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ABSTRACT

Criteria for operationalizing reading come from three considerations: the purposes for reading, the linguistic units interpreted as basic, and the cognitive processes assumed to underlie reading comprehension. One purpose of reading is objectification, in which the reader is an interpreter and verifier of an author's symbolic representation of reality. In defining objectification operationally, the basic linguistic units were described as propositions comprising arguments and predicates. Drawing implications from this operationalization, an experiment was designed to compare response latencies in a sentence verification task, in which sentences of the form "The dots are/are not red" were compared with visual displays. Sixty undergraduates participated in a study comparing reading aloud, reading silently, and listening, under four conditions of match or mismatch between sentences and pictures. The results indicated that reading aloud gives access to linguistic competence in a manner different from silent reading and listening. Comparisons of response latencies for the four information conditions supported the proposed model of reading comprehension. (AA)

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SIMONS' LAMENT
OR
A "NEW AND IMPROVED" PSYCHOLINGUISTIC COMPREHENSION MODEL APPLIED TO AN "OLD AND OVER USED" ASSUMPTION OF READING METHODOLOGY

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In order for a discipline to develop systematicity, it must develop what Kuhn (1962) calls a "paradigm." A paradigm is a metatheory whose principal functions include: (1) providing a principled procedure for gathering, editing, interpreting, and reporting data and (2) insuring that the data reflect what the researcher purports to be investigating. In other words, a paradigm provides the ground rules for a disciplines decisions of reliability and validity.

Farr and Tuinman (1972) have argued that of all the facets of a paradigm, the most important single factor is validity which, in turn, is contingent upon "the selection of the measure of the dependent variable." Simons (1971) has noted that reading comprehension has been an indecipherable process due to the inability of reading's paradigm to establish a valid, dependent-variable measure of comprehension. Simons (1971, pp. 354-355) laments:

> The current lack of descriptions of the mental process involved in reading comprehension render it very difficult to establish adequate behavioral criteria for successful comprehension. . . 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 the relevant measures of the process under investigation.

Underlying Simons' lament is the observation that reading research has yet to establish adequate dependent variables that yield a valid description of comprehension. This, in turn, stems from the absence of criteria which determine whether or not a reader is comprehending.

In broader terms, the reason why there is no reading-research paradigm is that an adequate "operational

definition" of reading has yet to be proposed. To define a phenomenon operationally, two procedures are required: A researcher must first select a set of criteria which are assumed to comprise a valid description of the phenomenon and, secondly, the researcher must translate these criteria into dependent variables which test for the presence of the phenomenon.

Given that reading research has failed to develop adequate criteria of comprehension, it has concomitantly failed to establish a valid operational definition of reading. But why has reading research failed to develop such criteria? Simons (1971) has blamed the fact that comprehension is a covert, ambiguous process, inexplicably intertwined with other psychological processes such as motivation, memory, attention, and personality. However, there is a much more significant reason. This stems from the fact that reading researchers and methodologists alike have been overly concerned with the "what" of reading and have largely overlooked the "why."

Reading is a Janus, pragmatic process. It has two faces to be considered: the theoretical and the methodological. Definers of reading may consider these faces separately or in combination. To present, researchers of reading have doted on the question, "What to research in researching reading?" Practioners, likewise, have nested in the corresponding question, "What to teach in teaching reading?" In asking these questions, two interpretations of "what" are considered: (1) what linguistic units are assumed to be basic elements of reading and (2) what cognitive, neurological operations of the mind comprise this process.

Were there but one linguistic paradigm for identifying the basic elements of language and but one psychological paradigm for identifying how the brain processes these units, reading researchers would have little difficulty in defining reading. But there are many linguistic and psychological paradigms, each identifying different linguistic units as basic and different psychological processes as descriptive of comprehension. But how does a reading researcher know which of these paradigms to choose in selecting his criteria for defining reading? In short, the problem is simply not selecting criteria for defining reading, but selecting criteria for selecting a paradigm from which to select criteria for defining reading.

Reading researchers have largely resolved the question of which paradigm to adopt by invoking the Law of Recency which assumes that the most recent paradigm is the most valid. But this strategy fails on two accounts: First, by the time reading researchers adopt a new paradigm and tailor it to the suit of reading, the paradigm itself has become outdated. (Psycholinguistic research in reading is a prime example of this.) Secondly, in the instances where two paradigms of a discipline, such as cognitivism and behaviorism in psychology, progress at seemingly equal rates, there is no particular reason for adopting one paradigm over the other, as the Law of Recency fails to apply in this case.

A more adequate resolution of this problem resides in asking the question, "Why read?" or "Why teach reading?" Unlike the means question of "what," the "why" question is an ends question. Logically, it is always easier to establish criteria of means based upon some ends than it

is to evaluate means on the basis of means. Furthermore, by raising the "why" question, one must confront the issue of whether or not reading is a purposeful behavior.

As long ago as 1890, William James acknowledged the significance of the question "Why?" in studying behavior. In particular, James noted that how one views the question of "Why?" determines how one interprets "mind." If one concedes that "Why?" is a significant question, then the researcher concedes the existence of "intelligence and religion." To view the question of "Why?" as insignificant is to perceive behavior as anomic, "so much mere mechanical sprouting from the past." Such a researcher, James would describe as an atheist and a materialist.

Thus, in terms of selecting a linguistic or psychological paradigm, one must first reconcile whether the criteria of reading behavior is to reflect an act of intelligence or an act of a machine. If one adopts the former, then one would most likely side with the phenomenological approach to linguistics and the cognitivist approach to psychology. On the other hand, he who is an "atheist and materialist" would most likely select a structuralist paradigm of linguistics and a behaviorist or psychophysical approach to psychology in order to select criteria for reading.

In the end, once a researcher has ascertained "Why?," he has a broad range of linguistic and psychological paradigms to choose from in order to operationalize this "why." While many purposes can be proferred for why one reads, these purposes can be subsumed under three purposes

underlying all behavior. It is the purpose of this paper to first briefly delineate these three purposes. This paper will then redefine one of these purposes of "why" in terms of "what." An operational definition and model will be proposed in the process.

Why Read?

Reading serves three purposes: Objectification, imitation, and imagination. In objectification, an author translates the meaning and form of reality into symbolic meaning and form. When a person reads objectively, he attempts to understand the meaning and form of reality via the author's mediated translation. In order to achieve such understanding, the reader must translate the author's meaning and form into a form interpretable to the reader, from which he abstracts meaning. In low level objectification, the reader attempts to verify that his meaning is the same as the author's. In high level objectification, the reader attempts to verify not only that his meaning corresponds to the author's, but that the author's meaning also corresponds to reality's.

To study reading as an objectification process necessitates a cognitivist paradigm, as the reader is perceived as an interpreter and verifier of an author's symbolic form.

In imitation, the reader abstracts no meaning; he simply duplicates or copies an author's form. In other words, the reader translates the author's form into his own interpretable form, but abstracts no meaning from this form.

To study reading as an imitation process lends itself to the behaviorist notion of operant conditioning

whereby the elicited response is shaped to duplicate a given stimulus. Since this interpretation of reading lends itself to high reliability in testing, reading is frequently operationally defined by tests of imitation.

Finally, in imagination, the reader does not attempt to verify that his meaning corresponds to the author's and reality's. Here the reader attempts to reconstruct new forms and/or meanings based on the given form and meaning of an author and reality. In imagination, rather than trying to answer "What is?," as he does in objectification, the reader attempts to answer "What is possible?"

To study reading as an imagination process entails a phenomenological approach to the mind. Unlike objectification or imitation which can be measured against some external or observable criterion, imagination must be studied intuitively. Due to the difficulty of defining imagination operationally, psychologists have not made impressive gains in understanding this process (cf. Holt, 1972). Except for a few response-to-literature studies (cf. Squire, 1964), reading researchers have largely ignored reading as an imagination process.

Given that paradigms of imitation fail to consider reading as a meaningful process and paradigms of imagination have yet to be formalized, this paper shall proceed to elaborate upon reading as an objectification process. In objectifying "objectification," "objectification" will be defined operationally.

Operationalizing Objectification

Objectification has been defined as the perceiver's ability to translate an author's form and meaning into

a form interpretable by the perceiver. The perceiver then abstracts meaning from this interpreted form. Note, the author's form does not necessarily have to be linguistic; it can be mathematical or graphic. Such a hypothesis assumes that one employs the same cognitive strategies to solve mathematical problems and understand pictures that one employs to interpret symbolic representation. In this respect, reading is subject to the same information processing procedures which characterize all objective understanding.

Within the past decade, a movement in psychology has attempted to verify such a synthetic theory of objectification. Beginning with the work of Gough (1966), psychologists became interested in how people objectify not only linguistic but graphic representation as well. In 1969, Clark proposed his "Linguistic Theory of Comprehension" which explained not only how one comprehends sentences, but pictures as well (cf. Clark & Chase, 1972). Clark's model has undergone slight modification as of late and has now emerged under the new title of the "Constituent Comparison Model of Comprehension." Not only does this latest model account for how one objectively understands sentences and pictures, but also how one solves mathematical problems.

This model, as proposed by Carpenter and Just (1975), postulates that objectification is a comparison procedure, e.g. comparing incoming information to previously stored, or comparing two forms of incoming information. But before comparison is effected, the information to be compared must be formulated propositionally. This means that before

a sentence, picture, or mathematical equation is understood, it must be interpreted as a relation structure consisting of a predicate and one or more arguments. To express such a proposition, Carpenter and Just use the conventional notation, (PREDICATE, ARGUMENT). Thus, the sentence, "The dots are red," would have the partial propositional representation, (RED, DOTS), whereby redness is what is predicated of the dots. Since the predication can be affirmed or negated, this sentence would have the full representation, [AFF, (RED, DOTS)]. Negative predication of this sentence would be represented as [NEG, (RED, DOTS)].

To effect comparison, a perceiver retrieves arguments and predicates from a set of representations and compares them in corresponding pairs. The representation's propositional structure provides a description of the order in which arguments and predicates are compared. Inner propositions are compared before outer propositions. Thus, in comparing the sentence, "The dots are red," to a picture of red dots, the proposition "red" is processed before the affirmative polarity marker. As this find-and-compare process is a serial, iterative operation applicable to representations with multiple embeddings, it enables the model to be generalized without additional assumptions.

Underlying the comparison procedure is the assumption that whenever a pair of constituents form a set of representations which are incongruent, the entire comparison process is reinitialized. To prevent the process from incessantly cycling in incongruency, Carpenter and Just argue that on the first incongruent cycle, the constituents

are tagged, so that on subsequent recomparisons the two can be made congruent.

Since incongruency necessitates a repetition of the comparison process, the total number of comparison procedures, and consequently the total latency, increases with the number of incongruencies. Moreover, an incongruency that occurs later in the comparison process will require a recomparison of earlier constituents. This means that incongruency occurring later in the cycle will entail more recomparisons than incongruency at an earlier stage. Thus total latency is a function not only of the number of incongruencies, but also where incongruencies occur.

A response index regulates congruency and incongruency between constituents. In verification, the index has two possible readings, "true" and "false." Before the first cycle has begun, this index is set to "true." As each incongruency is encountered, its reading changes to correspond to the new information. Although resetting the response index and tagging incongruent constituents are necessary procedures, they are assumed to require little time relative to the time required to find and compare constituents and make them congruent.

By applying this model to four conditions of comparing sentences to pictures, Carpenter and Just illustrate how the model works in practice. In the simplest case, the true affirmative sentence, "The dots are red," is congruent with a picture of red dots. The first comparison, between the inner propositions, i.e. sentential and pictorial "red," results in a match. The second comparison,

between the polarity markers, "Affirmative-Affirmative," also results in a match. Thus after one cycle of comparing two constituents, the truth index is set to "true" and this response is executed.

In the false affirmative case, the sentence, "The dots are red," is compared to a picture of black dots. Here the inner propositions of color mismatch between sentence and picture. This mismatch is detected and tagged as incongruent. This necessitates recycling the information, setting the response index to "false." Now, on the second cycle, the tagged inner constituents are compared and they match. The next comparison, between the polarity markers, also results in a match. Hence, the response "false" is executed after a total of three constituent comparisons.

The next most difficult condition is the false negative case whereby the sentence, "The dots aren't red," is compared to a picture of red dots. On the first cycle, the propositions of color are congruent but the polarity markers are not. This causes a tagging of the mismatch constituents and reinitialization of the cycle. As the cycle begins a second time, the response index is set to false. This time congruency is established after two comparisons and the response, "false," is executed. This procedure thus involves four comparisons.

Finally, in the true-negative condition, the sentence, "The dots aren't red," is compared to a picture of black dots. The incongruency between the color propositions necessitate tagging, and recycling comparisons at this level. On the second cycle, while the other propositions are now congruent, the polarity markers mismatch. This again

requires a recycling of the tagged constituents, preceded by changing the response index to "true." As all the propositions are now congruent on the third cycle, the response, "true," is executed. At this point a total of five constituent comparisons has been made.

The explanatory power of this model is impressive. It not only accounts for verification latencies for the above sentences, but also for verification of counterfactual clauses, implicit negatives, universal and particular quantifiers, and sentence recoding. As the formal structure of the model seems to explain a broad domain of language processing, one would assume that it applies to visual comprehension, or reading, as well as to aural comprehension.

This assumption of a universal comprehension model underlies many reading methodologists' practice of teaching children to read by requiring them to read aloud. Moreover, several informal reading inventories, including Goodman's miscue inventory, are based on the assumption that a person's visual comprehension ability is the same, whether one is reading aloud or silently. In other words, this assumption maintains that one's comprehension routine of objectively understanding sentences is the same no matter what the reading procedure.

This assumption has remained largely untested due to the lack of criteria which would provide a valid operational testing procedure for comparing comprehension of reading aloud to reading silently. Mosenthal (1975), using Clark's (1969) syllogisms as sources for operational criteria, recently demonstrated that this assumption, in fact, is

invalid for second graders. Although second graders showed an underlying linguistic competence for reading silently and comprehending language aurally, reading aloud did not access to this competence in a similar manner.

In order to further validate these findings, the present study redefined linguistic competence as the ability to verify picture-sentence comparisons in the manner described by Carpenter and Just. The four sentence-picture comparisons mentioned previously were used as sources of the dependent variable, latency time. Should Carpenter and Just's model be a valid explanation of linguistic comprehension, then their predicted latency times should be demonstrated for the three sentence comprehension modes of reading aloud, reading silently, and listening; true affirmative comparisons should require less time than false affirmative; false affirmative less time than false negative, and false negative less time than true negative comparisons.

Should reading aloud access differently to linguistic competence than do reading silently and listening, then the latency times for the four information conditions of reading aloud should significantly exceed the four conditions, respectively, in reading silently and listening. Moreover, if reading silently and listening access to the same underlying linguistic competence, then they should not differ significantly in their latencies in each of their four respective comparison levels. Should these results be obtained, it will constitute strong disproof of the one competence theory for silent and oral reading.

Experiment

Method. The experiment involved verifying twenty sentence-picture comparisons for each of the four information conditions, for each of the three modes of sentence comprehension, for a total of 240 verification tasks. To adjust for the difference in speed between reading silently and the conditions of hearing the sentences and reading them aloud, verification was defined as the number of milliseconds after the sentences had been presentend. Subjects were given 1800 msec to either read or hear the sentences after which a picture was presented.

The stimulus sentence included: "The dots are red" and "The dots aren't red." In addition to "red," the adjectives "black," "blue," and "green" occurred as color predicates, with equal frequency. The picture was an array of 16 dots of one color, either red, black, blue, or green. In the conditions where the color predicate of the sentence was incongruent with the color predicate of the picture, the variety of incongruent dot colors occurred with equal frequency.

In the visual conditions, each sentence was typed in elite type on one card; on a separate card, a 4x4 array of dots was drawn with a felt tip pen. The stimulus cards were then viewed in a tachistoscope at a distance of 58 cm. In the aural condition, sentences were recorded on a taperecorder.

The experimenter initiated a trial by pushing a switch, and 500 msec. later the later the stimulus sentence was presented. Subjects had 1800 msec in which to establish

sentence representation. In the visual conditions, sentences appeared in the upper channel of the tachistoscope and disappeared after 1800 msec; at the completion of 1800 msec, the picture appeared in the bottom channel. The subject's response was made using a two-button decision apparatus. The assignment of dominant hand to the "true" button was balanced across subjects. By pushing a button, the subject closed a microswitch, terminating the time measurement.

The subjects were given three practice trials for each of the three modes of sentence presentation prior to the experiment. Subjects were instructed not to guess. The subjects were sixty students at The College of Arts and Sciences at Geneseo, New York.

Sentences comprising the four sentence-picture comparison conditions were randomized and then presented in the same randomized order for all subjects. The ordering of the different modes of sentence presentation were randomized from subject to subject in attempt to counterbalance any practice effects in the repeated measures.

Results. The latencies for erroneous responses were discarded, and the subject's scores for each condition and treatment was the mean of his correct latencies. An overall F test reveals significance between treatments, F (3, 177)=98.72, $p < .01$, and between levels, F (2, 118)= 203.01, $p < .01$. The residual proved insignificant, F (12, 354)=1.53, $p > .01$. A Tukey's HSD test at the .01 level is significant above HSD=22.96, with df=59. In applying this test to the different mean latencies between conditions for all three treatments (see Table 1), the latencies

increase significantly as the number of necessary constituent comparisons increases; the difference in mean latencies between conditions are 215 msec, 291 msec, and 174 msec for reading aloud; 205 msec, 207 msec, and 169 msec for reading silently; and 212 msec, 240 msec, and 166 msec for listening. These findings strongly support the model's prediction that verification time increases linearly with the number of constituent comparisons.

In applying Tukey's test in comparing the latencies among the three treatments, no significant difference is demonstrated between reading silently and listening. The difference between mean latencies for the four conditions cinlude: 19 msec, 16 msec, 14 msec, and 17 msec--all of which are less than HSD=22.96, hence, $p > .01$. However, in comparing the mean latencies of reading silently and listening to reading aloud, the mean latencies are significantly different for each condition, the lowest mean difference being 139 msec in condition one, between listening and reading silently. This analysis further supports the findings that although reading silently and listening access to linguistic competence in a similar manner, reading aloud does not.

Discussion and Conclusion

The fact that reading aloud accesses to linguistic competence in a manner different from silent reading and listening raises the significant question: How far can one extend an operational definition before the assumption that it applies equally to a range of phenomena becomes invalid? The present study showed that given two phenomena

as logically identical as reading aloud and reading silently, the operational definition of comparing sentences to pictures does not apply equally. This, of course, raises the concomitant question of how valid are present comprehension tests which purport to assess comprehension but fail to consider the questions of why one reads and what one reads. To simply assume the why and what of reading is to construct meaningless dependent variables, unsupported by meaningful criteria.

This paper has argued that criteria for operationalizing reading comes from three considerations: The purposes for reading, the linguistic units interpreted as basic, and the fundamental cognitive processes assumed to underlie reading comprehension. Three purposes of reading were identified; one reads to objectify, imitate, or imagine. In defining objectification operationally, the basic linguistic units were described as propositions comprised of arguments and predicates. The fundamental cognitive processes for interpreting these propositions included establishing representations, comparing constituents, taggin incongruencies, and readjusting a response index.

In short, if one were willing to accept objectification as an important purpose of reading, and Carpenter and Just's model as a valid description of this process, these concession have important implications for reading research and methodology. Most important of these implications is that reading now has a set of criteria upon which to build a paradigm.

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TABLE 1

MEAN LATENCIES FOR FOUR CONDITIONS
OF COMPARING SENTENCES TO PICTURES
AMONG THREE MODES OF SENTENCE PRESENTATION

	Reading Aloud	Reading Silently	Listening
Sentence: The dots are red. Picture: Red Dots.	1493 msec	1336 msec	1355 msec
Sentence: The dots are red. Picture: Black Dots.	1708 msec	1541 msec	1567 msec
Sentence: The dots aren't red. Picture: Red Dots.	1999 msec	1821 msec	1807 msec
Sentence: The dots aren't red. Picture: Black Dots.	2173 msec	1990 msec	1983 msec