from transformational behavior. Because of this, the "sentence recall" studies suffered a fate similar to that of the "sentence processing time" experiments, in that their findings, too, came to be looked upon with a great deal of suspicion by psycholinguists.[64]

Interestingly enough, only the Coleman-Blumenfeld and Phillips-Miller studies, which indexed subjects' "sentence comprehension" are capable of withstanding serious criticism from those who proposed the two experimental/measurement design weaknesses outlined thus far. The reason for this is that in order to comprehend (ie. understand) a sentence, a person must assign a meaning to its symbols, which means, of course, that he has to resolve it to deep structure. In this light, it is reasonable to assume that the very nature of the experimental tasks used in these two studies demanded that subjects employ a highly natural sentence processing strategy. For this reason, the probability of subjects adopting an atypical decoding strategy in a comprehension task is greatly less than it would be in one involving either sentence recall or sentence recognition.

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[63] Greene, J., op. cit., pp. 111-114.

[64] It should be made clear at this point that the two weaknesses in the Derivational Theory of Complexity studies mentioned thus far are of entirely different natures. In the case of the first weakness, it is implicitly assumed that subjects did in fact resolve test sentences to their deep structural meaning and because of this, semantic and syntactic factors may have become confounded. In the case of the second weakness, just the opposite is true. Here it is assumed that subjects did not use transformations to link deep and surface structures but rather adopted some other sentence processing strategy which did not include the assignment of meaning to symbols in the normal way. Clearly, both of these problems could not have occurred at the same time in the same experiment, but either possibility is more than sufficient to cast serious dispersions on the validity of the resulting experimental findings.

The third major weakness to be attributed to the Derivational Theory of Complexity studies was that in every experiment transformational complexity had been investigated exclusively within the context of the individual "isolated" sentence. The psycholinguists who first pointed out this particular weakness suggested that when placed in an experimental situation where they had to process only a single sentence at a time, subjects may have been able to deal with the formal grammatical aspects of the test sentences in far greater detail than they would typically have time to do in normal message decoding. Because of this, psycholinguists argued that the comparative simplicity and unnaturalness of the experimental tasks employed in the Derivational Theory of Complexity studies may have caused their results to turn out as they did.[65]

This whole line of reasoning clearly suggests that transformational complexity may adversely affect language behavior only in relatively simple "single sentence" processing situations. In this light, it is entirely possible that the predictions of the Derivational Theory of Complexity might not be borne out in experimental situations in which subjects are required to decode and process longer passages of message discourse. One possible reason why these predictions might not be validated in such situations is that in more natural and realistic communication/language use tasks, a number of "message variables" may well come into play which are either not present or are of no particular importance when only single sentences are being processed. Once called into play by the very nature of the message processing situation, these variables may in some way interact with, or perhaps even wash out the effects of transformational complexity.[66]

The psycholinguists who noted this particular weakness suggested that in everyday communication people frequently have to decode lengthy messages but are seldom confronted with single sentences in isolation. For this reason, they very strongly argued that only message decoding tasks should be employed in future Derivational Theory of Complexity studies because their use would

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[65]This particular argument is developed in detail in:
Rommetveit, R., et al., "Processing of Utterances in Context", in Rommetveit, R., and Carswell, E.,(Editors), Social Contexts of Messages, New York: Academic Press, 1971, pp. 29-55.

[66]A partial list of some of these potential interaction/intervening variables would surely include: message length, message organization, message redundancy, message saliency, message language intensity, etc.

provide the most accurate manifestations of normal language processing behavior obtainable in laboratory settings.

The reason why some psycholinguists were so concerned with investigating transformations in "natural" situations was an outgrowth of their very strong belief that valid inferences about the nature of the cognitive mechanisms that underly language use could be drawn on the basis of observed language behavior only when the individuals whose behavior is observed are using language in a normal communicative way.[67]

Although they have been advanced by some of the most prominent scholars in the field, on the whole, the above arguments have fallen on deaf ears. The majority of psycholinguists do not agree with them and respond by pointing out that it is very difficult to successfully control and manipulate transformational complexity in lengthy messages. For this reason, many psycholinguists maintain that the isolated sentence is the only practical stimulus/analysis unit available for use in psycholinguistic research. The fact that psycholinguists have, by and large, failed to accept the above arguments is best reflected in their research. A quick perusal of the psycholinguistic journals will reveal that the majority of studies currently being done still deal exclusively with individual sentences.

Hopefully, the discussion to this point has made it clear that a great deal of uncertainty currently surrounds the question of the validity of the Derivational Theory of Complexity. In retrospect, as recently as five years ago nearly everyone agreed that the predictions of the Derivational Theory of Complexity were correct and that the findings of past research supported the contention that transformational rules have psychological reality for language users. Today, however, views have changed greatly and everyone is in basic agreement that these issues are still a long way from their ultimate resolution. Given that contemporary psycholinguists are confronted with much uncertainty and numerous points of view concerning the cognitive status of transformations, one would naturally assume that in the course of the last few years they have been hard at work seeking new and better formats in which to continue testing

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[67] A more complete discussion of the rationale underlying some psycholinguists' desire to investigate transformations (and all aspects of competence for that matter) in as natural a situation as possible is offered in: Searle, J., "Chomsky's Revolution in Linguistics", pp. 13-14.

the Derivational Theory of Complexity. Oddly enough, this is not what they have been doing. In fact, not only have psycholinguists failed to pursue the Derivational Theory of Complexity further, but they have, for the most part, abandoned the psychological investigation of syntax altogether and are instead concentrating on the study of semantics and meaning. While this rather abrupt shift in academic interest areas is understandable (particularly in light of the fact that current linguistic theories attribute great importance to the semantic component of the grammar), it is most unfortunate. It is unfortunate because the issue of the psychological reality of transformations still prevails as one of the most important questions that must be answered before accurate performance modelling can begin. Therefore, in a very real sense, psycholinguists' reluctance to continue investigating transformations means that the development of a performance model will have to be postponed longer than might otherwise be necessary.

Because psycholinguists have virtually stopped investigating transformations, it is not at all surprising that, in recent years, only one researcher has conducted a meaningful test of the Derivational Theory of Complexity using an improved experimental design.

This particular study was conducted by DeVito and, in a number of ways, is a very significant research effort.[68] The real importance of DeVito's study lies not so much in its findings (which were somewhat inconclusive) but rather in the fact that it did include some clever techniques which were successful in circumventing all three of the above noted weaknesses attributed to past transformational studies. DeVito's study is worthy of discussion here because the author has adopted each of these techniques for use in his own experiment, and an explanation of them at this time will serve as a useful introduction to it.

DeVito apparently agreed with those who maintained that the Derivational Theory of Complexity could be profitably studied within a message context because in his experiment the message was used as the primary stimulus/analysis unit. This served to create a highly natural communication situation in which to investigate the Derivational Theory of Complexity, thereby overcoming one of the major weaknesses psycholinguists have attributed to past transformational studies.

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[68]DeVito, J., "Some Psycholinguistic Aspects of Active and Passive Sentences", Quarterly Journal of Speech, 1969, 55:401-406.

In his published report of this study, DeVito did not offer a formal statement of the hypothesis tested, but if this report is carefully examined, it becomes clear that this hypothesis was as follows:

> As the overall transformational complexity of a message increases, receivers' ability to successfully comprehend that message will decrease.

Clearly, the above statement of the hypothesis honors the relationship between increased transformational complexity and receiver language processing abilities that is postulated by the classic "sentence based" version of the Derivational Theory of Complexity. In reality, all the above hypothesis does is to re-phrase the Derivational Theory of Complexity in a way which clearly indicates that the "message", rather than the "isolated sentence", is to be the basic stimulus/analysis unit.

For this particular experiment, DeVito created two stimulus messages, each consisting of several sentences. One of these messages contained only simple-active kernel sentences. The other, a more transformationally complex message, was created by passivizing all the sentences of the simple-active one. Since in no case did application of the Passive Transformation create a change in sentence meaning, the passivized message was an exact meaningful paraphrase of its simple-active counterpart.

DeVito's use of paraphrase message versions as test stimuli constitutes a most significant innovation in the psychological investigation of transformations because by so doing he was able to create an experimental/measurement situation in which there was little chance of semantic and syntactic factors becoming confounded as may have happened in some of the earlier Derivational Theory of Complexity studies.[69] To the extent that DeVito was able to overcome this particular weakness through the use of paraphrase messages, unlike most past researchers, it was possible for him to be relatively certain that any observed differences in the comprehension level of his two treatment groups could be

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[69]One should be careful not to conclude that through the use of paraphrase stimuli, DeVito had managed to "control" message meaning. While this technique did permit many linguistic aspects of meaning to be held constant across both versions, it ignored some of the other factors which contribute to meaning. To understand the most basic reason why meaning cannot be controlled, one need only look at the first axiom every beginning student of communication is taught; namely that an individual's meanings are a direct result of his past experiences and because no two people have the exact same past experiences, they cannot have identical meanings, even for the most common of things. This fundamental truism serves as a reminder that there is an experiental dimension of meaning within each individual which is different for everyone and so utterly personal that it can never be successfully "controlled" in an experimental sense.

legitimately attributed to the effects of increased transformational complexity rather than to spurious shifts in message meaning.

In his experiment, DeVito was also able to successfully circumvent the potential problem of subjects employing some sort of atypical sentence and/or message processing strategy in order to avoid having to use transformations to resolve individual sentences to their deep structural meaning. DeVito did this by not informing subjects, prior to the administration of treatments, of the exact nature of the experimental task in which they were ultimately to participate. This, of course, meant that subjects were not pre-sensitized to the nature of the experimental task which awaited them, and in this light, it is logical to assume that because of this, they received no "clues" to help them determine the kind of processing strategy to use while listening to test stimuli. In the absence of any such pre-sensitizing clues, it is highly likely that subjects had no choice but to rely on their normal message processing techniques.

In order to test the hypothesis stated above, DeVito presented his paraphrase message versions to two different but comparable groups of subjects. Immediately after subjects heard one of the versions, they were given a Cloze Procedure test of message comprehension.

Once obtained, subjects' Cloze tests were scored in two alternate ways. In one scoring scheme, only verbatim fill-ins were counted as correct. In the other scoring scheme, in addition to verbatim fill-ins, corresponding form class fill-ins were also counted as correct.[70]

DeVito analyzed these two sets of data separately and has outlined his results as follows:

> "When verbatim fill-ins were scored the passive version proved easier to comprehend but when form class fill-ins were scored the active version proved easier to comprehend. Although at first a seeming contradiction these results are not unexpected in light of the changes introduced by the passive transformation.
>
> The little words introduced by the passive transformation are used

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[70]As an example of what DeVito did in the scoring of form classes: if a subject were to supply a noun where a noun in fact belonged, due to the fact that all nouns are in the same grammatical form class, this response would be counted as correct, regardless of whether the word supplied was the right one or not.

repeatedly throughout the passage. It is this increase in lexical redundancy that cloze procedure, with verbatim scoring, succeeds in tapping. Therefore, the passive version proves easier to fill in simply because it contains a high degree of lexical redundancy.

The findings on form class fill-ins seem a result of an increase in grammatical rather than lexical redundancy."[71]

As the above quotation suggests, the results of DeVito's study are inconclusive. Looking first at his findings when form classes were scored, one would logically be tempted to conclude that the data strongly support the notion that the Derivational Theory of Complexity holds true in the context of "multiple sentence" messages. Upon closer examination, however, such a conclusion proves to be highly disputable. This is primarily due to the fact that the measurement of subjects' ability to supply correct parts of speech in a mutilated Cloze test message is not a particularly meaningful index of message comprehension. In fact, such a measure indexes something largely extraneous to comprehension, namely subjects' ability to make the test message "sound" grammatical by supplying missing words on the basis of their general knowledge of English vocabulary and grammatical English sentence structure. For this reason, in the form class scoring condition, it was impossible for DeVito to determine how successful subjects had actually been in their attempts to comprehend the specific message presented to them. The above line of reasoning clearly suggests that although DeVito did find his simple-active message version easier to comprehend when form classes were scored, the meaninglessness of such a mode of scoring as an index of comprehension means that in the final analysis, this particular finding sheds absolutely no light on the validity of the Derivational Theory of Complexity in message contexts.

Considerable research on Cloze Procedure has verified that the verbatim scoring of Cloze tests provides a highly valid indicator of subjects' message comprehension.[72] The reader will recall, however, that when DeVito analyzed his data using such a scoring scheme, the Derivational Theory of Complexity

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[71] DeVito, J., "Some Psycholinguistic Aspects of Active and Passive Sentences", Quarterly Journal of Speech, 1969, 55:405.

[72] A brief, yet good review of some important research concerning Cloze Procedure as a measure of comprehension may be found in:
DeVito, J., "Cloze Procedure", Today's Speech, 1967, 15:31-32.

was not supported. In essence, DeVito found that when verbatim fill-ins were scored, the more transformationally complex passivized message was easier to comprehend. This is, of course, exactly the opposite of what is predicted by the Derivational Theory of Complexity as reflected in DeVito's hypothesis. In an attempt to account for these contrary findings, DeVito has proposed that the lexical redundancy introduced by the constant reuse of the Passive Transformation made the passivized message easier to comprehend. Careful consideration of this explanation suggests that it is indeed a plausible one. This is true for two reasons. First, in the complex message version, application of the Passive Transformation to each sentence served to introduce a number of function words, such as "was" and "by", throughout the message. Second, since DeVito carefully followed the prescribed methodology for preparing Cloze messages (which stipulates that every fifth word is to be deleted regardless of its importance), such function words turned up as blanks on numerous occasions on the basis of chance alone. These reasons combine to suggest that once subjects recognized the recurrent word pattern present in the complex message version, correctly supplying the function words added by repeated use of the Passive Transformation undoubtedly became a very easy task. This being the case, it seems very likely that the increased lexical redundancy present in the complex message version overshadowed transformational complexity and rendered the passivized message easier to comprehend when verbatim fill-ins were scored.

Clearly, if DeVito had done one of two things differently in deriving his complex message version, he might have found support for the Derivational Theory of Complexity. First, he might have altered his sequencing of blanks to omit only important words such as sentence subjects or objects. This would have permitted him to retain his strategy of passivizing every sentence while at the same time offering him an opportunity to purge his measuring instrument of those redundant function words introduced by the repeated use of the Passive Transformation. As a result of having done this, he might have found that when verbatim fill-ins were scored, the simple-active message was easier to comprehend. Second, if DeVito had wished to retain the standard Cloze Procedure methodology of omitting every fifth word, instead of passivizing every sentence in the complex message version, he might have used a

more varied set of transformations. If the transformations used were carefully selected, he could have both derived a message in which each sentence had only one transformation added to it, and eliminated a large amount of lexical redundancy. Once again, one can only speculate that had he adopted such a strategy, he might have derived support for the Derivational Theory of Complexity when verbatim fill-ins were scored.

In spite of the fact that DeVito's study failed to produce conclusive findings concerning the Derivational Theory of Complexity, on other grounds, it does have considerable merit. In essence, the real value of this particular study lies in the potential usefulness of its overall "research strategy" which is one that suggests some very viable methods for overcoming those weaknesses present in many of the earlier transformational studies.

Thus, when considered specifically from a methodological point of view, DeVito's study clearly stands out as an extremely important piece of work in that it offers a research strategy which will undoubtedly have broad applicability in future psycholinguistic research. In fact, it is the author's opinion that were DeVito's study to be modified (to specifically overcome the problem he encountered with unwanted lexical redundancy) and replicated, the end result of such an endeavor might well be a highly conclusive set of findings concerning the psychological reality of transformations in general and the validity of the predictions of the Derivational Theory of Complexity in particular.

Unfortunately, in the years since DeVito conducted his study, this much needed replication has not been forthcoming. Therefore, in order to at least partially fill this void and hopefully shed new light on the advisability of incorporating transformational rules in an eventual model of linguistic performance, the author has conducted the study reported in this thesis.

This study may best be characterized as a modified replication of DeVito's original experiment. To suggest that it is a replication of DeVito's is meant to imply that both experiments hold a number of features in common. A list of some of the more important of these commonalities includes: 1) the Research Hypothesis tested, 2) the use of paraphrase message versions as test stimuli, 3) the use of comprehension as the dependent/measurement variable, 4) the use of Cloze Procedure tests to index receivers' compre-

hension of the message stimuli, and 5) the use of "secrecy" during preliminary instructions to subjects in order to avoid pre-sensitizing them as to the nature of the experimental task.

While the present study is, in many respects, a replication of DeVito's original work, it does include some modifications which were added in order to improve his overall experimental design.

These improvements include: 1) the use of four treatment message versions, as opposed to only two, as a means of providing a more precise test of the Research Hypothesis, 2) the addition of a "base line measures" group in order to index subjects' ability to successfully complete the Cloze task solely on the basis of their knowledge of English vocabulary, their knowledge of grammatical English sentence structure and lucky guessing, 3) the use of a variety of different transformations to create additional transformational complexity in order to partially overcome the problem DeVito had with lexical redundancy, and 4) the exclusive use of a verbatim fill-in scoring scheme in order to insure that receiver comprehension, rather than some extraneous variable, was measured by the Cloze tests.

The ways in which the author has built upon and modified DeVito's original experiment will become clear in the next two sections of this chapter and in Chapter Three where the present study is discussed in depth.

V. A Further Test of the Derivational Theory of Complexity

The general purpose of the present study was to provide a new and hopefully more conclusive test of the Derivational Theory of Complexity within a message context. Its specific purpose was to determine the degree to which receivers' comprehension of a message is adversely affected by an increase in its transformational complexity.

A. The General Research Hypothesis

As was indicated in the preceding section, the General Research Hypothesis tested in the present study was the same one that DeVito originally investigated. This particular hypothesis was discussed at length earlier (see pages 57-58), but in order to refresh the reader's memory, it is restated below:

> As the overall transformational complexity of a message increases, receivers' ability to successfully comprehend that message will decrease.

B. The Independent and Dependent Variables

The above hypothesis contains a single independent variable. The author chose to name it Message Transformational Complexity and has conceptually defined it as follows:

Message Transformational Complexity	:	is the combined number of individual transformational operations that are required to resolve each and every sentence in a message to its deep structure or to a specified level of intermediate structure.

The above definition clearly indicates that as it is used here Message Transformational Complexity refers to the cumulative number of individual transformations that are necessary to resolve all of the sentences in a given message to their deep structure or to an in-between level of intermediate structure.

Clearly, on this exclusively numerical basis, a message which requires a combined total of one hundred transformations to resolve all of its constituent sentences to deep structure would be more complex than a message which requires only seventy-five to accomplish the same thing, provided of course, that the transformations needed in each message are roughly equivalent in their individual cognitive complexity. This qualification to the above statement is an important one because it is quite possible that a message containing many simple transformations would actually be easier to process than a message containing fewer comparatively complex transformations.

The concepts of transformational operations, deep structure and intermediate structure figure significantly in the above definition, but because they have been defined earlier, no further discussion of them need be undertaken here.

In addition to the independent variable, the above hypothesis also contains a single dependent variable, which the author has named Receiver Message Comprehension.

The central component of this variable is the concept of "human comprehension". Although the presentation of a comprehensive definition of this concept would undoubtedly be a great asset to the present discussion, realistically, one cannot be offered. The reason for this is because although psychologists are firmly convinced that human comprehension is in some way related to the psychological processes of cognitive development, learning, information processing and

knowledge retention, they know next to nothing about the exact nature of the mental mechanisms that make it possible for receivers to "understand" the messages with which they come in contact.[73] Due to the fact that so little is known about the cognitive mechanisms that underlie and facilitate human comprehension, for the present at least, psychologists treat it as an "hypothetical construct". In characterizing comprehension in this way, psychologists mean to imply that although it is not directly observable and therefore not definable in precise cognitive terms, there are indirect indicators of comprehension which can be operationalized and observed. These indicators are typically individuals' overt response behaviors to carefully designed and well validated psychological testing instruments.

In light of the above noted difficulties involved in deriving a highly precise definition of human comprehension, it is particularly fortunate that for the purposes of the present study, a highly technical conceptual explication of Receiver Message Comprehension is not needed. For the purposes of the present discussion, the definition offered below will suffice. As it relates to the present study:

Receiver Message Comprehension	:	refers to the extent to which a receiver is able to correctly understand a message immediately after exposure to it, as reflected by his performance on a valid and reliable test instrument designed to measure message comprehension.

Admittedly, the above definition lacks a high degree of specificity but it does serve to draw attention to the most important point that needs to be made here. Namely, in the context of the present study, Receiver Message Comprehension refers to some behaviorally derived test score index of the relative level of "message content understanding" a receiver is able to attain as a direct result of having been exposed to the text of a particular communicative message.

At this point the author would like to clarify the basic rationale underlying his selection of "comprehension" as the dependent/measurement variable in the present study. This rationale is somewhat difficult to succinctly explain but essentially it is this; from the point of view of the communication scholar,

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[73]Some of the sticky questions that must be resolved before psycholinguists can begin to understand what is involved in the human comprehension of linguistic messages are mentioned in:

Miller, G., The Psychology of Communication: Seven Essays, Baltimore: Penguin Books, 1969, pp. 70-92.

none of the dependent variables measured in the "individual sentence based" Derivational Theory of Complexity studies, except those directly involving comprehension, are in any way appropriate for use in experiments dealing with message processing. This is clearly the case because while communicators are constantly called upon to decode and subsequently interpret (ie. comprehend) the messages they receive in their everyday interactions with others, seldom, if ever, do they find themselves in unusual situations where they must listen to a lengthy message and then attempt, for example, to repeat it verbatim or recall it in addition to a list of unrelated words.[74] The above line of reasoning clearly suggests that if a researcher is attempting to investigate transformations in the most natural communication/language processing situation he can possibly create in the laboratory, it makes little sense to adopt the message as his primary stimulus/analysis unit only to turn around and use a dependent variable which is blatantly unrelated to normal message decoding.

While the use of some of the more traditional dependent variables in message transformational studies may well yield interesting (although highly questionable) results, it is nevertheless quite unlikely that investigations involving such things as message memorization or message recall will do very much to advance scholars' overall knowledge of either the Derivational Theory of Complexity or the process of human communication.

The above arguments suggest that although many of the dependent variables employed in past transformational studies are perfectly appropriate for the investigation of single sentence processing behavior, they have no place in a study like the present one which deals exclusively with message processing. In this light, the author viewed comprehension as the only possible dependent variable that could have appropriately been used in his study.

C. The Concept of "Message"

A cursory review of the communication research literature will reveal that the term "message" has been used to characterize many different kinds of communicative discourse. In order to avoid possible confusion over the precise

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[74]Recall related activities are, of course, only one type of dependent variable used in past "sentence based" Derivational Theory of Complexity studies. Those activities cited above are merely examples of a broader class of experimental tasks, all of which are, to some extent, inappropriate in message processing situations.

meaning of this particular term, it should be pointed out that as it relates to the present study:

A Message : is defined as a passage of connected verbal discourse consisting of several sentences which together express a central theme.

D. Operationalization of the Independent Variable

Conceptual definitions aside, Message Transformational Complexity can now be operationalized.

Four messages were developed by the author for use as stimuli in his study. These four messages differed in overall transformational complexity, total number of words and specific wording. They did not differ in either total number of sentences or meaning.

The author made certain that the messages did not differ in meaning by using only meaning preserving transformations to create additional complexity. The exclusive use of meaning preserving transformations was sufficient to insure that the four stimulus messages were exact meaningful paraphrases of one another.

The most important advantage to be gained from the use of paraphrase stimuli in message transformational studies is, of course, that it allows the experimenter to design an experimental task in which 1) subjects must deal with message meaning just as they would have to do in normal communication, and 2) the meaningful equivalence of messages significantly reduces the chances of semantic and syntactic factors becoming confounded during any phase of the experiment.[75]

Each of the four paraphrase message versions told the same story about the fictitious combat exploits of a mythical military unit. The author chose to use a topic about fictional persons and events (as opposed, for example, to a topic about current new events and real people) in an attempt to control message "salience". The reason why the author saw a need to control message salience in the present study was primarily due to his awareness of a body of

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[75]In addition to the use of paraphrase, the author employed two other techniques to help insure the meaningful equivalence of the message versions. First, he avoided the inclusion of highly connotatively laden terms in the versions. And second, he made certain that meaningful "paralinguistic" or vocal cues were held relatively constant in all oral presentations of the versions. These two techniques are discussed in more detail later in this section.

communication research findings which make it clear that receivers have a natural tendency to pay more close attention to a message if its topic is in some way salient (ie. important or relevant) to them.[76] In the author's estimation, these findings hold a very important implication for his study. Specifically, they suggest that if the topic of the message versions had been based on factual/relevant material, it is entirely possible that because of this, it might very well have been highly salient to some subjects but quite unimportant to others. In light of this possibility, it is not unreasonable to suggest that the subjects for whom the topic was salient might have listened more intently to the message than other subjects and would, as a result, have performed better on their Cloze comprehension tests. The above line of reasoning clearly suggests that in terms of the present study, message salience, like spurious shifts in message meaning, was a potential confounding factor and should, therefore, have been held as constant as possible.

The author chose to hold message salience at a low rather than a high level for what was essentially a pragmatic reason. While it is not difficult, on a purely intuitive basis, to design a message topic that is of little salience to college student subjects, designing one of high salience, on the other hand, requires that careful topic pre-testing be done. This type of pre-testing, if done properly, is no small undertaking, and realistically requires a great deal of time to design, administer and analyze. The amount of time needed to do a good job of pre-testing seemed to the author to be prohibitive and for this reason, he chose to use a low salience topic of his own invention in the present study.

The four paraphrase message versions used as test stimuli in the study each consisted of twenty unambiguous grammatical English sentences.[77] All of the sentences used in these versions had the following five important

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[76]Some of these studies dealing with message salience are discussed in: McCroskey, J., An Introduction to Rhetorical Communication: The Theory and Practice of Public Speaking, Englewood Cliffs: Prentice-Hall, Inc., 1968, pp. 34-57.

[77]The sentences were unambiguous in both the syntactic and the semantic sense. In order to verify that all sentences were in fact unambiguous, the author had a graduate student friend in the MSU Department of Linguistics, African and Oriental Languages check them over. His analysis uncovered no ambiguities.

characteristics: 1) while not true kernels in the technical sense, all were relatively simple in nature, 2) all were active, affirmative and declarative, 3) all were intermediate structures capable of standing alone as grammatically correct surface structures to which additional optional transformational operations could be applied[78], 4) all were free of highly complex constituent embeddings, and 5) all avoided both hard to understand terminology and heavily connotatively laden words.[79]

The sentences contained in Version One were the simplest and therefore most resembled true kernels. This particular version was the least complex

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[78]Some transformations may be applied optionally; that is to say, they do not have to be used. The Particle Movement Transformation introduced earlier is a good example of an optional transformation. There is no difference in the grammaticality of the following two sentences:

"John threw out the trash." (Particle Movement Transformation not applied)

"John threw the trash out." (Particle Movement Transformation applied)

Other transformational operations are obligatory and must be applied in order to generate a grammatical sentence. One such transformation is the Verb Agreement Transformation which insures that the subject and verb of a sentence agree in person, number, etc.

[79]Hard to understand terminology was purposely avoided in the various versions in an attempt to insure that the messages were not "over the heads" of the subjects who heard them. It was important to use only terms familiar to the subjects because it is not at all unreasonable to postulate that were the versions to contain a relatively large number of incomprehensible words, this factor, rather than increases in Message Transformational Complexity, might have been the most influential determinant of subjects' message comprehension.

The author sought to avoid the inclusion of heavily connotatively laden words in a further attempt to hold meaning as constant as possible across all four message versions. While it is undoubtedly true that because of variable past experiences, no two individuals can ever share exactly the same meaning for any word, it is nonetheless possible, through consensus, for them to share remarkably similar ones. Those words which lend themselves most readily to such "consensus of meaning" among people are typically ones that refer to common everyday objects and ideas with which nearly everyone is familiar. On the other hand, those words which refer to highly intangible and abstract concepts such as "love", "peace" and "goodness" seldomn facilitate "consensus of meaning" among people because each individual must interpret these words in light of his own vastly different past experiences with them.

It was this latter type of "connotatively laden" word that the author consciously tried to avoid in preparing the versions in an attempt to reduce the chances that parts of them would mean many things to many people, simply because they contained a number of abstract words interpretable only in the light of subjects' own different past experiences.

of the four due to the fact that no additional transformations were applied to any of its sentences. All other message versions were constructed by applying a pre-determined number of optional meaning preserving transformational operations to the basic set of twenty sentences contained in Version One.

Versions Two, Three and Four were created as follows. In the Second Version, one additional optional transformational operation was applied to each original sentence. Thus, a combined total of twenty transformations were required to resolve all sentences back to their Version One form. In the Third Version, two additional optional transformational operations were applied to each original sentence. Therefore, a combined total of forty transformations were required to resolve all sentences back to their Version One form. In the Fourth Version, three additional optional transformational operations were applied to each original sentence. Thus, a combined total of sixty transformations were required to resolve all sentences back to their Version One form.

The discussion thus far indicates that Message Transformational Complexity was operationalized in a two-fold manner. First, it was operationalized in terms of the number of optional transformational operations needed to resolve each sentence in a particular version back to Version One form. Second, and most importantly, it was operationalized in terms of the combined number of transformations required to resolve all of the sentences within a particular version back to Version One form.

At this point it is appropriate to note that while it is assumed that subjects had to resolve each sentence in a particular version all the way back to its deep structure in order to recover its meaning, it is also assumed that the derivational history of each set of paraphrase sentences was exactly the same prior to Version One. The derivational histories of the sentences within a given paraphrase set differed in transformational complexity only as additional operations were applied in Versions Two, Three and Four.

Table Two below reiterates the points made thus far concerning the operationalization of the four paraphrase message versions used as stimuli in the present study. In addition, Table Two indicates the ordinal ranking of versions with respect to overall Message Transformational Complexity and the number of words in each.

TABLE TWO

Operationalization of the Message Versions

Message Version	No. of Sentences	No. of Words	No. of Transformations Applied to Each Sentence	Total No. of Transformations in Each Message Version	Message Transformational Complexity Ranking
1	20	258	0	0	Version #1 (least complex)
2	20	274	1	20	Version #2
3	20	271	2	40	Version #3
4	20	263	3	60	Version #4 (most complex)

Table Two reveals that the four versions were not of equal word length. From the beginning, the author recognized this as a potential problem and originally intended to avoid it by using only permutation transformations which do not add words to or delete words from the structures on which they operate. He soon discovered, however, that such transformations typically stand in "ordered" relationships with addition and deletion transformations and because of this could not be used exclusively.

While the use of addition and deletion transformations could not be completely avoided, it was possible to insure that gross differences in the lengths of versions would not occur. The author did this by strictly avoiding the use of the whole host of transformations which either add or delete a very large number of words in a given sentence. Because the addition and deletion transformations used were carefully chosen according to this criterion, it was possible to insure that only a relatively small number of words (ie. sixteen) separated the longest version from the shortest.

Since all versions were not of the same length it, of course, is possible that differential word length may have been a confounding variable in the study. It is unfortunate, but nonetheless true, that on the basis of the available data, there is no reliable way of knowing whether it actually was or not. However, due to the fact that all versions differed only slightly in length, the author has concluded that it is unlikely that the observed differences in treatment group comprehension means (which are reported in Chapter Four) should be attributed to differences in word length rather than to differences in Message Transformational Complexity.

Complete texts of the four paraphrase message versions used as test stimuli in the present study may be found in Appendix A.

E. Specific Hypotheses About the Message Versions

The General Research Hypothesis proposed above is basically a broad and all encompassing statement of the relationship between Message Transformational Complexity and Receiver Message Comprehension predicted by the Derivational Theory of Complexity. Clearly, this general statement of the hypothesis does not take into account the specific design of the present study and therefore, must be modified so as to indicate how increases in Message Transformational Complexity are expected to affect the comprehension Cloze scores obtained in each of the four complexity conditions the author has tested. When the General Research Hypothesis is modified in this way, it conveniently translates into the following three specific hypotheses:

H1: Version Four will be comprehended less well by receivers than either Version Three, Version Two or Version One.

H2: Version Three will be comprehended less well by receivers than either Version Two or Version One.

H3: Version Two will be comprehended less well by receivers than Version One.

Careful examination of the above three hypotheses reveals that taken together they do indeed preserve the original prediction of the General Research Hypothesis 1) by explicitly postulating that Message Transformational Complexity and Receiver Message Comprehension are inversely related, and 2) by strongly implying that obtained group comprehension means will array themselves in a linear progression.

This is perhaps a good place to pause and clarify two important points. The first point is the author's rationale for investigating the effects of increased Message Transformational Complexity on Receiver Message Comprehension in more than the traditional two treatment conditions.

The decision to use multiple treatments was based on the following line of reasoning. While an experimental situation in which Message Transformational Complexity is operationalized as a dichotomous variable (ie. with a high and a low complexity condition) will provide a test of the General Research Hypothesis, that test will be a highly imprecise one which can be only limitedly analyzed. Specifically, when Message Transformational Complexity is treated as a dichotomous variable, only mean comprehension differences between grossly different

transformationally complex messages can be studied. However, when multiple treatments are used, the investigator can study not only mean differences in comprehension, but in addition, the overall relationship between Message Transformational Complexity and Receiver Message Comprehension can be investigated via correlational analysis. To the extent that the use of multiple treatments makes correlational analysis possible, it clearly provides a more precise test the General Research Hypothesis than does the use of only two treatments in which Message Transformational Complexity is treated dichotomously.

The second point in need of clarification is, in question form, "which of the above three hypotheses needs to be supported by the data in order to conclude that the General Research Hypothesis has also been supported?"

Clearly, strong support for the General Research Hypothesis demands that all three of the above specific hypotheses be supported, for if they are, a correlational analysis will reveal that Message Transformational Complexity and Receiver Message Comprehension are indeed negatively correlated and thus inversely related. However, if the data were to reveal that the mean comprehension score of Group One was greater than that of Group Four (regardless of the mean differences between the other groups), the author would argue that since these two treatments are analogous to a dichotomization of the independent variable, this finding would constitute weak support for the General Research Hypothesis.

F. Transformational "Cycles"

At this point a somewhat detailed discussion of the type of transformations and the transformational "cycles" used in the present study seems in order.

Four different cycles of three transformations each were developed for employment in the manipulation of the independent variable, Message Transformational Complexity.

A complete description of these four cycles (which includes 1) the specific transformations in each cycle, 2) the ways in which these transformations can permissibly be ordered, and 3) examples of transformed sentences) is provided in Appendix B. A quick inspection of the cycles operationalized in Appendix B should be more than sufficient to verify the validity of two points made earlier; namely, that all transformations used were meaning preserving and that none caused considerable word addition or deletion as a result of their application.

All of the transformations found in Appendix B are technically "surface" transformations. This name is descriptively appropriate and is intended to imply essentially two things. First, surface transformations operate only on intermediate structures that can stand alone as grammatical surface forms. This, of course, means that surface transformations are optional and, therefore, do not have to be applied. Second, since surface transformations operate only on grammatically correct intermediate structures, they are employed at a very late stage in the evolution of a sentence and are, therefore, not far removed from the eventual surface structure of that sentence.

Surface transformations were chosen for use in the present study for two basic reasons. The first reason is that, unlike several more "abstract" transformations (ie. the Negative Transformation) used in past Derivational Theory of Complexity studies, surface transformations rarely, if ever, alter sentence meaning as a result of their application. This is particularly true if the sentences to which they are applied are carefully selected so as to avoid contexts conducive to meaning shifts. The second reason is that unlike numerous situations where more "abstract" transformations are applied, in all cases where surface transformations are used it is very easy to see what effect the application of a particular surface operation has had on a transformed sentence. Thus, when surface transformations are used, even the person not schooled in the intracies of Generative-Transformational grammar can easily spot where words have been substituted, added, deleted or rearranged in transformed sentences. This is a clear advantage because since surface transformations have this "observable" quality, it allows the author to easily defend a claim he would wish to make, namely, that each transformation applied in his manipulation of Message Transformational Complexity did indeed cause some overt change in particular sentence structures.

However, the use of surface transformations in the present study also presented a clear disadvantage. Specifically, the majority of transformations used have not, as of yet, been investigated by psycholinguists, and for this reason, it is not known whether all are of equal cognitive processing difficulty.[80] While the uncertain cognitive status of surface transformations did pose a dis-

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[80]The importance of using transformations of equal processing difficulty has already been explained (see page 64).

tinct problem in terms of selecting transformations for use in the present study, the author did not view it as an insurmountable one. In searching for appropriate transformations, the author had occasion to read several formal explications of the transformations of English.[81] These texts reviewed surface transformations together and considered them to be one "species" of transformational operation by virtue of the fact that they all introduce relatively minor modifications into the sentence structures on which they operate. Having selected a particular sub-set of surface transformations for use in his manipulation, the author spent many hours working with them in an effort to determine their comparative degrees of processing difficulty. As a result of having done so, the author then designed his transformational cycles and made the explicit assumption that the transformations contained in those cycles were all of roughly the same cognitive processing difficulty. From the outset, the author recognized both the seriousness and the tenuousness of this assumption in terms of assigning a correct interpretation to his results, but felt that because abstract transformations should be avoided at all costs, surface transformations alone were appropriate for use in the present study.

"Cycles" of transformational operations, rather than individual transformations, were selected for use in the present study in order to insure that the sentences within any given paraphrase set would have only one new transformation added as they passed from version to version and became more complex. To illustrate this point, suppose that to a given simple sentence, X, transformation A is applied in Version Two. In Version Three, transformation A will still be used and a new transformation, B, will be added. In Version Four, transformations A and B will still be used and a new transformation, C, will be added.[82] In short, the use of transformational cycles helped to insure that later sentences in a paraphrase set became neither easier nor harder to resolve to Version One form because completely new transformations were used in each version.

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[81]The discussions of English transformations noted above can be found in:
Burt, M., From Deep to Surface Structure, New York: Harper and Row, Publishers.
Falk, J., Linguistics and Language, Lexington, Massachusetts: Xerox College Publishing, 1973.
Jacobs, R. and Rosenbaum, P., English Transformational Grammar, Waltham, Massachusetts: Blaisdell Publishing Company, 1968.

[82]The reader can find concrete examples of this "only one new transformation per step principle" by inspecting the sentences the author has provided in Appendix B.

Since there were twenty sentences to be transformed and four cycles, each cycle was used five times. The order in which the cycles were used was randomly determined and is operationalized in Appendix C. In instances where the transformations in a particular cycle could be ordered in more than one way, the specific ordering used in each application of that cycle was randomly determined as well. The order in which cycles were applied was randomly determined in an attempt to insure that any lexical redundancy resulting from the re-use of the same four cycles was spread throughout the versions on the basis of chance rather than on the basis of some biased assignment scheme developed by the author.

This matter of lexical redundancy mentioned above deserves some consideration at this point. The reader will recall that earlier the author criticized the DeVito study for using the Passive Transformation exclusively and pointed out that the use of several different transformations to create additional complexity is one means by which unwanted lexical redundancy can be minimized. The author adopted this particular strategy in his own study and as a result, managed to eliminate a considerable amount of lexical redundancy, but certainly not all of it. Due to the facts that each transformational cycle was used four times and, in addition, the Passive Transformation appeared in more than one cycle, some lexical redundancy was unfortunately present in the versions.

The only truly effective way to completely eliminate such lexical redundancy would have been to develop twenty cycles each containing completely different transformations. Unfortunately, developing this many unique transformational cycles was literally an impossibility and for this reason, the author resigned himself to the fact that some degree of lexical redundancy was an inherent feature of his "transformational cycle" scheme and could not be avoided.

Once the sequence of cycles was determined, the sentences of Version One were constructed. Each sentence in this version was purposefully designed in such a way that the syntactic arrangement of its constituents would permit it to be operated upon by the first transformation in the appropriate cycle.

G. Oral Preparation of the Message Stimuli

The author chose to present the message stimuli to subjects orally rather than visually in an overt attempt to hold constant the individual's "amount of exposure" to the message. Often, in experimental situations where message stimuli are presented to subjects visually, the experimenter later learns, much to

his chagrin, that even though he carefully controlled the task time frame, some subjects had enough time to read the message twice, some only once, and others were unable to finish it at all. In instances where this happens, due to the fact that there are gross differences in subjects' "amount of exposure" to the test stimuli, the experimenter's independent variable(s) are clearly contaminated and his results must immediately be called into question.

This unfortunate problem can be easily eliminated by presenting message stimuli to subjects orally. Clearly, when this is done, each subject hears the stimulus message once and only once, and exposure is thus effectively controlled.

Each of the four stimulus message versions used in the present study were recorded in English on high fidelity magnetic recording tape in a sound-proof studio.

The individual who actually prepared the versions was a male graduate student colleague of the author who fortunately had an extensive background in radio broadcasting. This person was a native speaker of English and used what might best be described as a "standard" Mid-Western dialect of American English. Because of his broadcasting background, the speaker had a very clear and "professional" sounding speaking voice and a pleasing style of message delivery.

Several days before the actual recording session, the author asked the speaker to begin practicing his style of delivery. He requested the speaker to perfect his delivery to the point where each version could be presented as similarly as possible with respect to such vocal features as syllable stress, intonation pattern, word emphasis, rate, pitch, pause placement and overall version length (in seconds). The author felt that such uniformities of presentation were necessary in order to insure that potentially meaningful paralinguistically derived information remained as constant as possible across all versions, and that each message version fit into the same approximate time frame. The author saw both of these factors as potential confounding variables, if not controlled, and felt that they could be virtually eliminated through meticulous attention to them during the recording session.

During the recording session itself, the speaker's broadcasting talents

proved invaluable, and even though the versions had to be re-recorded numerous times, the desired end-products were eventually obtained. Each of the final recordings was remarkably uniform in delivery style, and all were between three minutes and three minutes eight seconds in total length.

H. Operationalization of the Dependent Variable

The reader will recall that according to the conceptual definition of Receiver Message Comprehension proposed earlier, this variable was to be indirectly indexed by means of some appropriate psychological testing instrument. The testing instrument chosen by the author for use in the present study was Cloze Procedure.

Cloze Procedure was developed several years ago by W. L. Taylor who has defined it as a psychological measuring instrument designed to guage:

> "the degree of correspondence between the language habits used by the source while encoding a message (fitting sequences of language symbols to the meaning) and the language habits of the receiver while decoding it (fitting meaning to the mutilated message) and, on the basis of the meaning perceived, attempting to encode those elements which will make the message's form whole again."[83]

The actual process of designing a Cloze test instrument is quite simple. To do so, the written text of a message is first prepared and then from some pre-determined starting point, every n^{th} word is systematically deleted from the text. This systematic deletion procedure insures that the omission of words is performed independent of and without regard for the particular words occurring in the message. According to Taylor, such a procedure is needed because:

> "... it seems necessary to let the occurrence of all sorts of words be represented according to the proportion of their occurrence."[84]

Taylor has offered the following empirically derived guidelines for developing Cloze tests:

> "Findings up to now indicate that the easiest way of applying Cloze Procedure may be the best in most cases. There seems to be little advantage in pre-classifying words and limiting deletion to them, and no advantage to putting oneself to the trouble of judging and scoring synonyms. Also

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[83] Taylor, W., Application of "Cloze" and Entropy Measures to the Study of Contextual Constraints in Samples of Continuous Prose, unpublished Doctoral Dissertation, University of Illinois, 1954, pp. 3.

[84] Loc. cit.

> it appears that an every-fifth-word deletion system spaces blanks as far apart as they need to be. Further, a series of about fifty blanks (and therefore a message of about two hundred and fifty words) is roughly sufficient to allow the chances of mechanically selecting easy or hard words to cancel out and yield a stable score of the difficulty of a passage, or of the performance of an individual, despite what specific words the counting-out process may delete."[85]

Once the deletion system has been determined, the proper words are then removed from the text of the message and replaced by blank spaces of uniform size.

At this point, the "mutilated" message, as it is called, is ready to be given to subjects who are then asked to correctly supply the missing words.

DeVito has pointed out that from subjects' Cloze scores two general types of inferences can be drawn.

> "First, we can infer the difficulty of the message--easy messages will contain a high percentage of correct (verbatim) fill-ins while difficult messages will contain a lower percentage of correct fill-ins. Second, one can infer the degree to which a receiver understood a given message despite its mutilated form. In drawing inferences concerning the difficulty of a message we have what is more commonly referred to as a measure of readability; in drawing inferences concerning the receivers' understanding we have ... a measure of comprehension."[86]

The author chose to use Cloze Procedure in the present study for the following three reasons.

The first reason is that past research has clearly demonstrated that Cloze Procedure is both a highly valid and reliable comprehension measuring instrument.

DeVito has described in detail the way in which Taylor sought to check the validity of Cloze Procedure.

> "In order to test the validity of Cloze Procedure as a measure of comprehension Taylor obtained two carefully matched (multiple choice) comprehension tests which were based on a particular article. He then took samples of the article and made them into Cloze tests ... Before subjects read the article they were given a before-comprehension test and a before-Cloze test. After reading the article they were given the after-comprehension test and the after-Cloze test.

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[85] Taylor, W., "Recent Developments in the use of Cloze Procedure", Journalism Quarterly, 1956, 33:48.

[86] DeVito, J., "Cloze Procedure", Today's Speech, 1967, 15:31.

> The before and after Cloze scores correlated very highly with the before and after comprehension scores, respectively, demonstrating that Cloze results serve as valid comprehension scores. Furthermore, since IQ scores were available for these subjects Taylor also correlated the IQ scores with the comprehension test scores and with the Cloze scores. Cloze scores were found to correlate more highly with the IQ scores than did the comprehension test scores."[87]

As part of the study outlined above, Taylor also checked the reliability of Cloze Procedure. He used the standard test--re-test method and found that individual subjects' Test One and Test Two scores correlated very highly (ie. $r > .80$).

The second reason is that Cloze Procedure has been demonstrated to be equally valid and reliable when measuring receivers' comprehension of messages presented orally as well as visually.[88] This, of course, is an important consideration in terms of the present study because the message versions were presented to subjects orally.

The third reason is that compared to other comprehension tests, Cloze tests are by far the easiest to devise and the simplest to administer.

The theoretic base upon which Cloze Procedure is founded is actually a notion borrowed from Gestault psychology. This notion is that human beings have a natural desire for what might be called "closure" in the things they perceive. Because of this desire, they tend to perceive incomplete or "broken" stimuli as complete or "unbroken".[89] Thus, a person who is presented with an incomplete geometric figure (a circle, for example) will tend to perceptually process it as a whole figure.

Applying this "closure principle to human linguistic communication, Sencer has noted that;

> "... a subject receiving a sequence of verbal stimuli, a sequence which is structured such that it forms a circle, that is a completed structure, will perceive that structure as a complete one even if it is broken by having elements actually missing from it."[90]

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[87] Ibid., pp. 32.

[88] Taylor's study which showed Cloze Procedure to be applicable in comprehension studies using an oral mode of stimulus presentation is outlined in: Taylor, W., "Recent Developments in the Use of Cloze Procedure", Journalism Quarterly.

[89] Sencer, R., An Investigation of the Effects of Incorrect Grammar on Attitude and Comprehension in Written English Messages, unpublished Doctoral Dissertation Michigan State University, 1965, pp. 26-27.

[90] Loc. cit.

The above quotation makes it clear that for language users a completed or "closed" linguistic message is a perceptually familiar and expected stimulus pattern. In this light, a Cloze test of comprehension can be viewed as a device for measuring a person's ability to provide "closure" for a message based on his understanding of it.[91]

Once developed, the four paraphrase message versions used as test stimuli in the present study were reduced to Cloze form as follows. Within each version, the fifth word, and every fifth word thereafter, was systematically deleted, regardless of what it happened to be. This deletion process was continued until that point in the last sentence of each version where fewer than five words stood between the last blank established and the conclusion of the message.

The number of blanks that appeared in each of the four message versions is shown in Table Three below.

TABLE THREE

Number of Cloze Blanks in Each of the Four Stimulus Messages

VERSION	NO. OF BLANKS
1	64
2	68
3	67
4	65

The reason for the discrepancy in the total number of blanks in each version was a direct result of the fact that they were of unequal word length.

Texts of the four stimulus message versions in Cloze form are provided in Appendix D.

I. An Overview of the Study

As a means of summarizing Section V of this chapter, the author shall present an overview of his study in an attempt to draw together and re-emphasize several of the more important points that have thus far been made.

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[91] Loc. cit.
The reader is reminded that, as was noted in connection with the DeVito study (see pages 60-61), a Cloze test effectively measures comprehension only when verbatim fill-ins are exclusively scored.

Perhaps the best way to begin is with a reiteration of the fact that the present study, in essence, was a modified replication of an experiment originally conducted by DeVito which attempted to capitalize on the strengths and overcome some of the weaknesses of its forerunner.

The specific purpose of the study was to attempt to determine the extent to which receivers' comprehension of a message is adversely affected by an increase in its overall transformational complexity. The General Research Hypothesis investigated by the present study was basically a re-statement of the original "sentence centered" Derivational Theory of Complexity modified to represent the predicted relationship between Message Transformational Complexity and Receiver Message Comprehension in message processing situations. This hypothesis was:

> As the overall transformational complexity of a message increases, receivers' ability to successfully comprehend that message will decrease.

In order to test the above hypothesis, the author developed a rather simple and straight forward experiment involving four different treatments. These treatments were versions of the same message which were exact meaningful paraphrases of one another. While the four versions did not differ in meaning, they did differ in overall Message Transformational Complexity by precisely defined amounts.

Since the design of the experiment called for the establishment of four transformational complexity conditions, the above General Research Hypothesis had to be translated into the following three specific hypotheses:

H1: Version Four will be comprehended less well by receivers than either Version Three, Version Two or Version One.

H2: Version Three will be comprehended less well by receivers than either Version Two or Version One.

H3: Version Two will be comprehended less well by receivers than Version One.

Subjects who participated in the experiment were divided into five groups. Four of these groups were "treatment" groups while the fifth group was what might best be called a "base line measures" group.

Each treatment group heard a tape recording of one of the four versions of the original message. Immediately after hearing a particular version once, each subject was given a Cloze Procedure test designed to measure his comprehension of the version heard.

Subjects in the four treatment groups were not informed ahead of time as to the exact nature of the experimental task in which they were about to participate.

Unlike the treatment groups, the "base line measures" group did not hear a message. This group was asked to complete a Cloze test of the simplest version (Version One) on the basis of message context and guessing alone. The data obtained from this group was later compared with that from the Version One treatment group in order to determine if hearing the message made a difference in the relative quality of subjects' performance on the Cloze test.

Clearly, this was a critical data point because if it were to be demonstrated that subjects who had not heard the version could do as well on the Cloze test as those who had, there would be no point in performing further data analysis, since having been exposed to the treatment version made no difference in test performance.

Only one "base line measures" group was used simply because there were not enough subjects available to allow each of the other three treatment groups to be compared with a separate "base line measures" group. Because of this non-availability of subjects, the author made the explicit assumption that if other "base line" vs. "treatment" group comparisons had been made, due to the paraphrase nature of the versions, the results obtained would have been relatively the same as those of the comparison that was actually done.

The experimental/statistical design, the procedures of administration and the subjects used in the present study are discussed in detail in the next chapter.

CHAPTER III

I. Introduction

The main purpose of this chapter is to complete the author's operational explication of the present study. In order to do so, the following five specific topics are discussed: 1) the experimental design of the study, 2) the procedures of administration employed, 3) the methodology used in scoring subjects' Cloze comprehension tests, 4) the nature of the subjects tested, and 5) the general framework for analysis of the data obtained.

These topics are discussed in Sections II, III, IV, V and VI, respectively.

II. Experimental Design

In the present study, the independent variable was, of course, Message Transformational Complexity. Under optimal conditions, this variable is interval in nature because, theoretically, a message could conceivably consist of sentences of infinite length which would, of course, require a correspondingly limitless number of transformational operations. However, as it was operationalized here, Message Transformational Complexity was converted into an ordinal variable, in that it could assume only one of four possible rank ordered values (see Table Two, page 71).

The dependent variable in the present study was, of course, Receiver Message Comprehension, and was measured by means of Cloze Procedure. Since Cloze scores (in percentage form) can permissibly assume any value between 0% and 100%, this variable, as measured here, was interval in nature.

Since there was but one independent variable and one dependent variable in the study, a relatively simple experimental design was called for. This design can be graphically depicted by means of the 1 x 5 table shown below in Table Four.

TABLE FOUR

Version Treatment Groups

MESSAGE TRANSFORMATIONAL COMPLEXITY

VERSION ONE (least complex version)	VERSION TWO (next least complex version)	VERSION THREE (third least complex version)	VERSION FOUR (most complex version)	BASELINE MEASURES (no message) Cloze Test Only
GROUP I	GROUP II	GROUP III	GROUP IV	GROUP V
n = 20	n = 20	n = 20	n = 20	n = 20

It should be pointed out that the values which actually belong in the five cells of Table Four are Group Cloze Percentage Means.

Table Four also indicates that cell n's were kept equal at twenty (20) subjects apiece. This was done in the interests of simplifying the subsequent statistical analyses by facilitating the use of "equal n's" techniques.

The sampling scheme employed in the study can best be characterized as an Intact Groups design featuring random assignment of groups to treatments.[1] In order to implement this Intact Groups sampling design, the author selected five groups of subjects. These subject groups were existing Communication 100 classes at Michigan State University. Once he had secured permission from the instructors of these classes to administer the experiment to their students, specific groups were then randomly assigned to the various treatments.

III. Procedures of Administration

On the basis of information gathered during three separate "procedural" pre-tests (using subjects highly comparable to those tested in the actual experiment), the following procedures of administration were developed for use in the present study. The discussion which follows indicates in a step by step manner, the procedures followed by the Experimenter during the administration of treatments:

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[1] Intact Groups sampling designs are discussed briefly in the following two sources:

Lindquist, E., Design and Analysis of Experiments in Psychology and Education, Boston: Houghton Mifflin Company, 1956, pp. 172-189.

Seltiz, C. et al., Research Methods in Social Relations, Revised Edition, New York: Holt, Rinehart and Winston, 1959, 136-143.

1. Prior to the arrival of the S's who were to participate in each administration, the volume of the tape recorder was adjusted so that all would be able to hear the message clearly.

2. When all S's had arrived and were seated, the class instructor introduced the E and asked for the cooperation of the class members.

3. E then came to the front of the room and offered the following explanation of the experiment in which the S's were about to participate:
   "Hello, my name is _____, and I'm a graduate student in the Department of Communication here at M. S. U. I'm here to ask you to participate in a short exercise, the data from which will be used as part of a Master's Thesis currently being done by myself." (Note: in the one administration where the E was not the author, his name was supplied here.)
   "Before I explain what I'd like you to do, I'd like to point out that your participation in this exercise is not mandatory in any way, and if you'd rather not take part, you can wait out in the hall and no questions will be asked." (Note: no students declined to participate in any of the administrations.)
   "At this point, I'd like to find out one thing. Is there anyone here for whom English is not their native language?" (Note: no non-native speakers of English were encountered in any of the administrations.)
   "Eventually I'm going to ask you to fill out a questionaire, but first I'd like you to just sit back and listen to the short message that's on this tape.
   Now, if you'll all settle down and get comfortable, I'll turn on the tape."

4. When all S's were quieted down, the tape was played.

5. When the tape was finished, the recorder was turned off and the test booklets were distributed. S's were asked to leave them face down on their desks until told to look at them.

6. When all the booklets had been distributed, E asked each S to turn his booklet over and write his Student Number on each page in the space provided. S's were told that the only reason their Student Numbers were needed was so that their test booklets could later be returned to them.

7. When S's had finished writing their Student Numbers, they were instructed to turn to the first page of the booklet and read the instructions thereon silently while E read them aloud.

8. At this point, E read the following instructions to the S's:
   "On the following two pages is the written text of the message you have just heard but with several words omitted and blanks appearing in their place. From what you remember of the message, please fill in each blank with the word you feel is correct. Each blank requires one word and only one word. You will have ten minutes to fill in all the blanks. Work as rapidly as possible, but pay attention to every clue that might suggest the 'right word' or eliminate a 'wrong word'. You should try to get through the whole message in

the time alotted and if no word seems exactly right, guess. If you finish before time is called, please stop and wait for further instructions before going on to the next section."

9. At this point, E reiterated the important points in the above instructions and asked if there were any questions.

10. After questions were answered, E made certain that all S's had something to write with and told them that they would be informed when five, three and one minutes were left of the allotted ten. (Note: this was done in an attempt to insure that a subject's ability or inability to judge the amount of time remaining to him in no way became a confounding variable.)

11. Preliminaries aside, S's were told to start.

12. At the end of ten minutes, time was called and the instructions for the two remaining sections of the test booklet were explained and any questions about them answered. (Note: these two parts of the test booklet were in no way related to the present study and sought to collect data for other experiments. For this reason, they will not be discussed further.)

13. While S's worked on the final two sections of the test booklet, E made certain that no one worked further on his Cloze test.

14. As each S completed his test booklet, it was collected and when all booklets were in, E thanked the S's for their cooperation and told them that within a few days they would get their tests back along with a complete text of the message, so that they could see how well they had done. (Note: S's Cloze tests were later returned to them as promised.)

The above procedures, with minor modification, were also used when data was collected in the "base line measures" group. In this case, however, it was made clear to S's that they were not to hear a message and would have to complete their Cloze tests solely on the basis of intuition and "guess work".

In all administrations except one, the author served as the Experimenter. In this one exceptional case, two treatments were being administered concurrently and in one of them a graduate student colleague of the author acted as Experimenter while the author did so in the other.

A sample copy of an actual test booklet is provided in Appendix E.

IV. Cloze Test Scoring Procedures

In scoring subjects' Cloze tests, the author followed the four procedures outlined below:

1, Only verbatim fill-ins were counted as correct.

2. If legible, a correct word that was either misspelled or abbreviated was accepted.

3. If two words were supplied in one blank, it was counted as wrong.

4. If a subject left ten (10) or more blanks vacant, his test was discarded.

Once all the Cloze tests had been "corrected" in accordance with the above procedures, the author derived each subject's overall Cloze Percentage Score by means of the following formula:

$$\text{(An Individual's) Cloze Percentage Score} = \frac{\text{Number of Blanks Correctly Filled In}}{\text{Total Number of Blanks in the Message Heard}} \times 100$$

The above formula is to be used to determine Cloze scores in situations in which individuals' performances are to be compared on two or more Cloze tests containing an unequal number of blanks.

Clearly, "raw score" totals can, and probably should, be used when performances on Cloze tests having an equal number of blanks are to be compared. However, in situations where the Cloze tests in question have an unequal number of blanks, the use of raw score totals is inappropriate because it understandably gives a decided advantage (in terms of overall group means) to the group or groups that worked on the Cloze test with the fewest number of blanks.

Because the Cloze tests prepared for use in the present study did not have an equal number of blanks, individuals' overall Cloze scores were derived on a "percentage of total" rather than a "raw score total" basis, in accordance with the formula proposed above.

V. Subjects

In all, the Cloze tests obtained from one hundred (100) subjects were included in the data analysis. Originally, one hundred thirteen (113) subjects were tested, but eleven (11) failed to complete a significant portion of their tests, and for this reason, were eliminated from the subject pool. In order to maintain the equality of treatment group n's, it was necessary to randomly eliminate one subject each from Groups II and IV.

All subjects tested were native speakers of English. In addition, all subjects were undergraduate students enrolled in one of four "commonly taught" class sections of Communication 100 being offered by the Michigan State University Department of Communication during the Spring Quarter of 1973.

On the basis of a very cursory investigation of demographic data supplied by each individual, it was determined that the pool of subjects had the following four general characteristics:

1. Roughly 60% of the subjects were male and 40% female.
2. Roughly 70% of the subjects were underclassmen (ie. freshmen and sophomores) and 30% were upperclassmen (ie. juniors and seniors).
3. Roughly 85% of the subjects were caucasian while most of the remaining 15% were black.
4. Nearly all of the subjects were between 18 and 23 years of age.

It should be noted that there is no evidence to suggest that this particular pool of subjects reflected any special or unusual distribution of either intelligence or verbal ability. Finally, since all classes in which treatments were administered met in mid-morning, there is no reason to suspect any peculiarities relating to the time of day during which the different groups were tested.

VI. Data Analysis

A. Descriptive vs. Statistical Analysis in Psycholinguistics

Unlike most other social scientists, when designing his research, the experimental psycholinguist often finds himself uncomfortably situated on the horns of a dilemma concerning the mode of data analysis on which he should primarily rely. Should it be mainly descriptive, mainly statistical, or some combination of the two?

Most experimental psycholinguists are reasonably well schooled in research methodology and are therefore aware of the advantages to be gained from the use of inferential statistics in their data analysis in terms of 1) knowing probabilistically whether their observed results should or should not be attributed to "chance" alone, and 2) knowing whether their results are in any way generalizable to some larger population. Because of this awareness, psycholinguists are normally strongly motivated to use inferential statistics when analyzing data.

However, in many instances, they do so very unhappily. There are basically two reasons for such feelings. The first reason is that while psycholinguists know that actually finding statistical "significance" is strongly tied to the relative size of the sample(s) tested, they often find themselves in situations where, for a number of legitimate reasons, the sample sizes they attain are

alarmingly small.[2] This, of course, means that their chances of finding statistical significance are severely jeopardized.

The second, and probably most important reason, is that psycholinguists often find themselves conducting experiments in which the individual performance differences they expect to find are quite small; so small, in fact, that relatively imprecise inferential tests might very well not find them statistically significant.[3] Because of this, it is not uncommon to find psycholinguists looking at their data intuitively rather than statistically in an attempt to determine whether the performance differences they have observed actually shed light on the validity of the hypothesis they are investigating.

Nowhere within experimental psycholinguistics is the "mode of analysis" dilemma more of a problem than in the psychological investigation of transformations. As one reviews the Derivational Theory of Complexity research literature, he is immediately struck by the following three facts. First, in virtually all of these studies, extremely small samples were tested. Second, the differences in language processing abilities observed were typically quite minute (see, for example, the results of the Miller, et al. study reported on page 37). And third, when and <u>if</u> statistical analyses were used in these studies, they were typically viewed as less important than corresponding descriptive analyses.

Miller and McKean, for example, used no statistical analyses in their study and justify their absence by implicitly suggesting that the psychological investigation of transformations is just beginning and, quite understandably, lacks experimental "sophistication".[4] According to Miller and McKean, any differences

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[2]In most cases, a restricted budget is the primary factor influencing the size of the samples that psycholinguists are able to deal with. Frequently, psycholinguists must use what little research funds they have available on expensive testing equipment such as tachistoscopes for use in their work. This, of course, means that their dollar cost per subject figure is raised to the point where they can test only a very few subjects with the funds remaining.

[3]The limitations of inferential statistical tests due to their relative imprecision are discussed in:
Morrison, D. and Henkel, R., (Editors), <u>The Significance Test Controversy: A Reader</u>, Chicago: Aldine, 1970.

[4]Miller, G. and McKean, K., "A Chronometric Study of Some Relations Between Sentences", <u>Quarterly Journal of Experimental Psychology</u>, 1964, 16:297-308.

in subjects' performance in various complexity conditions are important and do speak to the question of the validity of the Derivational Theory of Complexity hypothesis. On the basis of this line of reasoning, they imply that intuition, rather than statistical significance, should guide the researcher's conclusions concerning the findings of transformational studies. In many ways, this argument is no less valid today than when it was originally proposed some ten years ago simply because present day researchers still find experimental/methodological precision elusive in transformational studies.

The author's reason for presenting the above discussion was two-fold. First, he wished to make the reader aware of the problems the psycholinguist routinely faces in attempting to decide how to "correctly" analyze his data. But more importantly, he wished to offer the rationale underlying his approach to the analysis of the data he obtained from the present study. This approach used both descriptive and statistical analyses but used them for largely different purposes. Specifically, the author viewed descriptive analysis as the primary grounds upon which he would base his tentative decision to support or reject the hypotheses. He relied on statistical/correlational analysis primarily to determine 1) what adverse effects there were, if any, as a result of small sample size, 2) what adverse effects there were, if any, due to large within group variability, and 3) if there was any evidence to suggest the presence of unwanted extraneous variables. This mode of analysis was used only secondarily to directly test the hypotheses.

B. Descriptive and Statistical Analysis Design

There were four steps in the author's analysis of the data obtained in the study. These steps are outlined below in the order in which they were actually performed.

1. Descriptive Analysis

The primary purpose of the author's descriptive examination of the data was to determine if the obtained Group Cloze Percentage Means aligned themselves in accordance with the predictions of the three hypotheses proposed earlier (see page 72). That is to say, was $\bar{X}_1 > \bar{X}_2 > \bar{X}_3 > \bar{X}_4$.

2. Preliminaries to Statistical Analysis

Before launching a full scale statistical analysis, the author determined that he must first perform two preliminary investigations.

First, he sought to determine whether the variances of the four treatment

group distributions were homogeneous. This was done in an attempt to shed light on the advisability of using parametric F and t tests in later phases of the data analysis.[5] This comparison of variances was made by means of a standard Bartlett's x^2 Test for Homogeneity of Variance.

Second, the author sought to determine if the Cloze Percentage Mean of the "base line measures" group (Group V) was significantly different from that of Group I. (The need for and implications of such an analysis have already been explained on page 83.) This comparison was made by means of a standard one-tailed t test for independent samples.

3. Statistical Analysis

Provided the treatment group variances proved to be homogeneous, the following two part statistical analysis was planned.

First, a Single Classification Analysis of Variance was to be performed in order to determine if there were significant differences among any of the treatment group means.

Second, each possible pair of treatment group means (ie. I-II, I-III, I-IV, II-III, II-IV, III-IV) was to be compared using standard one-tailed t tests for independent samples, to determine which pairs, if any, were significantly different.

4. Correlational Analysis

The author performed a correlational analysis on the data in order to determine 1) the magnitude of the inverse relationship between increased Message Transformational Complexity and Receiver Message Comprehension, 2) whether this relationship was statistically significant, and 3) the amount of variance in Receiver Message Comprehension that was explained by increases in Message Transformational Complexity. The magnitude of the relationship was determined by means of a Zero Order Pearson Product Moment Correlational Analysis. The significance of this relationship was determined by the modified t statistic used for testing the significance of zero-order correlations. The variance explained was, of course, determined by squaring the obtained Correlation Coefficient.

The results of the four analyses outlined above are reported in the next chapter.

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[5]The need to check the homogeneity of treatment group variances was motivated by the fact that this homogeneity is an important prerequisite to the appropriate use of parametric statistical tests. The implications of the "homogeneity of variance" assumption for the use of parametric statistics is thoroughly discussed in:
Lindquist, E., Design and Analysis of Experiments in Psychology and Education, pp. 72-90.

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CHAPTER IV

I. Introduction

The sole purpose of the present chapter is to briefly outline the results of the descriptive and statistical analyses to which the data was subjected.

The reader will recall that the data analysis performed consisted of four parts: 1) a descriptive analysis of the observed rank ordering of treatment group means, 2) two "preliminary" statistical analyses: a check on the homogeneity of treatment group variances and a "base line measures" Group vs. Treatment Group I t test comparison, 3) an inferential statistical analysis of the differences among treatment group means, and 4) a correlational analysis of the observed relationship between Message Transformational Complexity and Receiver Message Comprehension.

The results of these four parts of the analysis are reported in Sections II, III, IV and V, respectively.

II. Descriptive Analysis

Table Five, below, shows the mean, variance and standard deviation of each of the five groups tested.

TABLE FIVE

Means*, Variances and Standard Deviations of the Five Groups

	GROUP I	GROUP II	GROUP III	GROUP IV	GROUP V("baseline measures")
$\bar{X}$	58.95%	57.25%	56.05%	52.30%	44.55%
s^2	95.62	97.67	148.65	208.11	48.05
s	9.77	9.88	12.19	14.42	6.93

*The means reported here (and in all other tables) are Group Cloze Percentage Means on the dependent variable, Receiver Message Comprehension.

The descriptive data reported in Table Five hold two important findings.

First, and most importantly, Table Five shows that the rank ordering of Treatment Group Cloze Percentage Means (Groups I-IV) on the dependent variable (Receiver Message Comprehension) is in exact accord with the predictions of the three specific hypotheses and the General Research Hypothesis under investigation. This is clearly the case because although the magnitude of the differences between means is rather small, the comprehension mean of Group I is highest, that of Group II is next highest, that of Group III is next highest, and that of Group IV is lowest. In keeping with the criteria the author has outlined for establishing strong support for the General Research Hypothesis (see page 73), at the descriptive level at least, this particular finding provides such support for the Derivational Theory of Complexity hypothesis in that as the overall transformational complexity of the message increased, receivers' ability to successfully comprehend it did indeed decrease.

Second, the second row of Table Five indicates that the variances of the four treatment groups are large in magnitude and widely separated. This finding strongly argues for the advisability of a precise statistical check on the relative degree to which these variances are homogeneous, in the interests of determining whether standard and unmodified F and t tests should be used in later analyses.

III. Preliminary Analyses

A. Homogeneity of Treatment Group Variances

Table Six, below, shows the results of the Bartlett's x^2 Test for Homogeneity of Variance that was conducted in order to determine if the four treatment group variances were indeed homogeneous.[1]

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[1] Bartlett's x^2 Test for Homogeneity of Variance is thoroughly discussed in: McNemar, Q., Psychological Statistics, Fourth Edition, New York: Wiley and Sons, Inc., 1969, pp. 285-286.

TABLE SIX

Results of the Bartlett's x^2 Test for * Homogeneity of Treatment Group Variances

(Alpha=.05)

GROUP	n	df (n-1)	p
I	20	19	-- (Ho
II	20	19	not rejected)
III	20	19	
IV	20	19	

df=K(Groups)-1=3 Ho: $\sigma_I^2=\sigma_{II}^2=\sigma_{III}^2=\sigma_{IV}^2$

$x^2(.05)=7.82$

x^2(observed)=3.97

*The Bartlett's Test assumes independent samples.

The observed x^2 value of 3.97 failed to meet the x^2 value of 7.82 needed for significance at the .05 level. According to convention, the null hypothesis cannot be rejected. This, of course, is the desired outcome and indicates that although the observed treatment group variances are quite large, they are homogeneously so. This finding certifies that standard F and t tests can safely be used in later parametric statistical analyses.

B. t Test Comparison of the "Base line Measures" Group vs. Treatment Group I

Table Seven, below, shows the results of the t test comparison of the Cloze Percentage Means of Groups I and V that was conducted in order to determine if they were statistically significantly different.

TABLE SEVEN

Results of the t Test* Comparison Group I vs. Group V

(Alpha=.05)

GROUP I		GROUP V			
$\bar{X}$	s^2	$\bar{X}$	s^2	t	p
58.95%	9.77	44.55%	6.93	5.39	<.01 (Ho Rejected)

df=38

Ho: $\mu_I \leq \mu_V$

critical t (.05)=1.69

*t test used was a one-tailed test for independent samples.

The data reported in Table Seven indicate that the comprehension means of Groups I and V are significantly different beyond the .01 level. On this basis, the null hypothesis was rejected.

This particular finding coupled with the observation that the mean of Group I is indeed higher than that of Group V clearly indicates that actually having heard the message did indeed make an important difference in subjects' ability to comprehend it, as indexed by their performance on the Cloze test.

This particular finding is important in two respects. First, it serves to reinforce the author's faith in his earlier contention that the observed rank ordering of Treatment Group Cloze Percentage Means provides strong support for the General Research Hypothesis. Second, for reasons cited earlier (see page 83), this finding indicates that further statistical analyses are indeed legitimate and warranted.

IV. Statistical Analyses

A. Analysis of Variance

Table Eight, below, reports the results of the Single Classification Analysis of Variance that was performed in order to determine if there was any statistical significance to be found among the total set of Group Cloze Percentage Means reported in Table Five.

TABLE EIGHT

Results of the Single Classification Analysis of Variance Involving All Treatment Groups

(Alpha=.05)

Source of Variation	ss	df	MS	F	p
Treatment (between)	447.63	3	159.21	1.15	-- (Ho not
Error (within)	10451.85	76	137.92		rejected)
Total	10929.43	79			

df=3,76

critical F (.05)=2.72

Ho: $\mu_I=\mu_{II}=\mu_{III}=\mu_{IV}$

The results of the Analysis of Variance reported in Table Eight indicate that the observed F value of 1.15 failed to meet the critical F value of 2.72 needed for significance at the .05 level when entering the F Table with (3,76) degrees of freedom. On this basis, the null hypothesis could not be rejected.

The observed F value of 1.15 is rather small but a quick check of the Mean Square (within) figure noted in Table Eight readily suggests why this might be so. In any Analysis of Variance, the Mean Square (within) is highly dependent both on the variability within each group involved in the analysis and the size of each group.[2] Once it is reiterated that the variability within each treatment group was extremely large and that there were only twenty subjects in each group, it is not at all hard to see why the Mean Square (within) turned out to be almost as large as the Mean Square (between), thus yielding a very low F value.

In the author's estimation, the most significant implication of the results of the Analysis of Variance reported in Table Eight is that they clearly point to large within group variability and small sample size as two important factors which very probably combined to prevent statistical significance from being found.

On the basis of this implication, the author concluded that the observed

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[2]The relationship between the Mean Square (within) figure and within group variability and sample size in an analysis of variance is discussed in: Gourevitch, V., Statistical Methods: A Problem-Solving Approach, Boston: Allyn and Bacon, Inc., 1965, pp. 251-256.

Mean Square (within) might be deceiving and so chose to proceed with his original plans to compare each pair of treatment group means using standard t tests.[3] This decision was strongly motivated by the assumption that large within group variability, small sample size and the general imprecision of the F test may well have combined to cause the Analysis of Variance to fail to detect a marginally significant difference between one or more pairs of treatment group means.

B. t Test Comparisons

Table Nine, below, reports the results of the six t test comparisons that were conducted in order to determine which pairs of observed treatment group means, if any, were statistically significantly different. The mean pairs compared were: I-II, I-III, I-IV, II-III, II-IV and III-IV.

TABLE NINE

Results of the t Test Comparisons* of Treatment Group Means

(Alpha=.05)

	GROUP I	GROUP II	GROUP III	GROUP IV
GROUP I		t=0.55 p-- (Ho not rejected)	t=0.83 p-- (Ho not rejected)	t=1.71 p <.05 (Ho rejected)
GROUP II			t=0.34 p-- (Ho not rejected)	t=1.27 p-- (Ho not rejected)
GROUP III				t=0.89 p-- (Ho not rejected)
GROUP IV				

In all cases, df=38

In all cases, critical t (.05)=1.69

Ho: for each comparison;

μ(largest) $\leq$ μ(smallest)

*All t test comparisons were one-tailed tests for independent samples.

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[3]Another important reason for conducting the planned t test comparisons of pairs of means was to test the author's three specific hypotheses in detail. Such an analysis would be permissible in light of an insignificant F test only if, as is the case here, specific hypotheses about particular pairs of means had been proposed before data analysis was begun.

The results of the six t test comparisons shown in Table Nine indicate that only the means of Groups I and IV are statistically significantly different at the .05 level. Taken together, these t test findings fail to support, in total, any of the three specific hypotheses proposed earlier. Because of this overall failure, these findings make it quite clear that the data have not produced strong statistical support for the General Research Hypothesis.

Returning now to the matter of the statistically significant difference between the means of Groups I and IV, the reader will recall from the discussion in Chapter II (see page 73) that in the author's opinion, were the mean of Group I to turn out to be significantly greater than that of Group IV, this finding could be viewed as offering weak support for the General Research Hypothesis. While the Group I vs. Group IV t test significance is indeed encouraging in this regard, two important words of warning must be offered before such an interpretation is made. First, although the Group I vs. Group IV t test comparison was found to be significant at the .05 level, Table Nine reveals that the observed t value of 1.71 was only slightly greater than the needed critical t value of 1.69. This, of course, signifies marginal significance and readily suggests that this finding might well be a fluke and should thus be interpreted very cautiously. Second, even though significance was found, due to the fact that whenever several pairs of sample means are compared according to some pre-determined pattern, as was done here, the researcher could expect to find one significantly different pair of means on the basis of chance alone.[4] There is, of course, no way of telling whether the Group I vs. Group IV t test significance observed here was such a chance occurrence but the mere possibility of this having happened strongly argues for a cautious interpretation of this particular finding.

Unfortunately, the two factors noted above make it quite clear that weak support for the General Research Hypothesis can be concluded only tenuously.

V. Correlational Analysis

A. Zero Order Correlation

Descriptive analysis of the rank ordering of the Cloze Percentage Means

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[4]The foundation of this expectation in terms of "probability theory" is discussed in:
Lindquist, E., Design and Analysis of Experiments in Psychology and Education, pp. 47-49.

of the four treatment groups indicates that Message Transformational Complexity and Receiver Message Comprehension are indeed inversely related. However, the author wished to index the magnitude of this relationship. In order to do this, a Zero Order Pearson Product Moment Correlational Analysis was performed in which Message Transformational Complexity was cast as the X variable and Receiver Message Comprehension was cast as the Y variable. This analysis yielded an $r = -0.1873$.

B. Significance of the Zero Order Correlation Coefficient

The above Correlation Coefficient, by itself, is not particularly meaningful unless its statistical significance is determined. In order to make this determination, the following modified two-tailed t test for independent samples when $N < 100$ was used to assess the significance of the obtained Zero Order Correlation Coefficient[5]:

$$t = \frac{r}{\sqrt{(1-r^2)/(N-2)}}$$

alpha = .05
N = 80
df = N-2 = 78
Ho: R = 0

When the appropriate values were substituted in the above formula, an observed t value of -1.52 was obtained, which for seventy-eight degrees of freedom failed to meet the critical t value of 1.93 needed for significance at the .05 level. On this basis, the null hypothesis could not be rejected.

The findings of the above analysis should predictably parallel those of the Analysis of Variance reported earlier. This, of course, is the case, thus indicating that the magnitude of the inverse relationship between Message Transformational Complexity and Receiver Message Comprehension is not great enough to offer strong correlational support for the General Research Hypothesis.

C. Percent of Variance Explained

As part of the correlational analysis the author also wished to know the amount of variance in Receiver Message Comprehension that increases in Message Transformational Complexity were capable of explaining. This was determined by squaring the observed Correlation Coefficient. Doing so yielded an $r^2=0.0351$ which when converted to percentage form indicates that only 3.51 percent of the

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[5]This modified t test statistic is explained in detail in: McNemar, Q., Psychological Statistics, pp. 156-157.

variance in the dependent variable was explained by increases in the independent variable.

This particular finding coupled with the fact that there was a great deal of variance in the dependent variable to be explained in the first place suggests that some extraneous variables may have been present and that they may have served to mask or else completely wash out the effects of increased Message Transformational Complexity on subjects' comprehension. Some of these spurious variables, which a subsequent re-analysis of the data showed to be sociolinguistic/demographic in nature, are discussed in the next chapter in which the major results reported in the present chapter are discussed in greater detail.

In summary, the main findings to come out of the data analysis outlined above are as follows:

1. The observed rank ordering of the Cloze Percentage Comprehension Means of the four treatment groups was as predicted. This can be interpreted as strong descriptive support for the General Research Hypothesis.
2. A t test comparison revealed that the Cloze Percentage Comprehension Mean of the "base line measures" group was far enough below the mean of Group I (and all other treatment group means) to provide evidence that there was indeed a treatment effect.
3. Taken as a whole, the parametric and correlational analyses of the data failed to derive strong statistical support for the General Research Hypothesis.
4. The t test comparison of the Cloze Percentage Comprehension Means of treatment groups I and IV was found to be significant at the .05 level, thus suggesting weak support for the General Research Hypothesis (when treating the independent variable dichotomously). However, due to the facts that the significance obtained by the t test was marginal and that the two means compared were purposely rather than randomly chosen, the stability and conclusiveness of this particular finding is highly questionable.

CHAPTER V

I. Introduction

Although the specific conclusions to be drawn from each of the four individual sub-parts of the overall data analysis have been outlined in some detail in the preceding chapter, more general conclusions gleaned from a consideration of all portions of the analysis combined have not yet been made explicit. Thus, the aim of Section II of this chapter is to present an overall interpretation of the data in light of the General Research Hypothesis. Although broadly concerned with providing an interpretation of the data, the discussion moves somewhat beyond this topic by considering a number of real and potential research design and methodological inadequacies. The design/methodological inadequacies discussed include potentially adverse effects due to small sample size, large within group variability, use of an inappropriate unit of analysis, too many contextual clues in the test instruments, inadequate manipulation of the independent variable, and pre-sensitization of subjects. The author's main purpose in criticizing his study in this manner is to suggest a number of ways in which it might be revised for future replication in the interests of trying, once again, to provide a truly definitive test of the effects of increased transformational complexity on message comprehension.

Section III goes on to elaborate specifics of a proposed replication study and in addition suggests a number of directions in which future investigations of transformational behavior might profitably move. The new research directions to be proposed should be of considerable interest to a broad range of scholars concerned with language and its users, including linguists, psycholinguists, sociolinguists and students of human communication.

The discussion in Section IV concludes this chapter by reiterating the basic aim of the study, its methodology, its results and the conclusions to be drawn from it.

II. Discussion and Interpretation of Results

When all aspects of the data analysis are taken into account, it becomes clear that the single most encouraging finding to come out of this study is that the Comprehension Means of the four treatment groups were aligned in exact accor-

dance with the inverse relationship between Message Transformational Complexity and Receiver Message Comprehension predicted by the General Research Hypothesis.

This finding takes on added importance in light of the fact that the "base line measures" Group vs. Group I t test findings clearly demonstrate the presence of a treatment effect. That this effect can legitimately be attributed to the operation of the independent variable seems quite probable given the general equivalence of the four stimulus versions on such relevant dimensions as denotative meaning, length and redundancy.

While there is evidence suggesting that the independent and dependent variables are inversely related, the results of the statistical parts of the analysis clearly show that this relationship is not statistically significant.

In terms of support or rejection of the General Research Hypothesis, the findings of the data analysis seem to argue for the following two conclusions. First, because of the general failure of the statistical analyses to detect a statistically significant relationship between the variables under study, the General Research Hypothesis cannot be accepted on the basis of the available data. Second, due to the fact that there appear to be a number of weaknesses in the design and methodology of the study which may have prevented significance from being found, the General Research Hypothesis should not be rejected at this time, pending a revised, and hopefully more conclusive, replication of the present study. That any final decision concerning the correctness of the General Research Hypothesis should be postponed pending further research seems both legitimate and warranted given the "exploratory" nature of the present study as a test of the Derivational Theory of Complexity within a message context.

With these conclusions in mind then, the remainder of this section is devoted to a discussion of those several weaknesses which may have detracted from the present study and which should be corrected in any future replication experiment.

A. Small Sample Size

The preceding chapter attributed the failure to find significance largely to the relative smallness of the treatment group samples. The correctness of this assertion can be checked because it is possible to mathematically determine needed sample size in experimental situations.[1] In order to determine what the minimal

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[1]The mathematical test mentioned above is the "determination of sample size" test and the interested reader is directed to:
Hays, W., Statistics for Psychologists, New York: Holt, Rinehart and Winston, 1963, pp. 229-233, for a full explanation of computational procedures.

sample size should be in a replication study involving four treatment groups and an alpha level of .05, the author conducted a "determination of sample size" test. This test showed that if the sample size of each treatment group was at least 48, one could be 95% certain that statistical tests would find significant differences if they in fact existed.

Since the results of this test were based, in part, on the estimated population means derived from the sample means observed in the present study, it is clear that the 20 subjects per treatment group used here were far too few. This strongly suggests that due to the smallness of the sample sizes, the present study did not constitute a fair test of the General Research Hypothesis, and that in a replication study the size of each treatment group should be around 50.

B. Large Within Group Variability

As was pointed out in the preceding chapter, the finding of significant differences through the use of statistical tests depends not only on sample size, but on variability as well. Quite probably, the great variability in subjects' comprehension accuracy was another factor which prevented significance from being found in the present study. The test for appropriate sample size discussed above suggests that in a future replication significance might be found if larger samples were tested. However, should the use of large samples for some reason be impractical or impossible, there appears to be yet another way of making the experiment a more fair test of the General Research Hypothesis.

In the present study, large within group variability was less of a problem than was the fact that most of this variability was left unexplained. This quite clearly suggests that some uncontrolled independent variable(s) played a confounding role, making it impossible to study the effects of increased Message Transformational Complexity on subjects' message comprehension in isolation. In conceptualizing a workable replication study, it is, of course, necessary to speculate as to what some of these confounding variables might be, in order to compensate for them through appropriate control. Fortunately, there is evidence suggesting what some of these variables might be. Specifically, it would appear as though three sociolinguistic variables and one individual performance variable are of critical importance.

Looking first at the sociolinguistic variables, in a re-analysis of the present data, Milkovich and Reagan sought to determine if the inclusion of a number of standard sociolinguistic/demographic variables would significantly

add to the percent of variance explained.[2] Thus, in their analysis, in addition to transformational complexity, the following information about each subject was also included: age, sex, year in college, size of the community in which he spent the first ten years of his life, whether or not a language other than English was used by his parents in his home, mother's educational level, father's educational level and the occupational status and income of the parent who provided the primary means of financial support for his family.

In part of their analysis, Milkovich and Reagan used a Multiple Regression analytic scheme and found that occupational prestige and income of the main family breadwinner, mother's educational level, use of a foreign language in the home and transformational complexity, in that order, accounted for the majority of the variance on the comprehension variable.[3]

The authors conclude that their findings are not too surprising given the importance sociolinguists such as Bernstein have ascribed to the sociological variables noted above in terms of governing an individual's linguistic performance and language comprehension abilities.[4] They further suggest that in order to be able to isolate and guage the effects of increased transformational complexity on message comprehension, relevant sociolinguistic variables affecting comprehension must either be experimentally controlled or statistically partialled out.

Evidence of the effects of a particularly troublesome individual performance variable comes from a study very much like the present one that was conducted by Reid.[5] In this study, Reid systematically varied the grammatical complexity of two versions of an otherwise equivalent message. These message versions were presented to two different groups of subjects who read them and afterward took

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[2]Milkovich, M. and Reagan, R., A Psycho-Sociolinguistic Account of the Comprehension of Spoken English Messages, unpublished paper, Michigan State University, 1973.

[3]The percent of variance explained by each of the above variables is as follows: occupational prestige and income of the main family breadwinner, 15%; mother's educational level, 13%; use of a foreign language in the home, 13%; and transformational complexity, 10%.
Milkovich, M. and Reagan, R., op. cit., pp. 15, Table 3.

[4]Bernstein, B., "A Sociolinguistic Approach to Socialization: With Some Reference to Educability", in Williams, F. (Editor), Language and Poverty: Perspectives on a Theme, Chicago: Markham, 1970.

[5]Reid, R., "Grammatical Complexity and Comprehension of Compressed Speech", Journal of Communication, 1968, 18:236-242.

a multiple choice test intended to index their comprehension of the version read.

Reid analyzed his data in two ways. In the first analysis he conducted a standard t test comparison of the two treatment group means and found that they were not statistically significantly different. Since he felt his samples were large enough, Reid attributed the failure of the statistical analysis to large within group variability (which was quite large). Reid then hypothesized that much of the unwanted variance on the comprehension variable might be attributable to variability in subjects' general level of verbal ability. In order to test this hypothesis, Reid conducted a second analysis of the data using an Analysis of Covariance analytic scheme in which subjects' verbal ability scores on their high school Scholastic Aptitude Tests were used as the "adjustment" variable on the basis of which the actual group means were recalculated.[6] The results of the Analysis of Covariance clearly showed that when verbal ability was controlled out, the presence of the predicted inverse relationship between increased grammatical complexity and subjects' message comprehension was easily detectable and quite strong.

Reid's findings clearly suggest that verbal ability is an important individual performance variable figuring in message comprehension and for this reason should be controlled in any replication of the present study. It should be noted here that it seems intuitively possible that verbal ability may well subsume some, or all, of those relevant variables identified by Milkovich and Reagan. This, of course, would have to be determined experimentally, but to the extent that substantial overlap should be found, a replication study would be greatly simplified in that verbal ability could be used as the sole "adjustment" variable in a standard Analysis of Covariance design, which has decided advantages over a more complicated Multiple Regression analysis involving several predictor variables.

Although the four specific variables mentioned above undoubtedly do not constitute a complete list of relevant variables affecting comprehension in transformational experiments, it seems reasonable to suppose that were they, at a minimum, to be controlled in a replication experiment which also tested large samples, support for the General Research Hypothesis might well be found.

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[6]Analysis of Covariance designs are quite thoroughly discussed in: Edwards, A., Experimental Design in Psychological Research, New York: Rinehart and Company, Inc., 1950, pp. 333-358.

C. Inappropriate Unit of Analysis

One of the most important aspects of the re-analysis of the present data done by Milkovich and Reagan was that they used the individual Cloze blank as their unit of analysis as opposed to each subject's Cloze Percentage Score for the entire message version. This was done specifically to determine whether the message Cloze Score (where each subject contributes one data point) or the individual Cloze blank (where each subject contributes approximately sixty data points) should be used as the primary unit of analysis in a replication study.

As part of their analysis, Milkovich and Reagan guaged the zero order correlation between Message Transformational Complexity and Receiver Message Comprehension and subsequently found that when the individual Cloze blank was used as the unit of analysis 18% of the variance in the dependent variable was explained by increases in the independent variable. Although this percentage was not found to be significantly different from zero, it clearly represents some improvement over the 3.5% of variance originally explained.

This finding suggests that in a replication study the individual Cloze blank might profitably be used as the unit of analysis. Since its use increases sample size considerably, most would be gained from the use of the individual Cloze blank as the unit of analysis in situations where the number of subjects is modest. If a large number of subjects is available, little is gained from the use of the individual Cloze blank as the unit of analysis because of the many complications that it adds to the analysis of data.[7]

D. Too Many Contextual Clues

Another likely problem in the present study was that numerous Cloze blanks were apparently very easy to fill in, largely owing to the frequent use of the Passive Transformation in the various transformational cycles and an over abundance of salient contextual clues. That these factors may have somehow combined to make portions of all the Cloze tests artificially simple seems relatively certain for two reasons. First, the treatment group means were all almost identical. Second, close inspection of the data indicated that several blanks were missed by no one; these particular blanks being, in all cases, function class words, clearly predictable on the basis of sentence context.

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[7]Taylor, W., "Recent Developments in the Use of Cloze Procedure", Journalism Quarterly, 1956, 33:48.

In a replication study, two minor modifications would eliminate the problem of too many contextual clues. In his work on the Cloze Procedure methodology, Taylor found that function class words are normally easier to guess than form class words.[8] This is so because function words are more clearly deducible from sentence context than are form class words. This clearly suggests that one modification in the Cloze tests would be to include as blanks only form class words such as sentence subjects, objects and main verbs. Doing so would eliminate testing on easy function words while at the same time not detracting from the efficacy of the Cloze methodology.

The problem associated with over use of the Passive Transformation is easily dealt with. All that needs be done is to modify the versions so that the Passive is used in only one cycle. Occurrences of the Passive in other cycles could be eliminated by replacing it with other workable transformations.

The end result of adopting the above two modifications in a replication study should be a greater difference in group mean values due to an increase in the complexity of the comprehension tasks. If greater mean differences result, significance may be obtained.

E. Inadequate Manipulation of the Independent Variable

The observed closeness of the treatment group means suggests a further weakness in the study. Specifically, in light of the similarity of means, it seems reasonable to postulate that the independent variable manipulation was not strong enough. That this may indeed have been a problem is substantiated by the fact that treatments twenty transformations apart were not significantly different. Only in one case where treatments were sixty transformations apart (Group I vs. Group IV), was significance detected.

The problem here can be stated as follows; even though twenty transformations difference between versions seems like a big difference when manipulating transformational complexity on paper, the data show that psychologically this difference is not very great. In order to correct this problem, drastic revision of the message versions is required. Specifically, the versions need to be more different in their respective levels of transformational complexity. Assuming that a difference of sixty transformations is a more realistic disparity, versions should be designed that have either zero, sixty, one hundred twenty or one hundred eighty

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[8] Loc. cit.

transformations each. Once these versions are created, they should be pre-tested on a small sample of subjects to determine if the manipulation of the independent variable is adequate. If it is, the replication can proceed using a large sample; if not, versions differing even more in transformational complexity should be designed and pre-tested.

In order to fairly test any hypothesis, the manipulation of the independent variable must be adequate. To the extent that the data suggest that this may not have been the case in the present study, the implication is clearly that the General Research Hypothesis was not fairly tested and that the manipulation should be strengthened in a forthcoming replication.

F. Pre-Sensitization of Subjects

It is entirely possible that subjects were pre-sensitized to the nature of the upcoming experimental task in the present study. This may have happened for two reasons. First, during preliminary instructions reference was made to the experimental task. Even though this reference was rather neutral, clues may have been provided to subjects. Second, in one administration someone other than the author acted as Experimenter. It is possible that this person may have provided extra clues as to the nature of the experimental task in this one administration that were not present in the other administrations.

That these problems may have existed clearly suggests two modifications in the replication study. First, no reference to the upcoming task should be made during preliminary instructions. Second, the same person should administer all treatments.

If these modifications are made, it seems unlikely that subjects will receive salient clues as to how to process the version they will hear which may in turn lead to atypical or short-cut decoding strategies.

III. Directions for Future Research

Given that the General Research Hypothesis can legitimately be neither accepted nor rejected on the strength of the present data, a replication experiment is clearly needed to more conclusively determine the effects of increased transformational complexity on message comprehension. Significant clues as to what this replication should be like were presented in the preceding section, but in order to better tie these ideas together and present some new ones, the discussion which follows is provided.

1. The replication should have four meaningfully equivalent versions of the same message, each differing by forty transformations.
2. These message versions should be pre-tested to insure that the manipulation of the independent variable is working.
3. In the present study, uniform cognitive processing difficulty was assumed for all transformations used. In the replication, this assumption should be pre-tested by devising a set of similar sentences each containing one of the transformations being considered. These sentences should be presented orally to a group of subjects one at a time who would be asked to write the test sentences immediately after presentation. If all transformations are of the same degree of cognitive complexity, all test sentences should have relatively the same mean number of recall errors.
4. Once the two pre-tests noted above have provided a similar set of transformations and four message versions in which the independent variable is clearly operating, the replication can proceed. In it, eight groups of at least 50 subjects each should be tested. Four groups would be treatment groups and four "base line measures" groups. Expanding the number of groups to eight allows each treatment to have its own "base line" comparison. This will permit evidence of a treatment effect to be obtained in each experimental condition.
5. In the replication, five independent variables should be used; they are: occupational prestige and income of main family breadwinner, mother's educational level, the use of a foreign language in the home, general verbal ability and transformational complexity.
6. In each administration of treatments, the same person should act as Experimenter and no reference should be made to the experimental task during preliminary instructions to subjects.
7. The Cloze test instrument should be revised to include as blanks only sentence subjects and objects. This would insure that the same words are tested in all Cloze tests as subjects and objects would be present for all sentences in all versions.
8. The data should be scored in two ways; once using the individual Cloze blank as the unit of analysis, and again using message Cloze scores.
9. Data should be analyzed using a Multiple Regression analytic scheme which would clearly indicate the percent of variance on the comprehension variable explained by each of the independent variables, holding all others constant.

Should the replication proposed above support the original General Research Hypothesis, the author would then like to explore the Message Transformational Complexity variable in other research areas. Three of the main questions that might be investigated are:

1. What, if any, "message" variables traditionally studied by the communication scholar (ie. saliency, organization, fear appeals, one sided vs. two sided messages, etc.) interact with Message Transformational Complexity during message decoding and are any strong enough to wash its effects out entirely? This is clearly an important line of inquiry for those

studying human communication because if it were found that even though transformational complexity affects processing in isolation, it has no effect when other persuasive message characteristics are involved, its continued use in communication research would be of dubious worth.

2. Sociolinguists such as Bernstein define elaborated and restricted codes in terms of vocabulary differences, differences in available responses and differences in sentence types.[9] Milkovich has proposed that complex vs. simple transformational usage may be a more effective way of defining an elaborated vs. restricted code user.[10] His ideas have not been tested as of yet but clearly the place to begin is by attempting to determine to what extent a delineation of elaborated vs. restricted code usage on the basis of transformational complexity corresponds with the more traditional definitions based on such things as vocabulary richness proposed by Bernstein. The author suspects that the overlap is extensive and that transformational usage may be most helpful in assigning borderline cases to one code system or the other.

3. The author would also like to know if his results are generalizable to speakers of languages other than English. Specifically, is transformational complexity as important a variable in languages which have a transformational system much different from English, for example African languages? Answering this question, of course, depends on an ambitious series of replications in foreign language communities, but it is clearly worth doing.

IV. Summary

The present study was intended to determine the extent to which increased Message Transformational Complexity detracts from receivers' message comprehension. In this study, four groups of subjects heard a meaningfully equivalent version of the same message, each version differing in transformational complexity by twenty transformations. Cloze procedure was used to measure comprehension accuracy.

Message Cloze Scores were used as the unit of analysis and it was found that although the means of the treatment groups reflected an inverse relationship between increased transformational complexity and comprehension, statistical analyses failed to find this relationship significant.

It was concluded that the descriptive data alone were not conclusive enough to facilitate acceptance of the General Research Hypothesis and further that numerous design weaknesses suggest only the need for a replication of the study rather than strong grounds for rejection of the research hypothesis.

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[9] Bernstein, B., op. cit.

[10] Milkovich, M., A Brief Look at Linguistic Models in Sociolinguistics, unpublished paper, Michigan State University, 1973.

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APPENDIX A

TEXTS OF STIMULUS MESSAGE VERSIONS

VERSION ONE

Someone gave each of the platoons in B Company combat assignments. Second platoon was ordered to blow up an enemy ammunition depot at the time when the assignments were made. The Lieutenant in command stated that they would strike the depot at midnight. Never having fought at night, something gave each of the soldiers an uneasy feeling about their mission. The Lieutenant gave the men the order to move out under the cover of darkness. Several hours later, the platoon radio operator sent headquarters a progress report, once they were behind enemy lines. The platoon soon found itself forced to shoot up an enemy patrol at a place where their rifle fire could easily be detected. One young soldier then argued that the mission should be aborted in light of enemy discovery. But as they neared the enemy camp, something gave each of the men renewed courage to fight on. The Lieutenant indicated that the platoon would approach its objective from the right. The Lieutenant gave the platoon last minute instructions on a hill overlooking the enemy ammunition depot. Several soldiers began blowing up enemy machine gun nests at the time when the rest of the platoon charged down toward the depot. Enemy sharpshooters gave the platoon members stiff opposition on their way down the hill. The enemy commander ordered that the attackers be repulsed in hand-to-hand combat if necessary. Several members of the assault force were able to blow up the depot at a place where enemy defenses were weak. The Lieutenant issued the enemy commander a demand for surrender on the battleground. The enemy commander ordered his men to lay down their arms at the time when he knew the battle was lost. Someone gave each of the men orders to take enemy prisoners. The Lieutenant indicated that the platoon had fought valiantly in battle. Thus, for their bravery, someone gave each of the soldiers a medal for heroism in combat.

VERSION TWO

Each of the platoons in B Company was given combat assignments by someone. At the time when the assignments were made, second platoon was ordered to blow up an enemy ammunition depot. That they would strike the depot at midnight was stated by the Lieutenant in command. Never having fought at night, each of the soldiers was given an uneasy feeling about their mission by something. The Lieutenant gave the order to move out to the men under the cover of darkness. Several hours later, the platoon radio operator sent a progress report to headquarters, once they were behind enemy lines. At a place where their rifle fire could easily be detected, the platoon soon found itself forced to shoot up an enemy patrol. That the mission should be aborted in light of enemy discovery was then argued by one young soldier. But as they neared the enemy camp, each of the men was given renewed courage to fight on by something. That the platoon would approach its objective from the right was indicated by the Lieutenant. The Lieutenant gave last minute instructions to the platoon on a hill overlooking the enemy ammunition depot. Several soldiers began blowing enemy machine gun nests up at the time when the rest of the platoon charged down toward the depot. On their way down the hill, enemy sharpshooters gave the platoon members stiff opposition. That the attackers be repulsed in hand-to-hand combat if necessary was ordered by the enemy commander. Several members of the assault force were able to blow the depot up at a place where enemy defenses were weak. On the battleground, the Lieutenant issued the enemy commander a demand for surrender. The enemy commander ordered his men to lay down their arms when he knew the battle was lost. Each of the men was given orders to take enemy prisoners by someone. That the platoon had fought valiantly in battle was indicated by the Lieutenant. Thus, for their bravery, each of the soldiers was given a medal for heroism in combat by someone.

VERSION THREE

The platoons in B Company each were given combat assignments by someone. When the assignments were made, second platoon was ordered to blow up an enemy ammunition depot. It was stated by the Lieutenant in command that they would strike the depot at midnight. Never having fought at night, the soldiers each were given an uneasy feeling about their mission by something. The men were given the order to move out by the Lieutenant under the cover of darkness. Several hours later, once they were behind enemy lines, the platoon radio operator sent a progress report to headquarters. At a place where their rifle fire could easily be detected, the platoon soon found itself forced to shoot an enemy patrol up. It was then argued by one young soldier that the mission should be aborted in light of enemy discovery. But as they neared the enemy camp, each of the men was given renewed courage to fight on. It was indicated by the Lieutenant that the platoon would approach its objective from the right. On a hill overlooking the enemy ammunition depot, the Lieutenant gave last minute instructions to the platoon. At the time when the rest of the platoon charged down toward the depot, several soldiers began blowing enemy machine gun nests up. On their way down the hill, enemy sharpshooters gave stiff opposition to the platoon. It was ordered by the enemy commander that the attackers be repulsed in hand-to-hand combat, if necessary. At a place where enemy defenses were weak, several members of the assault force were able to blow the depot up. On the battleground, the Lieutenant issued a demand for surrender to the enemy commander. The enemy commander ordered his men to lay their arms down when he knew the battle was lost. Each of the men was given orders to take enemy prisoners. It was indicated by the Lieutenant that the platoon had fought valiantly in battle. Thus, for their bravery, each of the soldiers was given a medal for heroism in combat.

VERSION FOUR

The platoons in B Company each were given combat assignments. When the assignments were made, second platoon was ordered to blow an enemy ammunition depot up. It was stated by the Lieutenant in command that at midnight they would strike the depot. Never having fought at night, the soldiers each were given an uneasy feeling about their mission. Under the cover of darkness, the men were given the order to move out by the Lieutenant. Several hours later, once they were behind enemy lines, a progress report was sent to headquarters by the platoon radio operator. Where their rifle fire could easily be detected, the platoon soon found itself forced to shoot an enemy patrol up. It was then argued by one young soldier that in light of enemy discovery, the mission should be aborted. As they neared the enemy camp, the men each were given renewed courage to fight on. It was indicated by the Lieutenant that, from the right, the platoon would approach its objective. On a hill overlooking the enemy ammunition depot, the platoon was given last minute instructions by the Lieutenant. When the rest of the platoon charged down toward the depot, several soldiers began blowing enemy machine gun nests up. On their way down the hill, stiff opposition was given to the platoon by enemy sharpshooters. It was ordered by the enemy commander that the attackers be respulsed, if necessary in hand-to-hand combat. Where enemy defenses were weak, several members of the assault force were able to blow the depot up. On the battleground, a demand for surrender was issued to the enemy commander by the Lieutenant. When he knew the battle was lost, the enemy commander ordered his men to lay their arms down. The men each were given orders to take enemy prisoners. It was indicated by the Lieutenant that, in battle, the platoon had fought valiantly. Thus, for their bravery, the soldiers were each given a medal for heroism in combat.

APPENDIX B

TRANSFORMATIONAL CYCLES*

*The transformational operations included within the transformational cycles noted in this Appendix were derived from discussions found in the following sources:

Burt, M., From Deep to Surface Structure, New York: Harper and Row, Publishers.

Falk, J., Linguistics and Language, Lexington, Massachusetts: Xerox College Publishing, 1973.

Jacobs, R. and Rosenbaum, P., English Transformational Grammar, Waltham, Massachusetts: Blaisdell Publishing Company, 1968.

CYCLE A

Transformations in the Cycle:

T1: Passive
T2: Extraposition of Noun Phrase Complement
T3: Prepositional Phrase Embedding

Ordering of the Transformations in this Cycle:

These three transformations must always be ordered as follows:

T1 - T2 - T3

Example Sentences from the Application of this Cycle:

1. Initial Sentence Before Cycle Begins (no transformations):

   "BILL ARGUES THAT COLUMBUS DISCOVERED AMERICA IN 1492."

2. Passive Transformation Applied (one transformation):

   "THAT COLUMBUS DISCOVERED AMERICA IN 1492 IS ARGUED BY BILL."

3. Passive and Extraposition Transformations Applied (two transformations):

   "IT IS ARGUED BY BILL THAT COLUMBUS DISCOVERED AMERICA IN 1492."

4. Passive, Extraposition and Prepositional Phrase Embedding Transformations Applied (three transformations):

   "IT IS ARGUED BY BILL THAT IN 1492, COLUMBUS DISCOVERED AMERICA."

CYCLE B

Transformations in the Cycle:

T1: Dative
T2: Passive
T3: Prepositional Phrase Preposing

Ordering of the Transformations in this Cycle:

T1 must always precede T2, thus the following three orderings of these transformations are possible:

T1 - T2 - T3
T1 - T3 - T2
T3 - T1 - T2

Example Sentences from the Application of the Cycle, T1 - T2 - T3:

1. Initial Sentence Before Cycle Begins (no transformations):

   "JOHN GAVE A MESSAGE TO BILL ON THE TELEPHONE."

2. Dative Transformation Applied (one transformation):

   "JOHN GAVE BILL A MESSAGE ON THE TELEPHONE."

3. Dative and Passive Transformations Applied (two transformations):

   "BILL WAS GIVEN A MESSAGE BY JOHN ON THE TELEPHONE."

4. Dative, Passive and Prepositional Phrase Preposing Transformations Applied (three transformations):

   "ON THE TELEPHONE, BILL WAS GIVEN A MESSAGE BY JOHN."

CYCLE C

Transformations in the Cycle:

T1: Time-Place Deletion
T2: Particle Movement
T3: Adverb Preposing

Ordering of the Transformations in this Cycle:

Any orderings of transformations is acceptable here, thus the following six orderings may be used:

T1 - T2 - T3
T2 - T1 - T3
T3 - T1 - T2
T1 - T3 - T2
T2 - T3 - T1
T3 - T2 - T1

Example Sentences from the Application of the Cycle, T1 - T2 - T3:

1. Initial Sentence Before Cycle Begins (no transformations):

   "JOHN BLEW UP THE BRIDGE AT THE TIME WHEN HE SAW IT."

2. Time-Place Deletion Transformation Applied (one transformation):

   "JOHN BLEW UP THE BRIDGE WHEN HE SAW IT."

3. Time-Place Deletion and Particle Movement Transformations Applied (two transformations):

   "JOHN BLEW THE BRIDGE UP WHEN HE SAW IT."

4. Time-Place Deletion, Particle Movement and Adverb Preposing Transformations Applied (three transformations):

   "WHEN HE SAW IT, JOHN BLEW THE BRIDGE UP."

CYCLE D

Transformations in the Cycle:

T1: Passive
T2: "Each" Hopping
T3: Agent Deletion

Ordering of the Transformations in this Cycle:

T1 must always precede T3, thus the following two orderings are possible:

T1 - T2 - T3
T1 - T3 - T2

Example Sentences from the Application of the Cycle, T1 - T2 - T3:

1. Initial Sentence Before Cycle Begins (no transformations):

   "SOMEONE GAVE EACH OF THE MEN A PRIZE."

2. Passive Transformation Applied (one transformation):

   "EACH OF THE MEN WAS GIVEN A PRIZE BY SOMEONE."

3. Passive and "Each" Hopping Transformations Applied (two transformations):

   "THE MEN EACH WERE GIVEN A PRIZE BY SOMEONE."

4. Passive, "Each" Hopping and Agent Deletion Transformations Applied (three transformations):

   "THE MEN EACH WERE GIVEN A PRIZE."

APPENDIX C

AN OPERATIONAL DESCRIPTION OF THE RANDOM ORDERING OF THE CYCLES AND INDIVIDUAL TRANSFORMATIONS USED IN EACH OF THE TWENTY SENTENCES

SENTENCE	CYCLE USED	TRANSFORMATION ADDED IN VERSION ONE	TRANSFORMATION ADDED IN VERSION TWO	TRANSFORMATION ADDED IN VERSION THREE	TRANSFORMATION ADDED IN VERSION FOUR
1	D	Simple Form	P	EH	AD
2	C	"	AP	TPD	PM
3	A	"	P	ENPC	PPE
4	D	"	P	EH	AD
5	B	"	D	P	PPP
6	B	"	D	PPP	P
7	C	"	AP	PM	TPD
8	A	"	P	ENPC	PPE
9	D	"	P	AD	EH
10	A	"	P	ENPC	PPE
11	B	"	D	PPP	P
12	C	"	PM	AP	TPD
13	B	"	PPP	D	P
14	A	"	P	ENPC	PPE
15	C	"	PM	AP	TPD
16	B	"	PPP	D	P
17	C	"	TPD	PM	AP
18	D	"	P	AD	EH
19	A	"	P	ENPC	PPE
20	D	"	P	AD	EH

KEY

P-----Passive

AP---Adverb Preposing

D----Dative

PM---Particle Movement

TPD--Time-Place Deletion

PPP--Prepositional Phrase Preposing

ENPC-Extraposition of Noun Phrase Complement

EH---"Each" Hopping

PPE--Prepositional Phrase Embedding

AD---Agent Deletion

APPENDIX D

TEXTS OF STIMULUS MESSAGE VERSIONS IN CLOZE FORM

APPENDIX E

SAMPLE TEST BOOKLET
(VERSION ONE)

Student No. _____

INSTRUCTIONS

On the following two pages is the written text of the message you have just heard but with several words omitted and blanks appearing in their place. From what you remember of the message, please fill in each blank with the word you feel is correct. Each blank requires one word and only one word. You will have ten minutes to fill in all of the blanks. Work as rapidly as possible, but pay close attention to every clue that might suggest the "right word" or eliminate a "wrong word". You should try to get through the whole message in the time allotted and if no word seems exactly right, guess. If you finish before time is called, please stop and wait for further instructions before going on to the next section.

Respondent No. _____

INSTRUCTIONS

Below you will find a series of four (4) five point scales. Each scale relates to some aspect of the style of the message you have just heard. Please read each one and place an X at the point on the scale which you feel is most appropriate.

MESSAGE STYLE

Organized _____:_____:_____:_____:_____ Disorganized

Easy _____:_____:_____:_____:_____ Difficult

Simple _____:_____:_____:_____:_____ Complex

Clear _____:_____:_____:_____:_____ Unclear

Student No. _____

While we are not interested in identifying you by name we would still like to identify certain sub-groups existing within the sample of people who have agreed to participate in this study. For this reason we would be grateful if you would provide demographic information by circling the appropriate answers. If you are not sure of the answer to a particular question please provide the best estimate you can make. In questions where there is a choice of answers please circle the number corresponding to the appropriate response.

(20) Sex: Male --- 1
Female --- 2

(21) What year in school are you at, M. S., U.?
Freshman --- 1
Sophomore --- 2
Junior --- 3
Senior --- 4

(22-23) What is your age?
Under 18 --- 1
18-21 --- 2
22-25 --- 3
26-29 --- 4
30-33 --- 5
34-37 --- 6
38-41 --- 7
42-45 --- 8
46 or over --- 9

(24) What is your ethnic membership?
Latin American --- 1
Caucasian --- 2
Black --- 3
Oriental --- 4
American Indian --- 5
Other --- 6

(25) What was the size of the community in which you spent the majority of the first 10 years of your childhood?
Farm or open country --- 1
Small town to 10,000 people --- 2
Town 10,000 to 25,000 people --- 3
Small city 25,000 to 100,000 people --- 4
Large city over 100,000 people --- 5
In a suburb of a large city --- 6

(26) For the first 10 years of your childhood where did you live most of the time?
East Coast and New England --- 1
South --- 2
Midwest --- 3
Southwest --- 4
Inter Mountain Region --- 5
Pacific --- 6
Foreign --- 7

Student No. _____

(32) Do you speak a language or languages other than English?
Yes -- 1
No -- 2

(33-34) If so, what foreign language do you use most often?

_____

(35) Is this language used frequently in your parents' home?
Yes -- 1
No -- 2

(36) For the first 10 years of his childhood, where did your mother live most of the time?
East Coast and New England-- 1
South---------- 2
Midwest---------- 3
Southwest---------- 4
Inter Mountain Region------- 5
Pacific---------- 6
Foreign---------- 7

(37) Does your mother speak a language or languages other than English? ?
Yes -- 1
No -- 2

(38-39) If so, what foreign language does she use most often?

_____

(40) Is this language used frequently in your parents' home?
Yes -- 1
No -- 2

(41-42) What was the last year of school your mother completed? _____

(43) For the first 10 years of his childhood, where did your father live most of the time?
East Coast and New England-- 1
South---------- 2
Midwest---------- 3
Southwest---------- 4
Inter Mountain Region------- 5
Pacific---------- 6
Foreign---------- 7

(44) Does your father speak a language or languages other than English?
Yes -- 1
No -- 2

(45-46) If so, what foreign language does he use most often?

_____

Student No. _____

(42) Is this language used frequently in your parents' home?
Yes--- 1
No--- 2

(43-44) What was the last year of school your father completed? _____

(45) When you were between the ages of 1 and 10, which of your parents was the main source of family income?
Father-- 1
Mother-- 2

(46-47) At that time, what kind of work did he or she usually do?

_____

(48-49) At that time, what type of business or industry did he or she work for?

_____

(50) What is your parents' present annual income?
$20,000 and over---- 1
$17,000 - $19,000--- 2
$14,000 - $16,000--- 3
$11,000 - $13,000--- 4
$8,000 - $10,000---- 5
$5,000 - $7,000------ 6
Below $5,000-------- 7