ABSTRACT
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in reading comprehension. It has been suggested that comprehension
differences between good and poor readers may arise from the way in
which they habitually organize intra- and inter-sentence elements
during input. Subject-generated visual imagery is singled out as a
particularly effective organizational strategy. Implications of this
research are considered in the context of aptitude by treatment
interactions and individual differences. (Author)

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SOME THOUGHTS ABOUT COGNITIVE STRATEGIES

AND READING COMPREHENSION

by Joel R. Levin

Report from the Project on Variables and
Processes in Cognitive Learning
Verbal and Visual Components of Children's Learning

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Statement of Focus

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Working Paper is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge about concept learning and cognitive skills, to synthesize existing knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

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Abstract

Psychological experiments investigating imposed and induced cognitive strategies are reviewed and related to operations in reading comprehension. It has been suggested that comprehension differences between good and poor readers may arise from the way in which they habitually organize intra- and inter-sentence elements during input. Subject-generated visual imagery is singled out as a particularly effective organizational strategy. Implications of this research are considered in the context of aptitude by treatment interactions and individual differences.

Introduction

I do not profess to be an expert in reading. Although this sentence is ambiguous, it applies to both my personal reading speed and comprehension, as well as my familiarity with the reading and perception literature in the respective fields of education and psychology. What I would like to do, as an outsider looking in, is to share with you some potential educational applications that grew out of a symposium entitled "Issues in imagery and learning" held at the 1971 Western Psychological Association meeting in San Francisco. The primary focus of the symposium was on visual imagery in children, and its reported positive relationship with learning and memory.

The bulk of the experimentation in which imagery processes have been engaged and inferred (through the use of pictorial and image-evoking materials) has incorporated associative learning tasks in laboratory settings. In a few experiments, comprehension of sentences and sentence-embedded materials has been investigated. A recurring result is that materials which are concrete, imageable, and dynamic are easier to remember than those which are not (e.g., Paivio, 1969; Rohwer, 1967).

A sentence is assumed to make its constituents more memorable by virtue of the organization it bestows on them. It has been hypothesized that the success of the organization depends upon the extent to which increased contextual meaning and imagery is produced (Levin, 1971). A collection of sentences should impose an organization on its constituents in analogous fashion. In this paper, we will restrict our attention to reasonably concrete materials. That is, sentences like "Continuous fraud negates implied sincerity" are probably less concrete and imageable than sentences like "Giddy spinsters terrify squealing infants" (Davidson, 1966). Paivio (1970) has presented data which support this notion, by showing that the former type of sentence is accompanied by longer imagery latencies (i.e., a greater amount of time is required to form a mental image of the sentence's contents), as well as by inferior recall of the general meaning of the sentence (though not necessarily the individual words).

Consider the school-age child who cannot comprehend—and consequently will not remember—the content of what he reads. I am not referring to the child who cannot identify (decode) the words, although the ensuing discussion may in fact be relevant when considering this type of reading disability as well.[1] Neither am I referring to the child who can identify the words correctly, but cannot derive meaning from them because they are foreign to his experiential vocabulary (see Wiener & Cromer, 1967). For now, I will focus my attention on the child who can identify the words, knows the meaning of individual words, but has difficulty in integrating the separate meanings into an organized whole. The child to whom I am referring possesses average or above average decoding and vocabulary skills, but exhibits poor performance on tasks which involve reading comprehension.

Wiener and Cromer (1967) have considered this type of reading disability in what they have called a "difference" model. Unlike the traditional view that all reading problems result from either disorders (generally organic) or deficits (lack of prerequisite identification and/or vocabulary skills), these authors have argued that at least two other models of reading difficulty need to be considered: the "disruption" model, where emotional and psychological barriers which are interfering with the reading process must be removed; and the "difference" model.

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[1] Personal communication from Dr. Roger A. Severson, Associate Professor of Educational Psychology, University of Wisconsin, February 1971.

The "difference" model asserts that:

...reading difficulty is attributable to
differences or mismatches between the
typical mode of responding and that
which is more appropriate, and thus has
the best payoff in a particular situation.
This model assumes that the individual
would read adequately if the material
were consistent with his behavior pat-
terns; thus, a change in either the ma-
terial or in his patterns of verbalization
is a prerequisite for better reading.
[Wiener & Cromer, 1967, p. 629]

Take another look at the last sentence.
What this is saying is that a "difference"
between good and poor readers is attributable
to the way in which they respectively input
what they read. Good readers typically com-
prehend; poor readers do not. In order for
poor readers to perform more like good readers,
one of two events must occur: (a) the reading
materials must be changed in some way (e.g.,
their content, their structure, their representa-
tional mode, and the like); or (b) poor readers
must learn (be taught) to employ some of the
successful responding "habits" of good
readers. It is interesting that the same two
recommendations have been made elsewhere,
with regard to making the performance of
children who are poor learners more like that
of children who are good learners (e.g., Levin,
Rohwer, & Cleary, 1971; Rohwer, 1970).

At the imagery and learning symposium,
I recommended that a distinction be made
between two different approaches to the study
of facilitative variables in children's learning
(Levin, 1971). One line of research has typi-
cally dealt with manipulations of learning
materials which render them more or less
memorable. Specifically, verbal and imaginal
representations *imposed* on subjects by ex-
perimenters have been shown to affect per-
formance on learning tasks. Rohwer's (1967)
extensive investigation of semantic and syn-
tactic aspects of verbal "elaboration" and
Paivio's (1969) manipulation of the concreteness-
image evocativeness of learning materials ex-
emplify the "imposed" paradigms to which I
refer. The variations in characteristics of
prose materials by Frase and his associates
(e.g., Frase, 1969; Frase & Washington, 1970;
Maroon, Washington, & Frase, 1971) are of
particular relevance here.

A second class of experiments has ex-
amined the effect of prelearning instructions,
usually in the form of a strategy or mnemonic,
which are *induced* in subjects by experimenters.

A technique is introduced by the experimenter
which, if adopted by the subject, likely will
facilitate the ensuing task. The comparative
effectiveness of various strategies (notably
those requiring subject-generated verbaliza-
tion and imagery) has been studied, summaries
of which may be found in the reports of Bower
(1971) and Levin (1971).

In the remainder of this paper, I will dis-
tinguish between the imposed and induced
methodologies which, in fact, I have already
done vis-à-vis the Wiener and Cromer (1967)
quote. The reader will be helped in making
this distinction through the use of appropriate
section headings, examples, and explicit ref-
erences.

Imposed Characteristics and Reading Comprehension

Cromer (1970) wanted to see if changes
in the structure (i.e., organization) of reading
materials would benefit subjects who had the
necessary identification and vocabulary skills,
but who exhibited poor comprehension. As a
partial validation of the reading difficulty
models mentioned previously, Cromer selected
samples of poor-reading junior college students
with either "deficit" or "difference" problems.
The two groups of poor readers were compar-
able in mean IQ (Deficit: 110.4; Difference:
111.3), but the Deficit group's mean vocabu-
lary score (154.4) was lower than that of the
Difference group (158.9). The mean vocabu-
lary score of the Difference group corresponded
to the median score for college freshmen.

Subjects read stories in which the sen-
tences were "organized" in various ways. In
two of the conditions, the sentences appeared
either in regular form, e.g.:

"The cow jumped over the moon"

or in predetermined phrase groupings, e.g.:

"The cow jumped   over the moon"

The latter groupings were based on agreed-
upon phrase boundaries as prescribed by
Lefevre (1964).

The basic finding of the Cromer (1970)
study was that when the story was presented
in regular sentence form, there were large
differences in comprehension between the
poor-reading groups and matched (in IQ) groups
of good readers. However, when the phrase
groupings were employed, the performance of
the Difference poor readers was as high as

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... ...ders. The Deficit group's
... ... remained low, in accordance with
... ...culty models. That is, a dif-
... ... organization of the materials would be
... ...p only those subjects who read
... ... reasons other than identification
... ...abulary deficits.

... ... the organization of printed ma-
... ... a technique which was found to
... ...ormance of poor readers
... ... Another question which may
... ... whether poor readers comprehend
... ...er better when they are presented
... ...odes (e.g., in auditory or pic-
... ... sed to printed, form). In a study
... ... Weener, and Cromer (1971), for
... ... was found that poor readers com-
... ...ightly more when they *listened*
... ...an when they *read* them themselves.
... ... readers, the reverse was true.
... ...and Rohwer (1971) used two groups
... ...ne from a white middle-class
... ...and the other from a black lower-
... ...pulation. The two groups differed
... ...ally in IQ, and (presumably) in read-
... ... achievement. Story passages were read
... ...in the company of either regular
... ...tences or line drawings which ap-
... ...required as each sentence of the
... ... for the better readers (middle-
... ...it didn't make much of a dif-
... ...whether a printed or pictorial accom-
... ...of the story was employed. Per-
... ... was good under both conditions. For
... ... readers (lower-class blacks), when
... ...were accompanied by printed sen-
... ...formance was very poor; when pic-
... ...entations were used, performance
... ...that of the better readers.
... ...that these children cannot comprehend
... ... quite different from saying
... ...cannot comprehend stories.

... ...same type of argument is used by
... ...his discussion of the differ-
... ...between Level I and Level II
... ...middle-and lower-class popula-
... ...correlation between IQ (a Level II
... ...and learning ability (a Level I mea-
... ... hypothesized to be quite strong for
... ...class children and quite weak for
... ...class children. An implication of this
... ...middle-class children with low IQs
... ...are slow learners as well; the same
... ...cannot be made with confidence for
... ... children with low IQs, however.
... ... results of both the Cromer (1970)
... ...Blatz and Rohwer (1971) studies may
... ...ented by the all-purpose model in
... ... When learning or comprehension is

assessed on the basis of a single method or
manipulation, only the subjects from Popula-
tion I will demonstrate mastery. When a dif-
ferent method or manipulation is imposed, the
mean performance difference between the two
populations virtually disappears.

This, of course, gets at the heart of the
aptitude-treatment interaction (ATI) debates,
the one difference here being that Method B
is better than Method A for *both* populations,
but comparatively less so for subjects in Popu-
lation I. Till now, the ATI'ers have been con-
cerned mainly with the detection of disordinal
(cross-over) interactions, such that Method A
works best for Population I and Method B
works best for Population II. This type of ATI
has not been easy to demonstrate, however
(Bracht, 1970; Cronbach & Snow, 1969). Neither
have aptitudes and treatments in the context
of task and ecological variations been seri-
ously considered (Levin, 1971; Salomon, 1971).

An ATI stance is certainly applicable to
the ordinal interaction model portrayed in
Figure 1. It simply says that variations in the
nature of instructional materials are not as
crucial for "good" students as they are for
"poor" students. This should not imply that
variations in the quality of the organization
or mode of the materials will have *no* effect
on the performance of good students [see, for
example, Maroon et al., 1971]. In the Oakan
et al. (1971) experiment already cited, good
readers comprehended substantially less when
they read stories which were transcriptions of
poor readers' efforts to read the normal pas-
sage. These transcribed stories included
"...all of the poor reader's pauses, false
starts, errors, mispronunciations, omissions,
etc.' Furthermore, as noted earlier, when the
good readers were tested for comprehension
after *listening* to stories read to them, their
performance was worse than when they read
the stories themselves.

An explanation provided by the authors is
that in reading the passages themselves, good
readers are able to go back and re-read any
misunderstood parts of the sentence which, of
course, is not possible when listening to a
single spoken version of the same story. It
is also probable that when good readers read,
they are employing well-developed organiza-
tional strategies which are conducive to com-
prehension, and as the authors suggest:

> ...if poor readers typically do not
> organize their input into certain ef-
> ficacious patterns, they may have con-
> siderable difficulty understanding what
> they read....(Oakan et al., 1971, p. 77)

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High

Performance on Dependent Variable

Population I

Population II

Low

A   B

Imposed Independent Variable
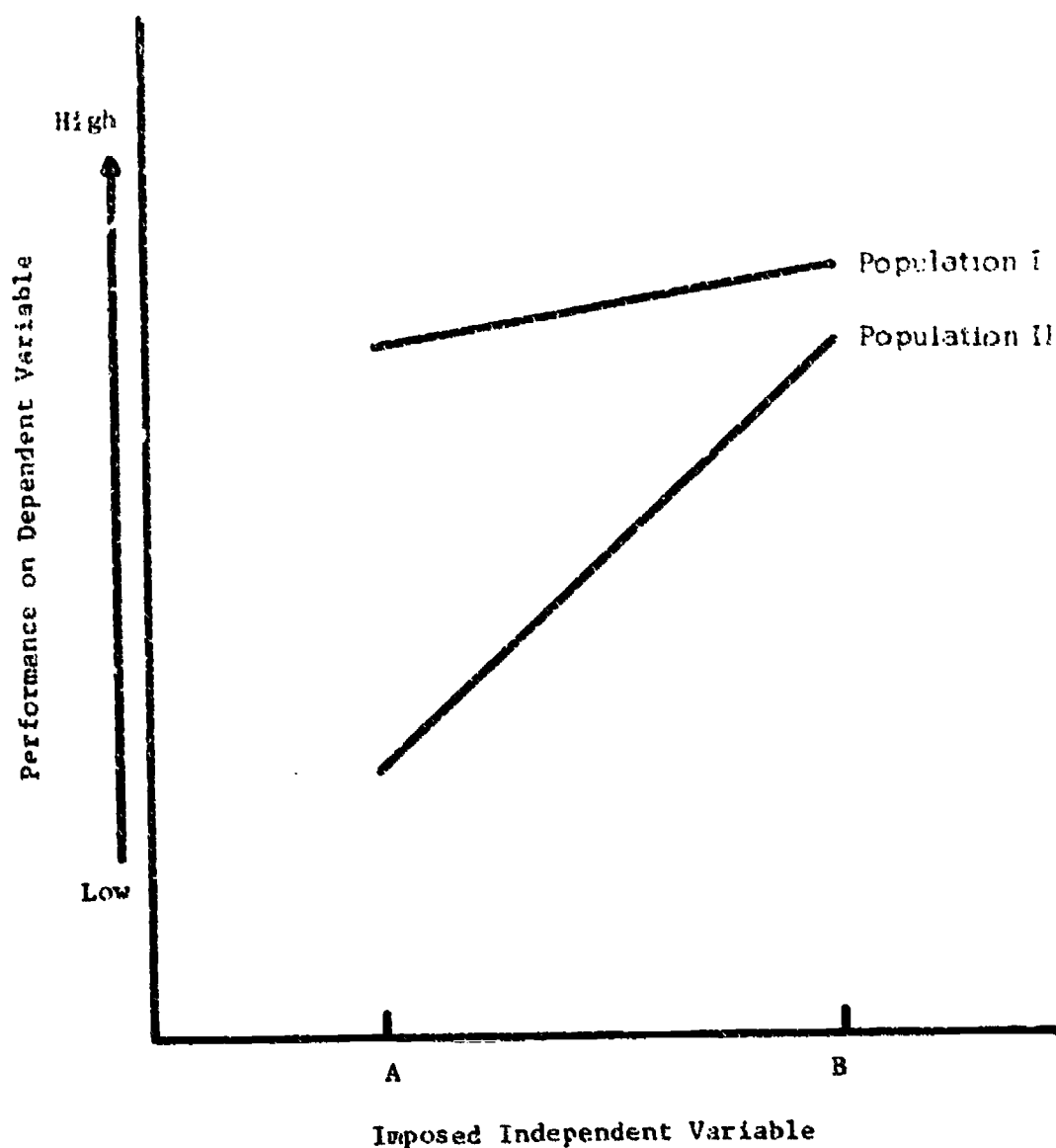
Figure 1.   Hypothesized Ordinal Interaction Between Aptitude (Population)
and Treatment (Imposed Independent Variable) to Account for
Some Recent Findings

There are two major recommendations
which follow from the ordinal ATI model in
Figure 1. The first of these is that it is in-
cumbent upon us to find the optimal presen-
tations of learning materials for children who
appear to be slow learners. Given a sufficient
variety of presentations, many children tabbed
as "nonlearners" will emerge as "learners."
At the same time, others will not. It is only
this latter group whom we may legitimately
regard as "nonlearners" and who will re-
quire greater remediation than merely changes
in materials.

Matz and Rohwer (1971) have demon-
strated that children from middle and lower
social class groups differ only slightly in
comprehension when pictures accompany an
auditory version of a story. We have just
completed a similar study with fourth graders
which suggests that good and poor readers
from the *same* social class differ less (in

terms of comprehension) when a pictorial
representation of text is used in place of the
text itself.

If both good and poor readers can com-
prehend stories based on pictorial representa-
tions, then it is reasonable to ask whether
good readers are doing something pictorial-
like when they are reading regular printed
materials, while poor readers are not. This
brings us to the second (and potentially more
important) recommendation indicated by the
model in Figure 1.

Induced Characteristics and
Reading Comprehension

Notice that until now we have been dis-
cussing changes in learning materials which
improve the performance of poor readers. That
is, we have considered *imposed* characteristics

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of reading materials. Our attention will now be directed toward presumed differences in the usual reading habits of good and poor readers. If certain of these can be identified, then it might prove fruitful to instruct or induce poor readers to employ the habits of good readers when less than "optimally structured" reading materials are presented. (Note that for school- and real world-related reading activities, this will generally be the rule rather than the exception.)

Just what might some of the habits of good readers be? Certainly those which contain facilitating structures. That self-generated visual imagery is an established tactic of proficient readers has been first mildly, and then strongly, suggested in a pair of recent studies by Richard Anderson and his associates at the University of Illinois.

The first experiment (Anderson & Hidde, 1971) extends some recent findings dealing with sentence comprehension. Bobrow and Bower (1969), for example, found that subjects who were asked either to "disambiguate" (determine the contextual meaning of a multiple-meaning word) or to "continue" (construct a logical consequence of a prov ded sentence) a list of sentences, exhibited recall superior to subjects who were asked to peruse the same sentences for spelling errors. Similarly, Begg and Paivio (1969) reported that subjects were better able to detect semantic changes—as opposed to lexical changes which had little effect on meaning—in a repeated list of sentences, especially when the materials were relatively concrete. The importance of "meaning" in comprehension has been demonstrated in these and similar experiments (e.g., Bobrow, 1970; Levin & Horvitz, 1971). By the same token, the role of "imagery" cannot be discounted.

In the Anderson and Hidde (1971) study, college students were asked to rate either the pronunciability or imagery vividness of 30 sentences. On a surprise test for recall of as many sentences as the subject could remember, it was found that the imagery-rating group recalled far more sentences and sentence parts (e.g., verbs and objects) than did the pronunciability-rating group.

This is interesting in light of the fact that subjects in the latter group actually read each sentence aloud (three times) in rating its pronunciability while those in the former group did not. On the other hand, this kind of sentence rehearsal may have been interfering (rather than imagery being facilitative), as has been shown to be the case in intentional learning paradigms with older subjects (e.g., Bean & Rohwer, 1971; Bobrow & Bower, 1969). Within the imagery-rating group, a moderate relationship was found between subjects' reported vividness of a sentence's imagery and its probability of being recalled.

Anderson's second study provides more direct evidence for the imagery-reading comprehension hypothesis. In that experiment (Anderson & Kulhavy, 1971), high school seniors were given a written passage to read either with or without instructions to visualize what they were reading. Although the experimental manipulation (i.e., instructions to use imagery) was not effective in a "main effect" sense, a pronounced relationship was found between subjects' reported frequency of imagery throughout the passage and amount of information recalled about it (independently of their instructional conditions). Thus, those subjects who reported having used imagery extensively recalled more of what they read than those who reported having used little or no imagery.

In our previously mentioned study with fourth graders, we manipulated the degree to which subjects presumed to be non-imagery producers (poor readers) generated visual images while reading, by inducing imagery in them or not. As predicted, the imagery strategy improved comprehension, and in accordance with the Wiener and Cromer (1967) models, "difference" poor readers (those with adequate vocabulary skills) benefitted more than "deficit" poor readers (those lacking prerequisite vocabulary skills). The interpretation of such results is similar to Cromer's (1970) and, of course, has important implications with regard to the teaching of reading to children who read poorly for diverse reasons. The training of imagery production in children in need of an organizational framework looms as a reasonable strategy.

Much of what I have been saying has been thought, if not articulated, by others before (including reading experts). It is especially noteworthy that in one of the standard reading tests, among the authors' suggestions for improving the reading of low achievers may be found:

> Word recognition practice, phrase practice and expression practice should require response to meaning and imagery. Reading is getting ideas from the printed word; all aspects of reading instruction should focus upon meanings and reactions to meanings. (Durrell & Hayes, 1969; Durrell & Brassard, 1969)

These comments appear on the primary (Grades 1–3.5) and intermediate (Grades 3.5–6) versions of the Durrell test, and are apparently intended for "deficit" poor readers. However, a generalization of the imagery idea from comprehension of words to comprehension of sentences and paragraphs is not included in Durrell's (1969) suggestions on the advanced (Grades 7–9) version of his test, where a greater proportion of poor readers are probably of the "difference" variety.

As educators, we should continually be seeking ways in which the learning process may be improved and hopefully be made more enjoyable. Changing characteristics of existing materials or changing students' characteristic learning behaviors seem to be two reasonable (and not necessarily mutually exclusive) possibilities. While the "imposed" approach caters to individual and group differences through the presentation of differentially effective organizations, the "induced" approach promises the greater educational payoff beyond the confines of the well-organized textbook, the optimally sequenced teaching machine, and the multitalented teacher. Equipped with efficient induced strategies, the child will be less dependent on the quality of stimuli in his environment, for he will be capable of reorganizing, elaborating, and concretizing relatively disorganized, unelaborated, and abstract materials. Of course, to anticipate this without regard to the auxiliary efforts required (for example, shaping such behaviors over time with the help of appropriate reinforcers) is beyond comprehension.

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