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The Ohio State University, Ph.D., 1975
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AS DETERMINED BY CHILDREN'S ABILITIES TO COMPREHEND
DETERMINATE AND INDETERMINATE SYLLOGISMS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

Peter Booth Mosenthal, B.A., M.A.

* * * * *

The Ohio State University
1975

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ACKNOWLEDGMENTS

A dissertation represents a synthesis of inspiration and perseverance, as well as a confluence of mind and insight. I owe a huge debt to many who have helped nurture both over the past six years. However, in deference to my principal benefactors, I wish to thank my parents for the opportunity to pursue my love of ideas, Victor Rentel for his rare sense of humor and Socratic approach to scholarship; Martha King for her pragmatism and enthusiasm; Charlotte Huck for her reminder that truth springs from imagination as well as from fact; and Gerry Giordano for constantly renewing my perspective that scholarship is but a means to the larger end of happiness in life.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>VITA</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>v</td>
</tr>
<tr>
<td>CHAPTER</td>
<td></td>
</tr>
<tr>
<td>1. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2. Competence Defined</td>
<td>13</td>
</tr>
<tr>
<td>3. Experiments and Results</td>
<td>69</td>
</tr>
<tr>
<td>4. Conclusions and Recommendations</td>
<td>109</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>115</td>
</tr>
<tr>
<td>APPENDIX</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>137</td>
</tr>
<tr>
<td>B</td>
<td>141</td>
</tr>
<tr>
<td>C</td>
<td>146</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table


3. T-Tests of Various Combinations of Syllogism Means within Oral (Gp. 1), Visual (Gp. 2), and Iconic and Enactive Representation with Motivation (Gps. 1 and 2), p. 127.

4. T-Tests between Oral and Oral with Motivation and Iconic and Enactive Representation; and between Oral and Visual and Motivation and Iconic and Enactive Representation, p. 129.

5. T-Tests of Various Combinations of Syllogism Means between Oral (Gp. 1) and Visual (Gp. 2); and between Oral (Gp. 1) and Visual (Gp. 2) with Motivation and Iconic and Enactive Representation, p. 130.


Chapter 1, Introduction

There are two distinct but overlapping concerns that underlie research methodology. The first is the need to discover an approved and practical procedure for gathering, editing, and reporting data. The second is the desire to find if the ensuing results are right or wrong; to find ways of calculating the degree of error, isolate the sources of error, and eliminate them. The first approach necessitates tests of reliability which insure that different researchers will produce the same data and the same analysis from a given set of data. The second approach deals with validity; validity is the extent to which research investigates what it purports to investigate, independent of the researchers or their paradigms of thinking.

The degrees of reliability and validity obtained in reading research are contingent upon how one defines the reading process. If reading is defined as a decoding process, then research studies of this purview tend to be reliable and valid due to the effectiveness of the S-R paradigm to explain peripherally processed stimuli. Here one may invoke an analogy to the square law of the retinal angle—that the size of the retinal image is the reciprocal of the square of the distance an object is from the eye. The analogy is this: the validity/reliability of a cognitive process is the reciprocal of
the square of the distance a process occurs from the brain. In other words, the less a stimulus is processed, the more likely research is to be valid and reliable. Hence, since Huey's (1908) time, studies defining reading as eye-voice span, retinal laterality, eye movements, and letter and word identification processes have yielded comparatively high reliability and validity.

On the other hand, when reading is defined as a comprehension process, the S-R paradigm provides little insight of how the reader extracts meaning from print. Such a definition of reading yields studies of low reliability and validity. Simons (1971, pp. 354-355) alludes to the unreliability and low validity of such studies in his discussion of the lack of progress in comprehension research:

The current lack of descriptions of the mental process involved in reading comprehension renders it very difficult to establish adequate behavioral criteria for successful comprehension. This in turn is due to comprehension being a covert mental process which along with other cognitive processes takes place without any overt behavior being produced. Thus the behavior that is measured in research--answers to questions on comprehension tests--may be only indirectly if at all related to the comprehension process. Furthermore, it is difficult to distinguish, in anything but an arbitrary way, between behavior that reflects other psychological processes--such as motivation, memory attitude, attention, and personality. To put the problem simply, it is almost impossible to conduct fruitful empirical research when there is a lack of knowledge of which behaviors provide relevant measures of the process under investigation.
Reading research's dilemma is thus this: Although lower-level and peripheral processing (e.g., word recognition) can be studied reliably due to operationally defined criteria, these processes do not adequately represent the reading process and, hence, have low validity. Due to the absence of any other suitable paradigm, reading researchers adopt intuitions to explain comprehension. The ensuing results not only lack validity but reliability as well. Reliability and validity cannot be achieved by intuition alone; they must be predicated on theory-based research. Simons (1971, p. 341) describes this need for theory-based research as:

Theory based research has the advantage of helping to provide a principled way of separating relevant from irrelevant facts, of determining appropriate behavioral criteria, and suggesting important hypotheses that can be subjected to empirical test. Also, theory based research allows empirical research to be conducted on a rational and systematic basis.

In attempting to arrive at a valid and reliable theory of comprehension, one needs to provide not only a sufficient definition of what constitutes this process, but somehow subject it to empirical test.

Perhaps the attempt which comes closest to including cognitive processes in describing reading as a comprehension process is that of the psycholinguistic school. Characteristic of the psycholinguists' definition of reading is the assumption that reading accesses to the same linguistic competence that hearing employs.
Smith (1973), for example, views reading comprehension as translating the surface-structure of printed meaning into deep-structure cognitive meaning. Visual processing of written language either may result in first a surface-structure representation similar to that of spoken language followed by an interpretation at the level of deep-structure meaning, or it may proceed directly from surface structure of the written representation to deep-structure meaning. Smith (1973, p. 82) summarizes this comprehension process as follows:

At the very least comprehension must involve

\[
\text{surface structure of writing} \rightarrow \text{surface structure of spoken language} \rightarrow \text{deep structure of spoken language}
\]

But ... it is not possible to go from the surface structure of written language to the surface structure of speech without meaning, without the deep structure of written language:

\[
\text{surface structure of writing} \rightarrow \text{deep structure of writing} \rightarrow \text{surface structure of spoken language} \rightarrow \text{deep structure of spoken language}
\]

However, since the two deep structures are the same, there is no point in extracting meaning twice; the deep structure is common to both the written and spoken forms.

Smith (1973, pp. 71-72) further asserts that visual and oral processing employ identical linguistic-competence means:

Written language is not speech written down ... Writing is a visual form of language (not the only one), and speech is an acoustic form of language (the only obvious one if we restrict the term language to systems in which there is a syntax, that is where
meaning can be changed by modifying either the form or the order of the elements). Both writing and speech are at the surface level of language, related by hierarchical systems of rules to underlying deep structures. Whether they should be called the same language depends on how broadly the word 'language' is defined. Whatever the definition, however, writing and speech stand at an equivalent level to each other, and not in any hierarchical relationship.

Here Smith is arguing that deep-structure written and deep-structure spoken language are actually identical. This implies that the nervous system has but one comprehension competency, or execution program, to which both visual and oral processing access. While this seems reasonable, this assumption—seminal to all psycholinguistic theories of reading—remains poorly investigated at the level of comprehension. Until present, this assumption has remained unchallenged, no doubt due to its implicit logicality. Logicality, however, is hardly sufficient grounds for justifying a theory. This assumption needs to be tested.

That logicality is not sufficient for warranting such an assumption has been demonstrated by Posner, Lewis, and Conrad (1972). These researchers have shown that classification, which one reasonably would assume employs a single competency, involves at least two competencies— one dependent upon linguistic mediation and the other independent of such mediation. Linguistically mediated classification abilities can further be subdivided into those that are performed on the basis of names or on the basis of rules. Although these
investigators do not refer to these classification abilities as competencies specifically, they do refer to them as three kinds of nodes of processing and as isolable subsystems, similar to the notion of competence as it will be defined in Chapter 2. Linguistically mediated classification, as an isolable subsystem or competency, requires the subject to draw upon stored knowledge; linguistically free classification is made on the basis of the stimulus itself, upon what these investigators refer to as "physical identity."

The only empirical evidence to support the one-competency-for comprehension assumption comes from K. Goodman's work (e.g. K. Goodman, 1965; K. Goodman & Burke, 1968; Y. Goodman, 1967) employing an analysis of miscues. K. Goodman's miscue inventory essentially is a weak application of Chomsky's (1965) Aspects of a Theory of Syntax, wherein Chomsky introduces the notion of "selectional restrictions." These are rules which syntactically and semantically dictate the properties of nouns adjoined to the same sentence node as a verb. For example, given the verb "drink," these rules would specify that the noun preceding "drink" must have the feature of +animate and the noun proceeding it, the feature + liquid. K. Goodman's (1969) miscue inventory uses the modus operandi of comparing a reader's actual response with the expected response in order to observe how the reader is operating with various kinds of input. His taxonomy of miscues does demonstrate that readers' miscues tend to obey either syntactic or semantic selectional restrictions, such that a miscue may retain some syntactic or semantic property that one would expect from the context of the
preceding or proceeding word(s).

But despite this achievement, K. Goodman's theory is inadequate for several reasons. First, K. Goodman's miscue inventory suffers from the limitations of Chomsky's early linguistic model. Since 1965, Chomsky's generative transformational theory has undergone radical revision. The most important criticism of Chomsky's Aspects theory and K. Goodman's miscue inventory is that they over emphasize the syntactic component of language and under emphasize the semantic component. Comprehension, as generative semanticists would argue, involves not so much syntactic processing as it does semantic processing. Under K. Goodman's theory, semantics is defined as a series of Markovian selectional restrictions, such that the syntactic or semantic acceptability of a word is determined by the preceding and proceeding words. In such a model, the preceding word determines the syntactic or semantic property of the proceeding word. For instance, given the adjective "blue," only a noun having visible properties could be specified to follow this word, hence "blue chair" and not "blue courage."

But such an approach fails to account for linguistic variables not directly manifested in the Markovian surface structure itself. For instance, consider the following sentences,

(1) It is June, but it is snowing.
(2) Wilbur is a Republican, but he is honest.
(3) It is June and it is snowing.
(4) Wilbur is a Republican and he is honest.
Sentence (1) asserts that it is June and it is snowing, as does sentence (3). However, sentence (1) is much more complicated than (3), as it presupposes that one would not expect it to be snowing in June. Similarly, both sentences (2) and (4) assert that Wilbur is a Republican and that he is honest. Yet (2), unlike (4), has the presupposition that it is unusual to be honest if one is a Republican. Such examples suggest that certain sentences can be comprehended only relative to certain propositions and deductions; that is, to certain thought processes and the situations to which they correspond. Yet K. Goodman's miscue analysis does not take such facts into account. To make a miscue on "snowing" in (1) or on "honest" in (2) is quite different than miscuing on "snowing" in (3) or "honest" in (4). In brief, in order for K. Goodman's miscue inventory to be more than just a description of surface structure constraints on word and phrase miscues, he must account for the additional semantic phenomena such as presupposition, entailment, author's intention(s) for writing, sentential logical complexity, speech-act types, not to mention language acquisition variables.

Secondly, K. Goodman's theory assumes the reader is reading for a purpose. However, no purpose is usually specified before the child begins to read. H. Smith (1961) has shown that establishing purposes for reading significantly influences the reading comprehension of good readers. Henderson (1963) has found that fifth graders differ in their ability to formulate a purpose for reading
and that this ability is positively related to reading comprehension scores. Does a reader produce different miscues under different purposes for reading?

Another important criticism is that K. Goodman's theory addresses itself to what readers do when they produce miscues rather than what they do when they read normally (i.e. without miscues). Superficially, K. Goodman's (1969, p. 12) rationale for using miscues to construct a theory appears reasonable:

The analytical system presented here begins with the premise that all responses to the graphic display are caused and are not accidental or capricious. In every act of reading, the reader draws on the sum total of prior experience and learning. Every response results from the interaction of the reader with the graphic display. Responses which correspond to expected responses mask the process by which they are produced. But observed responses . . . which do not correspond to expected responses . . . are generated through the same process as expected ones.

Nevertheless he presupposes the answer to the important question: Do readers employ the same processes when not miscuing as they do when they are miscuing? In the words of Bertrand Russell, K. Goodman has achieved by theft what he should have earned through honest toil: to achieve the most valid theory possible, Goodman needs to demonstrate that reading without miscues is, in fact, identical to reading with miscues.

A final criticism of K. Goodman's theory is that although his psycholinguistic definition of reading specifies an interaction between thought and language,
he has limited his investigation of reading to purely linguistic variables of graphophonic information, syntactic information, and, in part, to semantic information. To satisfy his own theory of comprehension, he must ask what concomitant cognitive variables influence one's ability to employ linguistic skills. While there is a danger here in proliferating a definition of comprehension beyond practical, empirical proportions, one must ask the question: To what extent does linguistic competence exist as a function of other higher-order cognitive processes?

In summary, an approach offering much promise for defining comprehension is the psycholinguistic approach, which addresses itself to the question of how language processing functions as a cognitive process. Present psycholinguistic reading theories, such as Smith's and K. Goodman's, have operated under the assumption that visual processing accesses to the same linguistic competence as does oral-language processing. Although K. Goodman's miscue-inventory investigations have demonstrated this in part, several problems with his method of research leave this assumption empirically unproven. A second important assumption underlying these psycholinguistic theories of reading is that reading accesses not only to linguistic competence, but to additional cognitive abilities as well. Finally, a third assumption peculiar to K. Goodman's approach has been that the reading process which produces miscues is identical to the process which does not produce miscues.

It is the purpose of this study to investigate
the validity of these three assumptions. These three assumptions can be stated, respectively, as the following hypotheses:

(1) Visual-language processing accesses to the same linguistic competency as does oral-language processing.

(2) Visual-language processing is a function of other cognitive variables of which oral language processing is a function.

(3) The normal reading process is the same as the reading process involving miscues; both these processes are the same as normal and miscued oral language.

Before testing these hypotheses, linguistic competence will be defined, first philosophically, then operationally and ostensively from the viewpoints of phenomenological psycholinguistics and developmental psycholinguistics. A theory of comprehension will be proposed in the process. Evidence will be further adduced for considering additional cognitive variables important for linguistic processing. It will be argued that comprehension is but a particular example of one's problem-solving abilities, which must incorporate the notions of strategies, representation type, and motivational competence. This, in sum, will constitute the rationale for the three experiments described in Chapter 3.

This third chapter further refines this study's comprehension theory and its underlying rationale. In this chapter tests of this thesis' three hypotheses and
results will be presented. Chapter 4 is a summary and discussion of these results and suggests implications for further studies.
Chapter 2, Competence Defined

Throughout the history of the study of the mind, there have been those who believe that such study can be advanced only by focusing upon observable manifestations of the mind. On the other hand, there have been those who maintain that such observations are significant only in so far as they reveal latent laws that only partially manifest themselves in overt behavior.

Chomsky (1965) has adopted the latter of these views. He has suggested the laws of language, which he has called "competence," can be intuitively derived by observing spoken language, or what Chomsky calls "performance." Chomsky's (1965, pp. 3-4) develops his rationale for this competence-performance distinction as follows:

Linguistic theory is concerned primarily with an ideal speaker-listener, in a completely homogeneous speech community, who knows its language perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention and interest, and errors (random or characteristic) in applying his knowledge of the language in actual performance. This seems to me to have been the position of the founders of modern general linguistics, and no cogent reason for modifying it has been offered. To study actual linguistic performance, we must consider the interaction of a variety of factors, of which the underlying competence of the speaker-hearer is only one. In this respect, study of language is no different from empirical investigation.
of other complex phenomena.

We thus make a fundamental distinction between competence (the speaker-hearer's knowledge of his language) and performance (the actual use of language in concrete situations). Only under the idealization set forth in the preceding paragraph is performance a direct reflection of competence. In actual fact, it could not directly reflect competence. A record of natural speech will show numerous false starts, deviations from rules, changes of plan in mid-course and so on. The problem for the linguist, as well as for the child learning the language, is to determine from the data of performance the underlying system of rules that has been mastered by the speaker-hearer and that he puts to use in actual performance. Hence, in the technical sense, linguistic theory is mentalistic since it is concerned with discovering a mental reality underlying actual behavior. Observed use of language or hypothesized dispositions to respond, habits, and so on, may provide evidence as to the nature of his mental reality, but surely cannot constitute the actual subject matter of linguistics, if this is to be a serious discipline.

Since the appearance of the above competence-performance distinction, a flurry of refinements have issued from the pens of scholars in all fileds of the social sciences. In order to elucidate the notion of competence and precipitate some sense from its myriad interpretations, this term will be approached first from the vantage of the philosophy of theory.

Competence as a Theoretical Construct

In constructing a new theory of grammar, Chomsky faced the problem common to all new theory builders--
the choice of what new concepts upon which to construct
the theory. Basically there are only two ways in which
a new concept can be introduced into a theory: by
definition (i.e. defining the new term by means of
terms already occurring in the theory), or by adding
the new concept as a primitive, or undefined term, to
the theory's presently established set of primitives.

For instance, imagine one were constructing a
time about animals resembling elephants and moose
and there arose the need to describe a newly discovered
beast having the properties of both elephants and moose.
This beast might be accounted for by calling it a
"phantoosy" and defined as having the body of an elephant
and the head of a moose. "Phantoosy," in this case, is
introduced into the theory by definition. Note, this
time is still dealing with elephants and moose.

On the other hand, imagine the situation where a
time must incorporate a third animal having none of
the characteristics of either an elephant or a moose,
say a bladder fish. In this instance, the term "bladder
fish" must be incorporated into the theory as a primitive,
or a term not defined by terms already existing in the
time. Thus, by introducing primitives into the theory,
time is modified to account for something previously unaccounted for.

Chomsky did essentially the same thing to linguistics
(albeit with more elegance). By adding the terms "compe-
etence," and "performance" as primitives to the then
existing theory, he was not adding to the structuralist
time of language, as he was replacing the old theory
with a new theory. No longer was language conceived of
as a string of words on paper; it was a dynamic process of the mind whose laws were inferrable from the output. In sum, Chomsky added bladder fish to an otherwise simplistic theory of elephants and moose.

As these primitives—competence and performance—constitute the basic framework for Chomsky's generative transformational theory of language, much of the subsequent revision of this theory has focused upon reinterpreting these terms. Four types of reinterpretation have been proposed. These include redefining competence and performance as: (1) operational terms, (2) ostensive terms, (3) observational terms, and (4) as dispositional-vs.-theoretical terms.

By redefining competence and performance as operational terms, we are referring to the process of conveying the meaning of these terms by specifying different operations required to test for the presence of what these terms are said to refer. Chomsky's modus operandi of assessing language competence with reference to intuition has been revised to include such reference assessments as cognitive constraints (e.g. perceptual constraints and memory limitations), neurological pathologies, acquisition sequences, and, more generally, language universals.

Reinterpretation of competence and performance as ostensive terms refers to the process of conveying the meaning of these terms by exhibiting an extension of the phenomena to which these terms refer. Hence many linguists have expanded the domain of competence to include such reference assessments as cognitive constraints (e.g. perceptual constraints and memory
limitations), neurological pathologies, acquisition sequences, and, more generally, language universals.

Reinterpretation of competence and performance as ostensive terms refers to the process of conveying the meaning of these terms by exhibiting an extension of the phenomena to which these terms refer. Hence many linguists have expanded the domain of competence to include not only linguistic rules, but sociolinguistic rules as well, these latter rules relating speech and interpretation to such social variables as sex, age, or relative rank of the speaker and listener, topic, setting, etc. This more inclusive ostensive definition of competence has been referred to by Hymes (1971) as "communicative competence."

Others have argued that language study has no validity unless one deals with the observable variables of language and infer competence properties based on these observations. Labov (1971, pp. 451-452), in particular, has raised questions about the validity of the mentalistic approach to describing competence:

The question of validity has been raised many times in regard to generative grammar, but Chomsky has explicitly rejected any definition of validity which would depend upon correlating linguistic rules with behavioral or biological data (1965, p. 9). In its present form, a generative grammar is one of many models that are descriptively adequate, selected by an internal evaluation measure. The competence/performance distinction serves to insulate generative grammar from the definition of validity advanced in our first section—that our theories must apply to the unreflecting language used by ordinary people in everyday life. But the insulation is perhaps only temporary, a matter of strategy, as Chomsky
seems to imply. It is not accidental that among those working within the generative framework, phoneticians and biologically oriented linguists, are the most dissatisfied with the competence/performance barrier.

Labov is raising the question of what criterion should determine the choices of the concepts that will be primitive within a scientific theory of language. The criterion he favors is that the primitives of a theory should be experimentally testable, thereby assigning the primitives the status of observational terms. By requiring that primitives have experimentally testable reference, one gains the concomitant advantage that all new concepts introduced via a given primitive will, in turn, be experimentally testable.

By citing the lack of validity of Chomsky's competence-performance distinction, Labov is suggesting that these primitives be redefined to refer to observables--"the unreflecting language used by ordinary people in everyday life." Although Labov's argument appears common sensical, the criterion of observability and experimental testability of competence is not this simple. In short, Labov fails to address the problem of this term's "dispositional significance."

Hempel (1959) has argued that the disposition to manifest some property is different from the actual manifestation of that property. To say a food is digestible is obviously not the same as saying it is being digested. It is possible that certain states may never exhibit their alternative states. Hence, while one's dispositional competence may suggest capability for
performing certain linguistic tasks, these tasks may never be exhibited. Labov would have us focus not upon the dispositional aspects of competence but rather on its observable aspects. This is equivalent to saying that performance is competence and, indeed, not Chomsky's idealized performance, but performance as defined either observationally or ostensively.

Discounting the dispositional characteristics of competence limits one to only partial formalization of competence. "Partial formalization" means that only a few of the possible sets of statements comprising a formalized system are deductively interrelated. By requiring that primitives be entirely observational terms, one limits his organizing account of the mind's universal properties to paradigms of observable study. While such an approach may unqualifiably yield the highest reliability, it does not yield the fullest formalization of a theory of mind and thereby suffers in terms of validity.

While partial formalizations have their own redeeming value, a full formalization of language competence merits examination of the extent to which visual and oral language access similarly to linguistic competence. Secondly, by viewing language competence both as a dispositional and observable phenomenon, one may more fully assess the roles representation and motivation play as higher cognitive variables affecting linguistic competence. Thirdly, by adopting a full-formalization approach to language, one may include "theoretical" terms in a theory. Theoretical terms
are distinguished from dispositionals insofar as the former refer to nonobservable characteristics of nonobservable phenomena, while the latter refer to nonobservable properties of observable entities. Later it will be observed that while linguistic competence is a dispositional phenomenon, observable via performance, logic as a construct representing cognitive reasoning is purely a theoretical term. It occupies a place in cognitive theory similar to the term "electron" in physics, "superego" in Freudian psychology, "cultural lag" in sociology, and other such constructs as "length," "volume," "mass," "charge," and "preference." By defining "logic" as a theoretical term, one avoids what Smedslund (1970) has termed the "circular relation between understanding and logic." Smedslund argues that more often than not "understanding" is adopted as a theoretical term and "logic" as a definable term. In such a case, logic becomes the independent variable while understanding is the source from which dependent variables are defined. A circular relation between understanding and logic is incurred when both are assigned the status of observable terms such that the presence of one is defined in observing the other. To avoid these problems, logic will be construed as a theoretical term serving as the source of dependent variables against which understanding (i.e. linguistic competence) will be measured.

In summary, the approach to be adopted in defining competence will strive for the fullest formalization possible, assessing competence not only as an observable term, but as a dispositional and theoretical term as well.
The Progenies of Chomsky's Competence--The Philosophical and Psychological Approaches to Linguistics

Dingwall (1971) has suggested that by introducing the competence notion with its concomitant mentalistic approach to study the mind, Chomsky realigned the discipline of linguistics with psychology. Such a view argues that Chomsky and his disciples' linguistic theories are not merely descriptive statements, but actual psychological processes. This branch of linguistics which treats generative language principles as psychological realities and which interprets competence as an observational term is called "psychological linguistics." Chomsky (1967, p. 100) himself noted the need for this type of interpretation of competence:

... sooner or later—in some areas sooner, in other areas later—it is going to be necessary to discover conditions on theory construction, coming presumably from experimental psychology or neurology, which will resolve the alternatives that can be arrived at by the kind of speculative theory construction linguists can do on the basis of the data available to them.

Psychological linguistics thus is characterized by a "harmony requirement" of the type proposed by Katz (1964, pp. 133-134) that "enables us to refute [or revise] a linguistic theory if we can find psychological theories or facts that are inconsistent with it or neurophysiological accounts which describe brain structure in a way that precludes the linguistic theory from being isomorphic to any of the structures in the human brain."
With regard to philosophical linguistics, Dingwall (1971) observes that although some advances have been made in developing descriptive accounts of meaning, these advances contribute much more to formal logic than they do to psychology. Dingwall further argues that competence as a theoretical term cannot and should not be conceived a priori as a direct representation of psychological reality. Although this caveat intuitively is clear enough, several philosophers and linguists have violated it. Fodor and Garrett (1966, p. 152), for example, have claimed:

A grammar is simply an axiomatic representation of an infinite set of structural descriptions, and the internal evidence in favour of the structural descriptions modern grammars generate is so strong that it is difficult to imagine their succumbing to any purely experimental disconfirmation.

In total, those who assign deep structure representations the status of directly reflecting real-time psychological representations are culpable of Smedslund's circular-relation criticism. Just as logic may be defined as understanding and understanding defined as logic, so may deep structure representation be defined as the psychological reality of language and the psychological reality of language may be defined as deep structure representation. This problem again can be obviated by assigning deep structure representation the status of a theoretical term and employing it as a source for dependent variables. The rationale for adopting this procedure will be explained more fully in the following section.
Philosophical Linguistics

In recent times, Chomsky's Aspects model has undergone the greatest revision at the level of the semantic component. Linguists have found this component too impoverished to enable Chomsky's grammar to achieve its objective of explaining all the linguistic relationships between sound and meaning. To demonstrate this, first a summary will be presented of what the semantic component is theoretically supposed to achieve.

Just as the syntactic component of a grammar is supposed to describe the speaker's syntactic competence (i.e. his knowledge of the structure of sentences) and the phonological component of the grammar is supposed to describe his phonological competence (i.e. his knowledge of how the sentences of his language sound), so the semantic component is supposed to describe the speaker's semantic competence (i.e. his knowledge of what the sentences mean and how they mean what they mean).

The aim of a Chomsky grammarian in constructing a semantic component is to construct a set of rules that will provide a model of the speaker's understanding of ambiguity, nonsense, synonymy, analyticity, self-contradiction, etc. To this ends, Chomsky and his predecessors have been successful. They have developed quite an elaborate system of rules and representations accounting for precisely such phenomena. Despite this efficacy of description, however, the Chomsky grammarians have overlooked the seminal question: Just what are these rules and representations that describe semantic
competence supposed to represent in describing the "meaning" of a sentence? In brief, Chomsky's theory is descriptively inadequate, as it has no theoretical terms whereby meaning can be systematically described. For example, consider the ambiguous sentence, "Milly took off Wilbur's pants." According to a Chomsky grammarian, the competence of an English speaker identifies this as ambiguous. In one case, Milly may be wearing Wilbur's pants, as he loaned her his pants for the evening. A second reading is that Wilbur is wearing his own pants and Milly is derobing him. A Chomsky grammarian would describe this kind of sentence by constructing a model, or a set of rules, that would represent the two meanings for this sentence. These two meanings would then be represented in two differently paraphrased deep structures. Note, however, this theory fails to explain semantic competence, as one definable set of terms is merely substituted for another set of definable terms. This semantic theory fails to explain competence, since the ability to understand paraphrases presupposes the very competence the semantic theory is seeking to explain. To achieve even partial formalization of a theory of semantic competence, a theory must have a set of primitives and/or theoreticals. No such set of terms exists at this level of Chomsky's theory. Having only definable terms at this level, Chomsky's theory is reduced to explaining general semantic competence in English by translating English sentences into other English sentences.
Although many Chomsky grammarians would be quick to argue that such paraphrases are for illustrative purposes only, and do not represent real meaning representations (or "readings"), Searle (1972, p. 22) is quick to question:

But what can the real readings be? The purely formal constraints placed on the semantic theory are not much help in telling us what the readings are. They tell us only that a sentence that is ambiguous in three ways must have three readings, a nonsense sentence no readings, two synonymous sentences must have the same readings, and so on. But so far as these requirements go, the readings need not be composed of words but could be composed of any formally specifiable set of objects. They could be numerals, piles of stones, for an analytic sentence the arrangement of stones and so on. There is nothing in the formal properties of the semantic component to prevent us from interpreting it in this way. But this will not do because now instead of explaining the relationships between sound and meaning the theory has produced an unexplained relationship between sounds and stones.

What Searle is essentially arguing for is the need for a set of primitives and/or theoretical terms by which one can characterize semantic competence. Two present modifications of Chomsky's theory do precisely this. Although these two modifications hold many assumptions in common, they differ mainly in that one approach has been built upon ostensively observable terms, whereas the other has been built upon operationally theoretical terms. While both these approaches may be subsumed under the broader paradigm referred to as "generative semantics," the former shall be referred to
as the "speech-functions approach" and the latter, the "natural-logic" approach.

The speech-functions approach has been largely a result of such philosophers as Wittgenstein (1953), Austin (1962), Grice (1957), and Searle (1961). According to these philosophers, linguistic competence consists of a speaker's knowledge of how to use sentences to make statements, ask questions, give orders, make promises, etc., and to understand other speakers when they, too, use sentences for such purposes. Under this approach, semantic competence is viewed largely as the ability to perform and understand "speech acts." Speech acts are a speaker's utterances which are both rule-governed and intentional. In other words, a speaker who utters a sentence and literally means it, utters it in accordance with certain semantic rules and with the intention of invoking those rules to render his utterance of a certain speech act.

The theory, as expostulated by Searle (1972), is this: Saying something and meaning it is essentially a matter of saying it with the intention to produce certain responses in the listener. And the type of responses evoked are determined by the type of sentence used to evoke them. For example, the speaker who knows the meaning of the sentence, "The flower is red," knows that its utterance consists of making a statement. But making a statement to the effect that the flower is red consists in performing an action with the intention of producing in the listener the belief that the speaker is committed to the existence of a certain state of affairs, as determined by the semantic rules characteristic of
this sentence type.

Thus, those adopting a speech-acts approach to linguistic description construe semantic competence as a matter of knowing the relationships between semantic intentions, rules, and conditions specified by the rules. This theory represents a revision of Chomsky's theory, as it adds a new set of primitives to Chomsky's formalization and thereby achieves even a fuller formalization of description. Searle (1972, p. 23) justifies this fuller formalization by noting:

The limitations of Chomsky's assumptions become clear only when we attempt to account for the meaning of a sentence without considering its role in communication, since the two are essentially connected. So long as we confine our research to syntax, where in fact most of Chomsky's work has been done, it is possible to conceal the limitations of the approach, because syntax can be studied as a formal system independently of its use, just as we could study the currency and credit system of an economy as an abstract formal system independently of the fact that people use money to buy things with or we could study the rules of baseball as a formal system independently of the fact that baseball is a game people play. But as soon as we attempt to account for meaning, for semantic competence, such a purely formalistic approach breaks down, because it cannot account for the fact that semantic competence is mostly a matter of knowing how to talk, i.e. how to perform speech acts.

In assessing why Chomsky has been reluctant to incorporate a theory of speech acts into his grammar, Searle (1972, p. 23) argues that Chomsky "has a mistaken conception of the distinction between performance
and competence. He seems to think that a theory of speech acts must be a theory of performance rather than of competence, because he fails to see that competence is ultimately the competence to perform, and that for this reason a study of the linguistic aspects of the ability to perform speech acts is a study of linguistic competence."

What Searle has observed is that competence is indeed a dispositional term. Rather than dismissing this term altogether, he approaches the discovery of this term's properties by adopting an ostensive, observational stance. His stance is ostensive in that rather than reformulating Chomsky's theory by introducing new terms operationally, Searle expands the scope of what competence is said to include. His approach is observable in that the terms he introduces, e.g. speech acts, are largely observable.

The natural-logic approach, on the other hand, is principally an operationally theoretical modification of Chomsky's theory. Based on the work of such linguists as Fillmore, Bach, McCawley, Ross, and Lakoff—to name only a few—it has been noted that many of the formalizations of deep structure assume the functional appearance of predication in natural logic. Lakoff (1970), for example, has observed that there is a close correspondence between basic syntactic categories and the primitive terms of symbolic logic.

Lakoff calls a logic that establishes primitive symbolic categories that adequately account for primitive relationships in natural language, "natural logic."
By specifying linguistic description in terms of logic, these grammarians claim to generate semantics via specified rules similar to Chomsky grammarians who generate syntactic structures by postulating lexical insertion rules and transformations. Hence, the name these linguists have adopted to characterize their approach to language is "generative semantics."

Lakoff (1970, p. 155) differentiates generative semantics from transformational grammar as follows:

Generative semantics differs from transformational grammar in a number of ways. Since it has been shown that deep structures in the sense of Chomsky's *Aspects* do not exist, grammars do not characterize such a level of analysis. A grammar is thought of as a set of rules, or well-formedness conditions, which generate not sentences, but pairings of derivations with classes of appropriate contexts. Since derivations are pairings of logical forms with surface forms, a grammar can be thought of as generating triples of the form (L, S, C), where L is a logical structure, S is a surface structure, and C is the class of contexts in which S can be used to express L. Each class of contexts C can be characterized by a consistent finite set of logical structures; the class consists of all those contexts in which each of the logical structures is true. Thus, we can view C as a finite set of L's.

In sum, generative semanticists interpret competence as the ability of the speaker to match appropriate sentential, logical structures with a given set of contexts. For example, consider the following sentences:

(1) Shut the door, won't you?
(2) Please shut the door.
(3) Shut the door, will you?
(4) Shut the damn door.
(5) Did you shut the door?

Although sentences (1) through (4) involve essentially the same speaker's request of the listener, they obviously must be used in different speech contexts, in descending order of politeness. To use (4) would require that the speaker is of a higher status than the listener. On the other hand, (2) suggests an equal status between the speaker and listener. The commity aspect of this context, generative semanticists would argue, must be represented in the logical deep structure of such sentences.

This notion of pairing logical structure and context is further exemplified in (5) above. In one case, generative semanticists would assign this sentence the logical structure: SAY (a, b, WANT (A, Q)) → REQUEST (a, b, Q), which means that the speaker (a) has the intention for listener (b) to close the door and so (a) makes a statement in the form of a question requesting (b) close the door. In the second case, the context of the situation may dictate that the speaker is merely asking (not requesting) the listener if he shut the door. In such an instance, the logical deep structure of this sentence would be: SAY (a, b, CONVEY (a, Q)), with the ensuing surface structure, ASK (a, b, Q).

Hence, such an approach asserts that rules of grammar for linguistic competence are inseparable from the rules that relate logical forms to surface forms.
within the constraints of certain contexts. By defining competence in this manner, generative semanticists have basically defined competence as a theoretical term predicated upon logical form.

Such a view of natural language is different not only from transformational grammar but also from formal logic grammars. Both formal logicians and transformational grammarians tend to view language as a sequence of elements. In natural languages, these elements are words and grammatical markers, whereas in logical language these elements are logical symbols. Oversimplifying a bit, the task of the formal logician is to devise artificial languages; the syntax of such languages consists of combining specified symbolic categories into descriptive formulaic patterns. Such patterns are taken to be meaningless sequences of symbols. The object of such logicians is to establish consistency and completeness in relating their categories to their formulas. Most logicians view natural languages as similar to artificial logical languages in this respect. They assume the set of well-formed sentences of a natural language can be recursively specified (or generated) by a set of rules that operate independently of the meanings of the strings. They view the problem of studying the logical form of a natural language, say English, as the problem of finding a translation of English into some logical language. Such translations are viewed as analogous to translations between English, French, and German. This likewise has been the approach of such researchers as Piaget, Roberge, and many others.
who have attempted to explain the logical operations of the mind in terms of some specified Boolean algebra of logic. But attempting to assess thought processes by specifying only logical relations among logical symbols independent of the meaning of the strings is specious.

Generative semanticists maintain that such a view is incorrect. The rules of syntax which recursively specify the well-formed sentences of English are not independent of the semantic interpretation of the sentence nor of the context in which these sentences are uttered. The grammar of natural language, thus, is fundamentally different from the syntax of artificial logical languages. In natural language, the grammar must specify not only logical structures but the semantic interpretations of these structures and, what's more, the contexts in which the surface structure of these logical structures are permissible.

Lakoff (1972, p. 270) has summarized the value such an approach to language may have for discovering the principles of higher cognitive operations:

The function of natural logic is to account for all of the relevant logical relations between the logical forms of natural language sentences. In other words, a natural logic characterizes all rational thought which is possible to carry out in natural language. It would seem then that the structures of the logical forms necessary for this endeavor would tell us something about conceptual structure. If it makes sense to talk of primitive concepts, then the atomic predicates found in logical forms are excellent candidates for such entities. If atomic predicates are thought
of as representing primitive concepts, then the
meaning postulates indicating the relations
between atomic predicates can be thought
of as showing how concepts are related to one
another. Models for natural logic can also be
thought of as explicating conceptual structure.
If the generative semantics hypothesis is correct,
then it is possible for there to be linguistic
evidence concerning just what atomic predicates
are. . . . Thus, if the generative semantics
hypothesis is correct, it is possible to begin
empirical investigations of conceptual structure
now on the basis of grammatical evidence together
with logical evidence.

While, in theory, it would be ideal for a researcher
assessing the extent to which reading competence overlaps with linguistic competence to simply employ the
conceptual structures as propounded by generative
semanticists as the source of dependent variables
characterizing linguistic competence, the theory is
not sufficiently complete to permit this shortcut.
Generative semanticists have, as yet, to establish
what constitutes the logical deep structure. Although
there has been much discussion and debate, there has
been little consensus among these semanticists as to
the properties of logical categories and their corre-
responding grammatical categories. In short, one is
confronted with the problem Chomsky (1967, p. 100)
foresaw some years ago when he stated:

. . . there will come a point . . . where one
can set up alternative systems to explain
quite a wide range of phenomena. One can think
that this or that system is more elegant and much
more deep than some other, but is it right?
The problem of assessing linguistic competence is essentially this: Although many researchers have attempted to investigate cognitive competence by using logical structures as dependent variables, they have failed to note that semantic interpretation of these logical categories and their logical relationships is an important variable in assessing competence. Generative semanticists, on the other hand, attempt to account for both logical structures, logical relationships, and interpretations of these structures. Unfortunately their formalizations are much too imprecise to employ as theoretical metrical terms by which one can assess linguistic competence. This can be resolved by: (1) opting for the stronger theoretical-metrical conception of logical structures and relations by adopting the more typical logical descriptions (e.g. conjunction, disjunction, conditionals, etc.) as one of the dependent variables and (2) attempting to formulate theoretical metrical terms of these structures' interpretations by recourse to language universals and other observations of psychological linguistics. The rationale and formalization of (2) is presented in the proceeding sections.

Psychological Linguistics

Psychological linguistics attempts to describe language by empirically studying the properties of the mind. Although many psychological approaches are available under this broad definition, two approaches will be dealt with, which have been direct
outgrowths of Chomsky's early competence-performance distinction. These approaches are the phenomenological approach and the developmental approach. The phenomenological approach most typically has been referred to as "psycholinguistics," whose goal is to ascertain whether or not philosophical linguistic constructs have a corresponding psychological reality. The developmental approach, on the other hand, attempts to validate philosophical linguistic constructs by citing evidence from child-language development. On the basis of these two approaches, the rationale is developed for employing syllogisms and their linguistic concomitants as a dependent variables source which will later be used to assess linguistic competence.

Phenomenological Approach

In contrast to psychological studies which dealt almost exclusively with the word—its meaning, its associations, its role in memory and perception—contemporary psycholinguistics employs the sentence as the basic unit of investigation. This has been due largely to Chomsky's demonstration that the sentence is not just a matter of words and associations; the structure of the sentence contributes as much to its interpretation as does its elements.

The first psycholinguistic experiments merely attempted to demonstrate that linguistic philosophy provides variables which reflect real-time cognitive processes. As Chomsky's transformational grammar as-
cribed to every sentence a number of characteristics, such as degree of grammaticality, surface structure, deep structure, and transformational complexity, these became the variables of psycholinguistic study. For example, degree of grammaticality was shown to determine the ease which sentences could be perceived in noise (Miller & Isard, 1963), repeated (Epstein, 1961), memorized (Marks & Miller, 1964), or paraphrased (Downey & Hakes, 1968). Surface structure was found to determine the perceived location of clicks superimposed on sentences (Fodor & Bever, 1965), and influenced where errors would be made in memorizing sentences (Johnson, 1965). Deep structure was shown to be related to how sentences are remembered (Mehler, 1963) and to the ease with which they can be understood under noise (Mehler & Carey, 1967).

As these studies supposedly demonstrated that surface structure and deep structure are perceived at different levels, this implied that these structures were cognitive realities and not just linguistic fictions. Furthermore, this evidence was consonant with the view that grammatical transformations were real cognitive processes, used to relate perceived surface structure to its corresponding deep structure.

Unfortunately counterevidence quickly undermined the initial success of these findings. Due to the work of Fodor and Garrett (1966, 1967), Fodor, Garrett, and Bever (1968), and Bever (1970), the equivocal nature of these findings was demonstrated. Reviewing the results of these early studies, Fodor and Garrett observed that
they seemed to converge on the notion that the perceptual complexity of a sentence is determined by the number of grammatical rules employed in its derivation. They noted that these studies had involved a paucity of linguistic structures and even fewer transformations, and a majority of structural variables had been confounded with potentially significant variables such as sentence length. Moreover, Fodor and Garrett found occasional conflicting results.

Such negative evidence, combined with the inconclusiveness of the positive, refuted this theory's basic hypothesis that given any two sentences, the one which requires the greater number of transformations will, ceteris paribus, be more complex. Furthermore, Fodor, Garrett, and Bever demonstrated that linguistic analysis provided a number of cases in which derivational complexity did not coincide with apparent perceptual complexity.

These considerations led Fodor, Garrett, and Bever to reject this early psycholinguistic theory and to re-examine the relationship between competence and performance. Bever (1970, pp. 342-343) summarized the problems of these early studies:

At first it appeared that many of the processes and structures postulated in Transformational Grammar would provide direct accounts of behavior . . . . Further research at first appeared to back up this simple competence-performance equation, but more recent research shows that this is incorrect. In point of fact, grammatically-defined structures may be reflected in speech behavior, but not grammatically defined processes. Thus we seem to be
in a dilemma: how to account for the psychological validity of linguistically-defined structures without taking into account the linguistic processes which define those structures, and their interrelations.

This dilemma is actually an illusion created by the artificiality of the distinction between 'competence' and 'performance' in grammatical analysis. A real grammar does not, in fact, describe an abstract linguistic world, but rather a set of intuitions about 'grammaticality' held by the native speakers. For example, the transformational grammarians appeals to an intuition shared by most of us about our language when he claims that he will consider only facts which pertain to complete sentences . . .

However, even if our linguistic intuitions are consistent, there is no reason to believe that they are uniquely direct behavior reflections of linguistic knowledge. The behavior of having linguistic intuitions may introduce its own 'performance' properties; that is, there is no guarantee that a linguistic grammar itself is either a direct or ideal representation of the linguistic structure. I have emphasized that the discovery of the linguistically pertinent data which the grammar describes is itself a poorly understood psychological process. Therefore, a grammar is not necessarily a unique, basic, 'nonpsychological' representation of linguistic structure; it is merely a description of the most direct and available of all behavioral reflections of real grammatical structure.

In brief, Bever has observed that there is no logical requirement, using intuition as a theoretical metrical, that the rules of the grammar be represented explicitly in the comprehension device of a speaker's competence.
Fodor, Garrett, and Bever (1968) have attempted to solve the dilemma Bever identifies above as follows. They first conceive a reasonable constraint to be that the grammar and the comprehension device are equivalent as recognition routines, i.e. the comprehension device assigns to a sentence the same structural description Chomsky's grammar does. Thus, Fodor, Garrett, and Bever accept the prior view that the comprehender recovers the deep structure of a sentence, but they reject the notion that grammatical transformations are involved. Instead of proposing that deep structure is recovered transformationally, these researchers have proposed that the comprehender is equipped with a set of heuristics or perceptual strategies which enable him, given a sentence surface structure, to project possible deep structures for that sentence. In some cases, the strategy may lead to an incorrect hypothesis. But the proposed deep structure is then evaluated against the evidence provided by the sentence surface structure. If it is not compatible with the evidence, it is rejected and other strategies are consulted to yield new possibilities. Otherwise the initial hypothesis is accepted as the appropriate interpretation of the sentence.

Based upon such theorizing, Bever (1970, pp. 343-344) has criticized Chomsky's notion of competence on the following grounds:

... to take linguistic grammar itself as the 'basic' structure would be to make the same mistake as the physicist who takes the parallelogram of force as the 'basic' concept of mechanical
systems. The parallelogram of forces is itself derived from a special case of more general physical principles; it has its specific properties due to the specific nature of its application to slow-moving bodies on planes. Similarly, a linguistic grammar may have formal properties which reflect the study of selected subparts of speech behavior (e.g. having intuitions about sentences), but which are not reflected in other kinds of speech behavior. Other kinds of speech behavior may bring out additional aspects of the actual linguistic structure, and they undoubtedly have laws of their own, independent of the actual linguistic structure; but all the formalizations of whatever kind of systematic speech behavior including grammar must exemplify at least part of the actual linguistic structure.

Here Bever is proposing that intuition as a theoretical metrical term is not enough by itself to assess the properties of linguistic competence, partly (as Searle noted) because by defining competence as intuition and then using intuition as a theoretical metrical to measure competence is not only tautological but counterproductive, and, partly because intuitions themselves appear to be a function of a broader conceptualization of the system of language behavior. Although Bever has argued that underlying this broader conceptualization are the properties of perceptual strategies, it will later be noted that these perceptual strategies are but a function of an even higher conceptual system characterized by Bruner as "conceptual strategies," having as their basis, motivation.

While Fodor, Garrett, and Bever's theory has received much attention as of late, their theory remains
only a weak, partial formalization at best. It is difficult to assay this theory's validity until the heuristics of language perception have been more fully delineated and until a description of how these heuristics are selected and implemented has been formulated. Fodor, Garrett, and Bever (1968, p. 460) themselves identify yet a further problem; these researchers "have presupposed as input to the sentence recognition process a representation of the sentence which makes at least a crude segmentation, including the identification of the main verb." More simply stated, since this theory purports to be a model of the sentence recognition process, this theory should account for how deep structure analysis is performed.

The problem, then, of when and how a sentence is understood remains quite unresolved. To manifest comprehension, a subject must respond; comprehension of a sentence can be manifested in a variety of ways. Psycholinguists have used only a few of these ways as indices of comprehension: subjects routinely are asked to paraphrase a sentence, repeat it, verify it, answer a question about it, or follow its directions. But even with these options, little is known about how the comprehender maps his understanding of the sentence onto some behavioral index.

Perhaps the most completely and successfully articulated theory of comprehension is that of H. Clark (1969b). His model assumes that each of the tasks used to measure comprehension is a task of comparison. That is, each task requires the subject to compare his mental
representation of the sentence with a mental representation of other information. The nature of that information distinguishes one task from another; in verification, it may be external evidence (e.g. a picture) or internal evidence drawn from the subject's store of prior information (e.g. the fact there is no king of France); in questioning, it is the task posed by the question itself.

H. Clark further proposes that comprehension tasks are accomplished by means of a four-stage serial process. In the first stage, a deep-structure representation of the sentence is formulated and a sentence is understood. In the second stage, the information required by the task is represented in deep-structure form. In the third stage, the representations achieved in the first two stages are compared, and in stage four, the appropriate response is executed.

The crux of the model lies in the third stage. H. Clark proposes that the comparison of representations transpires according to the "principle of congruence." This principle states that comparisons are based on identity. If the representations being compared are not congruent, then they must be made so. The operations which accomplish this take time. The more operations required, the more time required for comparison, and the longer the comprehension task will take.

H. Clark has shown that this model has application for a broad variety of tasks and sentences. The advantage of the model is that it is formalized fully enough
to explain most linguistic situations. For example, this model adequately accounts for the well documented facts that affirmative sentences are verified faster than negative, and true sentences faster than false; that true affirmative sentences are verified faster than false affirmatives, and false negative sentences faster than true negatives (cf. Trabasso, Rollins, & Shaughnessy, 1971). To account for the latencies obtained under these four conditions, H. Clark's model requires but three parameters.

What is impressive about this model is the consistency with which it can be applied to different tasks and, especially, to different semantic structures. Much of the strength of the model is a function of stage one. Underlying this stage is what H. Clark calls the "deep-structure" assumption. This assumption asserts that the sentential representations of the initial sentences and task correspond closely to the deep structure representations as posited by Chomsky grammarians. This assumption, in turn, explains why one can hear the sentence,

(1) John is better than Bill,
and can answer the question,
(2) Then who is best?
farther than one can answer
(3) Then who is worst?

According to the deep-structure assumption, (1) has the deep structure, "John is good++" and "Bill is good++"—two sentences related by a degree function. Sentence (2) would have a deep-structure to the effect of "Then who is good++?" whereas (3) has the deep
structure of "Then who is good-?" As sentences (1) and (2) have similar deep structures, the task is easily matched to the sentence, hence, having a low latency processing time. On the other hand, when (3) follows (1), the deep structures must be reformulated to have matching degree functions before processing can occur, hence involving a relatively longer processing time.

But how is H. Clark able to achieve this success by employing the deep-structure assumption as a theoretical metrical in assessing comprehension when, as Bever has argued, there is no a prioristic reason to believe that deep structures contrived by intuitions are unique, direct behavioral reflections of linguistic knowledge?

Two answers are plausible. The first stems from Bever's previously cited observation that "... grammatically defined structures may be reflected in speech behavior, but not grammatically-defined processes." This suggests that the problem stemming from early psycholinguistic studies was not so much a function of the posited deep structures as it was a function of the presumed transformations. What Fodor, Garrett, and Bever basically invalidated was the existence of transformations as postulated by Chomsky grammarians. H. Clark's deep-structure assumption makes no reference to transformations per se. This assumption is said to operate on the "principle of the primacy of functional relations" which asserts that the functional relations underlying a sentence, like the logical subject, verb, and object, are more available after comprehension than other less
fundamental kinds of information. For example, H. Clark claims that the comparative sentences "John is worse than Mark" and "Mark isn't as bad as John" both have as their underlying functional relations "John is bad" and "Mark is bad," which are joined by a comparative or equative construction. In a sense, all this deep-structure assumption claims is that a speaker knows more readily that John and Mark are bad (the functional relations expressed in the deep structure) and that John is more extreme in badness than Mark.

A second explanation has its roots in the generative semanticists' argument that language is not so much a syntactic phenomenon, as posited by Chomsky, as it is a semantic system. Rather than arguing for the psychological reality of syntactic deep structures and transformations, what one should be researching is the psychological reality of semantic structures. In short, it is not syntax that is important in competence but semantics. H. Clark, in fact, maintains a weak generative-semantic position by stating his deep-structure assumption in terms of functional relations rather than in terms of syntactic relations. In his "And and or, or the Comprehension of Pseudoimperatives," H. Clark (Springston & Clark, 1973) explicitly refers to the semantic logical forms of sentences containing and and or.

In addition to his principle of the primacy of functional relations, H. Clark's other two principles of comprehension are likewise formulated with a focus on semantic properties. The second principle, the principle of "lexical marking," maintains that unmarked
lexical items are coded in memory in a simpler form than the senses of the marked lexical items. Hence, unmarked items are more easily stored and retrieved in memory than marked items. As evidence, H. Clark (1969b) cites the observations of several linguists (e.g. Sapir, 1944; Greenberg, 1966; Bierwisch, 1967; and Lyons, 1968) that word pairs like "tall" and "short" are not symmetrical. "Tall," unmarked, can be neutralized in several contexts, as in "How tall is your grandmother?" whereas "short," the marked term, cannot (i.e. by asking how tall one's grandmother is does not presuppose any given height, whereas to ask how short one's grandmother is presupposes that she's short). "Tall," but not "short," can also be neutralized in comparatives. "John is taller than Mark" can mean that John and Mark are only being compared evaluatively, while "Mark is shorter than John" presupposes Mark and John to be short. Consistent with the principle of lexical marking, H. Clark (1969b) does, in fact, demonstrate that storage and retrieval are quicker for comparatives containing unmarked adjectives.

H. Clark's third principle, the principle of "congruence," has already been briefly mentioned. This principle represents an attempt to describe how a memory search is conducted. Retrieval of in-storage information is possible only when this information is congruent with the information being sought. Most importantly, this retrieval requires congruence not of superficial forms or syntactic specification, but of underlying functional semantic relations.
Assuming H. Clark's theory to be the most valid theory of comprehension to date, this theory's numerous implications for the reading process may be observed. If visual processing does access to linguistic competence, then it could be assumed that comprehension of written language should entertain the same principles propounded by Clark's theory. For instance, it might be posited that the reader first assigns a functional semantic relation to the written stimuli. In the second stage, the information demanded by the task of reading (i.e. typically referred to as the "purpose" of reading) is represented. This representation, at the sentence level, takes the same form as that of the functional semantic relation, further marked by the task problem, e.g. verification of another language function (e.g. commanding, questioning, promising, etc.). In the third stage, the representation in the first two stages are compared, and, in the fourth, the appropriate response is executed.

In summary, one of the major shortcomings of previous psycholinguists has been their too narrowly defined conception of competence. Bever is justified in arguing that language is a function of a broader cognitive system constrained by such variables as perceptual strategies, memory span and other cognitive processes. That Bever's perceptual strategies are similar to Bruner's conceptual strategies has been noted. Furthermore, H. Clark's theory of comprehension has been described. Although this theory is incomplete, it has enjoyed remarkable explanatory success in the investigation of syllogistic
reasoning tasks. Despite Fodor, Garrett, and Bever's criticisms of postulating deep structures via intuitions as having cognitive reality, H. Clark's success with his deep-structure assumption seems to be a function of his emphasis on relations and processes focusing upon semantics rather than syntax. That H. Clark's theory also directly describes the reading process, assuming, of course, that linguistic competence and reading competence are equivalent, has been proposed.

Further evidence for H. Clark's theory is demonstrated by evidence from child-language development. Moreover, the observation can be justified that additional variables affecting one's ability to comprehend (at least the child's ability to comprehend) depend upon the degree to which children can externally manipulate incoming data and the degree to which children are motivated to comprehend. These considerations are addressed in the next section.

Developmental Approach.

Paralleling the focus of early phenomenological psycholinguistics, early developmental linguistics focused on formal properties of child language rather than emphasizing communicative and processing properties. Bloom (1970, p. 1) has remarked:

They (these early studies) relied exclusively on distribution analyses—describing the form and co-occurrence of linguistic elements in children's utterances. There was no attention to linguistic function—to what the utterances seemed to be saying. Yet is is precisely this kind of information which is most directly relevant for inferring something
about the cognitive function underlying linguistic expression.

However, more recently, Bloom (1970) has demonstrated that children's surface structures can only be interpreted in terms of context and the child conceived intention to speak. Hence, much of present semantics development has focused on the semantic functions of words within the context of an utterance.

Although without specifically citing Grice (1957), Slobin (1971) has adopted this philosopher's notion that speech involves intention to speak in his explanation of how children acquire language. Slobin observes that in acquiring language, the child's basic problem is to find linguistic means to express his intention. Slobin (1971, pp. 321-322) has described this problem as follows:

In order to acquire language, the child must attend to speech and to the contexts in which speech occurs—that is, he must be trying to understand what he hears and be trying to express the intention of which he is capable. This means that he must have both cognitive and linguistic discovery procedures available—in order to formulate internal structures which are capable of assimilating and relating both linguistic and nonlinguistic data, and which are capable of realizing intentions as utterances. The emergence of new communicative intentions must bring with it the means to decode those intentions in the speech the child hears, and this makes it possible for him to discover new means for expressing those intentions.

In the above, Slobin adopts Piaget's (1967, 1970) and Sinclair-de-Zwart's (1967, 1969) position that the pacesetter in linguistic growth is the child's cognitive
growth. This primacy of cognitive development sets the tempo for the development of linguistic intentions. Hence, Slobin (1971, p. 323) proposes the linguistic universal that "The rate and order of development of the semantic notions expressed by language are fairly constant across languages, regardless of the formal means of expression employed. (Note that this proposition applies to semantic intentions, rather than to the formal means of intentions . . . )" Slobin documents this universal with a broad taxonomy of early two-word utterances, reflecting various intention types for speaking. His taxonomy demonstrates that identical semantic intentions for speaking emerge at the same rate in a large variety of languages.

Slobin's overall theory, then, emerges as a confluence of Grice's contention that language is an intention-communicating process, Searle's observation that speech functions are an observable manifestation of a speaker's intention and Piaget's theory of cognitive development. Slobin's (1971, pp. 369-370) resulting model is comprised of the following components:

The first component . . . is the development of semantic intentions, stemming from general cognitive development. The child, equipped with an inherent definition of the general structure and function of language, goes about finding means for the expression of those intentions by actively attempting to understand speech. That is to say, he must have preliminary internal structures for the assimilation of both linguistic and non-linguistic input. He scans linguistic input to discover meaning, guided by certain ideas about language, by general cognitive-perceptual
strategies, and by processing limitations imposed by the constraints of operative memory. As in all of cognitive development, this acquisition process involves the assimilation of information to existing structures, and the accommodation of those structures to new input. The speech perception strategies engender the formation of rules for speech production. Inner linguistic structures change with age as computation and storage space increase, as increasing understanding of linguistic intentions leads the child into realms of new formal complexity, and as internal structures are inter-related and re-organized in accordance with general principles of cognitive organization.

In sum, learning to speak, Slobin maintains, involves pairing linguistic means with intentions to communicate. Development proceeds as the child learns to express old intentions by new means, and new intentions by original means.

Another approach to the study of semantic development has been pursued by E. Clark (1973). Her focus has been on how words are used to represent external objects and events, from the earliest stages in acquisition on. She presents voluminous data to support what has been called the "Semantic Feature Hypothesis." This hypothesis asserts that when the child first begins to use identifiable words, he does not know their full meaning. He knows only a few of the total number of features present in the adult's understanding of a word. The acquisition of semantic knowledge, logically then, consists of adding more features of meaning to the lexical entry of a word until the child's summation of features corresponds to those of the adult. This hypothesis therefore assumes that the child's use and interpre-
tation of words may differ considerably from the adult's in the early stages of the language-acquisition process, but, over time, will come to correspond to the adult model.

This theory is of particular interest, as it deals explicitly with the question of whether some kinds of semantic features are learned before others. In terms of the discussion of H. Clark, this question might be rephrased to ask: Is there evidence from child-language acquisition which indicates that some words are more readily accessible to cognitive processing than others? Just as H. Clark's principle of lexical marking posits that unmarked lexical items are more easily processed than marked items, the Semantic Feature Hypothesis predicts that the unmarked item will be acquired earlier than the marked item. More specifically, the Semantic Feature Hypothesis claims that the general features of lexical items are acquired earlier than more specific features, even in the case of lexical items which are antonyms. For example, in the acquisition of "before" and "after," children first learn that both words have to do with time. Next they learn that these words refer to sequence rather than to simultaneity, i.e. -simultaneous. The feature -simultaneous carries with it a specification of ordering in the sequence, +prior. This combination of features (+time, -simultaneous, +prior) characterizes the meaning of "before" but not "after." In addition to E. Clark's work, several other researchers have obtained similar findings (e.g. Donaldson & Balfour, 1968; Donaldson & Wales, 1970;
Other Considerations in Defining Competence

Based on the above discussion, the notion of competence can further be extended in two ways. First, Slobin's proposal that language development is a function of developing new intentions to be expressed by new linguistic forms raises the important question of what constitutes a speaker's intention to speak. To say a person has an intention to speak is synonymous to saying he is motivated to speak. An intention to speak has the classic properties which psychologists ascribe to any general motivated behavior; it has an onset, a duration, and an offset. Primitively put, to have an intention to speak is similar to saying one has a need to speak. R. White (1959) has suggested that in order to account for such drives one must posit a competence of motivation. White (1959, pp. 317-318) characterizes "competence motivation" as follows:

I now propose that we gather the various kinds of behavior just mentioned, all of which have to do with effective interaction with the environment, under the general heading of competence. According to Webster, competence means fitness or ability, and the suggested synonyms include capability, capacity, efficiency, proficiency, and skill. It is therefore a suitable word to describe such things as grasping and exploring, crawling and walking, attention and perception, language and thinking, manipulating and changing the surroundings, all of which promote an effective--a competence--interaction with the environment. It is true, of course, that maturation plays a part in all these
developments, but this part is heavily overshadowed by learning in all the more complex accomplishments like speech or skill manipulation. I shall argue that it is necessary to make competence a motivational concept; there is competence motivation as well as competence in its more familiar sense of achieved capacity. The behavior that leads to the building up of effective grasping, handling, and letting go of objects, to take an example, is not random behavior that is produced by an overflow of energy. It is directed, selective, and persistent, and it continues not because it serves primary drives, which indeed it cannot serve until it is almost perfected, but because it satisfies an intrinsic need to deal with the environment.

Language, then, when conceived within the framework propounded by Grice, Searle and Slobin, may be construed as a directed, selective and persistent behavior which continues because it satisfies an intrinsic need to deal with the environment.

When viewed in light of Bever's proposal that language is a subprocess of higher cognitive processes yet to be identified, this view that motivation is an important cognitive variable reflected in language does not appear absurd. Two additional lines of thinking substantiate this claim.

As was noted earlier, many of the attributes Bever specifies for his perceptual strategies of comprehending are subsumed by Bruner's (Bruner, Goodnow & Austin, 1965) "strategies of decision making," or conceptual strategies. These strategies Bruner (1965, p. 54) has defined as "a pattern of decision in the acquisition, retention, and utilization of information that serves to meet
certain objectives, i.e. to insure certain forms of outcome and to insure against others." Among the objectives of a strategy, Bruner (1956, p. 54) includes:

(1) To insure that the concept will be attained after the minimum number of encounters with relevant instances.
(2) To insure that a concept will be attained with certainty, regardless of the number of instances one must test en route to attainment.
(3) To minimize the amount of strain on inference and memory capacity while at the same time insuring that a concept will be attained.
(4) To minimize the number of wrong categorizations prior to attaining a concept.

Language has structural properties which precisely lend themselves to such strategy objectives. For example, Bever (1970) notes that the processing of sentence-initial subordinate clauses is different from processing main clauses. The grammar of English is precisely designed to facilitate these processing differences. Thus the most obvious mark of subordination is a clause-initial subordinating conjunction, as in (1) and (2):

(1) While I was dancing, I had visions of Cinderella.
(2) Since he is a plumber, Murphy knows how to fix joints.

Sentence-initial subject complements, on the other hand, are marked by clause-initial complementizers, as in (3), (4), and (5):

(3) The fact that the dog bit me every day I jogged made me dislike it intensely.
(4) For Minnie to carry Micky's burden was thoughtful.
(5) The stone's brilliance blinded the gemologist.

The patterning of such morphemes as "while," "that," "'s," etc. is so governed as to distinguish subordinate clauses from main clauses, thereby minimizing processing strain of clauses. Notice that in sentences like (3), either one of the two initial complementizers may be deleted, but not both, as illustrated in (6) through (8):

(6) The fact the dog bit me every day I jogged made me dislike it intensely.

(7) That the dog bit me every day I jogged made me dislike it intensely.

(8) *The dog bit me every day I jogged made me dislike it intensely.

In sum, language seems to insure concept attainment and minimize processing strain and the number of wrong inferences by being so semantically and syntactically organized as to deploy the most appropriate comprehension strategies.

A similar parallel exists between Bruner's conceptual strategies and H. Clark's four-stage comprehension process. H. Clark's four-stage model, if you will recall, begins by establishing a cognitive representation of a sentence (i.e. a sentence is comprehended). In stage two, information demanded by a given task is represented, with this representation assuming the same form as the sentence representation. Stage three is characterized by an active comparison of the two forms of representation. Finally, in stage four, an appropriate response is executed.
Bruner (1957) likewise posits four stages in comprehending. The first he calls "primitive categorization." Before any additional inferential activity can occur, there is a process which results in the perceptual isolation of an object or an event with certain characteristic qualities. What is required at this stage is that an environmental event (e.g. a sentence to be comprehended or an object to be identified) is perceptually isolated and is identified by certain spatiotemporal-qualitative features.

In stage two, a feature search is employed. In the case where there is redundancy, identification is further refined by processing additional features. Where the fit between feature-processing and categorization is imprecise, a second feature-search is conducted. In such an instance, one continues to sample environmental stimuli in attempt to establish a greater congruency between cognitive category and feature-processing tasks.

Stage three entails a confirmation check between established cognitive categories and a decline in the feature-search process. The openness to stimulation decreases sharply in the sense that now, a tentative identity has been made and the search is restricted to the search of only confirmatory features to check this identification.

The last stage Bruner refers to as "Confirmation Completion." This stage is characterized by a termination of feature searching. Openness to additional cues is drastically reduced, and incongruent cues are either
normalized or disposed of.

While Bruner's four-stage model does not mirror H. Clark's exactly, where they aren't congruent, they complement one another. Both Bruner and Clark view comprehending as the process of establishing underlying categories or representations. These categories or representations are then reanalyzed in terms of an additional task or an additional scan of environmental features. Both processes involve a comparison between established categories and a concomitant set of inputs. While H. Clark, at this point, emphasizes that categories and task cues must be made isomorphic before processing occurs, Bruner focuses upon the fact that once initial congruency has been established, there is a reduction in attention to other features. In either case, once congruency is established, feature search is terminated and an appropriate response is executed.

What is particularly significant in observing similarities between Bruner's theory and those of Bever and H. Clark is that all necessitate consideration of cognitive motivation and cognitive representation. For example, Bruner (1965, p. 228) states:

Impelling drive states seem . . . to affect the extent to which a person is able to apply already firmly acquired coding systems to new material encountered, permitting him to go appropriately beyond the information given.

To support this statement, Bruner (1957) cites evidence from an experiment performed by Postman and himself on perception under stress. Two groups of
subjects were used. They began by having both groups recognize brief, three-word sentences presented tachistoscopically under usual laboratory conditions. Then the stress group was given an impossible perceptual recognition task to perform (reporting on the details of a complex picture presented at an exposure level too brief in duration for adequate performance). During these stress trials, they were constantly badgered by the experimenter for performing so poorly and were instructed to try harder. The other group was given a simple task of judging the illumination level at which the same picture was presented at the same exposure levels. They were not badgered. Finally additional sentences were given to subjects in both groups. The stress group showed no further improvement in their sentence-and-word-recognition thresholds; the nonstressed group continued to improve. What was striking about the performance of the two groups in the latter half of the experiment was that the stress subjects either overshot the information given and made wild inferences about the nature of the briefly presented words, or they undershot and seemed unable to make words out of the briefly presented data. The stress subjects did not behave consistently in the overshoot or the undershoot fashion, but seemed to fluctuate between the two. In total, the group operating under a modicum of motivation or drive state performed much more efficiently than the group under an extreme drive state.

That motivation is an important variable in strategy selection and problem-solving ability has also
been demonstrated by Mehler and Bever (1967). Instead of investigating the function of motivation under extreme conditions, Mehler and Bever have shown that motivation is further an important variable in solving Piagetian tasks. For example, using Piagetian-type arrays, these researchers biased the choice of one of the arrays in relation to the other by adding two pellets to the shortened row. For one set of trials, clay pellets were used. For the remaining trials, M&M's were used. The children were divided into two groups. One group was asked to judge which array contained the greater number of pellets. The other group was asked to decide which array they wanted to keep for eating. The results of this experiment were unexpected. Younger children, ages 2:4 to 3:4, tended to perform much more efficiently than children a year older. With the M&M's, however, no such difference was observed. Mehler (1971, pp. 211-213) interpreted these results as follows:

Our results indicate that children's ability to select the larger of two discontinuous quantity arrays does not appear gradually during the course of development. It seems in respect to be a cyclical process, in which a choice that is correctly performed at an early age is wrongly performed at a later age and is then correctly performed at an even later age. At the time we published our paper, we thought that the decrease in conservation was due to an overdependence on perceptual strategies in which some parameters like length and density, etc. would have weights that could result in one of the parameters being used almost exclusively in judgment. We had a procedure in mind similar to that presented by E. Brunswick (1956) in his account of perceptual constancies.
The M&M's, however, indicate that the perceptual strategies can be overcome—given enough motivation.

In order to further verify the above findings, Mehler (1971) studied very young children by testing them with a task of volume conservation. In an experiment with Parisian children, Mehler tried out two different procedures. In the first, he put ten M&M's into each of two identical beakers and established identity in the usual way. Then he asked the child to put one M&M into one of the unequal containers, i.e. either into the test-tube or into the dish. Thereafter, the contents of one beaker was poured into the test-tube and the contents of the other into the dish. The child was tested in two ways. He was first asked which container had more M&M's in it, and he was then asked to choose which one he wanted to keep for eating. Results indicated that up to about 3:4 years, the child chooses the container that has more candy in it, while the older children seem to base their choice on the shape of the container; they prefer the test-tube.

The second procedure followed the classical Piaget method more closely. M&M's were put into two identical beakers, and identity was established by the child. Then the contents of each beaker was poured into the test-tube and the dish respectively, without adding or subtracting any M&M's. Children between 2:6 and 3:6 chose to keep either container with equal probability. When they were asked whether the two containers had the same number of M&M's, or whether the one they
had just chosen had more, ten out of twenty-two children replied that they were equal. The children between the ages of 3:6 and 4:5 were tested, and eight of these ten chose the test-tube and claimed that it contained more M&M's.

On the basis of these findings, Mehler (1971, p. 215) concluded: "The results that we were able to gather concerning the development of thought processes in young children seem to indicate that they are capable of solving problems at an early age, by using rudimentary logic—probably the core from which they attain the sorts of logical functioning characteristic of adults."

Such findings make it plausible to include motivation as a significant variable in a definition of competence. Motivation, as this study interprets it, represents a need to deal with the environment. As Bruner has demonstrated, this need, when viewed as a function of drive state, readily affects the strategies one selects in problem-solving. Mehler and Bever's experiment suggests that different strategies may be employed under different motivational levels. Mehler's subsequent study further implies that children are capable of employing different logical processes which appear to discount Piaget's proposed four stages of operational, logical growth. The type of form of logic employed may, in fact, be viewed as a function of motivation.

That motivation constitutes a significant functional variable to the language process has likewise been
proposed by Bever (1973a, p. 282). He has noted that motivation or the "instinct to communicate" is a primary integrative factor of linguistic processes:

In each case in which we discover neurophysiological substrata involved in specific behavior systems, the problem is merely made more precise: how do the behavioral systems recruit and organize such that language structure and behavior are the joint product of both linguistic and psychological structures, leaves us with the analogous question: how does the instinct to communicate integrate the distinctive components of perception, cognition and motor behavior into human language?

In summary, it has been argued that in order to fully assess linguistic competence in particular, one needs to assess cognitive competence in total. Discussion began by noting that linguistic competence must be interpreted as the ability to convey intentions by symbolic means. These intentions are manifested by the type of speech act employed. Although no comprehension theory has been fully formalized to date, H. Clark's theory seems to be promising. Incorporating H. Clark's theory with Bever's and Bruner's theories of strategies, this study posits that linguistic competence, as comprehension, involves a categorization process such that deep structure representations are first established, mediated by such variables as perceptual strategies and motivational level. A second aspect of competence entails identification of a given task which is to be related to the established deep structure representation. In Bruner's framework, task cues must be identified. A third ability is that one is
able to translate the given deep structure representation with the representation constructed by the task. This ability, in short, enables one to establish congruency between the cues of the initial categorization and the cues of the categorization of the task. Once congruency is established, no further cues are scanned; an appropriate response is effected.

While this proposed theory does attempt to relate linguistic competence to cognitive competence in a relatively fully formalized manner, there yet remains the significant question: What is the nature of the representations established at the deep-structure or primary-categorization level and at the task level? So far it has been noted that the best way to specify these representations is to employ an eclectic approach, incorporating the Piagetian hypothesis that formal logic does represent thought categories and the generative semanticist's proposal that to most adequately represent thought structures, these thought categories must be assigned meaning. While this is all very fine and well, such an approach assumes the processor is equipped to establish a symbolic representation by linguistic encoding. While this appears to be true for the adult, Bruner (1973b) has shown this is not the case for young children.

Bruner (1973b, p. 316) notes the following characteristics of representation:

In effect, representation or a system of representation is a set of rules in terms of which one conserves one's encounters with events. A representation of the world or of some segment of one's
experience has several interesting features. For one thing, it is in some medium. We may represent some events by the actions they require, by some form of pictures, or in words or other symbols. There are many subvarieties within each of these three media—the enactive, the iconic, or the symbolic.

These three kinds of media or representational systems, Bruner maintains, are extremely important during the growth of the human intellect. These forms of representation—enactive, iconic, and symbolic—are characterized by knowing something through doing it, through a picture or image of it, and through some such symbolic means as language. Growth involves a successive mastering of these three forms of representation along with their partial translation each into the others.

To support this hypothesis, Bruner (1973b) cites an experiment by Sonstroem. The experiment was performed with six- and seven-year olds and began with a pretest which demonstrated that the children showed no conservation in the Piagetian sense. Some training trials ensued and a posttest was administered. Two major factors were studied in the training procedure: the effect of active manipulation of the materials and the effect of labeling the shapes manipulation produced. Four groups were formed: (1) those who altered the second ball of clay themselves and also had to characterize the shapes produced (both manipulating and labeling); (2) those who labeled but did not manipulate the material
(the clay was altered by the experimenter); (3) those who manipulated and did not label; and (4) those who did neither.

The results of the experiment confirmed Bruner's hypothesis. Only about a quarter of the children who went through the experiment without labeling and without handling the materials improved on the post-test. What is interesting is that only a few improved by virtue of having the labeling or manipulation training alone. But when both kinds of training were administered, a significant number of children showed conservation on the post-test. Bruner (1973b, p. 322) interprets these findings to mean:

There are by now a sufficient number of experiments from our own and other laboratories to indicate that failure of conservation involves not so much failure but, rather, another way of reckoning equivalence by a standard appearance—iconic reckoning which operates on the principle that if there is inequality between two events in a salient perceptual property, then equality is violated. The distinction between surface structure and deep structure is not grasped when appearance is the sole basis of judgment . . .

Sonstroem's experiment, by the joint use of labeling and manipulating, offered the child ways of representing the problem that conflicted with the iconic mode. By offering him manipulation, Sonstroem was encouraging enactive representation. By offering him dimensionalized verbal labeling, she encouraged symbolic representation by linguistic encoding. Manipulation and language were both pitted against
appearance. The interesting fact is that neither of the other modes of representation alone was able to induce enough conflict to produce appreciable learning.

Since manipulation, when combined with verbal labeling, facilitates representation construction, this observation must be incorporated into this study's ostensive definition of competence. It thus shall be hypothesized that representation construction is facilitated by additional modes of processing. It can be further hypothesized that if visual and oral language processing access to the same competency, then they both should establish representation with equal facility with the aid of iconic and enactive processing, in addition to the aid of motivation.

On the basis of such rationale, this study shall first assess the extent to which reading aloud and hearing language access to the same linguistic competence. Two-term syllogisms will be used as the source of dependent variables in this experiment. Secondly, this study shall investigate not only the extent to which reading silently and hearing language access to the same linguistic competence, but also the extent to which these modes of symbolic processing are influenced by the combined effects of motivation, iconic representation and enactive representation. In this experiment, three-term syllogisms will be used as a source of dependent variables. Finally, it will be determined whether visually processed miscues correspond to aurally processed miscues and whether misucing
via the visual process does, in fact, represent the same process as reading without miscues. In this last investigation, both determinate and indeterminate, three-term syllogisms will be used as sources of dependent variables.
Chapter 3, Experiments and Results

K. Goodman's (1969) miscue theory operates on the principle that as the child reads aloud, from time to time he will substitute a linguistic variable, such as a sound, word, or set of words, for that which is actually printed on the page. As the substituted variables seem to obey certain linguistic constraints, K. Goodman has hypothesized that reading accesses to linguistic competence. This theory, however, entails the corollary hypothesis that reading aloud accesses to the same linguistic competence as does reading silently. Again, while this appears to be a logical assumption, it remains inconclusively tested. Hence, the purpose of the proceeding experiment is to ascertain whether processing visually, aloud, accesses to the same linguistic competence as processing speech aurally. Linguistic competence is to be defined in this experiment as the ability to process two-term syllogisms in the manner proposed by H. Clark (1969b).

While H. Clark's theory has received substantial verification, this verification has largely been limited to the condition of silent reading and using adults as subjects. It is therefore necessary to first determine whether this theory applies to comprehending oral speech and reading out loud.

H. Clark's theory hypothesizes that linguistic competence is characterized by three principles. The
first is the ability to establish deep-structure, semantic representations. This parallels H. Clark's principle of primacy of functional relations. Principle two asserts that unmarked adjectives, such as "good," "more," and "tall," are stored in memory in a less complex form than their corresponding marked forms, such as "bad," "fewer," and "short." Hence, unmarked terms should be stored and retrieved from memory easier and faster than marked terms. In brief, this summarizes Clark's principle of lexical marking. Finally, principle three maintains that the ability to process deep-structure, semantic representation of a task involves the ability to make this information congruent at the level of functional relations with the previously established semantic representation.

These three principles characterize the general comprehension process used to solve comparative, two- and-three term syllogisms. This process involves: (1) comprehension of the propositions; (2) comprehension of the task; (3) search for information asked for in the task; and (4) construction of an answer. H. Clark's three principles are operative throughout this process. In stages (1) and (2), one establishes a representation similar to the form "A is good+; B is good" and "X is good++," by the principle of the primacy of functional relations. At these stages, the principle of lexical marking predicts that the deep-structure statements, "A is good+" and "B is good," should be processed and retrieved more quickly than "B is bad+" and "A is bad,"
since memory coding for "bad" is more complex than that for "good." In stage (3), one executes the instructions of the question or task. Here the principle of congruence is operative. Whenever the question is congruent with the preceding proposition, processing should be easy. In the case of the absence of congruency, the question must be reinterpreted to make it congruent and, hence, processing is predictably more difficult.

Experiment 1: Design, Analysis, and Results

Two-term syllogisms can be constructed such that there are four propositions and two tasks. The four propositions used in this experiment include:

(1) A is better than B
(2) B is worse than A
(3) A is not as bad as B
(4) B is not as good as A.

Any one of these propositions can be followed by one or the other of the following questions:

(5) Who is best?
(6) Who is worst?

These four propositions can be matched on the basis of their similarity at the surface structure level and at the deep structure level. Proposition (1) has the same sequence of terms in the surface structure as (3); in both propositions, A is the subject, B is the predicate, and the relation between the terms means "greater in goodness than." On the other hand, Proposition (1) has a different deep structure than Proposition (3). (1) has a deep structure similar to (4),
of the form:

(7) A is good, B is good.

Propositions (2) and (3) likewise share a common deep structure:

(8) A is bad, B is bad.

These four propositions, then, permit an orthogonal comparison of surface-and deep-structure orders: (1) and (3), and (2) and (4) having the same surface-structure order, (1) and (4), and (2) and (3) having the same deep-structure order. By H. Clark's three principles, the number of errors children make in solving different combinations of propositions and tasks should be predictable on the basis of the propositions' and questions' deep structures.

Method. Two sets of four examples of each of the eight problem types were constructed, using common English names as terms (see Appendix A). Each of the 64 problems was typed with the propositions on the top line and the question on a line underneath in the middle of a blank IBM card. The card had the form:

If John is not as good as Bill, Then who is best?

On a second card, the two terms of the proposition were typed, the sequence of the names being changed 50% of the time so that they would not always match their sequence in the proposition. The problems were arranged in four blocks of eight, each block containing one problem of each type for each condition. The order of all syllogisms was then randomized and different for each subject in both conditions.
Fifty subjects were randomly selected from three second-grade classes in a suburban elementary school (Valley Forge Elementary School) in Columbus, Ohio. Subjects ranged in age from 7:2 to 8:5. The first 25 heard the oral syllogism set and then read aloud the visual syllogism set. The second 25 subjects first read the visual syllogism set aloud and then heard the oral syllogism set. This was done to balance any practice effects which might be an artifact in solving a syllogism set.

In presenting syllogisms orally, each subject was read the syllogism once and then was read the names of the two terms. Subjects were given an unlimited amount of time in which to respond with an answer. In the case where subjects were presented the syllogisms visually, each subject read the syllogism out loud, flipped the card and then read the names of the two terms. Likewise, they were given an unlimited amount of time in which to respond.

Results. The mean number of errors, reported in percentages based on the number of errors per number of problem-type presentations, and the ensuing t values for different problem combinations are presented in Table 1.

The principle of the primacy of functional relations predicts that fewer errors would be made on the basis
of surface structure. (1) and (3) have similar surface-structure meaning, that "A is better than B," and (2) and (4) have the similar surface-structure interpretation, that "B is worse than A." On the other hand, (1) and (4) both have "A is better than B" in their deep structure, the only difference being that (4) contains a negative element. Similarly, the deep structure common to (2) and (3), "B is worse than A," is different due only to the presence of a negative in (3). Results demonstrate that Proposition (1) produces fewer errors than Proposition (2): t=2.63, df=49, p < .05 for the oral condition; t=3.03, df=49, p < .05 for the visual condition. If this difference is due to the superficial order and meaning of the terms, then (3) should produce fewer errors than (4); but if it is the result of their different deep structures, then (4) should produce fewer errors than (3). Results support the latter case; (4) produces significantly fewer errors than (3): t=3.25, df=49, p < .05 for the oral condition; t=3.11, df=49, p < .05 for the visual condition.

The principle of lexical marking predicts that propositions with "good" in their deep structure will produce fewer errors than those with "bad." This is confirmed, in part, by the same evidence in the preceding paragraph. In both cases, the propositions containing "good" produced fewer errors than the propositions containing "bad." This is further substantiated overall, as the propositions containing "good" produced fewer errors than those containing "bad" in their deep structure:
Thirdly, the principle of congruence predicts that questions congruent with a proposition in its deep structure will produce fewer errors than incongruent questions. According to this principle, the question "Who is best?" following (1) and (4) and "Who is worst?" following (2) and (3) should produce fewer errors than their incongruent counterparts that do not have the same words in their deep structure. This principle was not supported in either condition: \( t=0.96, df=49, p > .05 \) for the oral condition, and \( t=1.02, df=49, p > .05 \) for the visual condition.

A fourth set of results reconfirmed the findings that affirmative propositions are easier to process than negative propositions, or propositions containing the word "not." In short, the affirmative propositions (1) and (2) produced fewer errors than the negative propositions (3) and (4): \( t=7.08, df=49, p < .05 \) for the oral condition; \( t=5.71, df=49, p < .05 \) for the visual condition.

In sum, except for H. Clark's principle of congruence, his model appears to be quite descriptive of reading aloud and processing language aurally. On this basis this study shall proceed to compare the number of errors produced by reading the syllogisms aloud versus hearing them orally. The rationale here is that if these two modes of processing are identical, then there should be no significant difference in the number of errors produced between the two modes, following H. Clark's
principles. On the other hand, if one mode produces significantly more errors than another on one or more of H. Clark's principles, then it can be concluded that these modes differ and, hence, do not access to the same linguistic competence.

Results. In comparing the number of errors between aurally and visually processed syllogisms, a significant difference between the two modes is indicated (see Table 2).

| Insert Table 2 about here |

According to the principle of functional relations and the principle of lexical markings, one would predict that the propositions with "good" in their deep structures would be processed with a minimum of difficulty. If aural and visual comprehension access to the same linguistic competence, then this principle should apply to reading out loud as well as to comprehending oral speech. However, in comparing propositions (1) and (4) under the different modes, one observes that visual processing produces a significantly greater number of errors than aural processing: $t=4.16$, $df=49$, $p < .05$.

These principles would further predict that the propositions with "bad" in their deep structures would be more difficult to process. Again, however, in comparing (2) and (3) between modes, the visual mode produces significantly more errors than does the aural mode: $t=2.88$, $df=49$, $p < .05$. 
H. Clark's principle of congruency, while not verified as a functional principle for describing the two modes, also reveals a discrepancy between visual and aural processing. This principle asserts that questions having the same deep structure as the propositions they proceed, should be processed with a modicum of difficulty, whereas incongruent questions and propositions should be relatively difficult. In the case of question-proposition congruency, visual processing continues to produce a greater number of errors than does aural processing, $t=3.63$, $df=49$, $p < .05$. In the case of incongruency, this pattern is repeated, $t=3.60$, $df=49$, $p < .05$.

Finally, in comparing affirmative propositions it is observed that the visual mode again produces significantly more errors than does the oral mode, $t=6.15$, $df=49$, $p < .05$. However, this is not the case in comparing negative propositions in the two modes; no significant difference between the number of errors is obtained, $t=1.59$, $df=49$, $p < .05$.

In summary, if one conceives H. Clark's principles to represent a valid description of comprehension, then it may be concluded that reading aloud does not access to the same linguistic competence as oral-language processing does. The above findings demonstrate that none of H. Clark's principles are operative in the same manner in out-loud visual and oral language processing. The only instance where similar strategies or abilities of processing appear to be employed are in the case of negative propositions.
Silent Reading and Higher Cognitive Variables

One of the more seminal questions the results of the preceding experiment raise is: Does reading silently differ from reading aloud? Rather than testing this directly, this study shall proceed to test the extent to which reading silently accesses to the same linguistic competence as oral-language processing does. If it can be demonstrated that reading silently does not produce significantly more errors than aural processing, then it may be concluded that oral-and silent-reading comprehension are different phenomena, as they belong to different competencies.

In addition, if it can be shown that a common competence between silent reading and aural processing exists, then this study will assess the extent to which both modes are influenced by the higher cognitive variables of iconic and enactive representation, and motivation. If significantly fewer errors are produced for both modes when supported by these variables, then this would provide additional evidence that they access to the same competence and that this competence itself is subject to a higher cognitive schema.

Again a set of syllogisms will be employed as a source for the dependent variables. However, in this experiment, three-term syllogisms shall be used instead of two-term. Although Clark's principles are operative in three-and two-term syllogisms alike, the advantage of using three-term syllogisms is that they are more difficult to solve; they involve three propositions to be related
instead of two. By being more difficult, they add a greater force to the hypothesis that motivation, and enactive and iconic representation do facilitate comprehension as H. Clark's principles have defined it.

Moreover, if it can be demonstrated that children are capable of solving three-term syllogisms, this will present evidence, refuting Piaget, that children are capable of deductive thinking well before the formal operations stage. Furthermore, it will show that thought is not so much language circumscribed by logical operations, but rather logic circumscribed by linguistic factors, as H. Clark hypothesizes.

Even adults encounter some difficulty in solving three-term syllogisms. Logically, then, children should find them most difficult to solve. This is what Piaget's (Piaget, 1928, 1950, 1966; Inhelder & Piaget, 1958; Flavell, 1963) theory of logical operations would predict. This theory maintains that children have difficulty with deductive thinking at an early age due to their inability to adopt another point of view. Even in the stage of concrete operations, the child is said to lack the ability to entertain two or more parts of a concept simultaneously. It is not until the formal operations stage, around 11 or 12 years of age, that children fully manifest the ability to reason deductively, reasoning which involves drawing conclusions from two or more propositions. However, that children do show deductive reasoning much before this period is well substantiated.

Hill (1961), for example, demonstrated that children, ages 6 to 8, are capable of recognizing valid conclusions
drawn from hypothetical premises. Furthermore, in her studies of sentential, quantificational, and classical logic, she discovered that sentential, or conditional logic, is more operative than quantificational, or classical logic at age 6. But by age 8, children are equally facile with both types.

O'Brien and Shapiro (1968) continued Hill's research. They studied children's ability to recognize principles for which there were no valid conclusions. Their findings were similar to Hill's; children between 6 and 8 did manifest considerable ability in recognizing valid conclusions in different types of deductive logic.

Donaldson (1963) has shown that children, even as young as 5, have the ability to reason deductively. In studying children's ability to solve verbal deductive problems, Donaldson (1963, p. 199) discovered:

The making of a firm deduction on the basis of a survey of possibilities can on occasion happen long before the appearance of the formal schemata, given the possibilities are of a sufficiently simple nature--and that no consideration of combinations is required.

While many of these studies seemingly contradict Piaget's theory, in reality they represent merely a refinement and extenuation. These investigators' criticisms of Piaget have largely focused on his inattention to the differential development of specific principles of deductive reasoning. All in all, these studies have been cast within the same paradigm of defining thinking in terms of formal logic.
These studies have been of nominal value for several reasons. First, deductive reasoning has been too narrowly defined as the ability to solve particular types of reasoning problems, either by validation, i.e. deciding whether a deductive statement is valid or invalid, or by verification, i.e. deciding whether a statement summarizing a syllogism is true or false. The strategies and abilities presumed for these reasoning problems' solutions have therefore been of a limited generality; they apply in only one kind of problem.

Secondly, many of these studies are culpable of Smedslund's criticism that such investigations study logical abilities presupposing understanding. To investigate logical ability using logical statements as a source for dependent variables presupposes that such statements are comprehended linguistically; it is the ability to logically combine statements that is presumed to be assessed. However, it may be that the child's inability to solve a deductive task is based on his inability to understand their logical relationship.

Thirdly, while investigators have noted that the content of logical arguments is a factor influencing the child's ability to draw valid inferences (e.g. Wilkins, 1923; Welch, 1942; Miller 1968), the complexity of linguistic content has been little studied. Those studies which have dealt with linguistic complexity have largely focused on connectives (e.g. Neimaker, 1970; Suppes and Feldman, 1971; and Paris, 1973) and negatives (e.g. Evans, 1972; Johnson-Laird and Tridgell, 1972;
Roberge, 1974). But even these studies have paid no attention to the developmental aspects of linguistic complexity. That the stage of linguistic development is a significant variable in the solution of syllogisms has been argued in the previous discussion of the Semantic Feature Hypothesis.

H. Clark's model obviates these problems by asserting that reasoning is accomplished mainly through certain general linguistic processes, the same processes that are regularly used to understand language. Rather than assuming a formal logical complexity, H. Clark shows that the complexity of solving syllogisms is a function of linguistic complexity. H. Clark defines this linguistic complexity as the degree of difficulty by which semantic relations are established. This thus avoids Johnson-Laird, Legrenzi and Legrenzi's (1972) criticism that although content is a significant variable in syllogism solution ability, those who approach thinking from a strictly formal point of view (such as Piaget) fail to account for this fact, as they presume that the same mental operations are carried on regardless of content. Such formal approaches fail to explain why it is harder to execute syllogisms with one sort of material than with another. H. Clark's model not only accounts for complexity, it is able to predict which statements and tasks will be easy and difficult to process.

In sum, then, H. Clark (1969b) has taken as strong linguistic position, asserting that reasoning is accomplished through the same linguistic processes that are used regularly in the comprehension of language. Ability
to solve deductive syllogisms is, for Clark, a linguistic ability rather than a higher order logical ability.

Piaget (1952), on the other hand, views language as being a function of certain logical operations, such that language development is conceived to be a function of a child's logical development.

Sinclair-de-Zwart (1969) has attempted to substantiate this theory experimentally. She has examined the extent to which language and logic are related by studying children's verbal capacities of comparatives. First she asked children to tell the differences between two pencils, a short, thick one and a long, thin one. The children's comprehension was determined by asking them to execute certain orders, such as finding a pencil that was shorter but thicker than another. The subjects were then divided into three groups according to their responses on a Piagetian task. The groups included conservers, nonconservers, and those in transition between the two stages. No differences in comprehension were found among the three groups. Almost all of the children performed the orders correctly. However, striking differences occurred between the conservers and nonconservers on the description tasks. For example, a large majority of conservers used comparatives, while 90% of the nonconservers used absolute terms. Sinclair-de-Zwart concluded from this and similar experiments that logic appears to dictate the development of language. In her words (1972, p. 160), "These Genevan results,
together with the results of the research of deaf and blind children . . ., confirm Piaget's view on the role of language in the constitution of logical operations: language is not the source of logic, but on the contrary, structured by logic."

How, then, is the success of Clark's linguistic description of thought to be reconciled with the Piaget-Sinclair-de-Zwart notion that logic is the mechanism by which thought is structured? This dilemma is solved by adopting the previously cited generative-semanticist position that language has both logical and linguistic properties. At the deep structure level, language is comprised of logical categories, e.g. arguments and predicates. At a later stage in the derivation (i.e. surface structure), these logical categories are assigned representation such as words. But as Bruner (1965) has demonstrated, this representation need not always be symbolic.

Bruner (1973b), if you will recall, differentiates three modes of internal representation that endow the child with the capacity for intellectual growth. These are the enactive, or motoric response patterns; the iconic, or perceptual images; and the symbolic, or internalized language. In later stages of development, language not only represents experience, but transforms it according to its own inherent rules. However, in early stages of development when symbolic representation doesn't completely dominate the other two modes of representation, either enactive or iconic representation may function as the child's primary mode of representation
or, as Sonstroem's experiment manifested, they may act in concert, providing the child with the ability to solve operational problems.

That a child may have a dominant representation mode other than symbolic has further been demonstrated by Corsini (1969) and Hoffman (1971). Corsini found, in studying children from 3:6 to 7:0, that older children were able to remember more than younger children when presented a series of digits. But, if the children were tested such that they could employ nonverbal cues as memory aids, the younger children were able to remember as much as the older children. In this case, memory ability was not a function of age. What differs is the younger child's inability to handle verbal information as well as older children. Data collected for five-year-olds (Corsini, 1969) and for three-year-olds (Corsini, Jacobus, and Leonard, 1969) further support these findings.

Hoffman has reported a similar set of findings. The to-be-remembered materials in his experiment were color pictures taken from popular magazines. Children, after having been shown a series of such pictures, were asked to select between the picture they had previously seen and a distractor picture. Surprisingly, three-to-nine year old children performed as well as adults. The only reported significant difference occurred between the three-year olds and the rest of the subjects. In a similar experiment, Brown and Scott (1971) found that the performance of children in a continuous recognition task with pictorial materials did not differ significantly
from the adults' performance. The children showed an impressive ability to recognize pictures, indicating their iconic mode of representation was equally as developed as an adult's.

But mode of representation is not the only variable which influences a child's logical and memory-retention abilities. Mehler and Bever (1967) administered a series of number-concept tasks to 200 children. The subjects were comprised of seven age groups of children ranging in age from 2:4 to 4:7. Children were presented parallel rows of either clay or chocolate pellets (M&M's). The arrays were modified so that there was a short row of six, parallel to a longer row of four. In presenting the M&M arrays, children were instructed to take the row he wanted to eat and eat all the M&M's in that row.

Mehler and Bever summarized the responses by age; the results revealed a decrease in conserving responses by age, which are at a minimum in the group between 3:8 and 3:11. Thus, as the child surpasses 2:6, he supposedly becomes worse at quantity conservation. The authors further noted that the 23 youngest children, under 2:8, demonstrated the highest frequencies of conserving responses. Only at the age of 4:6 do children again demonstrate operativity for both kinds of quantity judgment.

These results, the authors have claimed, suggest that nonconservation is not a permanent phase in the overall cognitive development of the child. That every young child can successfully solve such con-
servation problems manifests that he does have the logical capacities for such cognitive operations. The temporary inability to solve the conservation problem is a result of a period of over-dependence on perceptual strategies or, in Bruner's words, over-dependence on the iconic mode of representation. However, a child in this stage apparently can overcome his perceptual fixation when motivated to perform a task (in this case, acquiring M&M's for eating).

While Mehler and Bever's results were impressive, successful replication of their experiment has been checkered. For instance, Rothenberg and Courtney (1968) administered tasks similar to Mehler and Bever and a second set of tasks identical to Piaget's (1952) conservation procedures. These investigators demonstrated that children conserved equally as well, using either clay pellets or candy, in both the easy and difficult procedures. However, while the age trends noted in the Mehler and Bever's study were not substantiated, a comparison with the results of all conservation tasks indicated that some children 2:4 to 4:7 could be classified as conservers.

Goldschmid and Buxton-Payne (1968) also attempted to replicate Mehler and Bever's study. Their results indicated that older children performed at a significantly higher level of operativity than the younger children.

The only reconfirming evidence for Mehler and Bever's experiment comes from Calhoun (1971). In addition to providing corroborative evidence, she cites
several oversights in Rothenberg and Courtney's study. In brief, she hypothesizes that the extreme variability of testing has produced such discrepant results.

Furthermore, an important factor not considered in the above experiments is the "gestalt effect" of higher cognitive variables. As Sonstroem's experiment showed, given a variable such as manipulation of labeling by itself, children fail to appreciably increase their ability to conserve. However, when these variables are combined, conservation ability is greatly enhanced. Thus, while motivation may be a significant variable in facilitating a child's ability to conserve, by itself it is not always significantly manifested. This suggests the hypothesis that motivation, when combined with manipulative, symbolic, and iconic representation, significantly enhances the child's ability to adopt a more flexible strategy for solving logical problems. If manipulation and iconic representation and motivation constitute a synthetic cognitive variable influencing linguistic competence, then it is reasonable to hypothesize that reading silently and aurally comprehending would both be facilitated in an equivalent manner when influenced by this gestalt variable. This is tested in the following experiment.

In summary, this experiment will attempt to test two hypotheses. The first hypothesis is that reading silently accesses to the same linguistic competence as processing oral speech does. If this hypothesis is supported and if it can be demonstrated that iconic
and enactive representation with motivation combine
to form a synthetic cognitive variable which facilitates
comprehension, then this study shall test the hypothesis
that both silent reading and aural processing are
equally influenced by this gestalt variable.

To test the above hypotheses, the dependent
variables will consist of three-term series problems
composed of two propositions and a question. Such
syllogisms will have the form: "If John is better than
Frank, and Frank is worse than Ted, then who is best?"
Eight sequences of paired propositions will be of the
form:

(1) A is better than B, B is better than C
(2) C is worse than B, B is worse than A
(3) A is better than B, C is worse than B
(4) B is worse than A, B is better than C
(1') A is not as bad as B, B is not as bad as C
(2') C is not as good as B, B is not as good as A
(3') A is not as bad as B, C is not as good as B
(4') B is not as good as A, B is not as bad as C

(For ease of understanding the syllogisms, H. Clark's
convention is adopted whereby "the best" is designated
by A, "the worst" by C, and "in the middle" by B.)

Following each of the eight proposition pairs,
the questions "Who is best?" and "Who is worst?" will
be asked.

Similar to the two-term syllogisms, the above
syllogisms can be paired on the basis of their similarity
of surface and deep structure. The numbers match the
proposition pairs having similar surface structures.
For instance, syllogisms (1) and (1') are identical except for the relational terms; in both cases the relational term, "is better than" or "isn't as bad as" respectively, means "strictly greater than." The deep structure of each pair, on the other hand, is different. The proposed deep structures for the above syllogisms are presented by their respective numbers as follows:

(1) A is good; B is good; C is good
(2) A is bad; B is bad; C is bad
(3) A is good; B is good, bad; C is bad
(4) A is bad; B is bad, good; C is good
(1') A is bad; B is bad; C is bad
(2') A is good; B is good; C is good
(3') A is bad; B is bad, good; C is bad
(4') A is good; B is good, bad; C is bad.

From the above, it is shown that (1) and (2') have similar deep structures, as do (2) and (1'), (3) and (4'), and (4) and (3').

Clark's principles make a number of predictions about syllogisms with homogeneous propositions, namely (1), (2), (1'), and (2'). The syllogisms with "good" in their relational terms, i.e. (1) and (2') should, as in the two-term syllogisms, produce fewer errors than those with "bad," i.e. (2) and (1'). In addition, a question that is congruent with the information in the syllogisms should be easier than an incongruent question. In other words, "Who is best?" should produce fewer errors when following (1) and (2'), rather than following (2) and (1').
In the case of heterogeneous syllogisms, namely, (3), (4), (3'), and (4'), predictions are more involved. Consider syllogism type (3). This syllogism has the deep structure: "A is good; B is good, B is bad, and C is bad." The answer to "Who is best?" is A, a term which is congruent with the first proposition of this syllogism. Note, however, the answer to "Who is worst?" is C, which also fulfills the congruence condition, being congruent to the third proposition. Congruency between these two questions is also met by (3').

Syllogism-types (4) and (4'), on the other hand, demonstrate complete incongruence between the propositions and questions. A, the answer to "Who is best?" is part of the deep structure, "A is bad," and C, the answer to "Who is worst?" is part of the deep structure, "C is good." Because of this internal disagreement, Clark hypothesizes that (3) and (3') should be easier to solve than (4) and (4').

In sum, it shall be hypothesized that if the oral condition does not produce significantly more errors than the visual condition on different syllogism combinations, under both the unmotivated and motivated with representation treatments, then these modes access to the same linguistic competence. Furthermore, if the unmotivated and the motivated treatment conditions differ significantly, then it can be concluded that the isolated variables represent a synthetic cognitive variable influencing linguistic competency.
Experiment 2: Design, Analysis, and Results

Method. Two sets of four examples of each of the eight problem types were constructed using "Snoopy," "Linus," "Charlie," and "Patty" as terms. Each proposition was typed on a blank IBM card in the following manner:

If Snoopy isn't as good as Charlie,  
And Snoopy isn't as bad as Linus,  
Then who is best?

On a second card the terms of the sequence were typed. Care was taken to counterbalance the names such that they didn't match the sequence of the syllogisms (see Appendix B).

In addition, four practice problems were constructed for each set. The problems were arranged in four blocks for each set and then randomized for each subject. The practice problems were administered before presenting the thirty-two syllogisms in each set.

In the first treatment, subjects silently read the syllogisms or heard the syllogisms. In the visual condition, subjects had fifteen seconds to read the card with the syllogism. The card was then turned over and subjects were instructed to read the three names present on the second card. This second card was then removed. Subjects had an unlimited amount of time in which to give a response. In the oral condition, subjects were read the syllogism once, and then the three names of the terms. Again they had an unlimited amount of time in which to respond.
In the second treatment, subjects either silently read or heard the syllogisms. Subjects reading the syllogism had but fifteen seconds to study a syllogism before reading the names of the terms. Orally, the syllogisms were read but once. In both cases, subjects were then instructed to distribute three trays—one containing three marbles, a second, six marbles, and a third, thirteen marbles—to three of the four Peanut dolls before them, whose names occurred as terms in the syllogism. Once the trays were distributed, the child then responded to the question. The children were told previous to this part of the experiment that for every correct response, they would immediately receive an M&M, which was placed in a cup for eating after the experiment. Rather than rewarding correct strategy selections, M&M's were given for the majority of wrong answers as well as for right answers. Subjects were given a time limit of thirty seconds in which to distribute the trays. This constraint was placed to keep the subjects' attention on the task.

The subjects were 30, second-grade students, ages 7:1 to 8:5, from a suburban school (Berington Elementary) in Upper Arlington, Ohio, randomly selected from two classrooms and randomly assigned to either the visual condition or the oral condition. Subjects either first read or heard the syllogisms in treatment one and then in a second treatment with iconic and enactive representation with the motivation of winning M&M's.
Results. Clark's principles are operative for both modes, as the data in Table 3 demonstrates.

Only in the case of hearing the syllogisms under the representation-with-motivation treatment are these principles poorly supported.

The principles of the primacy of functional relations and of lexical marking predict that syllogism types (1) and (2') will be solved with fewer errors than (2) and (1'). This is corroborated in the first treatment of the oral condition, \( t=2.42, df=14, p < .05 \), and in the second treatment of the visual condition, \( t=2.21, df=14, p < .05 \). The principles of the primacy of functional relations and of congruence predict that (3) and (4') will be solved with fewer errors than (4) and (3') combined. This is substantiated in the first treatment of the oral condition, \( t=5.17, df=14, p < .05 \), and in both cases of the visual condition: \( t=5.67, df=14, p < .05 \) for the first treatment; \( t=4.42, df=14, p < .05 \) for the second.

These two principles further predict that fewer errors will be made for syllogism types (1) and (2') when the question is "Who is best?" and for (2) and (1') when the question is "Who is worst?" than their opposite counterparts. This is supported in both treatments for the oral condition, \( t=4.49, df=14, p < .05 \) for treatment one, and \( t=5.65, df=14, p < .05 \) for the second.
for treatment two. However, in neither treatment of the visual condition is this principle significantly manifested.

Finally, in comparing the affirmative syllogisms (1), (2), (3), and (4) to their negative counterparts, significantly more errors occur for both conditions under both treatments: oral, $t=4.49$, $p < .05$; visual, $t=5.18$, $p < .05$; oral with motivation and representation, $t=3.34$, $p < .05$; and visual with motivation and representation, $t=2.20$, $p < .05$; in all cases, $df=14$.

Besides demonstrating that Clark's principles are descriptive of these modes, the results quite conclusively show that motivation, when combined with iconic and enactive representation, enhances children's ability to employ comprehension strategies (see Table 4).

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Insert Table 4 about here

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In comparing both oral and visual conditions of treatment one to treatment two, a striking decrease is observed in the number of errors in the second treatment: $t=5.75$, $df=14$, $p < .05$ for oral and $t=6.59$, $df=14$, $p < .05$ for the visual treatments. Hence, iconic and enactive representation, when combined with motivation, form a significant synthetic cognitive variable which significantly affects a child's ability to comprehend in both hearing speech and in silent reading.

The success of these findings enable this study to now compare the extent to which reading silently
and processing aurally access to the same linguistic competence under both treatments.

Results. In comparing the number of errors of combined syllogism types, no significant difference is found at any level between the oral and visual conditions in either treatment one or two (see Table 5).

Insert Table 5 about here

For instance, in comparing syllogism types (1) and (2'), and (2) and (1') to test for differences in the facility or difficulty with which deep structure representations are constructed, and the influence of "good" and "bad" in solving these problems, no significant difference is produced in either condition in either treatment. This likewise applies in comparing affirmative statements, negative statements, and congruent and incongruent syllogism tasks for both conditions in both treatments.

In general, this study's hypotheses are confirmed: not only does reading silently access to the same linguistic competence as hearing oral speech, but iconic and enactive representation with motivation significantly influence comprehension. With the aid of this synthetic cognitive variable, children manifest remarkable deductive capacities, much in advance of the formal operations stage.

Having hereby demonstrated a common competency between silent reading and aural processing, this study shall proceed to test the hypothesis that not
only are silent reading and aural processing similar instances where strategies are employed to produce appropriate results, but also in cases where miscued results are incurred.

**Miscuing Strategies in Reading Silently and Aural Processing**

The third hypothesis to be tested is that the strategies which result in miscues are identical to those which attain some criterion level, such as pronouncing all that is printed on a page or solving syllogisms.

Clark's theory, again, is applicable for testing this hypothesis. Implicit in Clark's three principles is the strategy that the problem solver retains information in the form of a statement's deep structure. In establishing deep structure, structures containing marked adjectives and/or negatives are more difficult to store and retrieve than those containing unmarked forms. When presented with a question, the comprehender first must search for stored information that is congruent with the question. If successful, he then compares deep-structure and task information. If he fails to establish congruency, he must reformulate the question and continue his search, or, at this point, simply guess. The presence of congruency has been demonstrated above when the criterion for strategy success has been to solve syllogisms correctly.

This strategy can likewise be verified when errors are produced in solving syllogisms. This strategy can be shown to be operative in what Clark (1969b)
has called "indeterminate" syllogisms. These are syllogisms which have undetermined answers for one of the tasks. For example, given the syllogism, "Herb is better than Frank, and Dick is better than Frank," when followed by the question, "Then who is best?", the correct answer is "Can't Tell."

Using such syllogism types, one can detect if the congruence principle is operative when one selects an inappropriate answer to the syllogism (i.e. a "paralogic miscue"). For illustration, consider the problem, "If Herb is better than Frank, and Frank is worse than Dick, then who is best?" Under certain conditions, a comprehender will select "Herb" or "Dick" instead of the answer, "Can't Tell." Clark's strategy predicts that the comprehender will first search for information congruent with the question. If this strategy fails overall to yield a definitive answer, the comprehender will be prompted to answer "Herb" instead of "Dick," as "Herb" most closely satisfies the congruence conditions.

Based on this reasoning, one should be able to predict the type of error most often made on the following three types of indeterminate syllogisms:

A. (1) G is better than J; H is better than J; who is best?

(2) G is worse than J; H is worse than J; who is worst?

(3) G is better than J; J is worse than H; who is best?
(4) C is worse than J; H is better than J; who is worst?
(5) J is worse than H; G is better than J; who is best?
(6) J is better than H; G is worse than J; who is worst?
B. (1) J is not as bad as G; J is not as bad as H; who is worst?
(2) G is not as bad as J; J is not as good as H; who is worst?
(3) G is not as bad as J; J is not as good as H; who is best?
(4) J is not as good as H; G is not as bad as J; who is best?
(5) J is not as bad as G; H is not as good as J; who is worst?
(6) H is not as good as J; J is not as bad as G; who is worst?
C. (1) G is better than J; G is better than H; who is worst?
(2) G is worse than J; G is worse than H; who is best?
(3) G is not as bad as J; H is not as bad as J; who is best?
(4) G is not as good as J; H is not as good as J; who is worst?

In (1) through (4) in set A, note that the task is congruent with the G term in the first proposition, whereas in (5) and (6) the task is congruent with the G term in the second proposition. If Clark's proposed
strategy is correct, then comprehenders should signifi-
cantly make more G-type errors, independent of whether
it occurs in the first or second proposition, since
this term satisfies the congruence principle while
H and J do not. If significance is obtained, then
this substantiates Clark's principle of congruence.

In syllogism set B, a different set of circumstances
prevail. In all the syllogisms of this set, J is the
term which is congruent with the task at the deep-
structure level. For instance, Clark's proposed deep
structure for (1) would be: "J is bad; G is bad; H
is bad." The question which makes this syllogism
undetermined is "Who is worst?" The twist is that a
negative appears in both propositions of this syl-
logism. If congruency is established at the surface-
structure level, then G in (2) and (3) with the deep
structure, "G is bad, J is bad," would be selected
significantly more often than either J or H. However,
if congruency is established at the deep-structure
level, then J, with the concomitant deep structure,
"J is good, H is good" in (2) and (3), should be chosen
more often, as its deep structure proposition is con-
gruent with that of the question's. Hence, if J is
selected more often than either G or H in set B,
then Clark's principle of functional relations is
further corroborated.

Finally, the syllogisms in C illustrate what
has been hypothesized in A, namely, that when no
deep structure is immediately congruent with the
deep structure of the task, the comprehender will tend to
randomly select J, G, and H as errors rather than select G which, in this case, is the first term of the first incongruent proposition. No significant difference in the number of error types in C would therefore support the claim that such errors are the result of the comprehender searching both propositions for congruency and finding none, he resorts to the strategy of guessing rather than taking the time to reformulate the propositions to establish congruency.

If the hypothesis that one employs the same strategies when miscuing as not miscuing is correct, then one would predict that significantly more G errors will occur in solving type-A syllogisms and more J errors in solving type-B. The number of G errors should not be significantly greater for type-C syllogisms. This can be validated for both silent reading and aural processing. If these predictions are supported, then it can be inferred that miscuing, or the incomplete application of strategies, applies in a similar manner for both modes, thereby supporting the contention that they access to the same linguistic competence.

To additionally substantiate this second hypothesis, error types for determinate and indeterminate syllogisms can be compared. Given the following three-term syllogisms:

(1) a. A is better than B; B is better than C
   b. B is better than C; A is better than B
(2) a. C is worse than B; B is worse than A
   b. B is worse than A; C is worse than B
(3) a. A is better than B; C is worse than B
b. C is worse than B; A is better than B

(4) a. B is worse than A; B is better than C
   b. B is not as good as A; C is not as good as B

(5) a. A is not as bad as B; B is not as bad as C
   b. B is not as good as A; C is not as good as B

(6) a. C is not as good as B; B is not as good as A
   b. B is not as good as A; C is not as good as B

(7) a. A is not as bad as B; C is not as good as B
   b. C is not as good as B; A is not as bad as B

(8) a. B is not as good as A; B is not as bad as C
   b. B is not as bad as C; B is not as good as A,

where A is the correct answer for the question, "Who is best," while C is the correct answer for the question, "Who is worst?," one can test the overall extent to which one error type versus another will occur in a given mode. Moreover, one can assess the extent to which children are likely to guess in either mode. This is possible if a fourth option is added to the syllogism distractors—the option of "Can't Tell." By mixing determinate and indeterminate syllogisms, "Can't Tell" serves two purposes. For indeterminate problems, it sometimes is the correct answer. On the other hand, when a comprehender finds a syllogism too difficult to process, he may opt for "Can't Tell." The purpose of this category, then, for determinate syllogisms is to minimize randomly selecting other error types, enabling us to hypothesize that the other error types when selected do, in fact, constitute the outcome of some logical strategy. Hence, this study shall proceed not only to compare the predicted error types hypothesized
above, but also to test for any significant difference in overall error types for the determinate and indeterminate propositions listed above.

**Experiment 3: Design, Analysis, and Results**

**Method.** Two problems were constructed for each of the 64 possible problem types—32 determinate and 32 indeterminate types. In addition, eight practice problems, four indeterminate and four determinate—were constructed. For the visual group, English names were used as terms in the syllogisms (see Appendix C); syllogisms were printed three to a page, with each syllogism having the form:

If Frank isn't as good as John,
And John isn't as bad as Herb,
Then who is best?
Herb  John  Frank  Can't Tell

For the oral group, the term names and "Can't Tell" were linearly typed, sixteen to a page. Names were counterbalanced across problems between groups.

Two classes of sixth graders, 35 students in each class (from Kenston Elementary School in Bainbridge, Ohio), served as subjects for this experiment. One class was assigned to the oral condition; the second to the visual condition. Sixth graders, instead of second graders, were selected for this experiment, as this was the youngest age group deemed amenable to the trial of an hour-and-twenty minutes of testing.

The syllogisms were divided into three sections, labelled "Team One," "Team Two," and "Team Three."
Each class was informed that the purpose of the experiment was to see which class could best identify the best and worst players, as defined by the syllogisms. A short break occurred at the completion of each "team" section.

In the oral condition, subjects were read each syllogism once and then given ten seconds to answer before the next was read. In the visual condition, subjects were given ten seconds in which to select an answer. After solving each syllogism, subjects were instructed to turn the page; additional instructions included when to commence reading and when to stop reading. Team-One syllogisms were solved first. They occurred at the top of each page. Team-Two syllogisms were solved secondly and occurred in the middle of each page. Finally, Team-Three syllogisms were solved and they occurred at the bottom of each page. Hence, upon turning the pages, subjects knew in which row the syllogism problem was to be found.

Before the experiment commenced, the class as a group solved the eight practice problems. At this time it was explained what constituted a "Can't Tell" answer.

Results. The congruence strategy predicts that in syllogism set A, more G errors will be made than H-or J-type errors. An analysis of variance depicts a significant means difference for both the oral and visual modes (see Tables 6 and 7): $F=3.83$, $df=2/102$, $p < .05$ for the oral mode and $F=5.34$, $df=2/102$, $p < .05$ for visual. A Dunn's test further reveals that G, in both modes is the most significantly chosen.
The deep-structure principle predicts that in syllogism set B, more $J$ errors will be made than will the other two types. If the comprehender processes at the surface-structure level, he will most likely choose $G$-type errors, as these errors occur in propositions with a surface structure which complies with the question. On the other hand, if the comprehender processes at the deep-structure level, more $J$ errors should be made, as these errors occur in propositions with a deep structure which complies with that of the question's. Again, in both oral and visual modes, an $F$ reveals an overall significant difference (see Tables 8 and 9): $F=4.22$, $df=2/102$, $p < .05$ for the oral; $F=3.56$, $df=2/102$, $p < .05$ for visual.
A Dunn's test for both conditions substantiates the claim that significantly more J errors are made than either G or H errors: $\sqrt{LSD}=6.99$, $M_J - M_G=8.35$, $M_J - M_H=7.10$ for oral; $\sqrt{LSD}=7.87$, $M_J - M_G=7.93$, $M_J - M_H=7.99$ for visual.

The final hypothesis predicts that if no deep structure is immediately congruent with that of the question, the comprehender will tend to randomly choose among error types G, H, and J. On the other hand, if he processes at the surface-structure level, then he should select G most often, as this is the error type found in the first proposition having a similar surface structure meaning to the question. This hypothesis is substantiated in both cases, as no significant mean differences for either oral (see Table 10) or visual (see Table 11) are detected.

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Insert Table 10 about here

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Insert Table 11 about here

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In sum, the congruence and deep structure strategies, which have been shown to operate at a criterion level in both silent reading and aural processing, have hereby been demonstrated to operate in the case of miscuing in comprehending syllogisms. However, while both these strategies appear to be
functioning in the visual and oral modes, this does not provide substantial evidence to conclude that miscuing in one mode is identical to miscuing in another. After all, the same strategies were seen to operate in both reading aloud and in aural processing, but to different degrees. This second hypothesis is confirmed by a second set of findings.

Results. It was reasoned above that by providing the additional category, "Can't Tell," this would tend to minimize guessing on other categories, thereby making each error-type more representative of a given strategy selection in solving the syllogism. In comparing the number of errors for each error type between the oral and visual modes, the data reveals no significant difference in any instance (see Table 12). This applies for the determinate syllogisms, where the A term is the correct answer to the question, "Who is best?"; the determinate syllogisms where the C term is the correct answer to the question, "Who is worst?"; and in the indeterminate syllogisms, in both cases where "Can't Tell" and J are the correct answers. It is particularly interesting to note that in both modes, the option, "Can't Tell," is used to nearly the same extent, thus implying that the guessing strategy is equally functional for both modes. The no-significant differences on the other error types likewise support
the hypothesis that strategies resulting in miscues in reading silently are similar to those in aural processing.
Chapter 4, Conclusions and Recommendations

The preceding triology of experiments have supported the following hypotheses: (1) that a common linguistic competence underlies both silent reading and oral-language processing, (2) that this linguistic competence is not shared by reading aloud, (3) that iconic and enactive representations with motivation function as a synthetic cognitive variable which greatly enhances a child's ability to comprehend; (4) that miscuing, or making paralogic errors in the solution of syllogisms, utilizes the same basic strategies as solving a task at a criterion level; and (5) that miscuing in aural processing is similar to miscuing while reading silently.

Although these findings have important and numerous extenuations for pedagogy, a caveat is in order. The significance of these results, at this stage of research, is not that they support one reading method over another, but rather they illustrate that cognitive operations cannot only be described, but explained to the extent of predictability. The intrinsic worth of such a study is that it has established a functional definition of linguistic competence and has shown that this definition can serve as a theoretical metrical, or yardstick, by which comprehension can be assessed. Although the primitives upon which this definition is based—Clark's three principles, "strategy," "synthetic cognitive variable," "logical structure" (or deep structure),
and "interpreted structure" (or surface structure)—remain loosely specified, this definition and its concomitant theory have perhaps the greatest validity in the field of reading today.

Although this study fails to achieve the same consistent results in the first two experiments as Clark's principles achieve for his own data, there is an explanation for this. Clark's experiments used adults as subjects. In most instances (e.g. Clark, 1969a), syllogisms were performed at a criterion level known to the subjects, such that time for reaching a correct response, rather than the number of errors, was used as the dependent variable. In such a case, guessing was an unacceptable strategy.

In this study's experiments, however, there was no such specified criterion. All the answers children gave were accepted. Children quite often would randomly guess or else employ the strategy of always choosing the first or last term in the syllogism, thus confounding Clark's strategies with those of guessing.

In addition to the predictive advantages of this study's theory, it is the only theory which views children's language as dynamic rather than static. This is accounted for by hypothesizing that children will process unmarked words, e.g. "good," "tall," "more" and unmarked logical structures, e.g. affirmative sentences, more easily than marked words and structures. Such a hypothesis implies that instead of a child being a nonreader, he may simply have a slowly developing linguistic competence. In sum, the fault here lies not
in the fact that the child "can't read" but rather he linguistically can't understand.

Another advantage of this theory is that it asserts that linguistic competence is a function of a higher, synthetic cognitive competence which significantly influences comprehension. To attempt to assess a child's comprehension ability without considering his level of motivation and his preferred modality of representation is like trying to describe the state of water without considering its temperature.

This study's conception of reading, then, is that it is a motivated behavior employing strategies in a given context (e.g. reading syllogisms or a newspaper). These strategies serve the purpose of relating information represented in logical-structure form to an assigned task (either assigned by the individual doing the reading or by an external agent—should the individual choose to accept the agent's task). The information translated into a logical structure is a function of what the comprehender decides to focus his attention on.

Given this interpretation of reading, several explanations can be posited why oral reading does not access to the same linguistic competence as does silent reading. In oral reading, the comprehender has the additional problem of formulating strategies to establish not only logical structures but also to retranslate these structures into surface structure (a hypothesis similarly shared by F. Smith, 1969). A corollary to this is that the comprehender must not only focus his attention upon establishing congruence between his logical
structures and his accepted task, he must also focus his attention upon verbalizing these structures. So besides having to adopt two sets of strategies simultaneously, the comprehender is faced with the problem of focusing simultaneously upon two different tasks—one, establishing meaning; the other, verbalizing the written surface structure.

Although this theory has many advantages over most current theories of reading, there are many difficulties underlying its claims. The greatest shortcoming of this theory, as well as with this study's definition of linguistic competence, is that what constitutes deep structure, or logical structure, remains yet undetermined. True, this study succeeded in quantifying deep structure to the point that one knows that if "good" or its comparative form, "best" appears in the task's surface structure, then the proposition containing "good," whether preceded by a negative or not, will be processed more easily than the proposition containing "bad." Yet this hardly answers the question, What constitutes the cognitive deep structures of sentences? This question could be taken even a step further and asked as, What constitutes the meaning properties of "good" and "bad" such that they tend to be more congruent with their comparative counterparts? In short, this definition of deep structure needs both extensive qualified and quantified elaboration before comprehension can be fully understood.

Secondly, this study's definition of linguistic competence has dealt with only a few identifiable
strategies. Surely these strategies which have been proposed are but a shotgun description of many rifle-fine processes. These additional strategies need to be delineated and their interrelations demonstrated.

A third area which warrants investigation is the extent to which Clark's principles apply to other types of tasks, e.g. verification or performing commands. Also, the extent to which this theory is generalizable beyond the syllogisms needs to be studied.

A final consideration is the extent to which the variance of reading comprehension can be predicted from aural comprehension. This study's experiments have merely demonstrated that differences and similarities exist between the modes, with apparently many more similarities than differences. The questions that remain are how similar and how different are the two modes.

In conclusion, by constructing a fully formalized definition of linguistic competence, this study has applied this definition as a theoretical metrical to determine whether reading comprehension and oral-language comprehension access to the same linguistic competence. A similar competence was demonstrated for reading silently and aural processing but reading orally was quantitatively different, as significantly more errors in this mode were produced than for the oral mode. An identified synthetic cognitive variable was shown to significantly influence a child's comprehension ability in both oral and visual modes. Finally, miscuing is the same as not miscuing in both modes; miscuing in
aural processing is the same as miscuing in reading silently. The perceived significance of this study is not in the answers discovered but in the questions raised. As Kazantzakis, in *Report to Greco*, has written:

> Reality... does not exist independent of man, completed and ready; it comes with man's collaboration, and is proportionate to man's worth. If we open a riverbed by writing or acting, reality may flow into that riverbed, into a course it would not have taken had we not intervened. We do not bear the full responsibility naturally, but we do bear a great part.

In other words, this study has resurrected Thorndike's (1917) question, "Is reading reasoning?"
REFERENCES


Bruner, J. S. Going beyond the information given. In J. Anglin (Ed.), Beyond the information given, 1973, 218-238. (a)


Brunswick, E. Perception and the representative design of psychological experiments. Berkeley: University of California, 1956.


Gardiner, W. An investigation of understanding of the meaning of the logical operators in propositional reasoning. (Doctoral dissertation, Cornell University, 1966). (University Microfilms No. 60-4109)


Hempel, C. The logic of functional analysis. 
In L. Gross (Ed.), *Symposium on Social Theory*. 


Hill, S. A. *A study of the logical abilities of children*. 
(University Microfilms No. 61-1229)


Hymes, D. Competence and performance in linguistic theory. 


Miller, W. A. The acceptance and recognition of six logical inference patterns by secondary students. (Doctoral dissertation, University of Wisconsin, 1968.) (University Microfilms, No. 68-13-651)


Piaget, J. Quantification, conservation and nativism. Quantitative evaluations of children aged two to three years are examined. Science, 1968, 162, 976-979.


Springston, F., & Clark, H. *And and or, or the comprehension of pseudoimperatives.* *Journal of Verbal Learning and Verbal Behavior,* 1973, 12, 258-272.

Thorndike, E. Reading as reasoning: a study of mistakes in paragraph reading. The Journal of Educational Psychology, 1917, 8, 6, 323-332.


### Table 1

**T-Tests of Various Combinations of Syllogism**

Means within Oral and Visual Conditions

<table>
<thead>
<tr>
<th>Conditions and Syllogism Combinations</th>
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<tr>
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*P < .05
Table 2
Paired T-Tests of Various Combinations of Corresponding Syllogism Means between Oral and Visual Conditions

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*p < .05
Table 3
T-Tests of Various Combinations of Syllogism Means
Within Oral (Gp. 1), Visual (Gp. 2), and
Iconic and Enactive Representation with
Motivation (Gps. 1 and 2)

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Table 4

T-Tests between Oral and Oral with Motivation and Iconic And Enactive Representation; and between Oral and Visual And Motivation and Iconic and Enactive Representation

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Table 5
T-Tests of Various Combinations of Syllogism Means between Oral (Gp. 1) and Visual (Gp. 2); and between Oral (Gp. 1) and Visual (Gp. 2) with Motivation and Iconic and Enactive Representation

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<td>Visual 3, 3'</td>
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### Table 5 (Continued)

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### Table 6

Analysis of Variance of the Number of G, H, and J Errors For Syllogism Set A in the Oral Mode

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<td>498.43</td>
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*p < .05
Table 7
Analysis of Variance of the Number of G, H, and J Errors
For Syllogism Set A in the Visual Mode

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*p < .05

Table 8
Analysis of Variance of the Number of G, H, and J Errors
For Syllogism Set B in the Oral Mode

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*p < .05
Table 9
Analysis of Variance of the Number of G, H, and J Errors
For Syllogism Set B in the Visual Mode

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Table 10
Analysis of Variance of the Number of G, H, and J Errors
For Syllogism Set C in the Oral Mode

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Table 11
Analysis of Variance of the Number of G, H, and J Errors
For Syllogism Set C in the Visual Mode

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Table 12
T-Tests between Oral and Visual Syllogism Error Types
For Determinate and Indeterminate Syllogisms

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<td>Visual K</td>
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<sup>a</sup>K refers to the category, "Can't Tell"
PSYCHOLINGUISTIC PROPERTIES OF AURAL AND VISUAL COMPREHENSION
AS DETERMINED BY CHILDREN'S ABILITIES TO COMPREHEND
DETERMINATE AND INDETERMINATE SYLLOGISMS

By
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The Ohio State University, 1975
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This study first constructs a fully formalized
definition of linguistic competence, delineating
several processes of how the reader/listener arrives
at linguistic understanding. This definition of comp­
etence is then used as a theoretical metrical to deter­
mine whether reading comprehension and oral-language
comprehension access to the same linguistic competence.
A similar competence is demonstrated for reading silently
and aural processing, but reading orally is shown to be
uniquely different. A synthetic cognitive variable is
identified, comprised of enactive and iconic represen­
tation with motivation. This variable is shown to
significantly influence a child's comprehension
ability in both oral and visual modes. Finally, it is
demonstrated that miscuing is the same as not miscuing
in both modes and that miscuing in aural processing
is the same as miscuing in reading silently.
APPENDIX A

Two-Term Oral Syllogisms

1. If Bill is worse than Dick, then who is worst?
   Bill  Dick
2. If John is worse than Carl, then who is best?
   John  Carl
3. If Todd is better than Jeff, then who is best?
   Todd  Jeff
4. If Mike is not as good as Rich, then who is best?
   Rich  Mike
5. If Neal is not as bad as Jeff, then who is best?
   Jeff  Neal
6. If Neal is not as bad as Carl, then who is best?
   Carl  Neal
7. If Jack is better than Bill, then who is best?
   Bill  Jack
8. If Nick is not as bad as Carl, then who is worst?
   Nick  Carl
9. If Bill is worse than Dick, then who is best?
   Dick  Bill
10. If Fred is not as good as Kent, then who is best?
    Kent  Fred
11. If Nick is not as bad as Carl, then who is best?
    Carl  Nick
12. If Andy is better than John, then who is worst?
    John  Andy
13. If Herb is not as good as Luke, then who is best?
    Herb  Luke
14. If Neal is not as bad as Carl, then who is worst?
    Neal  Carl
15. If Dale is not as bad as Kent, then who is worst?
    Dale  Kent
16. If Scot is worse than Burt, then who is best?
    Burt  Scot
17. If Andy is better than John, then who is best?
    Andy  John
18. If Mike is not as good as Rich, then who is worst?
    Mike  Rich
19. If Herb is worse than Hank, then who is best?
   Hank  Herb
20. If Todd is better than Jeff, then who is worst?
    Jeff  Todd
21. If Neal is not as bad as Jeff, then who is worst?
    Neal  Jeff
22. If Scot is worse than Burt, then who is worst?
    Scot  Burt
23. If Jack is not as good as Glen, then who is worst?
    Jack  Glen
24. If Paul is better than Fred, then who is best?
    Paul  Fred
25. If Dale is not as bad as Kent, then who is best?
    Kent  Dale
26. If Paul is better than Fred, then who is worst?
    Fred  Paul
27. If Jack is not as good as Glen, then who is best?
    Glen  Jack
28. If John is worse than Carl, then who is worst?
    John  Carl
29. If Herb is worse than Hank, then who is worst?
    Herb  Hank
30. If Herb is not as good as Luke, then who is worst?
    Luke  Herb
31. If Jack is better than Bill, then who is worst?
    Jack  Bill
32. If Fred is not as good as Kent, then who is worst?
    Fred  Kent

Two-Term Visual Syllogisms

1. If Phil is not as good as Doug, then who is best?
   Doug  Phil
2. If Nick is better than Neal, then who is best?
   Nick  Neal
3. If Rich is worse than Carl, then who is best?
   Rich  Carl
4. If Pete is not as bad as Kent, then who is best?
   Kent  Pete
5. If Scot is not as good as Dale, then who is worst?
   Scot  Dale
6. If Pete is not as bad as Kent, then who is worst?  
   Pete Kent

7. If Kirt is worse than Hank, then who is best?  
   Hank Kirt

8. If Scot is not as good as Dale, then who is best?  
   Dale Scot

9. If Rich is worse than Carl, then who is worst?  
   Carl Rich

10. If Luke is not as good as Andy, then who is best?  
    Andy Luke

11. If Mark is not as bad as Todd, then who is best?  
    Mark Todd

12. If Jeff is better than John, then who is best?  
    Jeff John

13. If Luke is not as good as Andy, then who is worst?  
    Luke Andy

14. If Mark is not as bad as Todd, then who is worst?  
    Todd Mark

15. If Kirt is worse than Hank, then who is worst?  
    Kirt Hank

16. If Jeff is better than John, then who is worst?  
    John Jeff

17. If Herb is not as good as Phil, then who is worst?  
    Herb Phil

18. If Dick is worse than John, then who is worst?  
    Dick John

19. If Herb is not as good as Phil, then who is best?  
    Phil Herb

20. If Burt is better than Fred, then who is worst?  
    Fred Burt

21. If Rich is better than Mike, then who is best?  
    Rich Mike

22. If Bill is not as bad as Doug, then who is best?  
    Bill Doug

23. If Rich is better than Mike, then who is worst?  
    Mike Rich

24. If Dick is not as bad as Bill, then who is worst?  
    Dick Bill

25. If Jack is worse than Paul, then who is best?  
    Paul Jack
26. If Dick is worse than John, then who is best?
   John   Dick

27. If Burt is better than Fred, then who is best?
    Burt   Fred

28. If Bill is not as bad as Doug, then who is worst?
    Doug   Bill

29. If Dick is not as bad as Bill, then who is best?
    Bill   Dick

30. If Jack is worse than Paul, then who is worst?
    Jack   Paul

31. If Phil is not as good as Doug, then who is worst?
    Phil   Doug

32. If Nick is better than Neal, then who is worst?
    Nick   Neal
APPENDIX B

Three-Term Syllogisms Presented without Additional Representation

1. If Linus has more than Snoopy, and Snoopy has more than Charlie, then who has the fewest?
   Linus  Snoopy  Charlie

2. If Snoopy has fewer than Linus, and Linus has fewer than Patty, then who has the most?
   Snoopy  Linus  Patty

3. If Linus has more than Snoopy, and Snoopy has more than Charlie, then who has the most?
   Linus  Snoopy  Charlie

4. If Snoopy has fewer than Linus, and Linus has fewer than Patty, then who has the fewest?
   Snoopy  Linus  Patty

5. If Charlie has more than Patty, and Linus has fewer than Patty, then who has the fewest?
   Charlie  Patty  Linus

6. If Snoopy has not as many as Linus, and Linus has not as many as Patty, then who has the fewest?
   Snoopy  Linus  Patty

7. If Charlie has more than Patty, and Linus has fewer than Patty, then who has the most?
   Charlie  Linus  Patty

8. If Snoopy has fewer than Linus, and Linus has fewer than Patty, then who has the most?
   Snoopy  Linus  Patty

9. If Charlie has fewer than Snoopy, and Snoopy has more than Patty, then who has the fewest?
   Charlie  Snoopy  Patty

10. If Snoopy has fewer than Linus, and Linus has fewer than Patty, then who has the fewest?
    Snoopy  Linus  Patty

11. If Patty has not as many as Snoopy, and Snoopy has not as many as Charlie, then who has the fewest?
    Patty  Snoopy  Charlie
12. If Linus has more than Snoopy, and Snoopy has more than Charlie, then who has the most?
Linus  Snoopy  Charlie
13. If Charlie has not as few as Patty, and Linus has not as many as Patty, then who has the fewest?
Charlie  Patty  Linus
14. If Patty has not as few as Linus, and Charlie has not as many as Linus, then who has the fewest?
Patty  Charlie  Linus
15. If Charlie has not as many as Snoopy, and Charlie has not as few as Patty, then who has the most?
Charlie  Snoopy  Patty
16. If Patty has not as many as Snoopy, and Snoopy has not as many as Charlie, then who has the most?
Patty  Snoopy  Charlie
17. If Charlie has not as many as Snoopy, and Charlie has not as few as Patty, then who has the fewest?
Charlie  Snoopy  Patty
18. If Patty has not as many as Snoopy, and Patty has not as few as Linus, then who has the most?
Patty  Snoopy  Linus
19. If Linus has not as few as Snoopy, and Snoopy has not as few as Charlie, then who has the most?
Linus  Snoopy  Charlie
20. If Patty has not as few as Linus, and Charlie has not as many as Linus, then who has the most?
Patty  Linus  Charlie
21. If Charlie has not as few as Patty, and Linus has not as many as Patty, then who has the most?
Charlie  Patty  Linus
22. If Linus has more than Snoopy, and Snoopy has more than Charlie, then who has the fewest?
Linus  Snoopy  Charlie
23. If Charlie has more than Patty, and Linus has fewer than Patty, then who has the fewest?
Charlie  Patty  Linus
24. If Linus has not as few as Snoopy, and Snoopy has not as few as Charlie, then who has the fewest?
Linus  Snoopy  Charlie
25. If Charlie has fewer than Snoopy, and Charlie has more than Patty, then who has the most?  
Charlie  Snoopy  Patty

26. If Snoopy has not as many as Linus, and Linus has not as many as Patty, then who has the most?  
Snoopy  Linus  Patty

27. If Charlie has more than Patty, and Linus has fewer than Patty, then who has the most?  
Charlie  Patty  Linus

28. If Patty has not as many as Snoopy, and Linus has not as few as Snoopy, then who has the fewest?  
Patty  Snoopy  Linus

29. If Linus has not as few as Snoopy, and Snoopy has not as few as Charlie, then who has the fewest?  
Linus  Snoopy  Charlie

30. If Linus has not as few as Snoopy, and Snoopy has not as few as Charlie, then who has the most?  
Linus  Snoopy  Charlie

31. If Charlie has fewer than Snoopy, and Charlie has more than Patty, then who has the most?  
Charlie  Snoopy  Patty

32. If Charlie has fewer than Snoopy, and Charlie has more than Patty, then who has the fewest?  
Charlie  Snoopy  Patty

Three-Term Syllogisms Presented with Additional Representation

1. If Linus has fewer than Patty, and Linus has more than Charlie, then who has the fewest?  
Charlie  Linus  Patty

2. If Charlie has not as few as Snoopy, and Patty has not as many as Snoopy, then who has the fewest?  
Charlie  Patty  Snoopy

3. If Patty has not as many as Snoopy, and Snoopy has not as many as Charlie, then who has the fewest?  
Charlie  Patty  Snoopy

4. If Linus has fewer than Snoopy, and Snoopy has fewer than Charlie, then who has the fewest?  
Charlie  Linus  Snoopy

5. If Linus has fewer than Patty, and Linus has more than Charlie, then who has the most?  
Charlie  Linus  Patty
6. If Snoopy has not as few as Patty, and Patty has not as few as Linus, then who has the most?
   Linus   Patty   Snoopy

7. If Charlie has not as many as Linus, and Linus has not as many as Patty, then who has the fewest?
   Patty   Charlie   Linus

8. If Linus has not as many as Patty, and Linus has not as few as Charlie, then who has the fewest?
   Linus   Charlie   Patty

9. If Snoopy has more than Patty, and Patty has more than Linus, then who has the most?
   Patty   Linus   Snoopy

10. If Patty has fewer than Linus, and Charlie has more than Linus, then who has the most?
    Snoopy   Patty   Charlie

11. If Patty has fewer than Snoopy, and Snoopy has fewer than Charlie, then who has the most?
    Snoopy   Linus   Charlie

12. If Linus has not as few as Charlie, and Snoopy has not as many as Charlie, then who has the fewest?
    Snoopy   Linus   Charlie

13. If Patty has not as many as Snoopy, and Snoopy has not as many as Charlie, then who has the most?
    Patty   Snoopy   Charlie

14. If Snoopy has not as few as Linus, and Linus has not as few as Patty, then who has the most?
    Patty   Linus   Snoopy

15. If Linus has more than Charlie, and Snoopy has fewer than Charlie, then who has the fewest?
    Snoopy   Linus   Charlie

16. If Linus has fewer than Snoopy, and Snoopy has fewer than Charlie, then who has the most?
    Linus   Charlie   Snoopy

17. If Snoopy has more than Linus, and Linus has more than Patty, then who has the most?
    Linus   Patty   Snoopy

18. If Charlie has not as few as Snoopy, and Patty has not as many as Snoopy, then who has the most?
    Snoopy   Charlie   Patty

19. If Patty has fewer than Snoopy, and Snoopy has fewer than Charlie, then who has the fewest?
    Patty   Charlie   Snoopy
20. If Linus has not as few as Charlie, and Snoopy has not as many as Charlie, then who has the most? Charlie Snoopy Linus
21. If Charlie has not as many as Linus, and Charlie has not as few as Snoopy, then who has the most? Linus Snoopy Charlie
22. If Patty has more than Charlie, and Snoopy has fewer than Charlie, then who has the most? Charlie Snoopy Patty
23. If Patty has more than Charlie, and Snoopy has fewer than Charlie, then who has the fewest? Patty Snoopy Charlie
24. If Snoopy has more than Linus, and Linus has more than Patty, then who has the fewest? Linus Snoopy Patty
25. If Charlie has not as many as Linus, and Charlie has not as few as Snoopy, then who has the fewest? Snoopy Charlie Linus
26. If Snoopy has more than Patty, and Patty has more than Linus, then who has the fewest? Linus Patty Snoopy
27. If Patty has fewer than Linus, and Charlie has more than Linus, then who has the fewest? Linus Charlie Patty
28. If Charlie has not as many as Linus, and Linus has not as many as Patty, then who has the most? Patty Linus Charlie
29. If Linus has not as many as Patty, and Linus has not as few as Charlie, then who has the most? Charlie Patty Linus
30. If Snoopy has not as few as Patty, and Patty has not as few as Linus, then who has the fewest? Snoopy Patty Linus
31. If Linus has more than Charlie, and Snoopy has fewer than Charlie, then who has the most? Linus Charlie Snoopy
32. If Snoopy has not as few as Linus, and Linus has not as few as Patty, then who has the fewest? Linus Patty Snoopy
APPENDIX C

Determinate and Indeterminate Syllogisms

1. If Rich is not as good as Nick, and Hank is not as bad as Nick, then who is worst?
   Rich  Hank  Nick  Can't Tell

2. If Scot is better than Dale, and Burt is better than Dale, then who is best?
   Burt  Scot  Dale  Can't Tell

3. If Rich is not as bad as Kirt, and Kirt is not as bad as Jack, then who is worst?
   Kirt  Rich  Jack  Can't Tell

4. If Mack is worse than Lyll, and Jack is better than Mack, then who is best?
   Lyll  Mack  Jack  Can't Tell

5. If Mark is not as bad as Todd, and Mark is not as good as Kent, then who is best?
   Mark  Todd  Kent  Can't Tell

6. If Carl is not as good as Glen, and Carl is not as bad as Joe, then who is worst?
   Glen  Carl  Joe  Can't Tell

7. If Rich is not as good as Nick, and Hank is not as bad as Nick, then who is best?
   Nick  Hank  Rich  Can't Tell

8. If Scot is better than Dale, and Burt is better than Dale, then who is worst?
   Scot  Burt  Dale  Can't Tell

9. If Fred is better than Phil, and Phil is worse than Herb, then who is best?
   Herb  Phil  Fred  Can't Tell

10. If Mack is not as good as Carl, and Carl is not as good as Greg, then who is worst?
    Carl  Greg  Mack  Can't Tell

11. If Kent is not as bad as Bill, and Doug is not as good as Bill, then who is best?
    Bill  Kent  Doug  Can't Tell

12. If Bart is better than Neal, and Bart is better than Kirt, then who is worst?
    Kirt  Neal  Bart  Can't Tell

146
13. If Todd is worse than Kent, and Dick is worse than Todd, then who is best?
   Dick   Todd   Kent   Can't Tell
14. If Bob is not as good as Hank, and Bill is not as good as Hank, then who is worst?
   Bill   Bob   Hank   Can't Tell
15. If Scot is not as good as Carl, and Scot is not as good as Mark, then who is best?
   Scot   Mark   Carl   Can't Tell
16. If Pete is worse than Mark, and Mark is worse than John, then who is worst?
   Mark   John   Pete   Can't Tell
17. If Phil is not as good as Bart, and Bart is not as bad as Pete, then who is best?
   Pete   Bart   Phil   Can't Tell
18. If Tom is better than Joe, and Joe is better than Ted, then who is best?
   Ted   Joe   Tom   Can't Tell
19. If Greg is worse than Jim, and Ted is worse than Jim, then who is best?
   Greg   Ted   Jim   Can't Tell
20. If Bob is not as good as Tom, and John is not as good as Bob, then who is worst?
   Bob   John   Tom   Can't Tell
21. If Hank is better than Herb, and Hank is worse than Neal, then who is best?
   Hank   Herb   Neal   Can't Tell
22. If Tom is better than Kent, and Nick is worse than Tom, then who is worst?
   Nick   Kent   Tom   Can't Tell
23. If Pete is worse than Dick, and Pete is worse than Luke, then who is worst?
   Dick   Luke   Pete   Can't Tell
24. If Mack is not as good as Carl, and Carl is not as good as Greg, then who is best?
   Greg   Carl   Mack   Can't Tell
25. If Dale is better than Bill, and Bill is worse than Luke, then who is best?
   Bill   Luke   Dale   Can't Tell
26. If Luke is not as bad as Herb, and Luke is not as bad as Mack, then who is worst?
   Luke  Mack  Herb  Can't Tell.
27. If Dale is better than Bill, and Luke is worse than Bill, then who is worst?
   Dale  Bill  Luke  Can't Tell
28. If Luke is not as bad as Herb, and Luke is not as bad as Mack, then who is best?
   Herb  Luke  Mack  Can't Tell
29. If Bart is not as bad as Lyll, and Glen is not as bad as Bart, then who is best?
   Lyll  Glen  Bart  Can't Tell
30. If Phil is better than Herb, and Herb is worse than Fred, then who is worst?
   Herb  Fred  Phil  Can't Tell
31. If Bob is better than Jim, and Ken is better than Bob, then who is worst?
   Bob  Ken  Jim  Can't Tell
32. If Ted is not as bad as Kirt, and Kirt is not as good as Dick, then who is best?
   Kirt  Ted  Dick  Can't Tell
33. If Phil is worse than Scot, and Doug is better than Scot, then who is worst?
   Scot  Doug  Phil  Can't Tell
34. If Neal is not as bad as Jim, and Greg is not as bad as Jim, then who is best?
   Greg  Jim  Neal  Can't Tell
35. If Hank is better than Herb, and Hank is worse than Neal, then who is worst?
   Hank  Herb  Neal  Can't Tell
36. If Tom is better than Kent, and Nick is worse than Tom, then who is best?
   Kent  Nick  Tom  Can't Tell
37. If Phil is not as good as Bart, and Bart is not as bad as Pete, then who is worst?
   Bart  Pete  Phil  Can't Tell
38. If Burt is not as bad as Joe, and Todd is not as good as Burt, then who is best?
   Todd  Joe  Burt  Can't Tell
39. If Ted is not as bad as Kirt, and Kirt is not as good as Dick, then who is worst?
   Kirt  Ted  Dick  Can't Tell
40. If Bob is better than Jim, and Ken is better than Bob, then who is best?
   Ken   Jim   Bob   Can't Tell.

41. If Ken is worse than Dale, and Dale is worse than Glen, then who is worst?
   Glen   Dale   Ken   Can't Tell

42. If Burt is worse than Nick, and Burt is better than Fred, then who is best?
   Nick   Fred   Burt   Can't Tell

43. If Glen is not as good as Carl, and Glen is not as bad as Joe, then who is worst?
   Carl   Joe   Glen   Can't Tell

44. If Neal is better than Kirt, and Neal is better than Bart, then who is best?
   Kirt   Neal   Bart   Can't Tell

45. If Nick is better than Tom, and Kent is worse than Nick, then who is best?
   Tom   Kent   Nick   Can't Tell

46. If Bart is not as bad as Lyll, and Glen is not as bad as Bart, then who is worst?
   Lyll   Glen   Bart   Can't Tell

47. If Mark is not as bad as Todd, and Mark is not as good as Kent, then who is worst?
   Todd   Mark   Kent   Can't Tell

48. If Dale is better than Burt, and Scot is better than Burt, then who is best?
   Burt   Scot   Dale   Can't Tell

49. If Glen is not as good as Carl, and Glen is not as bad as Joe, then who is best?
   Glen   Joe   Carl   Can't Tell

50. If Neal is better than Kirt, and Neal is better than Bart, then who is worst?
   Bart   Neal   Kirt   Can't Tell

51. If Tom is not as good as Bob, and John is not as good as Tom, then who is worst?
   John   Tom   Bob   Can't Tell

52. If Pete is worse than Dick, and Pete is worse than Luke, then who is best?
   Dick   Luke   Pete   Can't Tell

53. If Rich is not as good as Hank, and Nick is not as bad as Hank, then who is best?
   Hank   Nick   Rich   Can't Tell
54. If Greg is worse than Jim, and Ted is worse than Jim, then who is worst?
   Greg    Jim    Ted    Can't Tell
55. If Bill is better than Dale, and Luke is worse than Dale, then who is best?
   Luke    Bill    Dale    Can't Tell
56. If Scot is not as good as Carl, and Scot is not as good as Mark, then who is worst?
   Carl    Scot    Mark    Can't Tell
57. If Todd is worse than Kent, and Dick is worse than Todd, then who is worst?
   Todd    Dick    Kent    Can't Tell
58. If Kirt is not as bad as Dick, and Dick is not as good as Ted, then who is best?
   Dick    Ted    Kirt    Can't Tell
59. If Burt is not as bad as Joe, and Todd is not as good as Burt, then who is worst?
   Joe    Burt    Todd    Can't Tell
60. If Ken is better than Jim, and Bob is better than Ken, then who is best?
   Jim    Ken    Bob    Can't Tell
61. If Kent is not as bad as Bill, and Doug is not as good as Bill, then who is worst?
   Bill    Kent    Doug    Can't Tell
62. If Luke is worse than Pete, and Luke is worse than Dick, then who is best?
63. If Dale is worse than Glen, and Glen is better than Ken, then who is worst?
   Glen    Dale    Ken    Can't Tell
64. If Kirt is not as bad as Rich, and Rich is not as bad as Jack, then who is best?
   Kirt    Rich    Jack    Can't Tell
65. If Fred is better than Phil, and Phil is worse than Herb, then who is worst?
   Phil    Fred    Herb    Can't Tell
66. If Tom is not as good as Bob, and John is not as good as Tom, then who is best?
   Tom    Bob    John    Can't Tell
67. If Phil is worse than Doug, and Scot is better than Doug, then who is best?
   Scot    Doug    Phil    Can't Tell
68. If Bill is not as good as Bob, and Hank is not as good as Bob, then who is worst?
   Bob   Hank   Bill   Can't Tell

69. If Bill is not as good as Bob, and Hank is not as good as Bob, then who is best?
   Bob   Bill   Hank   Can't Tell

70. If Phil is worse than Doug, and Scot is better than Doug, then who is worst?
   Scot   Doug   Phil   Can't Tell

71. If Mack is worse than Lyll, and Jack is better than Mack, then who is worst?
   Lyll   Mack   Jack   Can't Tell

72. If Mack is not as good as Greg, and Greg is not as good as Carl, then who is best?
   Mack   Greg   Carl   Can't Tell

73. If John is not as good as Rich, and Doug is not as bad as John, then who is best?
   Rich   Doug   John   Can't Tell

74. If Pete is worse than John, and John is worse than Mark, then who is worst?
   Mark   Pete   John   Can't Tell

75. If Burt is worse than Nick, and Burt is better than Fred, then who is worst?
   Burt   Fred   Nick   Can't Tell

76. If Mack is not as bad as Luke, and Mack is not as bad as Herb, then who is best?
   Herb   Mack   Luke   Can't Tell

77. If Dale is worse than Glen, and Glen is better than Ken, then who is best?
   Glen   Dale   Ken   Can't Tell

78. If Kirt is not as bad as Rich, and Rich is not as bad as Jack, then who is worst?
   Kirt   Rich   Jack   Can't Tell

79. If Pete is not as good as Phil, and Phil is not as bad as Bart, then who is best?
   Bart   Pete   Phil   Can't Tell

80. If Tom is better than Joe, and Joe is better than Ted, then who is worst?
   Ted   Joe   Tom   Can't Tell

81. If Pete is worse than John, and John is worse than Mark, then who is best?
   Mark   Pete   John   Can't Tell
82. If John is not as good as Rich, and Doug is not as bad as John, then who is worst?
   John  Doug  Rich  Can't Tell

83. If Neal is better than Herb, and Neal is worse than Hank, then who is best?
   Hank  Neal  Herb  Can't Tell

84. If Neal is not as bad as Jim, and Greg is not as bad as Jim, then who is worst?
   Jim  Neal  Greg  Can't Tell

85. If Ted is worse than Greg, and Jim is worse than Greg; then who is best?
   Ted  Jim  Greg  Can't Tell

86. If Kent is not as bad as Todd, and Kent is not as good as Mark, then who is worst?
   Mark  Todd  Kent  Can't Tell

87. If Mack is not as good as Greg, and Greg is not as good as Carl, then who is worst?
   Greg  Carl  Mack  Can't Tell

88. If Ken is worse than Dale, and Dale is worse than Glen, then who is best?
   Ken  Dale  Glen  Can't Tell

89. If Bart is better than Neal, and Bart is better than Kirt, then who is best?
   Neal  Kirt  Bart  Can't Tell

90. If Dale is better than Burt, and Scot is better than Burt, then who is worst?
   Scot  Dale  Burt  Can't Tell

91. If Ted is worse than Greg, and Jim is worse than Greg, then who is worst?
   Jim  Ted  Greg  Can't Tell

92. If Kent is not as bad as Todd, and Kent is not as good as Mark, then who is best?
   Kent  Mark  Todd  Can't Tell

93. If Jack is worse than Mack, and Lyll is better than Jack, then who is best?
   Jack  Lyll  Mack  Can't Tell

94. If Bill is not as bad as Kent, and Doug is not as good as Kent, then who is worst?
   Bill  Kent  Doug  Can't Tell

95. If Luke is worse than Pete, and Luke is worse than Dick, then who is worst?
   Luke  Pete  Dick  Can't Tell
96. If Carl is not as good as Glen, and Carl is not as bad as Joe, then who is best?
   Joe  Carl  Glen  Can't Tell

97. If Kirt is not as bad as Dick, and Dick is not as good as Ted, then who is worst?
   Ted  Kirt  Dick  Can't Tell

98. If Phil is worse than Scot, and Doug is better than Scot, then who is best?
   Phil  Scot  Doug  Can't Tell

99. If Rich is not as good as Doug, and John is not as bad as Rich, then who is best?
   John  Doug  Rich  Can't Tell

100. If Bill is better than Dale, and Luke is worse than Dale, then who is worst?
    Luke  Bill  Dale  Can't Tell

101. If Joe is better than Tom, and Tom is better than Ted, then who is worst?
    Tom  Joe  Ted  Can't Tell

102. If Pete is worse than Mark, and Mark is worse than John, then who is best?
    Pete  Mark  John  Can't Tell

103. If Pete is not as good as Phil, and Phil is not as bad as Bart, then who is worst?
    Bart  Phil  Pete  Can't Tell

104. If Phil is better than Herb, and Herb is worse than Fred, then who is best?
    Herb  Phil  Fred  Can't Tell

105. If Rich is not as good as Hank, and Nick is not as bad as Hank, then who is worst?
    Hank  Nick  Rich  Can't Tell

106. If Glen is not as bad as Lyll, and Bart is not as bad as Glen, then who is best?
    Glen  Lyll  Bart  Can't Tell

107. If Greg is not as bad as Neal, and Jim is not as bad as Neal, then who is worst?
    Greg  Jim  Neal  Can't Tell

108. If Bill is not as bad as Kent, and Doug is not as good as Kent, then who is best?
    Kent  Bill  Doug  Can't Tell

109. If Jack is worse than Mack, and Bill is better than Jack, then who is worse?
    Jack  Lyll  Mack  Can't Tell
110. If Carl is not as good as Mark, and Carl is not as good as Scot, then who is worst?
Mark  Scot  Carl  Can't Tell.

111. If Nick is worse than Burt, and Nick is better than Fred, then who is best?
Burt  Fred  Nick  Can't Tell

112. If Nick is worse than Burt, and Nick is better than Fred, then who is worst?
Burt  Nick  Fred  Can't Tell

113. If Carl is not as good as Mark, and Carl is not as good as Scot, then who is best?
Carl  Scot  Mark  Can't Tell

114. If Bob is not as good as Tom, and John is not as good as Bob, then who is best?
Tom  Bob  John  Can't Tell

115. If Nick is better than Tom, and Kent is worse than Nick, then who is worst?
Tom  Kent  Nick  Can't Tell

116. If Joe is not as bad as Todd, and Burt is not as good as Joe, then who is best?
Burt  Joe  Todd  Can't Tell

117. If Kent is worse than Todd, and Dick is worse than Kent, then who is worst?
Dick  Todd  Kent  Can't Tell

118. If Bob is not as good as Hank, and Bill is not as good as Hank, then who is best?
Hank  Bill  Bob  Can't Tell

119. If Neal is better than Herb, and Neal is worse than Hank, then who is worst?
Herb  Hank  Neal  Can't Tell

120. If Glen is not as bad as Lyll, and Bart is not as bad as Glen, then who is worst?
Bart  Lyll  Glen  Can't Tell

121. If Greg is not as bad as Neal, and Jim is not as bad as Neal, then who is best?
Neal  Jim  Greg  Can't Tell

122. If Ken is better than Jim, and Bob is better than Ken, then who is worst?
Ken  Bob  Jim  Can't Tell

123. If Joe is better than Tom, and Tom is better than Ted, then who is best?
Tom  Ted  Joe  Can't Tell
124. If Joe is not as bad as Todd, and Burt is not as good as Joe, then who is worst?
   Todd    Joe    Burt    Can't Tell
125. If Kent is worse than Todd, and Dick is worse than Kent, then who is best?
   Kent    Todd    Dick    Can't Tell
126. If Mack is not as bad as Luke, and Mack is not as bad as Herb, then who is worst?
   Luke    Herb    Mack    Can't Tell
127. If Rich is not as bad as Kirt, and Kirt is not as bad as Jack, then who is best?
   Rich    Kirt    Jack    Can't Tell
128. If Rich is not as good as Doug, and John is not as bad as Rich, then who is worst?
   Doug    Rich    John    Can't Tell