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ABSTRACT
                This single volume constitutes the third and fourth
yearbooks of the North Central Reading Association and consists of
most of the papers presented at the 1963 and 1964 annual meetings of
the NCRA. The papers are grouped into four sections: Discrimination,
Information Theory, Skill Therapy and Skill Training, and The Visual
Process. Among the topics covered in the seventeen papers are the
cloze procedure, research reviews of skill therapy and visual
discrimination, a college composition program, the SQ3R system, and
reading as information processing. (TO)

ED 082157

COLLEGE AND ADULT READING

III and IV

THE
THIRD AND FOURTH
YEARBOOKS
OF THE

NORTH CENTRAL READING ASSOCIATION

Edited by

David M. Wark
Reading and Study Skills Center
Student Counseling Bureau
University of Minnesota

1965

PREFACE

This single volume constit:.ce:: the third and
fourth yearbooks of the North Central Reading Asso-
ciation, The papers printed here were presented
either at the University of Michigan in 1963, or
at the University of Notre Dame in 1964. A date
following the author's name on the table of con-
tents tells which year, Donald E. P. Smith has
our thanks and admiration for hosting the Michigan
meeting, and planning both programs.

Unfortunately, all of the papers are not
printed in this yearbook. Two reports by Alton
Raygor, of the University of Minnesota, will be
published through other sources, Another by Carl
Semmelroth was an extensive auto-instructional pro-
gram in experimental format, Stuart Margules, of
Basic Systems, Incorporated, presented a copyright
magnetic tape recording, which, of course, we
could not publish. Donald and Judy E. P. Smith
presented parts of an experimental version of a
program to teach basic language skills. Both the
Margules tape and the Smiths' final program have
recently been cited as examples of excellence in
programmed instruction.

I have taken several liberties in combining
papers into four Sections. The reader will note
that papers presented at different years are
grouped together. I tried to juxtapose them either
to show historical development, or to contrast
differing points of view. The papers on discrim-
ination, for example, seem, in retrospect, to con-
verge to Smith's paper on learning to read. Sec-
tion 4 concerning the visual process, on the other
hand, offers somewhat diverging points of view.
Stanford Taylor summarizes a great deal of prior
literature on the study of eye movements. At the
same meeting, Smith and Semmelroth present evidence
of an entirely new phenomenon, micro-movements.
The largest section is a collection of papers

having to do with study skills. As Richard Stevens
points out in his critique, here you will find both
an attack on old formulations and an embryonic "new
look" at recurring problems.

Combining two years' papers in one large volume
is a particularly valuable technique when, as in
this case, they report on going research. The read-
er gets a very dramatic feeling of watching the sci-
entific Zeitgeist evolving, longitudinally. The
feeling is, at least for me, vastly different from
that produced by the typical yearbook, with its
often cross-sectional or retrospective coverage.

To the people who researched and wrote, our
thanks for new light on the still murky old problems
of reading. Most especially, thanks to Don Smith
for focusing that light so sharply.

Before closing, I would like to publicly ac-
knowledge my private debt to the five young ladies
whose skills were made available by the Student
Counseling Bureau. Karla Nyman, Marky Peterson,
Katherine Steele and Paulette Wank labored most
patiently preparing the rough drafts for this Year-
book. Miss Marjorie Hoines did a truly impressive
job preparing the final copy. Their efforts made
my job much easier. To these gracious charmers,
my deep gratitude. To you, gentle reader and
sharp-eyed reviewer, my apologies for whatever errors
I alone may have let slip through to annoy you.

<div align="right">D.M. W.</div>

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REVIEW OF RESEARCH: VISUAL DISCRIMINATION

Frank Greene
University of Michigan

Perception is the "black box" of the reading pro-
cess. Therein should lie answers to many of the
reading specialist's pressing problems. But no
clear theory of perception exists. The best he
can do is to review the vast array of data and spec-
ulation and try to discover some of its order.

The purpose of this review is to present selected
definitions and findings, to erect a rough scaf-
fold from which the reading specialist can view
the perceiver, the perceived, and possibly, the
viewer himself.

I. Perception versus Discrimination

A. The Problem

The observer (O) responds (R) to a stimulus (S),
some part of the printed page. Which part of R
is attributable to properties of S, which to the
interwoven variables effecting O, and which to the
kind of R required? This very complex question
might be attacked by defining some terms.

Perception is defined as the processing of infor-
mation within a closed system. Given the exist-
ence of some S as input, the processing consists
of the organization (identification, recognition,
categorization) of the S and its integration with
other active elements in the system in such a
way that an output occurs, i.e., some potentially
identifiable behavior, R. This definition ties the
processing to the public world at both ends: there
must be some S and some R, the existence of which
are potentially observable. The processing itself

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must be inferred.

Discrimination. When a particular R occurs consis-
tently in the presence of a particular S or class
of S but not in the presence of another S or classes
of S's, we may infer that a discrimination has oc-
curred Since the S and the R are both observable
phenomena, we need not speculate about mediating
processes. Such speculation occurs when the appar-
end, literal S is responded to in variable ways.

Veridicality of perception. The physical charact-
eristics of S can usually be described. It might
be called a literal S. To some investigators, per-
ception is defined as some R to a given literal S,
thus "literal perception." But the more common
event is that called selective or "schematic" per-
ception. In achieving his purposes, O tends to
respond to the literal S in unpredictable ways
His description of the S in such cases indicates a
distortion of the literal S.

Literal perceptions are adequate and exact. The
agreement between the perceptions of different O's
is impressive. We do all live in the same world,
On the other hand, schematic perceptions are selec-
tive, creative, fleeting, inexact, generalized,
The lack of correspondence between perceptions is
very impressive We do each live in our separate
and unique worlds.

How much literalness is adaptive is often of inter-
est to teachers of reading. In spelling we wish
the perceptions to be very literal: the form of
letters and their order must be exact. But with
regard to comprehension, it is not important what
the word is, but only that the schematic perceptions
are in reasonable agreement with the literal S,
i.e., did O get the message? E. J. Gibson (5)
has suggested two different ways an O might iden-
tify S input. One might run through a property-
list procedure of subjecting each S to a series
of tests, each determining some S property of

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heuristic value. Or one might subject S input to
a normalizing procedure and then attempt some sort
of template matching. It seems likely that both
methods are used with every S input identification.
For any discrimination to occur there must be a
template to match against. When literal perception
is required, a thorough checking of all the criti-
cal features built into the template occurs. When
schematic perception is acceptable, only a rough
fit (checking fewer of the possible features) is
needed. However, the very existence and precision
of any template is limited by the accurate loca-
tion and identification of critical features of S
during the learning of the templates. The preci-
sion of the learned template limits literal percep-
tion, even though the actual precision used during
matching is determined by selectivity considera-
tions, i.e., amount of distortion required by O to
fulfill his purpose.

B. Solutions

Perceptual theorizing tends to bridge the two
views of how the world is constructed: percepts
are accurate reflections of a common world we
share vs. percepts are highly individualistic.
The task is to tie together the public and exact
world of all people (literal) and the private and
selective world of each person (schematic). I
will discuss two notable efforts by psychologists
to provide some tie.

Hebb (9) offers a physiological model. In the new-
ly developing nervous system, the spread of exci-
tation is random at first. After repeated recep-
tor stimulation, neurons become organized in
functional units (cell assemblies) which can keep
an input active after the S has been removed. With
further stimulation, these units increase in
stability. As sensory experience continues, these
units combine into more elaborate temporal organ-
izations (phase sequences). The role of experience
is to establish percepts or "templates" by eliciting

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these stable organizations in the presence of part-
icular S arrays. Thus as R to a particular S be-
comes possible via the mediation of these cell as-
semblies and phase sequences.

Complex perceptions will depend on higher order
organizations, evolved from the more literal units
through a process called condensation. "Over a
series of trials trace activity leads to perser-
vative consolidation. Through repeated interference
a series of trials also leads to fractionation
(splitting off). In this way condensation, the
development of a smaller more efficient trace,
occurs." (11) The ability to perceive schematically
arises out of stimulation by critical features of
the S array. Necessary and sufficient features
consolidate over time while non-critical features
cancel (fractionate) out.

Attneave (1) applies the language of information
theory to the analysis of perception. He views
perception as information handling, where most of
the information is redundant (non-critical) areas
of homogeneous color, persistent direction or
slope, symmetry of design, uniform texture gradient.
The individual letters in a "sight word" for ex-
ample would be seen as largely redundant. A highly
"predictable" word in a given context is also re-
dundant: it adds little information to the message.
During perception, redundant aspects of S are over-
looked, i.e., not encoded. The resulting encoded
message is more economical from an information
point of view than the S array from which it came.
That is to say, schematic perception is more effi-
cient than literal, for, by basing a response on
only the critical (non-redundant) features, one
is not required to attend to the redundant ones.
When a literal perception is required, complete
and exact accounting must be made of all the
S features, redundant or not. Note, however,
the problem of the sophisticated O. After the
critical features have been located (consolidated,
chunked), a sufficient match between template

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and S occurs on the bias of those features alone.
It may then be difficult to attend to even non-
redundant features (cf. later discussion of S in-
congruity). Attneave's use of concepts from infor-
mation theory is a useful strategy. One more no-
tation might be usefully adopted. Noise may be
defined as anything which interferes with clear
reception of the message In a visual context,
noise would be analogous to clutter, (to coin a
term), i e., the presence of non-critical, non-
redundant visual stimulation.

The term gating refers to the shutting out of
irrelevant stimuli, e.g., lack of awareness of
street noises outside the window or the pressure
of the chair. From the point of view of informa-
tion theory, gating might be interpreted as fol-
lows: irrelevant stimuli are "chunked", thereby
providing a unit with the critical features of the
S array standing out as a figure on a ground of
irrelevant features. A template can encompass any
features of the S array, and most likely a range
of background stimulation is indeed a part of every
template.

Distortion of what might be considered ground
rather than figure in any S array will prevent
template matching just as much as will figure
distortion.

Summary. The essential problem in describing
how we perceive is to specify conditions which
lead to literal or to schematic interpretations of
S. Purpose or set, template precision and redun-
dancy have been implicated. Section II will con-
cern the development of literal perception.

II. Literal Perceptions

The Stimulus. J. J. Gibson (6) postulates some
"anchoring" characteristics for literal percep-
tions. To perceive is to differentiate (dis-
criminate), and a differentiation implies a dif-

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ference. For example, "d" is different from "a"
because it has a tail and not because the reader
knows more or fewer words that begin with either
letter.   Similarly "a" is not different from "a"
if the writer had done his job properly, and no
enrichment by past experience or inspired guessing
will help to make them different (2) Considering
the poor visual apparatus with which humans oper-
ate, and the multitude of conditions under which
different O's can experience the same S, it is in-
deed remarkable how closely most perceptions match
the "real world".

Stevens (19) defines S as follows: "An adequate
S to a visual perception is a spatial and temporal
pattern of radiant energy impinging on the retina "
Furthermore, Gibson (6) points out that "It is not
true to say that what happens on the retina is a
succession of fragmentary images. There occurs a
succession of _overlapping_ images 180o wide, only
the centers of which are registered by the nervous
system in fine detail." (See also (17)).

If these statements are true, it is clear that
the literal world cannot be perceived all at once,
A single fixation yields only a momentary visual
field. To see more takes time   Successive retinal
images are not distinct pictures like comic strip
frames   They overlap so that each image is a
transposition of the just preceding image.

It might be predicted, then, that if a person were
to read rapidly enough, the order in which the
material is scanned might become immaterial We
must " ...assume each fixation is followed by a
primary memory which fades very slowly, Each
segment of each image is fitted to every other by
the compensation mechanism, The result would be a
panoramic world which will have faded least in
memory at the point of regard and most at points
longest ago regarded, The fading would not be a
decrease in clarity (like that from center to
periphery of visual field), but only a decrease in

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reportability or that quality of experience that goes with recency." (J. J. Gibson, (6)).

Learning to Discriminate. Perceptual development is illustrated by observing a series of responses by an infant over time; at first to stimuli grossly similar to the focal S and later only to those closely similar. Any round, facelike object will satisfy a very young child, but soon the babe demands a real face, a real, smiling face, the real, smiling face of his very own mother.

Redundancy. Wohlwill (21) expresses this developmental progression in terms of S redundancy and increasing age. The younger the child, the more the need for complete and simple (highly redundant) patterns for successful discrimination. Younger children show a preference for an uncluttered S array. That is, prior to the learning of some control techniques for non-specific input from various sensory modalities, all children behave in relatively non-specific ways. Young children do, however, show a marked tendency to follow along continuous linear paths in their perception of shape and to focus on the general outline of the figure rather than on internal detail. This tendency to go from line to line and curve to curve rather than to follow some more complex sequential pattern may well persist as a basic scanning procedure even in well developed visual search. The low potency of form (e.g., the "shape" of an object) when contrasted with the spatially more redundant cues, such as color or solid (filled in) vs. outline, shows this same developmental change.

Space. The need for two-dimensional border cues in learning to discriminate b, d, p, q, and other such similar letters is clearly supported in the developmental studies of Witkin (20). This need for a non-symmetric reference frame has direct implications for the teaching of letter formation, if not for the reading task where the other letters and words provide some frame of reference. If the

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only reference frame the child has is the outline
of the paper itself, it is little wonder that he
wanders about in forming letters and in stringing
them into words.

Chunking. With a given S array, the problem of
how to handle the information available may well
be determined on the basis of S complexity. Many
studies of perceptual organization of complex S
arrays have shown that, up to some quite limited
number of components, O attends to each. When S
complexity becomes greater, O tends to unitize
(chunk) by categorizing the components. That is,
he responds to grosser patterns of clues, the com-
monest features (15, 16).

The perceived S complexity and consequent attempt
to handle the overload may result in what we usu-
ally call closure. When closure occurs, the state
of clutter can be dramatically reduced with the
emergence of a simpler, chunked pattern.

"Processing" time. It may well turn out that the
difference between good and poor readers is not in
visual acuity or number and duration of fixations
but in the amount of time necessary to "process"
or categorize visual stimuli (7). The concept of
differential processing time may be related to the
notion about directionality during reading. Given
a rather slow processing time, a sequential moder-
ate pattern might lead to maximum comprehension.
With fast processing time combined with a very fast
rate, the importance of coverage pattern should be
reduced. All of the information should still be
recent enough to be categorized "reportable."

Saccadic movements. Contrary to many early state-
ments, it appears quite clear that saccadic move-
ments are not random or "thrown" (as implied by
the word, saccadic), but are rather more like
guided missile movements, with a predetermined
goal and in-flight control. "Studies of the se-
quence of eye fixations during search show that

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the eyes usually move ballistically from one quite
clearly defined object or element in the display
to another such element, i.e., the paths of the
movement and the stopping point are determined be-
fore the movement begins. For this to occur the
object of each succeeding fixation must be per-
ceived peripherally before it is perceived foveally"
(18). The implication here is that the contribu-
tion of peripheral vision to the smoothness of
saccadic movements during search of the S array
(e.g., printed plate) may be of much more impor-
tance than one would suspect from searching   the
literature. Burian (14) reported on the effect
of peripheral stimuli on fusional movements. The
peripheral retinal areas were reported to exert
such powerful fusional control that it would affect
the relative position of the eyes even to the ex-
tent of losing central vision! Recalling Gibson's
conclusion that there occurs a succession of over-
lapping images with clear centers, peripheral stim-
ulation takes on a new role of guiding the mechanism
by which each successive image is fitted into the
total panoramic memory of just-preceding fixations.

Summary. Time for space awareness, development
of perceptual constancies, the guiding of the
clearest (foveal) vision by peripherally acquired
information, the level of random neuron firing at
the time of template formation, and individual
"processing" time requirements are all considered
as necessary for the emergence of literal per-
ception. The efficiency of each of these process-
es is seen as setting the limits for the precision
with which a template can be formed. No discrim-
ination can be more accurate than available tem-
plate precision.

III.   Schematic Perceptions

Literal perceptions arise from accurate, distinc-
tive-feature checking. The resulting patterns
of features may then be conceived as templates to

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which incoming patterns of stimulation can be
matched.   Yet, in many reading situations, the S
itself may be ambiguous (look-alike words, etc.),
or be ambiguous for certain O's (where private con-
ditions such as high emotionality may grossly in-
fluence the perception of a word). A common ex-
pression of this problem is the continuing con-
cern for sensitivity to context. Some words cannot
be responded to without contextual confirmation,
i.e., selective or schematic perception is neces-
sary. In other words, literal perception would be
insufficient to satisfy a set.

A.   Template Precision

The development of schematic perceptions must rest
on literal experience. Given adequate templates,
their use in schematic perception is a function of
their precision and their availability.

Template precision includes the maximum specific-
ity of which the template is capable and the amount
of inexactness allowable by the immediate task or
set. Premature chunking of S would be expected to
lead to an inaccurate model simply because it
is likely to be incomplete in its inclusion of
critical features of the total S array. Children
who look too quickly at a word tend not to learn
it well enough to be able to discriminate it
successfully later. There is also a problem
that what may look like template inaccuracy may be,
in fact, simply looseness in matching the template
to the S. An example of this would be the apparent
intolerance we have for stimuli which are not con-
gruent with our past experiences. The Bruner (13)
experiments with cards having red spades and black
hearts provides an example of O's inability to
recognize the incongruity of some stimuli. Another
condition that looks like low template accuracy may
be just the opposite. If the template is so exact
that an exceptionally large number of features of
the S background array assume a role in the figure,
it may be nearly impossible to replicate the or-
iginal conditions sufficiently that matching can

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ever occur. This condition might be present in
the inability to recognize a sight word because
this presentation lacks the smudge in the lower
corner of the card, or because the teacher left
the room and in all previous contacts with the
word, she was somewhere in the background of the
page. Even assuming a potentially exact template,
so etimes past experience or current states can
influence the apparent allowance in a template.

B. Template Availability

Some amount of perceptual processing (the loca-
ting in storage of a template potentially match-
able to the current S) must occur before experi-
ence can exert any influence on the template (cf.,
22). It is postulated that, given an available
template, the effect of experience will be reflected
in either sharpening or leveling the accuracy with
which the template might be used. It may be that
motivation and experience act rather like a moni-
tor which tunes the receiving system to narrow or
broad template selectivity. With high selectivity
O would have high sensitivity to a limited S,
i.e., an exact and potent template. With broad
selectivity, O would have low sensitivity to a
wide range of S features, i.e., a number of tem-
plates might match the input.

Assuming the existence of a template, there still
arise conditions under which O seems unable to
perform in the manner one might expect. Of such
conditions, Semmelroth (16) states: "....the
size of the effective visual peripheral field may
be of importance in tasks which require the pro-
cessing of visual information from an uncertain
field. If this is so, then other variables may be
important in such tasks besides those pertaining
to the content and structure of the (foveal) visual
field." These other variables might include stress,
set, emotionality, or other factors which, through
their influence on the size of the visual field,
might affect the relative potency of other stimuli
(clutter) in the field.

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Reading can be classed as a visual task with some
field uncertainty. If needs influence the rela-
tive dominance of peripheral vs foveal control,
erratic saccadic movements in "tense" readers
might be explained by influencing the sharpness
or levelness of a template. Another way experience
might affect the perceptual process is by simply
making it impossible to locate any appropriate tem-
plate. Increased peripheral sensitivity would
make it much harder to get a clear look of suffi-
cient duration at any point of regard before the
eyes were moved. Even if the eyes were controlled
in rate sufficiently to allow a clear look, with
high peripheral sensitivity it would be very diffi-
cult to achieve adequate fusion if the data from
the Burian studies (4) is correct.

What are the determiners of foveal vs. peripheral
dominance? Perhaps specific purposes, a set to
find "X", act to increase foveal dominance, thus
reducing excess movements and allowing rapi , ac-
curate perception. On the other hand, emotionality
(non-specific tension) in a reading situation may
lead to increased peripheral dominance, with re-
sulting erratic movements. If the tension of emo-
tionality is non-specific, its action would be to
increase the "random" or task irrelevant inputs.
Thus, no "appropriate" template could be matched.

The recent findings of Kaplan (11) also suggest
another cause of template unavailability. The
consolidation of learning into a usable form
(i.e., retrievable from storage) apparently takes
some time. It is as if the necessary template is
involved with some perseverative activity which
firmly sets the template in memory. Since it is
already in service, it is not available for
use now. It might, however, be available at a
later time.

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Summary   Schematic perceptions appear to result
when set requirements fail to match the avail-
able stimuli. Template precision, template avail-
ability, and conditions of emotionality which in-
fluence the matching process appear to be the
most relevant variables.

IV. Training

Set   Discrimination is a function of the perceiv-
er's set or readiness to respond. Keislar (12)
reported an attempt to shape learning sets in
reading Using passages with two kinds of infor-
mation in them, he had one group (6th and 7th grad-
ers) test their comprehension after each selection
using tests that only required one type of infor-
mation   The other group used the same procedure
except that their tests required only the other
type of information. After twenty training pas-
sages both groups were given more passages which
had tests covering both types of information. The
type of information required for the training
tests was the type of information best responded
to on the post-training tests. The training tests
had defined what was worth learning, which is to
say, only necessary discriminations will be made.

Kossov (13) designed a study to bring out the
essential features of a perceived object. After
manipulating various components of the object he
concluded that the transformation of a feature
into a "dominant component" is better done by var-
iations of the essential feature than by varying
any or all of the non-essential ones (i.e., only
necessary discriminations will be made).

Noise. Many of the problems in training better
reading appear to stem from failure to observe
these principles: a) only necessary discrimina-
tions will be made; b) the presence of non-neces-
sary information makes the task of discovering
critical features more difficult and occasionally
impossible. If children are to learn to discrim-
inate the letters from one another, the exercises

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prepared must require that the response be depen-
dent upon critical features of the letters and
not on anything else. What we have called clutter
is most common in primary readers. They have many
irrelevant, colored pictures and full pages. The
possibility of having the child make a response
based on the critical features of a given word or
sentence go down as the amount of clutter goes up.
With so-called hyperactive children, this inability
to control for clutter is belatedly evident in
their distractability, their inability to attend,
i.e., to discriminate.

Time. Harris (8) concludes his review of percep-
tion and reading with the statement: "Clear per-
ception in reading, however, is more dependent
upon what happens in the eyes." This writer con-
siders his "in the eyes" to refer to the character-
istics of light waves and considers that the ret-
ina is a functional part of the brain. With this
interpretation, the conclusion that the differences
between good and poor readers lie in differences
in processing and not in intake acuity or response
capability is clear. Several studies have shown
that good and poor readers are not too different
in ability to recognize words or symbols flashed
quickly on a screen if there is a sufficient per-
iod of time in which to respond before the next
S is flashed. There is, however, considerable
difference in their performances when the S is
followed quickly by another, even if the second
presentation is a rather low level unpatterned ar-
ray which need not itself be responded to. The
conclusion is that the poorer readers need more
time to process a "message" than do the better
readers.

Vision. Low (14) has done several studies on the
improvement of peripheral vision. "Subsequent
studies with many test objects and limited view-
ing time have indicated that the principal require-
ment for improvement (of peripheral vision) is unlim-
ited viewing time which permits the individual to
'work out' his impression of the stimulus. After

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some hours of such practice, peripheral stimuli be-
come noticeable and the quantitative measures of
the function show improvement."

Independent of the S or the required R, it then
appears that individual differences in processing
time exist for both the handling of familiar mater-
ial and the initial attempts to become familiar
with new material.

The Response. It may not be possible for O to make
the required R, even though the stimulus is appre-
hended. Up to now we have not really looked at
the problem of response relevance. Reading is
usually considered as "getting the message" and
the manner of demonstrating such acquisition is not
often considered critical. One area of concern to
reading teachers, spelling, requires production
accuracy. It is not enough to be able to read the
word, or even to recognize that a word is incor-
rectly spelled: to be correct it must be produced
with only limited variations. This differentiation
of learning into discrimination learning and pro-
duction learning will be returned to shortly.

Emotionality. What Kaplan (11) calls arousal,
Holland and Skinner (10) call emotionality and
Semmelroth (16) calls non-specific tension. Arous-
al can exist from the slow, limited firing of
deep sleep, through the alertness of being wide
awake, to the extreme of such massive random fir-
ings that it is not possible to utilize previously
acquired templates. In the last condition, the
overwhelming noise of random input covers the "sig-
nal" produced by S so that matching cannot occur.
The presence of non-specific tension is seen as
disruptive of discrimination. This discrimination
learning, then, can be viewed as a process by which
non-specific tension becomes specific, i.e., con-
trolled by need states on the organism side and by
particular stimuli on the environment side. Set
might then be viewed as a readiness to respond to
a particular S, such readiness constituting arousal
of templates by needs.

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In the reading process it may be that set versus
emotionality has a relationship to foveal versus
peripheral dominance. Under conditions of a spec-
ific set, the fovea would be dominant, the periphery
would continue to guide movements, but clear cen-
tral images would dominate. Under conditions of
emotionality, foveal acuity would lose out to ex-
cessive peripheral control, and the eyes would
move on even before a clear image was gained. In
addition to erratic fixations, it would be expected
that, under high emotionality, successful fusion
would also be more difficult.

Peripheral acuity appears trainable. Low (14) re-
ports that "The mean peripheral acuity increased
from an initial 100% to 334% with individual ex-
tremes at 200-1200%. The improvement was found
to transfer successfully to unfamiliar test ob-
jects, unpracticed retinal areas, limited viewing
time, night visual acuity and situations in every-
day life outside the laboratory. . . .Outside the
lab, peripheral stimuli which had remained unnoticed
beforehand intruded themselves on the consciousness
without the individual having been thinking of
training. In such situations as walking, driving,
sports, and reading improved peripheral perceptual
ability was recognized by the individuals."

Let me define discrimination learning as that type
of learning experience during which the individual
is "working out" some S array., identifying the
critical features and putting down into memory stor-
age whatever pattern now represents these critical
features. During this stage, the R required need
not bear any resemblance to the actual S. It is
the stage of making templates of stimulus arrays:
the template matches the S. Production learning
occurs when O learns how to produce the critical
features of some template so that the product
matches the template. Using this paradigm, no com-
plete production can be expected until discrimin-
ation is completed: the accuracy of the production
is limited by the fidelity of the template.

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Summary. As teachers, if we use a perception frame
of reference upon which to make our diagnosis of
reading, our prescriptions will consider not only
the visual stimulus, but also the conditions of
emotionality during learning. Successful discrim-
ination requires all three stages of the process
to be functioning adequately.

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A SELF INSTRUCTION PROGRAM FOR
DISCRIMINATION TRAINING

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In order to understand written material, the reader
must recognize individual words and the letter sym-
bols which compose them. The term _recognition_ im-
plies both discrimination and the maintenance of that
discrimination over time, i.e., memory. Most teach-
ing of beginning reading begins at the level of
word recognition. The child learns a sight vocabu-
lary or a few techniques for "sounding out" words
or, more commonly, a combination of the two approach-
es. Significantly, most efforts at remedial teach-
ing have also begun at the word recognition level,
in spite of the fact that the child may have a
long history of failure in discriminating and remem-
bering words.

Thus we have come to think of reading comprehension
as a complex skill which relies upon, and can only
follow, the development of a previous skill at the
level of word recognition. Yet is has been widely
supposed that word recognition itself is a com-
plex skill with its own set of underlying funda-
mental skills at the level of visual perception
and neurological function. Recent research in
visual discrimination and eye movement phenomena
such as that reported by Smith and Semmelroth (2)
support the multiple level position. This is a
report of an attempt to identify some of the per-
ceptual skills underlying the reading process and
to improve these skills through training.

At the outset six skills were identified. The
first was called _tracking_, i.e., the ability

to stay on the right line of print as one reads.
The eyes tend to make erratic jerks and momentary

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fixations in the wrong places. There is some
evidence to support the hypothesis that in some
cases the eye moves away from the line on which
it is traveling to letters or groups of letters
similar to those being processed, but in a nearby
line of print. Difficulties encountered by read-
ers deficient in tracking skill include missing
lines, losing one's place, and reading words or
parts of words which appear at places on the page
other than the line apparently being read. The
second perceptual skill is orientation in space,
i.e., the ability of the reader to begin a line
of print at the left and move his eyes along each
line and each word in the line from left to right.
Difficulties encountered by readers deficient in
this skill include reversals and the reading of
words in the wrong order. Both tracking and ori-
entation may depend in some way on the four re-
maining skills, those found in factor analyses of
perceptual tests, i.e., memory, speed, accuracy,
and closure. The first three of these perceptual
factors—memory, speed, and accuracy, may enter
into the fundamental skill, discrimination.

Criteria were established for constructing ex-
ercises to provide training in the perceptual
skills. Seven criteria emerged: 1) The exercises
should provide training in the perceptual skills
identified. 2) They should resemble the reading
task sufficiently to provide for transfer to read-
ing. 3) They should be simple enough to be used
in the reading readiness program of kindergarten
and first grade and yet be challenging to college
students and adults in reading improvement classes.
4) They should proceed from very easy to diffi-
cult. 5) They should provide immediate knowledge
of results, and reinforcement (reward) for cor-
rect responses. 6) They should allow each learn-
er to proceed at his own speed, and 7) they should
be self-correcting and require a minimum of teacher
supervision.

The exercises which were finally developed to
meet these criteria were assembled into a work-

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book titled <u>Visual</u> <u>Tracking</u> (1). The task is sim-
ply to find the letters of the alphabet in order,
and to circle them, as one proceeds through a para-
graph of eight to ten lines of nonsense words.
When the learner finished a paragraph, he records
the amount of time it took and then tries to fin-
ish the next paragraph in less time. The complete
alphabet, in order, appears at the top of every
page.

The task is so arranged that detection of each
letter requires discrimination in the presence
of a controlled amount of "clutter", i.e., com-
peting stimuli. A $\underline{d}$, for example, will ordinarily
appear near a $\underline{b}$, $\underline{q}$, or $\underline{p}$; or another $\underline{d}$ will appear
in the preceding line at a point above or nearly
above the correct one. However, the clutter is
controlled. In the early paragraphs the letter
size, letter spacing, and line spacing are suffi-
ciently large to facilitate choice of the correct
letter.

The skill required to complete the 160 exercises
in the book is increased in nine steps as the
size of type, distance between letters, and dis-
tance between lines of print is gradually reduced.
Frequency of occurrence of each letter is approx-
imately the same as that in ordinary text. Self-
correction is provided for: if the correct let-
ter is not detected the learner will not find it
in the following line either. Thus he is aware
immediately that he has made an error and he goes
back to find it, with the lost seconds counting
automatically on his total time.

As the learner searches the paragraph of non-
sense words he is practicing the perceptual skills.
In order to finish successfully and in good time,
he must stay on the correct line of print, pro-
ceed from left to right, and discriminate the
individual letters (thus using memory and ac-
curacy) at the highest speed at which discrimina-
tion is possible for him at his present level of

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skill. Reinforcement or "reward" occurs first as
he finds each letter, and secondly when he records
his time for all twenty-six letters at the end
of each exercise. He is then encouraged to graph
his scores on a progress chart which appears at
the end of each of the five main sections of the
workbook. As he reduces his time, the performance
curve rises.

Validation procedures were begun with the first
half of Visual Tracking in mimeographed form at
the University of Michigan Reading Improvement
Service early in 1962. The subjects were forty
retarded readers, aged eight to thirty. In all
but four cases, perceptual speed and/or accuracy
increased. Transfer of skill to a test of percep-
tual speed and accuracy (Thurstone's Identical
Forms) showed an average gain in speed of 22% and
in accuracy from an initial level of 88% to a
final level of 93%.

The first systematic investigation of the effect-
iveness of the exercises for children who are not
remedial cases was carried out in grades two through
five of the Greenfield Village Schools in Dear-
born. A group of first grade children was given
the first section of paragraphs only. At each of
the other grade levels, a class of twenty-five
children was divided into equivalent experimental
and control groups on the basis of Gates Reading
Test scores. The children in the experimental
group in each of the grades were given the entire
set of 160 exercises over a three to four month
period. During the practice sessions the control
groups were given other reading-related activities.
Since the purpose of the study was to test the
effect of the exercises as a supplementary teach-
ing aid, regular classroom teaching of reading
was continued for both groups.

Progress is recorded in Figure 1. The mean
time scores decrease on each level of difficulty,
while type size decreases from 18 point with wide
spaces between lines of print in Section 1, to 10

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TIME
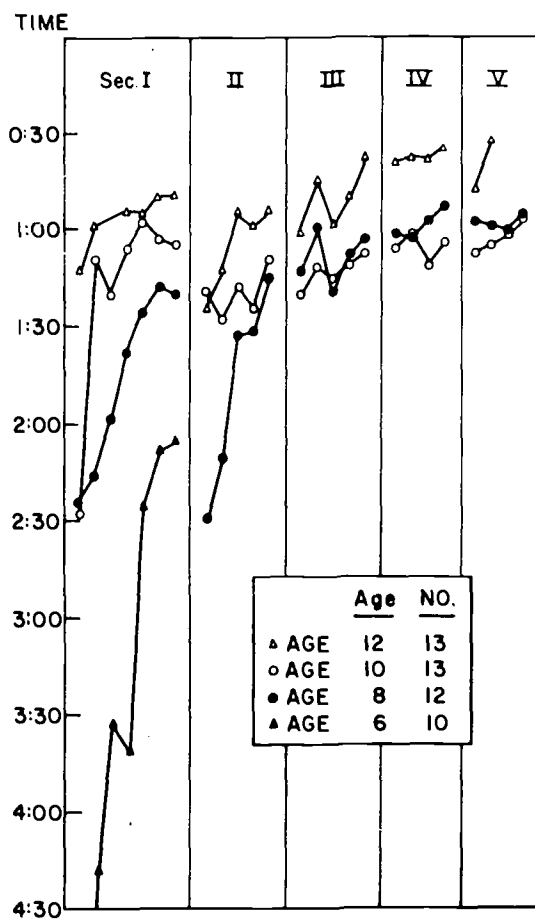
VISUAL TRACKING PROGRESS GRAPHS OF NORMAL
READERS FROM PRIMER TYPE (I: 18 PT.) THROUGH
NEWSPRINT (Ⅴ: 10 PT.)

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point with the lines very close together. At
every stage of difficulty of the exercises, the
older a child is, the more rapidly he completes
the exercises. At each successive stage of in-
creased difficulty, at first there is a drop in
tracking rate followed by a gain which reaches a
new level exceeding that of the former section.
This habituation may be seen at each age level.
But as skill and experience with the exercises
develop, the drop at each new section no longer
occurs.

As the experimental group in each class completed
the workbook, the total class was retested with
an equivalent form of the Gates Test. (See Table
1). In grade two, the experimental group was
found to have improved significantly more than
the control group on the Word Recognition Test,
while no significant differences were found be-
tween the two groups in Paragraph Reading. It
may be that skills developed by the tracking exer-
cises are immediately applicable to word recognition
skill but less directly applicable to reading com-
prehension.

Beginning with grade three, the Gates Reading
Survey was used, yielding a rate score as well as
a comprehension score. In grade three, the child-
ren who had had the tracking exercises were found
to have increased in reading rate by an average of
25 w.p.m., as compared with an increase of 10
w.p.m. in the control group. In comprehension,
the experimental group showed seven months improve-
ment as compared with two months in the control
group. These differences were significant at the
.01 level of confidence. In grade four, no sig-
nificant differences were found between the exper-
imental and control groups on any measure immedi-
ately following the end of the training period.

In grade five, the children who had had the track-
ing exercises were found to have increased
in reading rate by an average of 23 w.p.m. as

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Table 1

READING RATE AND COMPREHENSION CHANGES AT END OF TRAINING AND

ONE MONTH FOLLOWING END OF TRAINING

	N	Initial	Rate Change (WPM)		Comp. Change (Mos.)	
			End	One Mo.	End	One Mo.
Grade 3						
Exper'l	12	93	+ 25**	+ 28**	+ 7.0**	+ 9.0*
Control	11	91	+ 10	+ 11	+ 2.0	+ 2.0
Grade 4						
Exper'l	12	118	+ 20	+ 26**	+ 3.0	+ 9.0*
Control	13	115	+ 13	+ 13	+ 3.0	0.0
Grade 5						
Exper'l	13	129	+ 23*	—	+ 1.5*	—
Control	12	123	+ 11	—	+ .3	—

*Significant at the .05 level.
**Significant at the .01 level.

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compared with an increase of 11 w.p m. in the con-
trol group. This difference was significant at
the .05 level, as was a corresponding difference
in improvement in reading comprehension, also fav-
oring the experimental group.

One month after the end of training, the children
in grades three and four were tested with a third
equivalent form to check on the durability of these
gains. In grade three significant differences
have increased. In grade four, where no signifi-
cant differences were found at the end of train-
ing, the children who had the tracking exercises
were now found to have increased an average of
26 w.p.m. as compared with an increase of 13 w.p.m.
in the control group. In comprehension, the ex-
perimental group had improved nine months as com-
pared with three months in the control group.

In general, however, it appears that the tracking
exercises emphasize skills which are more closely
related to those required for recognizing words
than for reading generally.

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LEARNING TO READ AS A DISCRIMINATION PROCESS

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Behaviors subsumed under the term reading may be
viewed as a set of discriminations. A behavioral
analysis of the process by which children learn to
read reveals discriminations in the visual and
auditory modalities singly and in combination, i.e.,
bi-modality discriminations. In the visual realm,
components to be discriminated one from another
comprise such apparent forms as letters, words and
phrases and less obvious ones, such as spaces be-
tween words and points in space. The auditory
components include phonemes and morphemes, and less
obvious tonal "forms," such as words and word order
within utterances. All of these components are
within the stimulus domain. On the response side
are vocal utterances and graphic behavior.

Sample Discriminations

The term, discrimination, as used here, refers to
an organism's response when the learning environ-
ment includes:

1) two "equivalent" stimuli (i.e., each occasions
the same response);

2) provision for a set to discover a difference
between the stimuli; and

3) conditions which allow resolution of the task
(i.e., discovery of a difference) by a sufficient
visual or auditory search.

In the visual modality, the "equivalent" stim-
uli might be [d] , [b] , letters commonly con-
fused; in the auditory modality, /r/, /w/ as in
/rake/, /wake/, also confused. In bi-modality
pairing, equivalent stimuli may be involved in
the confusion of verb forms. That is, the vis-
ual signal [He ran] may elicit a vocal response

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appropriate to the visual signal $\overline{\lceil \text{He run} \rceil}$, (spoken
/he rǝn/). Failure to discriminate may have oc-
curred in any one of three component tasks:

1. Visual task

$$\lceil \text{ran} \rceil \equiv \begin{cases} \lceil \text{ran} \rceil \\ \lceil \text{run} \rceil \end{cases}$$

In this case, the configurations of the words,
$\lceil \text{ran} \rceil$ and $\lceil \text{run} \rceil$, are similar enough to account for
the error. But given evidence that the visual
discrimination has been made, the error might
then be a failure to discriminate in the auditory
modality:

2. Auditory task

$$/\text{ran}/ \equiv \begin{cases} /\text{ran}/ \\ /\text{rǝn}/ \end{cases}$$

In this case, the child may be unable to discrim-
inate between /ran/ and /rǝn/ for organic reasons,
or more commonly, may fail to do so because the
sounds are not phonemically different in his dia-
lect, i.e., others in his culture use them inter-
changeably or use one form for two referents. But
given both the visual and the auditory discrimin-
ations, the error may still occur:

3. Aural-visual task

$$\lceil \text{ran} \rceil \equiv \begin{cases} /\text{ran}/ \\ /\text{rǝn}/ \end{cases}$$

In this case, the responses /ran/ and /rǝn/
may be equally probable in the presence of $\lceil \text{ran} \rceil$.
The learner has failed to associate the equivalent
visual and auditory signals. The bi-modality dis-
crimination illustrated here is more commonly
called paired-associate learning.

The single modality and bi-modality discrim-
inations described above constitute the major

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lines of inquiry in a task analysis of the learn-
ing-to-read process. When the components of lit-
eracy are viewed as discriminations, some of the
knotty problems of early reading instruction are
resolved, others are reduced, and still others do
not arise at all. Furthermore, the task of teach-
ing is facilitated. Techniques for educing dis-
criminative behavior are readily available.   For
example, the matching-to-sample task has proved to
be a useful technique for shaping behavior, both
in experimental animals and in man (8, 11).

This paper presents a task analysis of literacy,
viewed as a set of discriminations. Reading,
writing and listening were programmed as a series
of discrete and, later, of interwoven, match-to-
sample tasks. They were field tested and revised
as necessary until a sample of low-average, first
grade children were uniformly successful on the
material; i.e., learned to read.

The Learning Paradigm I
Single Modality Discriminations

While part of the task analysis preceded the pro-
gramming effort, much more was accomplished as
a result of observing children's behavior in the
presence of the task. Thus it is appropriate here
to describe "frames" which illustrate the task.

1. Form discrimination

The learner is presented with a sample or "model"
and two or three choices. In early frames he
discriminates single letters. Later the task
requires finding groups of letters and, finally,
groups in the correct order. (Figure 1)

The increase in complexity from frame 9 to frame
225 was carefully controlled. If a change in
the format occurred, an "easy" discrimination
was required on that task. Thus, after revisions,
all pages are roughly comparable in difficulty,
judging from children's responses. Revisions were

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Figure 1. Letter discrimination frames from a basal reading program.

From Teacher's Script:

If the words are the same,
circle the picture. If they
are not the same, circle the
NO.

1. HAT . . . BAT . . . HAT
2. STAR . . . STAIR . . . STAR
3. BOY . . . BOY . . . BOY

Child's Response Sheet:

1. ⌒ (NO)
2. ☆ (NO)
3. ⊛ NO

Figure 2. Phoneme discrimination frames from a basal reading program.

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continued until all tasks reached the criterion of 95% correct responses.

2. Phoneme discrimination.

The task design for discriminating phonemes is analagous to that in the visual modality. Contrastive pairs of words are presented. The members of the pair are identical in sound except for one phoneme, as /cat/ /bat/; /cat/ /cut/; /cat/ /can/. Note that the phoneme contrast is in the initial, middle and final position of the words in the above examples. In the visual task, the model remains available during the search. In the auditory task, the model occurs twice, in the first and third positions, with the contrasting word in the middle position (Figure 2). Half of the choices are, of course, same words. The child is required to determine only whether the pairs are same or different. Each of the 43 phonemes of English is contrasted with every other phoneme in the positions within words in which they ordinarily occur.

Some 1100 frames, half of which include contrasts, constitute the discrimination program for phonemes. All words used are picturable nouns. No "pay-off," confirmation or other extrinsic reinforcer is given and none appears necessary. Each task is equivalent to a novel stimulus array. In the visual task, uncertainty is reduced, i.e., habituation occurs, when a difference is discovered between the model and a distractor. When that same difference is not found in the correct choice, the task is resolved, i.e., the learner has found "the same one." In the auditory task, the phonemic contrasts are carefully graded. At a given level of discriminative training, the succeeding contrast is clear enough for the forced choice, yes-no decision to be made. At the moment of decision, uncertainty is resolved.

In both the visual and auditory modalities, the behavior occurring immediately prior to uncer-

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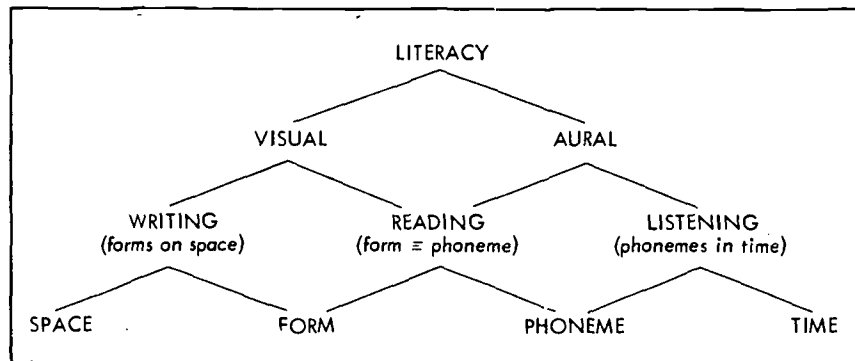
Figure 3. Classes of discriminations required for literacy and their relationships.
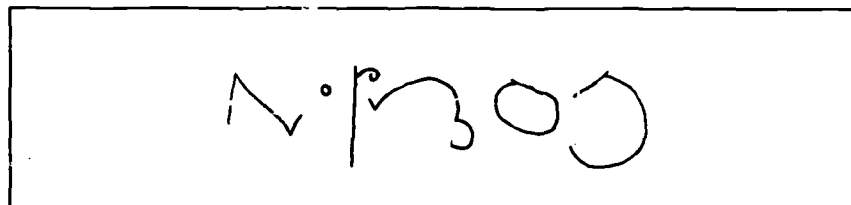
Figure 4. Norman's rendition of his name (age 7).

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tainty reduction is thought to be the behavior
learned. For example, in the visual situation,
the learner searches for the point of contrast in
two similar letters. The cross bar and absence of
a cross bar in [e] : [c] is the part which "makes
the difference", the discriminandum. Attending to
the discriminandum is reinforced by resolution of
the task uncertainty, "finding a difference."
Thus, what is reinforced, i.e., learned, is attend-
ing to points of difference in letters, In the
auditory situation, attending to the parts of
words which provide a phonemic contrast is rein-
forced by perceiving such a contrast,

One effect of the training would appear to be
an increase in accuracy of reception, with a cor-
responding decrease in variability of response
to the signal   One can observe the gradual re-
duction in "restlessness" (noise-related random
behaviors) during the auditory task over a period
of a few days,

Another apparent effect of the training is an
increase in time spent attending to spoken langu-
age, There is an increase in sustained attention
during the auditory task, from five minutes at the
beginning of training to about twenty minutes af-
ter three weeks, accompanied by a reduction in
errors,

The Structure of Literacy

We assumed some primitive grasp of English, its
basic vocabulary and syntax, Literacy was then pre-
sumed to embrace reading, writing and listening.
A simplified schema of the perceptual competencies
constituting literacy is presented in Figure 3.

Writing is viewed as a task primarily within
the visual modality and based upon form and space
discrimination. Listening is an aural task based
upon perception of patterns of phonemes over time.
Reading is unique in its dependence upon a visual

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equivalence to a phonemic signal. To illustrate
the relationships in Figure 3, let us consider
the problem of learning to do manuscript writing.
This skill is viewed herein as essentially a vis-
ual task. The learner is required to discriminate
from one another such similar forms as $\boxed{b\ d\ p\ q}$,
$\boxed{f\ t}$, $\boxed{h\ n\ u\ v\ w}$, etc. When he attempts to re-
produce them, he is required to do so by imposing
them upon a given "space." Children commonly
draw letters of greatly disparate size and orien-
tation (Figure 4). At a given time step, t_1,
Norman must choose a point in space, the limits
of which are the edges of his paper, and arrive
there at t_2. If he is unfamiliar with the space,
he will tend to overshoot or undershoot the mark.
As a result, he must carry out a substantial
amount of trial and error behavior. The writing
task, then, is viewed as requiring the imposition
of forms on space. If training in the perception
of points in space were to precede the writing,
much of the error should be avoided. Sample tasks
appear in Figure 5. A nine point matrix is re-
quired for manuscript writing. Tasks include, in
increasing difficulty, two, three and four point
arrangements. After some fifty frames, the learner
moves on to the discrimination of the locus of
forms on space and, then, to the production of the
letters, with and without support (C). Later
frames teach the use of the paper edge as a refer-
ence frame, followed by the use of adjacent letters
for that purpose.
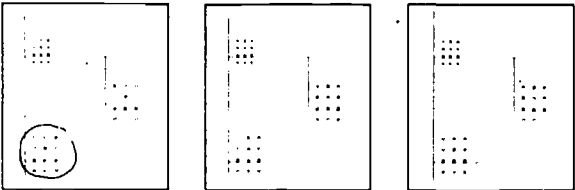
The Learning Paradigm II

Form-phoneme equivalences first occur in the
learning of words. Selection of words to be pre-
sented required that we take a position on some
long-standing problems of reading instruction. The
perennial problem of "phonics," i.e., phonemic
analysis, may be stated as follows: A verbal re-
sponse to an unknown word is facilitated by a re-
sponse to some known part of it. For example, the
$\boxed{ph}$ in $\boxed{phone}$ is a common graphic equivalent of the
phoneme /f/. The resulting phonemic analysis
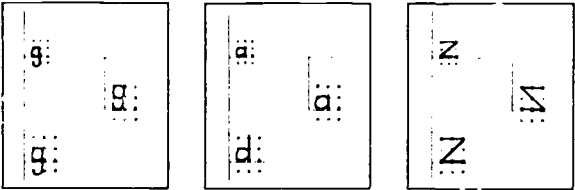
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Figure 5. Training tasks for (A) discriminating space, (B) discriminating the locus of forms in space, and (C) imposing, forms on space (writing).

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is commonly called "sounding out" words. Nearly
all investigators agree that some skill in phone-
mic analysis is necessary for reading. How and
when it should be taught is the issue. Gates and
Russell (4) and others (1, 6) maintain that skill
is likely to occur spontaneously in some children
after they have learned a number of "sight" words,
words of high associative value which are recog-
nized without analysis. Other children will then
need only incidental instruction. Other special-
ists contend that systematic instruction in gra-
pheme-phoneme pairs should precede the learning of
words (5). Evidence thus far has been equivocal,
partly because control of classroom variables has
been inadequate.

Since discrimination of the parts constituting
a novel array usually follows discrimination of a
primitive whole (7), we followed the recommenda-
tion of Gates and began instruction with sight
words.

Another issue to be faced was that raised by
Bloomfield (2). Which sight words should be used?
Early investigators suggested common nouns and
function words, the former because of their asso-
ciative value and consequent ease of learning, the
latter because of their ubiquity. For example,
some 210 words provided by Dolch account for some
67% of all words in third grade readers (3).
Bloomfield took issue with the contention that
associative value and commonness should determine
selection of words. He pointed out that a large
proportion of function words are not "regularly
phonemic," i.e., are not representative of the
sound-symbol regularities of the language. Thus
a heavy burden is put on the child: he is re-
quired to master words with elements of limited
transfer value.

We begged the question by selecting both function
words and Bloomfield's list of phonemically regular
words. We then arranged the task so that the
child learns both regularities and irregularities.

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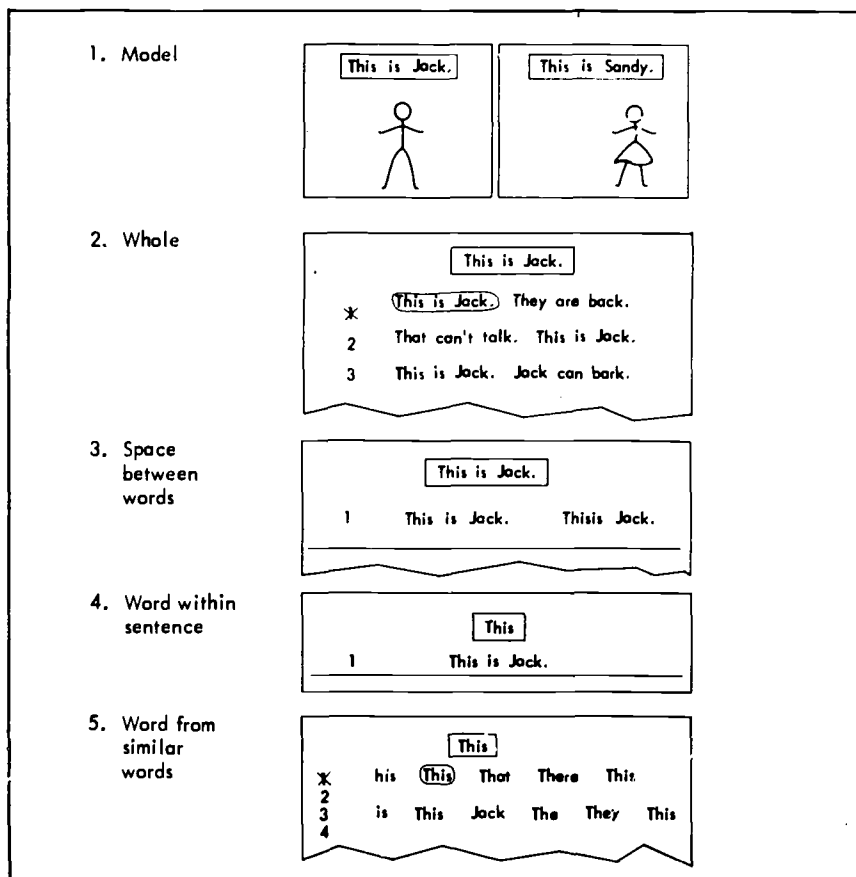
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Figure 6. Sequence of discriminations for the visual component in the learning to read process.

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1. Form discrimination

The learning paradigm for words is analogous to
that of the letter discrimination program but
more complex.

In Figure 6, Step 5 illustrates the embedding of
the word [This] among distractors consisting o.'
common words increasingly similar in configuration.
Searching the array requires a matching to sample
of each word, thus discovery of the parts of the
word which make it unique.

It will be noted, however, that a number of steps
precede this one. While children's reading dif-
ficulties often arise from faulty perception,
they sometimes result simply from "unavailability"
(9, 13) of a word learned on a previous trial. To
facilitate retrieval, all words are presented in
the context of a story.

The story is learned as a whole in the auditory
portion of the program with the aid of simple
stick figures. If a word is not available, the
learner has recourse to the model, the original
sentence with picture cue.

As one discovers when programming for children,
"simple stories" and "simple stick figures" are
not simple. The "reading" of stick figure repre-
sentations of common syntactic relationship [This
is my dad] also required extensive programming
(not shown).

When the child "knows the story", i.e., emits
the sentence when presented with the illustration,
he moves to Step 2, discrimination of the whole
sentence among similar wholes. Steps 3 and 4, the
teaching of spaces between words and words within
the sentence, resulted from discovery that some
children were not aware that the word [This]
had appeared (as a non-isolated) part of Step 2.
Subjects can be relied upon to make only those

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discriminations required by the task.

To this point, the child has carried out only the visual task. Before form and phoneme are associated, he must make certain discriminations in the aural modality.

2. Morpheme discrimination.

The assumption of a knowledge of English by our first grade children was simply uninformed. Our subjects had only a primitive grasp of their native language. The phoneme discrimination program described above appeared to increase their competency.

Their teacher reported a class-wide increase in the use of adjectives in spontaneous speech thereafter. Another problem, however, was the discrimination of words within a "vocal utterance." As linguistic investigators are aware, the sentence /This is Jack/ may well be considered to be one word. To realize that /I'm a boy/ and /She's a girl/ contain several words requires a good deal of linguistic sophistication.

A program was designed to provide for discrimination of all words taught within the story sentences in which they appeared. It was followed by an oral language program providing for the use of those words in sentences constructed by the children.

3. Aural-visual discrimination.

The form-morpheme association in reading is usually viewed as a particular case of paired-associate learning. But it need not be so construed. Paired-associate learning may, instead, be viewed as a special case of discrimination learning. The following conditions are required.
    a) A model or sample is available to the learner;
    b) The aural-visual pair to be associated is

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discriminated from three kinds of dis-
tractors rather than from the one kind
required in single modality learning:
i.   It is discriminated from aural-visual
     pairs already in the repertoire of S.

Example: The child knows the equivalence
           of [Sandy] :/Sandy/ and [Jack] :
           /Jack/. He is about to learn
           [This] :/This/.

Teacher's Script
I am going to say a word: This. Look at number 1. Which word says This? Circle it. Number 2, Which one says Thi.?

Response Sheet	
1. This	Sandy
2. Jack	This

ii. It is discriminated from aural-visual
     pairs consisting of the visual form to
     be learned paired with an incorrect
     auditory signal.

Teacher's Script
I am going to say a word. If it is the same as the word on your paper, circle the word. If not, circle the No. Number 1. /Jack/ Number 2. / Sandy/ Number 3. /This/

Response Sheet	
1. This	No
2. Sandy	No
3. This	No

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    iii. It is discriminated from aural-visual
         pairs consisting of the <u>auditory</u> signal
         to be learned paired with an incorrect
         <u>visual</u> form.

Teacher's Script

I am going to say a word. If it is the
same as the word on your paper, circle
the word. If not, circle the No.

Number 4. /This/
Number 5. /Jack/
Number 6. /This/

Response Sheet

4.	Sandy	No
5.	Jack	No
6.	This	No

The formulation of the paired-associate task in
terms of discriminations may provide a control of
the learning process not previously available.
Such control is necessary for effective program-
ming.

4. Production.

Skill in phonemic analysis is thought to develop
when the following condition obtains: Vocal pro-
duction of the phoneme in a word occurs concur-
rently with viewing the graphic equivalent of the
phoneme. This condition can be fulfilled when the
paired-associate task is completed. At that time,
on observing a word, the child emits its name,
i.e., it is now a "sight" word. He next carries out
this procedure:

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This	is	Jack
is	is	ack
Th		Ja
	is	J ck
Th s		
This	is	Jack

A complete phonemic analysis is included for each
word he learns (349 in the total program).   The
child writes the sentence completely each time
through, producing the graphic equivalent of each
phoneme while completing each word. Since the
vocal production occurs spontaneously in the pre-
sence of the word, the foregoing condition f--
learning phonemic analysis is fulfilled.

Later stories narrate various adventures of ack
and Sandy. Increasing amounts of alliteration and
rhyming are introduced in order to accentuate the
sounds of the language. A terminal part of the
word program requires systematic use of phonemic
analysis to identify unknown words.

Independent reading occurs at that point. There-
after, common phrase structures in the language
are programmed, followed by a set of transforma-
tions and substitutions required for comprehending
sentences. The terminal part of the program is
concerned with paragraph analysis.

Problems and Solutions

Problems requiring solutions provided useful infor-
mation about the perceptual process in these children.

Letters. One rule-of-thumb in programming is to
specify the behavioral outcome desired and to
teach it directly. Since the discrimination of
letters was one objective, the first frame (inde-
pendent of directions) is number 9 in Figure 1.
If subjects had been unable to make that discrim-
ination, further analysis would have been needed.

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The field trial was carried out with 19 first grade
children, all of whom were judged to be unready
for first grade. Since all the children responded
correctly, no further analysis of components was
required. More primitive children might require
a program in length, direction, and continuity of
line, in contours and enclosed areas.

Problems which arose are illustrated in Figure 7.
Note the added horizontal line in the revised
frame for the ⌈b⌉ : ⌈p⌉ discrimination. Child's
comment: "This one [P] comes closer to the line
(pointing to the added line) than that one ⌈d⌉ ."
We infer that extension of the ⌊p⌋ is first dis-
criminated by noticing its relationship to an ex-
ternal referent, such as a line.

In a similar way, the resolution of the ⌈d⌉ : ⌊b⌋
discrimination suggests that the difference in
the shape of the space between the letter and the
orientation line is the initial discriminandum.
In the first revision, there is no difference in
the shape of that space, thus, no difference is
noted. When queried after completing the second
revision, a child verbalized, "This one ⌊d⌋ points
at the line. The other points away." Apparently,
the "direction of bend" now becomes the discrim-
inandum.

Writing, As noted earlier, manuscript writing
may be viewed as the imposition of a previously
discriminated space. Errors, such as reversed
letters, are not unusual among normal children:
|ƨƨ69|. One condition of practice common in
classrooms is the repetitive production of one
letter with the dictum that the same sequence of
movements be used. The letter shapes rapidly
deteriorate for some children. Others are able
to continue drawing acceptable shapes but their
sequences of movements alternate.

Such alternation behaviors were found in other
tasks: turning pages in the wrong direction;
moving alternately from left hand choices to right

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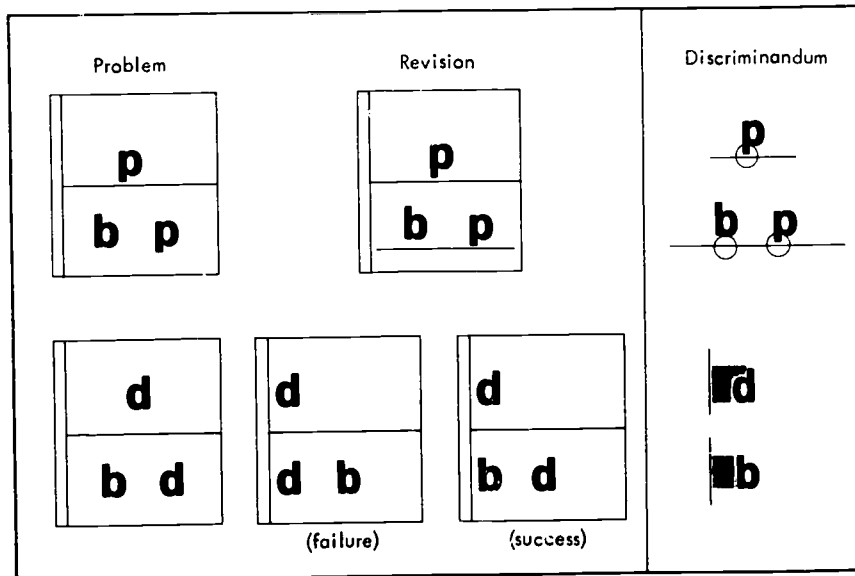
Figure 7. Problem frames illustrating use of an external referent (horizontal or vertical line) for initial discrimination.

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hand choices on response sheets; completing the
top task on one page, the bottom on the next, the
top on the next, etc. When children were allowed
to stop a task at will, the incidence of alterna-
tion behavior appeared to diminish. Thus, self
pacing (10) was introduced to the program.

Concerning the writing task, review of the samples
from the writing program above will demonstrate
how we resolved this problem. In effect, the
child may make the letters with any sequence of
movements. Furthermore, we have substituted dis-
crimination tasks for repetitive production.

The Learning Paradigm III: The Milieu

Children repond to a novel situation in the same
fashion as do experimental animals: They are
"emotional"--fearful, aggressive or immobile. The
paper and pencil learning task as a source of un-
certainty is overshadowed by uncertainty represent-
ed by a novel environment. But, while experimental
animals must habituate only to a stable, unchanging
apparatus, children must develop appropriate re-
sponses to a classroom, to a teacher and to other
children. None of these sources of uncertainty
remains stable. The room is changed unpredictably
by the addition of student art work, chalk board
announcements and a variety of educational flotsam
introduced by others. The variable behavior of
other children is a continuing source of uncer-
tainty. Much of a child's interaction with other
children is repetitive, apparently an attempt to
determine predictable responses from them. "When
I pushed him, he said, 'Stop that!' If I push
him today, he'll say, 'Stop that!'"

Since much of the child's repertoire of coping be-
haviors has been learned in the presence of adults,
the teacher tends to be the most likely source of
uncertainty reduction and, thus, the focus of the
child's habituation responses. And how predict-
able is the behavior of the teacher?

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In the presence of certain task-irrelevant pupil
behaviors, teachers' responses are relatively pre-
dictable. She responds to hand-raising, smiling,
requests for help and seductiveness by various
supportive behaviors. She responds to "nervous
habits" (i.e., random behaviors), a variety of
aggressive acts and to masturbatory activities
with punitive behavior. To the child in an ex-
treme state of uncertainty, a predictable response
is reinforcing no matter what its apparent intent.
Thus, children are shaped into dependency, fawn-
ing and seductiveness, on the one hand, and with-
drawal on the other.

Irrespective of the value of such training, one
result is a lack of opportunity to learn the skills
which are the presumptive reason for the educa-
tional enterprise. The skill task tends to be used
instead as a ground on which is played a two-way
interpersonal relations game in which child and
teacher take turns acting as the manipulandum.

Producing a stable environment. One way to pro-
vide a stable environment is to reduce the number
and kinds of stimuli to which the teacher must
respond. The teacher was trained to "not respond"
to task irrelevant behaviors of the children. To
"not respond" is a complex response. The end re-
sult of training is the ability of a teacher to
continue an activity in the presence of a normally
disruptive child behavior. The effect on the
child's behavior is clear and pronounced. First,
his previous coping behaviors in the presence of
adults simply extinguish in the presence of the
teacher. Second, an important source of uncer-
tainty reduction, the teacher's behavior, is re-
moved. The learning task remains. Since it is
carefully programmed, the child is able to encap-
sulate his uncertainty within task requirements
and to reduce it by resolving the task, i.e., by
attending to the appropriate discriminandum. And,
since the teacher does not respond to irrelevant
behaviors (including requests for help or requests
for commendation), all reinforcement must be derived
from task relevant behavior.

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The Teacher's Role:

1. Direct control: The teacher used two control
    techniques.
    a) New activity. Before any new group activ-
        ity was initiated, the teacher said, "Sit
        quietly and fold your hands." She waited
        for absolute compliance before beginning
        the new activity.
    b) Ongoing activity. Behavior was not re-
        sponded to, with one exception. A crisis
        .situation was defined as a behavior which
        distracted other children. The distract-
        ing child was removed from the group tempor-
        arily, without comment.

2. Indirect control:
    a) Physical arrangements. The primary source
        of control consisted of arrangement of the
        environment. For example, after the child
        was removed, an analysis was made of the
        environmental variables contributing to
        his difficulty. A hyperactive child was
        placed next to one wall and facing another,
        unpatterned wall, thus providing relief
        from distraction. A suspicious, aggres-
        sive child was placed in the last seat of
        the last row so that he was able to keep
        everyone under observation.

        Information dictating an environmental
        change was derived from observation of the
        group and of the response booklets. For
        example, consistent errors in auditory
        discrimination were thought to be due to
        stress. One fearful child was placed near
        the teacher and his error rate reduced
        sharply. After two days, the rate began to
        increase again. He was then placed in a
        protected position, facing out from a cor-
        ner. His error rate dropped sharply again
        and remained low thereafter.

    b) Task modifications. Errors common to

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several children indicated inadequacies in another
part of the environment, the program. A task an-
alysis was carried out on the same day and revised
materials were usually ready for all the children
on the following day,

Teacher training. Teachers involved in use of the
program during its development were trained in
situ. Thereafter, the training procedures were
programmed along with methods of task analysis
and the programming of discrimination tasks in
literacy training for inclusion in the MANUAL (12).
The effectiveness of this method of training has
yet to be determined.

Changes in behavior. The foregoing description
of environmental control may call forth in the
reader a vision of a cold, sterile learning sit-
uation. In actuality, such a result did not occur.
The most common reaction verbalized by visitors
was the eagerness and orderly activity of the
children when they stopped working. Three of the
children had been "school refusals" the previous
year. The problem did not recur. None of the
children was seen by a visiting teacher. Behavior
problems from the previous year either failed to
occur or had diminished to acceptable levels.

Summary. An analysis of skills constituting lit-
eracy yields a series of discriminations. Single
modality discriminations of visual form and space
and of phonemes and time provide skills which can
be combined within the discrimination paradigm to
yield reading, writing and listening skills. All
discriminations are arranged as match-to-sample
tasks. Phenomena described elsewhere in terms such
as unavailability, alternation behavior, habitu-
ation, eye-hand coordination, and behavior prob-
lems are discussed within the discrimination par-
adigm. It is suggested that adequate programmed
materials and teacher training may provide an
effective educational and therapeutic milieu.

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CRITIQUE OF
"LEARNING TO READ AS A DISCRIMINATOR PROCESS"

Philip Clark

I am a bit of an outsider among these people who are busily engaged in the design and testing of programmed materials, since I am not. I am concerned, I _wever, with certain features of this approach which have high relevance for behavior change, which I see as the aim of education.

I would like to present what seem to me to be two major advantages of the approach Dr. Smith has outlined.

The first of these two major advantages is that this approach focuses the child's attention and effort on the material. This point may seem unimportant at first, but when one considers the tension-reducing possibilities embodied in the teacher, and the teacher-satisfying behavior resorted to by pupils as a substitute for the learning they are "supposed to be doing," this focusing of attention upon the materials assumes dramatic significance. Here the attempt is to make the mastery of the material in question the "only" outlet for the child's needs. To the extent that this "behavioral control" is successful, the child must satisfy his needs through activities directly relevant to the "task-at-hand," I find this, at very least, an admirable economy and, at best, an invaluable service to the child in terms of his development of a generally task-oriented approach to uncertainty reduction (or need reduction) which, I would postulate, would be a highly adaptive strategy.

Perhaps even a more obvious advantage of this approach is that it focuses attention upon the behavior of the individual and away from inferences about what is occurring in his private mental world. The programmer must, at each step, specify

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the response to be emitted by the child   This op-
erationalization, not only of objectives but of
each step in the process leading to attainment of
the final skill, forces the educator to be specific
about what he wants to accomplish. This "task
analysis" procedure might be construed as an at-
tempt to define that fuzzy "learning process" we
enjoy talking about but can't quite specify, in
terms of products which are specified in the form
of the responses emitted in the frames.

It is these two features, then, of Dr. Smith's
approach which recommend it most highly to me:
1) A realistic and positive motivational focus,
and 2) an emphasis upon what we can observe and
specify,

I have two questions to raise concerning the ap-
proach, The first depends somewhat upon whether it
is expected that this technique is generalizable
to a normal population of pupils. There seems to
be an implicit assumption here that a significant
amount of uncertainty will be reduced for all
pupils by the same materials. I suppose my ques-
tion is: "Won't there be some pupils for whom the
pace is too slow, that is, who aren't sufficiently
uncertain to maintain enchantment with the task or
for whom the task has little perceived relevance?"
Won't some subjects be "bored silly" with the pro-
gram? The "subjects" mentioned in Dr. Smith's
paper were "low normals." How generalizable is
the technique?

Another question is: "Is it expected that this
approach will lead to general reading skill inde-
pendent of the criteria involved in the program
itself?" If so--and I can't imagine otherwise--
what is the prospect for experimental studies de-
signed to test the influence of this technique as
contrasted with that of others for teaching read-
ing?

CLOSURE AND THE CLOZE PROCEDURE

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The primary purpose of this paper is to review se-
lected studies on closure relevant to the cloze
procedure, As a result, we may gain some insight
into the role of closure in the reading process,

The Cloze Procedure

Definition
The cloze procedure is a technique for measuring
the effectiveness of communication by determining
the degree of language correspondence between a
message source and a receiver. This is accomplished
by deleting words from a message in some mechanical
fashion and asking the receiver of the message
(i,e,, the reader or listener) to predi t from the
remaining context precisely what words were deleted.
To the extent that the message source and the re-
ceiver share common language patterns, communication
will be effective, and the degree of effectiveness
will be revealed by the ability of the receiver to
make correct predictions regarding the exact word
the message source used at various choice points
in the message.

Rationale
A theoretical rationale for the cloze procedure is
to be found both in Gestalt theory and information
theory, The term "cloze" is derived from the Gestalt
term "closure" which (for the time being) we shall
define as the tendency to fill in gaps in an incom-
plete structure, When the receiver fills in the
correct word which has been deleted from a mes-
sage, he has achieved "closure" (i,e,, the sentence
or paragraph pattern is now complete). When closure

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has taken place, the message (or some part of the
message) now makes sense to the receiver.

Another way of viewing the cloze procedure is from
the viewpoint of information theory.[1] In simple
terms, "information" is communicated to the ex-
tent that a message unit (e.g., letter or word) is
not predictable from the previous message context.
The opposite of "information" is "redundancy" (or
predictability). A difficult message containing
unusual words organized in atypical grammatical
patterns would be highly unpredictable and, hence,
would communicate more information than a redun-
dant message containing many cliches so that the
receiver could easily tell "what is coming next"
at any point in the article. The cloze procedure
allows one to sample the degree of information (or
redundancy) in a message by counting the number of
correct predictions made by the receiver. Taylor
(57) obtained a correlation of -.87 between cloze
scores and a measure of "information" on a sample
of continuous prose.

Relationship to Reading

Several investigators have shown the value of the
cloze procedure to the study and improvement of
reading. Taylor (56) has demonstrated its use as
a measure of readability. Rankin (39, 40, 41) has
shown its value as a measure of reading comprehen-
sion. Jenkinson (23) has revealed its potential-
ities as a diagnostic tool in the reading clinic.
And Bloomer (6) has shown that it has value as a
technique for constructing reading improvement
exercises.

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[1] The relationship between "closure" and "informa-
tion" will be shown in the next section.

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The Nature of Closure

<u>Definition</u>

According to Gestalt theory, psychological organ-
ization always tends to move toward a state of
<u>Pragnanz</u> (i,e , a good <u>Gestalt</u>. A good <u>Gestalt</u>
is characterized by simplicity, regularity, and
stability. Closure (i e,, the tendency to fill
in gaps in an incomplete structure) is a special
case of the Law of <u>Pragnanz</u> As Woodworth (66)
has pointed out, "The tendency to close a gap is
akin to the tendency to overlook irregularities,
and in general to see as 'good' or 'pregnant' a
figure as possible under the given conditions,"
(p 130'

In elementary psychology texts, closure is usually
presented as one of the primitive organizing ten-
dencies in perception, However, the term is not
limited to perceptual phenomena, Let us look at
a few definitions which illustrate the generality
of this concept, Tiernan (60) states,

>   the organism, when confronted by a
situation which is non-symmetrical, incom-
plete, out of rhythm--the situation may be
an open triangle, an unsolved arithmetical
problem, the pangs of hunger--labors under
a stress or strain until the disturbing
situation is adjusted and equilibrium
reached, The final stage when the tension
is released and equilibrium reached is
known as closure. (p 97)

Murphy (34) defines closure as,

> > > a basic principle whereby the
tension initiated by a situation is
resolved and the configuration (whether
of behavior or of mental process) tends
to as complete or 'closed' a condition

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> as the circumstances permit, An
> interrupted sneeze or a face in pro-
> file without a nose is an unclosed
> configuration which one tends to
> complete, (p, 982)

Bobbitt (7) defines it as,

> , .. , any psychological phenomenon in
> which a condition of incompleteness,
> either in the stimulus field or in some
> phase of the organism's activity, creates
> a tendency to overcome this incomplete-
> ness by perceptual reorganization, by
> a combination of two or more experiences,
> or by some overt activity of the
> organism. (p. 137)

The generality of the term has led to some criti-
cism. Schoenfield (45) feels that it has never
been adequately defined as a perceptual phenomenon
and that its extension to other behavioral levels
is unwarranted. He states, "Gestalt psychologists
have been much too free in the use of the term,
and have reduced it to the status of a metaphor
which they loosely apply to a wide range of be-
havior." (p. 496) In any case, whether or not
one agrees with this criticism, it is clear that
the concept of closure has been used to apply to
thinking and overt behavior as well as perception,

At the perceptual level, the term sometimes refers
to a situation where one actually perceives the gaps
as being filled in (as in tachistoscopic studies
of closure). In other perceptual studies the missing
parts are not actually seen. Instead, the remaining
parts are organized as belonging to a complete fig-
ure despite the gaps which are clearly perceived.

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At the cognitive level, closure may take many forms
ranging from finding the answer to a simple factual
question to solving an abstract mathematical or
philosophical problem. It may be synonymous with
insight, or, if premature, it may prevent insight
from occurring,

At the psycho-motor level, closure is exemplified
by such diverse phenomena as fitting pieces of a
jig-saw puzzle together or blending sounds together
to make up words,

This general use of a theoretical concept may be
considered both as a strength and as a weakness,
It allows many different aspects of behavior to
be viewed within a unifying frame of reference,
As such it has great heuristic value. On the other
hand, in trying to encompass too much with one
general concept we may be lacking in rigor and
precision, We might be well advised to follow
the advice of the General Sematicists and use the
term "closure" with subscripts to differentiate
its meaning in varying contexts, In other words,
"$closure_1$" is not "$closure_2$,"

Previous Experience

Gestalt psychologists have tended to look upon
the laws of organization (including closure)
as innate, primitive organizing tendencies in the
nervous system which do not depend upon past ex-
perience, They presumably recognize the influence
of past experience but tend to de-emphasize its
importance, Some writers have made a distinction
between primitive or naive closure which is not
dependent upon previous experiences and closure
which operates under the guidance of learned con-
cepts, Sells (46), for example, makes a distinction
between simple closure (e.g., filling in gaps in
a circle) and "normalizing" which is described

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in the following quotation.

> The primary mechanism of closure
> takes on greatly expanded signif-
> icance after the individual has
> learned many percepts. Then he
> not only completes broken, incom-
> plete, or ambiguous figures toward
> symmetry, but also normalizes
> them by perceiving them as figures
> or objects he knows, expects, and
> desires . . . (p. 193)

Munn (33) uses the term "redintegration" to cover
the learning process by which "parts of situations
come to elicit the same response formerly aroused
by the entire situation." (p. 322) His examples
of "redintegration" parallel those which others
have used as examples of closure.

Studies by Leeper (28), Bruner and Minturn (9),
Bruner and Wechsler (10), and Postman and Bruner
(38) clearly demonstrate that closure is influenced
by previous learning and that the Gestalt prin-
ciples of perceptual organization have been stated
in too general a form. Although the theoretical
distinction can be made between primitive closure
and closure under the influence of previous
learning, this distinction is seldom made in the
research literature on closure.

Neurological Theory

Attempts have been made to account for closure in
terms of hypothetical neurological processes. Ges-
talt psychologists postulate an "isomorphism" (i.e.,
identity of form) between phenomenal gestalten
and physiological configurations within the nervous
system. The flavor of this type of speculation is

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revealed in the following quotation from Woodworth (66):

> This tendency to cloze a gap is re
> garded as revealing a fundamental
> principle of brain dynamics; a ten
> dency of the brain activity to bridge
> a gap, like the tendency of an
> electric current to jump a small gap
> in the circuit. Tension is built up
> on both sides of the gap. With the
> gap present there is a state of
>
> unbalanced tensions, but closure
> brings equilibrium. The sensory
> brain activity tends toward equil
>
> ibrium or minimum tension, just as
> other continuous physical systems do--
> drops of water, soap bubbles, or
> electric currents. (p. 130)

This theorizing has a superficial plausibility,
but after reviewing research in this area, Allport
(2) came to the following conclusion: "It seems,
therefore, that the gestaltists' efforts to find
a satisfactory physiological correlate for their
highly developed phenomenological system, and
more particularly their hope of sustaining an
isomorphic postulate by means of a neurological
field-theory, have not yet been fulfilled." (p. 137)

A more recent attempt to account for a type of closure involved in reading (i.e., auditory blending)
in terms of a neurological model has been made by
Smith and Carrigan (48). The authors maintain
that separate sounds in words can be integrated
only if the neural activity aroused by separate
word parts continues until all parts are reverberating simultaneously so that blending can occur.
They offer a chemical "synaptic transmission" theory to account for this and other types of closure
involved in reading.

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Information Theory

In the description of the cloze procedure, we saw
that this technique could be conceptualized in
terms of both "closure" and "information."   We
might therefore expect the concepts of closure
and information to be related.   Such is the case.
As you will remember, closure is a special case
of the law of Prägnanz (i.e., the tendency of
psychological organization to move toward a "good
Gestalt").   Attneave (3) maintains that the "good
Gestalt" is a figure with a high degree of internal
redundancy (i.e , a low degree of information) and
that the Gestalt laws of organization (which in-
clude the law of closure) all refer to conditions
which reduce uncertainty.   He maintains that the
human brain cannot utilize all the information
provided by patterns of stimuli which are not high-
ly redundant.   Therefore, an important function of
perception is to encode incoming information in a
form more economical than that in which it impinges
on the receptor organs.   By closing gaps in a
structure, we overlook irregularities (i.e., reduce
uncertainty) and organize the remaining portions
of an incomplete figure in a more economical form
than that which impinges on the receptors.   Infor-
mation is greater at gaps in a structure, and per-
ception functions to decrease this uncertainty
by filling in the gaps, thereby forming a more
stable (i.e., redundant) figure.

Research on Closure

Closure Factors

In 1931 Street (53) constructed the Street Gestalt
Test to measure closure.   The test consisted of 15
mutilated black and white pictures constructed so
that it is necessary to bring about a closure in
order to recognize the pictures.   He administered

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this test together with a sentence completion test,
a dissected sentence test, a dissected words test,
and an intelligence test to students in elementary
school and high school. He found no relationship
between the Street-Gestalt Test and either the
intelligence test or the verbal closure tests. The
verbal closure tests, in contrast, correlated sig-
nificantly with the intelligence test. He concluded
that there were two closure factors--a pictorial
factor and a verbal factor.

Thurstone (58) performed a factor analysis of 40
perceptual tests and found a visual closure factor
and another factor which he described as flexibil-
ity in manipulating several irrelevant or conflict-
ing gestalten, In a subsequent factor analysis
made in 1949, Thurstone (59) found two factors which
he now identified as "c_1--speed of closure" and
"c_2--strength (or flexibility) of closure." The
speed of closure factor was measured by such tests
as the Street-Gestalt and Mutilated Words tests,
It was measured by tests in which the perceptual
field was initially disorganized and in which the
subject had to unify the field, The flexibility
of closure factor was measured by such tests   as
the Gottschaldt Figures, This test requires the
subjects to find the one of five outlines of a sim-
ple figure that is embedded within a more complex
design, Such tests require the ability to manipu-
late two configurations simultaneously or in suc-
cession and to shake off one set in order to take
on a new one, To quote Thurstone, "The first clo-
sure factor c_1 seems to facilitate the making of
a closure of an unorganized field; the second clo-
sure factor c_2 seems to facilitate the retention
of a figure in a distracting field." (p. 17)

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Other investigators have found similar closure
factors. Before Thurstone's 1949 factor analysis
(59), Rimaldi (42) had found a factor similar to
flexibility of closure and Meili (29) had found
two factors corresponding to speed and flexibility
of closure. Subsequent to Thurstone's 1949 analy-
sis, Botzum (8) and Adkins and Lyerly (1) found
both speed and flexibility factors

In addition to the two perceptual factors, Bechtaldt
found a speed of ideational closure factor with
verbal materials. Pemberton (36) also found a ver-
bal closure factor in addition to the speed and
flexibility factors. Mooney (31) performed a fac-
tor analysis on six closure tests and found 5 fac-
tors: (1) verbal closure, (2) cognitive rigidity
(similar to "flexibility of closure"), (3) concep-
tual closure, (4) formal reasoning, (5) perceptual
closure (similar to speed of closure). The formal
reasoning factor was clearly marked off from the
others.

In summary, it appears that many investigators
have found a speed of closure factor and a flexibil-
ity of closure factor. In addition, several studies
have revealed a separate closure factor involving
verbal concepts.

Closure and Cognition

Thurstone (59) hypothesized that speed of closure
might be related to inductive thinking and flexibil-
ity to deductive thinking. Regarding speed of
closure, Street (53) found no relationship to in-
telligence, Botzum (8) found it to be unrelated to
either inductive or deductive reasoning, Adkins and
Lyerly (1) found that it did not transcend the
visual modality, Pemberton (36) found a slight cor-
relation (.24) with deductive reasoning, and Mooney
(31) found it to be unrelated to ?

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formal reasoning (deductive). Botzum (8) and Bech--
toldt (5) found it to be negatively related to a num-
ber factor, and Wilson et. al. (64) found it to be
negatively related to an originality measure and
found no relationship to flexibility measures in
creative thinking.

Regarding flexibility of closure, Thurstone (59)
found it loaded on a composite reasoning score
for Primary Mental Abilities; Yela (67) obtained a
.59 correlation with a reasoning factor; Botzum (8)
found induction, deduction, and flexibility of
closure on a second-order factor interpreted as an
"analytic" factor; Adkins and Lyerly (1) found "most
of the tests loaded on this factor are also loaded
on other factors that seem to fall within the realm
of reasoning"; and Pemberton (36) obtained a strong
relationship with deductive reasoning and a slight
negative relationship to synthetic reasoning. In
contrast to other findings, Mooney (31) found his
formal reasoning (deductive) clearly marked off
from "cognitive rigidity" which, according to the
author, is similar to flexibility of closure. White
(63) suggests that this factor may be of central
importance in a wide variety of behaviors and sug-
gests a redefinition to free it of its specifically
perceptual connotations.

In summary, it seems that Thurstone's hypothesis
regarding speed of closure being related to induc-
tive reasoning has not been supported by subsequent
research. In fact, speed of closure appears to be
generally unrelated to reasoning and flexibility in
creative thinking and negatively related to numerical
thinking and originality. On the other hand, there
is ample evidence to support Thurstone's contention
that flexibility of closure is related to deductive
reasoning. In fact, the relationship of flexibility
of closure and reasoning is so strong that there is
some question as to whether or not this should be
termed a strictly "perceptual" factor. It appears
to partake of both perceptual and cognitive elements,
while speed of closure is a relatively pure

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perceptual factor,

Closure and Personality

There has been a considerable amount of work done
on the relationship between personality variables
and closure. Street (54) found that psychiatric
patients performed better on the Street-Gestalt
Test than normal adults. Roseman (44) compared
normal and psychiatric patients on a jig-saw
puzzle closure-behavior test, and concluded that
the greater the personality disorganization, the
lower the frequency of closure behavior.

Frenkel-Brunswik (15) postulated "intolerance of
ambiguity" as a personality trait which is mani-
fested not only in social and emotional areas
but also in perception and cognition. She implies
that some people have a tendency to form clear-
cut Gestalten which are closed and difficult to
modify. Such people are characterized by prema-
ture closure and the rigid perseverance of old
configurations. Prejudice is presumably related
to intolerance of ambiguity. She compared percep-
tual responses to ambiguous pictures of children
who were high and low in prejudice, and she found
the prejudiced children held on longer to their
initial perceptions as a series of pictures
changed gradually from a picture of a dog to that
of a cat. Rokeach (43) compared rigidity in prob-
lem solving among children with high and low preju-
dice, and found prejudiced children maintained
their original set longer after they were given a
simpler and more direct method of solving a prob-
lem. Smock (52) hypothesized that anxiety is a
determinant of intolerance of ambiguity, and found
that subjects who made decisions either relatively
early or relatively late on a Decision Location
Task showed shorter latency of responses on a
speed of closure test than the group who made

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decisions in the middle portion of the task series.
Both early and late decisions were interpreted as
being due to anxiety. Douglas (14) found a corre-
lation between an authoritarianism scale and a
strength of closure test. Taylor (55) found extreme
liberals and conservatives on social attitudes
showed no differences in degree of closure but both
showed significantly greater closure tendencies
than the intermediate group in social attitudes.

On the other hand, Davids (12) found no relation-
ship between authoritarianism and tolerance for
ambiguous visual or auditory stimuli. The author
mentions several different negative findings by
other investigators (not reviewed in the paper)
concerning predictions made from the theory of the
authoritarian personality. Guilford (20) states
that rigidity is an ill-defined concept. He says,

> ...it has been used broadly to describe
> stereotyped or persistent behavior in
> many areas, including perception, think-
> ing, motor behavior, and even attitudes.
> Scattered studies have tended to show,
> however, that rigid behavior in one of
> these areas is not necessarily correlated
> with rigid behavior in others. It is
> very unlikely, therefore, that there is
> a single common factor of rigidity. (p. 387)

Pemberton (37) studied temperamental character-
istics as a function of speed of closure and
flexibility of closure. He found that subjects
who were high in speed of closure had the fol-
lowing characteristics: sociability, self-
confidence, quick reactivity, artistic interests,
systematic and neat, and interested in doing

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more than thinking. Subjects high on flexibility
of closure were characterized by the following
traits: socially retiring, independent of other's
opinions, analytical, interested in theoretical
and scientific problems, dislike routine and
tidiness, and think of consequences before acting.
The lack of sociability of subjects high in flex-
ibility of closure suggests that they are able
to detach their egos from the outside world. This
interpretation is supported by the findings of
Smith (50) and Witkins (65). Smith found that sub-
jects who scored high on the Gottschaldt Figures
Test (measures flexibility of closure) were socially
retiring. Witkins found that subjects scoring
high on the Gottschaldt Figures were able to ig-
nore the visual clues of a tilted room and to rely
on their own body sensations to determine vertical
orientation. The theoretical orientation of high
flexibility of closure individuals is supported
by the studies of Gehlmann (16) and Jay (22).
Gehlmann found a significant correlation between
Gottschaldt Figures scores and interest in physi-
cal science. Jay found a positive relation be-
tween the same test and the theoretical score on
the Allport-Vernor Scale of Values.

There are several bits of evidence concerning
the influence of emotional and motivational states
on closure. Verville (61) found that situationally
induced sets of tensic. failure and frustration,
etc., had significant effects on the perception of
incomplete figures. Korchin and Basowitz (27)
found the ability to see openings in circles was
influenced by stress set up by parachute jumping
practice. Smock (51) discovered that stress
tends to result in increased intolerance of am-
biguity. Moffitt and Stagner (30) found a

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relationship between situationally induced anxi-
ety and closure but failed to find a similar re-
lationship between manifest anxiety and closure.
Dittes (13) found that situationally induced threat
to self esteem resulted in greater "impulsiveness
of closure" in making complex judgments.

In summary, there is little doubt that psychiatric
illness and closure are related although the dyna-
mics are not understood. There is conflicting
evidence regarding the generality of premature clo-
sure and rigidity in the "intolerance of ambiguity"
syndrome. Some clear-cut personality differences
have been found between subjects who excel on
speed of closure and those who do well on flexibility
of closure. And, finally, closure is apparently
influenced by stress and anxiety.

Age and Sex Differences in Closure

In the initial standardization of the Street-
Gestalt Test, Street (53) gave the test to third
grade, sixth grade, and high school students and
found no age differences. Street's results on
the standardization study prompted Thurstone (58)
to say that the finding was of interest because
it indicated the test involved factors which ma-
ture at an early age and it may be taken as an
indication of some primitive function. Verville
and Cameron (62) compared age and sex differences
in closure among adults ages 16-23 and 35-56 and
found no age or sex differences other than speed
of reaction time in favor of the younger subjects.
However, as Mooney (32) pointed out, Street had
eliminated items which showed age differences in
standardizing his test, and Verville and Cameron's
study was limited to adults, used only ten items,
and included percepts which could not be assumed

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to be of equal familiarity to all subjects   Moon-
ey (32) studied the relationship between closure
and age under conditions which minimized differ-
ences in perceptual experience and social and
educational background. He gave closure tests to
children in grades 2-8 and to a group of adults.
He found no sex differences, but obtained a con-
stant and significant association between closure
and age, Basowitz and Korchin (4) compared speed
of closure and flexibility of closure between a
group of young adults (mean age 26.8) and a group
of old adults (mean age 78.1), They found the
older group inferior on both tasks, The older
group displayed lessened integrative ability and
excessive cautiousness.

Shopshire (47) compared seventh grade boys and
girls on five tests of closure and found the girls
excelled on four of the five closure measurements.

In summary, despite early indications that there
are no age differences in closure, more recent
studies have found age differences over a wide
span of years. No clear pattern of evidence has
emerged regarding sex differences.

Bender-Gestalt Studies

The Bender-Gestalt Test is a test of psycho-
motor ability which involves copying various
types of figures. Guertin (18)   performed a
factor analysis of Bender-Gestalt results for
hospitalized mental patients and found six
factors, including a "propensity for curvilinear
movement."   The non-closure of elements is

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important in this factor. Guertin believes that
underlying this factor is poor emotional control
which makes it difficult to maintain a Gestalt
once it is formed. In a factor analysis of curvi-
linear distortions on the Bender-Gestalt, Guertin
(19) found an "unstable closure" factor. The high-
est loading on this factor was for catatonic schizo-
phrenics, and a negative loading was found for
hebephrenics. Pascal and Suttell (35) found ina-
bility to integrate parts into wholes on the Bender-
Gestalt to be related to learning problems among
children. Byrd (11) found the "closure difficul-
ties" score of the Bender-Gestalt to be one of four
scores which differentiated maladjusted boys (8-16
years old) from normal boys of a similar age.

Harriman and Harriman (21) compared Bender- Gestalt
results of five year old children who had not
learned to read with seven year old children who
were making satisfactory progress in reading. They
found the readers performed better in several cate-
gories (including closure) than the non-readers.
Koppitz (25) compared Bender-Gestalt results of
children whose achievement in reading, writing and
spelling was above average with children whose
achievement in these areas was below average. She
found seven categories which differentiated the
two groups, and one of the categories was "failure
to integrate parts into wholes." Keller (24) and
Koppitz, Sullivan, David, and Shelton (26) report
correlations between Bender-Gestalt total scores
and reading ability, but no data on closure are
given.

In summary, the Bender-Gestalt Test measures
closure, among other things, and the closure
scores on this test appear to be related to
reading ability.

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Closure and Reading

Regarding the relationship between reading and clo-
sure, Thurstone (58) states:

> Reading seems to involve a form of
> closure, and it is a reasonable guess
> that there are temperamental differences
> among people in the assurance that they
> demand in the reading process. Some
> readers are able to form an acceptable
> closure over a wide span without
> actually perceiving all the detail, A
> part of the difference between fast and
> slow readers may be attributable to the
> subjects' willingness or unwillingness
> to accept a closure over a wide span
> that seems plausible even though he
> does not have the perceptual assurance
> that the closure is correct (p. 12)

Thurstone compared fast and slow college age
readers on a number of perceptual tests but
failed to find significant differences between
slow and fast readers on the closure tests,
Shopshire (47) studied the relationship between
closure and reading among seventh grade pupils
and found a significant correlation between
closure and reading for boys but not for girls,
Goins (17) found strength of closure (i.e,,
Thurstone's flexibility of closure) to be ,
significantly related to reading at the end
of the year among first graders, but found
the Street-Gestalt (i.e,, speed of closure)
to be unrelated to reading skill at the end of
the year. She found several closure tests to
be a better prediction of reading than
standardization intelligence tests, and she

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recommended the inclusion of visual closure tests
in readiness test batteries. Smith (49) performed
a factor analysis of test results of poor readers
among children and found several factors including
a closure factor. He found particular combinations
of factors identified different types of reading
problems such as "low speed and closure with high
memory and accuracy" and "high speed and closure
with low memory and accuracy." Suggestions were
made for dealing with such types of reading problems.

In summary, limited evidence indicates that closure
may not be related to reading speed at the college
level but is definitely related to reading skill
among children.[3] More research is needed in this
area.[4]

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[3]R. R. Geake found a substantial relationship
(r=.50) between gain in reading speed and Thurstone's
Mutilated Words Test when speed was measured
fifteen weeks following a reading course for high
school students (Differences in Reading Rate Im-
provement between Slow and Fast Readers, etc.,
unpublished dissertation, The University of
Michigan, 1962).

[4]For persons interested in carrying out research
on closure and reading, Mooney and Ferguson (1959)
have devised a new group closure test which can
be obtained for experimental purposes from the
Department of Psychology, McGill University,
Montreal, Quebec. Also Moran and Mefferd (1959)
have devised tests of speed and flexibility of
closure for longitudinal studies. There are 20
alternate forms which require less than 3 minutes
to administer. These tests can be obtained for
experimental purposes by writing Hogg Foundation
for Mental Health, University of Texas, Austin, Texas.

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Closure and the Close Procedure

We shall now consider the cloze procedure in
the light of the foregoing review of research
on closure. Any conclusions regarding closure
and the cloze procedure may be applied to clo-
sure and the reading process: guessing the miss-
ing words from context in the cloze technique is
analogous to (although not identical with) the
reading situation where the reader is confronted
with a new word, in context, of unknown or uncer-
tain meaning. Our question is, how is closure
involved in this type of reading situation and
what factors influence it?

First, let us consider types of closure (i.e.,
perceptual, cognitive, and motor) which may be
involved in making cloze responses (i.e., filling
in gaps in a printed message). Although the evi-
dence is limited, there is some doubt that
visual closure is involved in the cloze pro-
cedure--at least for most readers. Sentence
completion tests bear a close resemblance to the
cloze procedure and Street (53) found no relation-
ship between the Street-Gestalt and a sentence
completion test among children. Botzum (8),
using college students as subjects, found no re-
lationship between a sentence completion test and
either the speed of closure or the flexibility
of closure factors. Several investigators have
found a closure factor for dealing with verbal
materials as distinct from visual closure factors.
All of this suggests that making cloze responses
is primarily a cognitive rather than a perceptual
task. The speed of visual closure factor would
not appear to be involved because (a) the gaps
are not actually seen as filled before the
correct word is written in the blank space and

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(b) the remaining parts of the sentence cannot be
organized as a complete configuration until the
correct word is cognized. It may be that very
young children (or older children with intellectual
deficiencies) might make cloze responses utilizing
flexibility of closure which appears to partake of
both perceptual and cognitive elements. This
factor involves the ability to hold in mind a per-
ceptual Gestalt while at the same time manipulating
parts of the whole. Insofar as cloze responses
are attempted at a visual perceptual level, flex-
ibility of closure should facilitate the testing
of various hypotheses regarding the words that
"look right" in the blank spaces in the message
context. Reading, as we know, is primarily a
perceptual task for young children, whereas it
becomes more of a cognitive task with increasing
age. For older readers, decisions regarding cloze
responses are more likely to be made in terms
of what "makes sense" rather than what "looks
right". Therefore, for most readers, the cloze
procedure probably involves cognitive more than
visual closure.

At the cognitive level, closure may range from
an instantaneous "aha!" experience to a fully
conscious logical evaluation (e.g., "If I put
this word in the blank space, the sentence
makes sense in relation to the whole paragraph.")

Auditory-motor closure may be involved if the
word to be filled in the blank space is
vocalized or sub-vocalized. In such a case,
the separate sounds which make up the word
must be blended together. This could be done
at the level of auditory imagery or vocal blend-
ing or both. On the other hand, it is possible

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to cognize the meaning that fills the
gap directly without any vocalization or sub-
vocalization, in which case the only motor closure
involved would occur as one writes the word in
the blank space.

Closure failure may occur at one or more behavior-
al levels--perceptual, cognitive or motor. These
types of closures are not necessarily related.
For example, it is possible to "see" the word that
fits the context without being able to pronounce
it, or to be able to vocalize a word without ful-
ly understanding its meaning, or to understand
the meaning required by the context without being
about to write the word.

Personality factors may influence cloze responses
in many ways. Insofar as "intolerance of ambi-
guity" is a valid concept, it may be that rigid
personalities would tend toward premature clo-
sure in making cloze responses and rigidly main-
taining an initial set when it is incorrect. To
such persons, the ambiguity inherent in a muti-
lated verbal passage may be extremely unpleasant
or even threatening.

Impulsivity would also tend to bring about pre-
mature closure in making cloze responses. Rankin
(39) found that extroverts (who tend toward im-
pulsivity) made such erratic responses to the
cloze technique that one form of a cloze test
was relatively unreliable and invalid for them as
a measure of reading comprehension. On the other
hand, the reliability and validity of this cloze
test for introverts was significantly higher.
In addition, as might be expected, the introverts
made significantly higher mean scores than the
extroverts.

The social context in which the cloze responses
are made should influence closure. If the situ-
ation is threatening t the self-esteem of the

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respondent, premature or delayed cloze responses
may be the result. The level of manifest anxiety
of the reader may also influence cloze responses.
Rankin (39) found one of several equated forms of
a cloze test was threatening to readers with a high
anxiety level. This was attributed to the initial
difficulty of the items in the form of the cloze
test which caused readers with high anxiety to make
lower scores.

Age differences should also influence cloze respon-
ses, not so much because of increased visual clo-
sure ability but due to more mature cognitive func-
tioning and the effects of learning influencing
the "normalizing" (see Sells) and "redintegration"
(see Munn) processes. Through increased learning
ability and accumulated experience, people learn
to bring about closure under the guidance of
learned percepts and to respond more adequately to
reduced clues.

Perhaps this paper will help to bring about some
"closure" in the mind of the reader concerning
the concept of closure and its relationship to
the cloze procedure and the reading process.

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READING AS INFORMATION PROCESSING

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To define reading as information processing avoids many problems of epistemology. When one asks, "What is reading?", he may mean, "What behavior does one ordinarily refer to when he uses the word, 'reading'?" The answer requires specifica-tion of the behaviors named reading and those which are not so named. This kind of answer is called definition by ostension.

Another kind of answer to the question is called definition by intension. It is usually rather crude and unsatisfying: "Reading is getting mean-ing from printed material." Such definitions strain friendships and usually end, "Well, you know what I mean," followed by, "But I don't and that's just the point."

Let me offer a third kind of definition: Reading is information processing.

Because of the above considerations, I hasten to add some qualifications. (1) I do not intend the definition in the ostensive sense, i.e., not all information processing tasks are reading tasks. (2) Neither is it simply intended as a descrip-tion of reading. As a description it is both obvious and trivial. (3) It does not carry the intent of ordinary usage. As such, it would be both incomplete and inappropriate.

Nevertheless, it is a definition in a very strict sense. It says "Reading is information process-ing," not "acts like," "looks like," or "involves," but is. Thus, for purposes of this paper, I wish to treat information processing as being iden-tical with the reading process.

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In brief, this is definition by postulation. This
sort of initial definition is characteristic of
model building. It is a way of removing a term
(such as "reading") from the morass of meanings,
connotations, and implications of ordinary usage
and giving it a highly discreet and unequivocal
definition, This kind of maneuver cannot, of
course, do justice to the "meaning" of the term.
However, it can furnish us with a logico-deductive
framework from which we may draw certain conclu-
sions, and possibly, insights.   The problem of
evaluating the definition becomes one of ascer-
taining the model's usefulness for answering
questions about the process defined.

Information Processing Defined

"Information processing" is used here in a re-
stricted and technical ser.se. "Information" is
intended in the sense used by Shannon and Weaver
(1). They were interested in developing a math-
ematical language for quantifying certain aspects
of communication by electronic systems. The
method is often referred to as information theory.
In fact, it is neither a theory nor does it con-
cern information in the ordinary sense. Rather,
it is a method for calculating a quantity which
Shannon originally called "entropy," and which
more recently has come to be called "uncertainty."
Thus, perhaps a more descriptive name for "infor-
mation theory" is "a method for uncertainty
analysis." The mathematics of Shannon's method
is not important for our present purposes. How-
ever, his concept of "information" as "uncertainty"
is of interest because it forms the basis of our
model definition, information processing.

Information defined. The concept of information
as used in uncertainty analysis is best illus-
trated by example. Someone chooses a word at
random, from a book chosen at random, from a large
university library. Then he asks you to guess
the first letter of the word.   If all letters

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occurred with equal frequency in the language,
your chances of choosing the correct letter would
be 1 in 26. Your uncertainty in this situation
would be quite high in the ordinary sense of
"uncertainty." However, all letters do not occur
with the same frequency. You are given a table
which lists the relative frequency or probabil-
ity of occurrence of each letter in written Eng-
lish. In this table, you note that there is a
large variation in the relative frequency of
different letters running from e (1 in 8 times)
to z (less than 1 in 1,000). Given this data,
your chances of guessing the correct letter would
be better than 1 in 26. Thus, in a sense, the
table of letter frequencies has resulted in a
decrease in your uncertainty about being correct
on any guess, even though you still don't know
and haven't tried to guess the letter. To this
point, I have been using "uncertainty" in its or-
dinary sense. Now let us consider the meaning
of uncertainty (information) in this situation in
the context of information theory.

In the given case, (guessing 1 of 26 letters with
equal probabilities), the uncertainty ($\hat{H}$) is a
characteristic of the situation, and can be
calculated as a quantity (4.7 bits)[1]. The method
of calculating this quantity is not of impor-
tance to us here, but what it reflects is of
interest. It is probably best described as
average uncertainty. It represents how much infor-
mation, on the average, would be gained by guess-
ing one of each of the 26 letters, each trial,
over a great many trials.

The concept of how much could be gained by guess-
ing is the key. How much could be gained on the
average by guessing in some sense reflects the

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[1] $\hat{H} = \log_2 A$, where A equals the number of equally
likely alternatives.

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amount of disorganization in the situation. In
the present example, on the average you would be
wrong 25 out of 26 times, i.e., most of the time.
This reflects considerable uncertainty, informatiion
or disorganization. If the situation were such
that you were right every time, this would reflect
complete organization, hence no uncertainty, hence
no information.

It is this sense of uncertainty, amount of disor-
ganization, which is the basis of information
theory. As a mathematical quantity it has two
important characteristics:

1. It reaches a maximum when all of the alterna-
tives in a situation have equal probability of
occurrence. This would be the case for guess-
ing 1 of 26 letters if their relative frequencies
were equal. ($\hat{H} = 4.7$, the highest value for a set
of 26 alternatives.) Thus, if there is any in-
formation or regularity in the data, some probab-
ilities are increased while others are decreased
and $\hat{H}$ is reduced. In the case where we take
into consideration the relative frequencies of
letters in written English, $\hat{H}$ drops to 4.1.

2. The second characteristic of $\hat{H}$ is that it in-
creases as the number of possible[2] alternatives
increases. Thus, if there were 32 equally likely
alternatives instead of 26, $\hat{H}$ would increase from
4.7 to 5.0.

Implications. We are now in a better position to
interpret the definition of reading as information
processing. The term "information" now takes on an
unequivocal meaning, i.e., it is to be identified
with the conception of information or uncertainty
as used in information theory. Before addressing
the problem of specifying what "processing" is to

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[2] $\hat{H} = -\Sigma p(i)\log 2p(i)$ for the case of unequal alter-
natives; where $p(i)$ is the probability of occur-
rence for an individual alternative (letter).

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mean in the definition, it is necessary to point
out some implications of viewing reading as in-
volving uncertainty. These implications are
derived directly from the two properties of the
information ($\hat{H}$) measure cited above. First,
since $\hat{H}$ varies with the number of alternatives,
those alternatives must be in the repertoire of
the individual. Second, since $\hat{H}$ varies with the
probabilities of occurrence of the alternatives,
these probabilities must in some sense be pro-
grammed in the reader. My use of "information
processing" as a model definition requires that I
argue the reasonableness of the implications I
draw. In doing so for the first implication
above, I will lay the groundwork for a distinc-
tion between two senses of "processing." In this
way, specification of the meaning of "information
processing" as it is used in the definition will
be completed.

Processing defined. I have contended that alter-
native responses must be available for reading to
occur. Our meaning of the term "information" de-
mands that these alternatives exist at the time
of the reading act, as discrete alternatives in
the system, not just as logical possibilities. I
am going to argue that it is reasonable to con-
ceive of these alternatives as relatively discreet
neural circuits which may be active concurrently.
Such a condition seems to be required to account
for the process of visual perception. Let me
illustrate.

Psychology traditionally makes a distinction be-
tween perception and sensation. This distinction
is often blurred for the reason that we have no
access to experiences of sensations except as
percepts. Hence, we are unable to point to any-
thing in our phenomenal experience and say that
it is a sensation and not a percept. Nevertheless,
the distinction may still be made by examining
the sensory apparatus itself as well as certain
perceptual phenomena.

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There is a set of phenomena referred to as "perceptual constancies." For example, when one views a rectangular object such as a book cover from several different angles, one still sees a rectangular book cover. This is the case, even though the sensory image on the retina varies a great deal when one changes his angular relation to the book. That is, the visual image on the retina may be a parallelogram with extreme angles, and yet we "see" or perceive an oi inary rectangular book cover. Consider also some facts about the visual apparatus itself. The eye is often thought of as being analogous to a camera in its operation. The camera analogy is helpful for some purposes, but it can also be very misleading. Whereas an image can be focused clearly on the film in a camera, this is not the case in the eye. If we were able to take the retina, while the eye is fixated on some object, and develop it as we can a photographic film, the resulting picture would not begin to approach the clear, well-defined photograph of a camera. Our appreciation of the primitive state of the visual sensation is further enhanced by considering the organization of the visual receptors in the retina.

The receptors themselves are not only facing <u>away</u> from the direction from which the light is coming, but they are covered by several layers of translucent cells consisting of nerve fibers and ganglion cells of several sizes and types. The picture is further complicated by their distribution. An area in the center of the visual field, smaller than the size of a penny held at arm's length, is the only place where precise pattern discriminations can be made. This area of the retina (less than 35 minutes of visual arc in diameter) contains an immense number of visual receptors (cones), but from there on out, they drop off quickly in number. Furthermore, those in the periphery must share nerve fibers so that they are less able to sense fine spatial differences in stimulation.

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If the eye were always perfectly stationary, only
that part of the image which falls on this tiny
central portion could be "seen" clearly. For this
reason, it is indeed fortunate that the eyes are
capable of moving with such speed and precision.
But these movements themselves present a puzzling
problem. That is, we perceive stable objects in
the world, and yet the sensory image is jumping
around from position to position on the retina.

Considerations such as these lead one to a grow-
ing appreciation that the perceptual process must
involve more than a simple passive identification
of sensory events. The events of sensation by
themselves are just not capable of accounting for
the high degree of constancy, clarity and organ-
ization present in our percepts.

For this reason, it is plausible to conceptualize
the perceptual process as being much more "cen-
trally" determined than a common-sense notion
suggests. (The common-sense notion has the per-
ceiver as a kind of receiver of information.) This
suggestion goes further than the so-called "new
look" at perception which has come about in psy-
chology. What is suggested here is not just that
internal states such as motives or need affect
perception. Rather, it is suggested that pre-
viously existing internal states of the organism
are responsible for perception.

The concept of "information" in our model def-
inition may now be further clarified. It has
been previously identified as the amount of dis-
organization contained in a situation involving
a number of discreet alternatives. One property
which affects the amount of disorganization (in-
formation, uncertainty) is the number of alter-
natives present. Thus, our model of the reading
process may be stated: Reading is the processing
of a number of previously existing states of the
organism. These states are not seen as being

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brought about by the presently existing sensory
stimulation, i.e., the presence of the words or
letters on the page, but rather they are seen as
being the neural activity present while the sen-
sory events are being initiated.

The information being processed in reading is
within the person, not on the page, or on the re-
tina. The page may be a necessary condition for
this processing to take place, but it is not a
sufficient condition. In order for reading to
take place in terms of the present definition,
there must also be a state of uncertainty exist-
ing within the person. Further, the processing
of this uncertainty (in the presence of the print)
is exactly what is meant by our definition of
reading. It does not mean that if uncertainty is
present it will be processed when reading takes
place; rather, it says reading cannot take place
unless uncertainty is present.

Now we may distinguish between two ways in which
information (uncertainty) may be thought of as
being "processed". If the information exists in
the form of alternative internal states, these
states may be most easily conceptualized as si-
multaneously firing neural networks. In one sense
then, processing of information could refer to the
"choice" of one of these networks through the in-
teraction of sensory stimulation (looking at the
word on the page) and the operation of the active
networks, This process can be seen as a matching
between the sensory input and the appropriate net-
work firing, It, of course, assumes that one of
the networks firing will in fact be an appropriate
match for the sensory stimulation. This condition
may fail to be met in either of two ways:

1) An appropriate network may never have been
formed. This would be the case when one comes
across a word never seen before.

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2) The appropriate network may not be active.
This would be the case when the reader's atten-
tion lapses during reading.

Thus another sense of processing may be distin-
guished: the initiation of firing in appropriate
networks so that matching can take place. This
is to be distinguished from the process of form-
ing these networks in the first place which falls
under the heading, learning to read.

To summarize, the definition of reading as infor-
mation processing, with the appropriate specifi-
cation of terms, leads us to a model of the read-
ing process which yields several distinctions and
implications:

1) Reading is the processing of "uncertainty"
which exists in the person, not on the page.

2) This uncertainty exists (if it exists) in the
form of active alternative states within the in-
dividual.

3) Reading cannot take place unless these alter-
natives are present.

4) Reading cannot take place unless these active
alternatives are appropriate with respect to the
material to be read.

This model may also provide us with some insight
into the operation of methods which are commonly
used to improve reading skill. When you coax a
student to form questions before attempting to
read a passage, you are attempting to stimulate
some uncertainty in him. This is also true of
surveying and skimming before reading. Further-
more, processing his uncertainty requires that it
be relevant to the material constituting the sti-
mulus array, i.e., the page. Therefore, his ques-
tions must continually be revised to fit the passage.

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In a general qualitative sense, the model pictures
reading as a very active, goal-oriented behavior,
not a passive stimulation by the print.

The model implies, furthermore, that more is neces-
sary than a general active, attentional state in
order for reading to take place. The required active
attention implied by the model is "goal-oriented",
not general, in nature. Attention must be directed
to something, not just activated. When one asks
a student to "concentrate" or "pay attention",
one is telling him no less than to be ready for
anything which might occur. If the student actually
tries to follow this advice while attempting to read,
the results will be disastrous. To the extent that
he concentrates, in this "raw" sense of concentrate,
he will become increasingly distracted and unable
to "read". The result will be the familiar inabil-
ity to remember what was said at the beginning of
a sentence or paragraph when the end is reached.
In terms of the model of reading as information
processing, this phenomenon would be pictured as an
overload of information or uncertainty, resulting
in extreme cases, in an inability to process any
information at all. The remedy in this situation
would be to narrow the student's attention, i.e.,
decrease the uncertainty. This may involve em-
phasizing the student's preconceptions, fantasies,
and internally determined mental activity, not de-
emphasizing them. Such de-emphasis is equivalent
to making him a kind of homogeneously cluttered
slate on which all sensory activity has an equal
probability of being written.

In summary, reading may be seen as a process of
information processing in which information is
conceived as internally existing uncertainty in
the form of alternatives to be matched with sen-
sory events. This model emphasizes the need for
a limited, hence directed, amount of attentional
activity in the reader as a necessary condition

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for reading. It conceptualizes the processing
of information in the reading task as the re-
duction of uncertainty within the reader, not the
gathering of "information" from the page.

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READING COMPREHENSION AS INFORMATION PROCESSING

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Is reading comprehension a single skill or a composite of many skills? Attempts at definition typically lend themselves to positioning along a "specificity-generality" continuum, according to Rankin (13). Armchair analysis suggests that comprehension involves a large number of separate, specific skills (1, 7, 16, 17), while results of factor analyses suggest that reading comprehension involves a relatively few, general factors (2, 4, 5, 6, 11). Those who argue the "specific skills" position cite the "low" correlations between "general" reading ability and ability in "specific" subject matter areas, such as those reported by Pressey and Pressey (12) and Grimm (8). The "general factors" position should predict high correlations between general reading and specific subject area reading and between selections from different subject areas.

This paper will present a model which accomodates both the "specific skills" and the "general factors" points of view. Individual differences in information processing is the key variable for effecting the rapprochement. In brief, "divergent" thinking is appropriate for certain passages and "convergent" thinking fits others.

Models of Comprehension

Kingston (10) has reminded us that the reading process involves the total organism. He presented this point of view as a communications model.

If the organism has the requisite "reading skills" and if anxiety, lack of motivation or other "psychological factors" do not interfere, the reader will comprehend. However, input (the reading passage) must be pitched at a level of abstraction, experience level, developmental level, and

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linguistic symbol level commensurate with those of
the reader.

This model does not, nor does it purport to, tell
us anything we have not known. It does, however,
represent an attempt to organize what we know in
terms of the familiar input-system-output para-
digm. In this case the output is defined in terms
of the nature of the input and the "psychological
condition" of the organism.

A somewhat different emphasis is provided by Guil-
ford's (9) Structure of Intellect model:
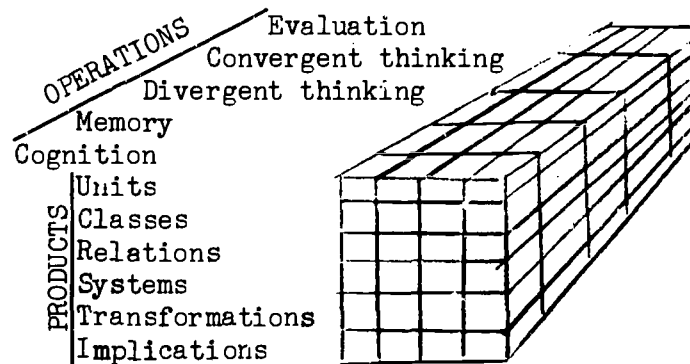
(Guilford, (9) p. 4)

Figural
Symbolic
Semantic
Behavioral

CONTENTS

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Here again we have an input-system-output model,
but this time there is no apparent attempt to de-
fine the "psychological condition" of the organ-
ism. The input is organized as various forms of
content on the "Contents" face of the model (Figu-
ral, Symbolic, etc.), and the output is described
in terms of various levels of complexity on the
"Products" face (Units, Classes, etc.). The "Op-
erations" face of Guilford's model is an attempt
to describe the functions performed by the organ-
ism (or system) upon the input in order to produce
the output. For example, a Symbol (Content) is
Cognized (Operation) as Unit or a member of a
Class (Product). It will be observed that the
factors comprising the Operations face are aligned
in a roughly temporal order for cognition through
memory, convergent thinking and divergent think-
ing, to evaluation. That is, the performance of a
function toward the right side of this face of the
model implies the prior successful performance of
at least some of the functions to its left. Cog-
nition and memory, for example, would presumably
be necessary prior to performance of any of the
other three functions.

Individual Differences

This temporal organization of factors along the
"Operations" face serves as an interesting and
provocative description of human thinking and
might also be construed to apply to the informa-
tion processing which occurs during reading. How-
ever, it does not provide for individual differ-
ences in "style" of thinking or mode of processing
information. Guilford's neglect of individual
differences on the Operations face is understand-
able. It reflects a bias characteristic of the
psychology of learning and thinking through the
years. The tendency has been to examine the
learning process or the reading process. As
Spence (15) has pointed out, the testing of learn-
ing hypotheses in terms of the mean group result
and the ignoring of individual curves frequently
leads to distorted interpretations. Largely for

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this reason, it has been proposed that the "Opera-
tions" face of Guilford's Structure of Intellect
be redesigned in order to reflect individual dif-
ferences in modes of processing information. A
consideration of the redesigned face will be help-
ful in our consideration of reading comprehension
as information processing.

The establishment of an individual differences
processing continuum running from high persevera-
tion of input at one extreme to low perseveration
at the other was recently undertaken (3). A
broadly representative battery of twelve percep-
tual and conceptual tests, many of which were the
same ones used by Guilford, was administered to a
group of approximately 150 eighth grade students.
The method of analysis involved inter-correlation
of results, principal axes factor analysis solu-
tion, oblique rotation, and principal axes solution
at the second order level. Results of the oblique
rotation, the inter-correlation matrix of first
order factors, and the results of the second order
analysis are reported in Tables1, 2, and 3.

It was concluded that, given the battery of tests
used and the sample of subjects tested, (a) it is
possible to isolate at least three processing fac-
tors; (b) two of these factors represent basic
modes or "styles" of dealing with input and the
perceptual and/or cognitive level; (c) the factors
at the extremes of the dimension define a continuum
of information processing modes from high persever-
ation of input, thus, well defined visual patterns
controlling responses, to low perseveration, thus,
poorly defined patterns controlling responses; (d)
the factor in the middle of the continuum emerged
because the tests which load on it allow success
by both those who are predominantly perseverative
in their processing behavior and those who are
predominantly non-perseverative, each using his
own style. Those who score best on tasks defining
the high and low perseveration ends of the con-
tinuum are called Convergent and Divergent types
respectively, after Guilford. (Tests defining the

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high perseveration extreme are Concealed Figures
similar to Gottschaldt figures and Memory for De-
signs; at the other extreme are Word Fluency and
Gestalt Completion.)[1]

Comprehension as Pattern Discrimination

Let us now assume that reading equals pattern dis-
crimination. That is, reading comprehension may
be viewed as a series of responses to discrimina-
tive stimuli, consisting of letters and/or words
and/or phrases, and so on. The introduction of
the individual differences dimension suggested by
the study cited above will now clarify the appar-
ent discrepancy between the "specific skills" and
"general factors" points of view.

The eye-movement study reported by Smith and Sem-
melroth (1963) strongly suggests that, during pat-
tern discrimination, some unspecified number of
discriminanda are required for recognition. If
we can accept the reading process as a member of
the class, pattern discrimination, and if indivi-
duals differ in discriminative style,[2] it would
then follow that readers will differ in the amount
of external input (Number of discriminanda) re-
quired to discriminate among symbols depending up-
on their modes of processing information. The Di-
vergent type, that is, could be expected to re-
quire less stimulus support for recognition of a
symbol due to superior "closure," the tendency to
respond to poorly defined patterns. The Conver-
gent type, on the other hand, should require more
external support for recognition. Hence we should
expect the Divergent type to be a rapid reader
with relatively poor mastery of detail but good
understanding of the overall message, and the Con-
vergent type to be a relatively slow reader with

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[1]see also Rankin, E. F., this volume (Ed.)

[2]defined as individual differences in persevera-
tion of input.

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good mastery of detail and perhaps great diffi-
culty understanding the message as a whole. The
former might be described as a "context reader"
since he relies on only parts of the message, that
is, a minimum of stimulus support. The latter has
classically been called a "word reader" since he
does not "close" well but relies on a relatively
larger amount of stimulus support for discrimina-
tion.

The "specific skills" - "general factors" debate
should be somewhat clarified by the proposed in-
dividual differences continuum. Apparent differ-
ence between word recognition and paragraph com-
prehension skills, for example, may be explained
in terms of individual differences in processing
modes. The so-called low correlations between
general reading ability and reading in specific
subject areas may well simply reflect differences
in handling of various types of reading material
depending upon whether the two reading tasks equ-
ally favor those with a Divergent or a Convergent
style. For example, an argumentative passage pre-
senting a logical and consistent line of reasoning
should be more easily mastered by the Divergent
type, whereas a historical article describing a
battle, in which comprehension relies on mastery
of names of commanding officers, details of posi-
tions held by various units, and intricate synchro-
nization of movements might be more easily mastered
by the Convergent type. A "low" correlation should
be found in this instance.

The mode of testing would be expected to have an
important influence on correlations also. Testing
for detail should favor the Convergent type, while
testing for main idea and inference should favor
the Divergent type.

Furthermore, degree of familiarity with the sub-
ject area should influence the efficiency of com-
prehension and thereby the size of the correlation
coefficient. That is, regardless of how a person
processes information (divergently or convergently),

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he will comprehend material from subject areas he
has had more experience with more efficiently than
that from areas with which he had had less experi-
ence.

In summary, an input-system-output paradigm such
as that used in information theory appears promis-
ing as a device for analysis of reading compre-
hension. This paper has focused upon the system
portion of the model suggesting that it be ex-
pressed as an individual differences dimension
rather than as a series of processing functions
common to all people. The proposed model might
appear as follows:
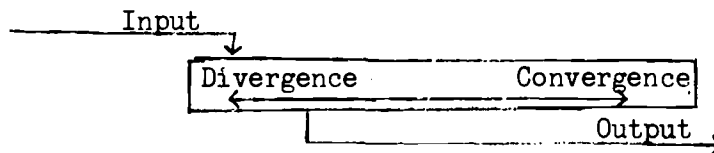
It is felt that the consideration of individual
differences reflected here helps to resolve some
of the apparent conflict among points of view re-
garding comprehension.

TABLE I
Biquartimin Rotation of
Three-Factor Orthogonal Structure
Primary Pattern

Test	Factor		
	I	II	III
Coding	.37	.04	.39
Word Fluency	.11	.08	.62
Brick Uses	-.08	-.04	.55
Gestalt Completion	.05	.11	.57
Mutilated Words	.16	.29	.35
Remote Associates Test	.41	.37	.08
Identical Forms	.17	.41	-.03
Memory for Designs	-.02	.62	-.00
Concealed Figures	.09	.68	.06
Picture-Number Recall	.67	.06	.00
Paired Associates	.57	.17	.06
Digit Span	-.00	.42	.11

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TABLE 2

Three-Variable Intercorrelation Matrix of
Obliquely Rotated Factors

	I	II	III
Factor I			
Factor II	.39		
Factor III	.24	.30	

TABLE 3

Principal Axes Solution at Second Order Level

	I
Factor I	.53
Factor II	.56
Factor III	.44

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REVIEW OF RESEARCH: SKILL THERAPY

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Emotional maladjustment and reading skill defi-
ciency are thought to be related, judging from
the large number of reports published in this area
in the last thirty-five years. Most studies have
addressed the question, "Is emotional disturbance
a cause or a result of reading disability?" The
position taken depends largely on the bias of the
researcher and on the nature of the populations
studied. There appears to be little doubt, how-
ever, that many cases of mild to severe maladjust-
ment can be traced to failure in reading or in
some other skill area (11, 12, 14, 15).

If skill deficiency frequently leads to emotional
problems, it is certainly logical to conclude
that effective remedial training will result not
only in an increase in skill, but also in a posi-
tive change in affect. Most clinicians in skill
areas are convinced that their successful exper-
iences with clients clearly support such a con-
clusion. Nevertheless, among the hundreds of
publications dealing with the relationship be-
tween affective variables and deficiency in read-
ing or some other skill, it is difficult to find
more than a handful which are concerned with ob-
serving or measuring the effects of remedial
therapy on personality adjustment.

The earliest publications of this type are based
on clinical observation, and are reported in the
form of a series of case studies. Blanchard (3)
described four cases, purportedly representative
of a larger clinic sample, in which failure in
reading resulted in such mild behavior deviations
as daydreaming, over-sensitiveness, absent-
mindedness, inattention, and "laziness." She
stated that correction of the disability, and sub-
sequent substitution of success for failure in

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school, was followed by a cessation of the behavior deviations. In a similar study of nine children by Monroe (9) it was asserted that successful remedial training in reading resulted in a simultaneous increase in confidence, perseverance, attentiveness and cooperation, as well as in a reduction of tension. Kirk's (7) study of the effects of remedial reading instruction in a group of maladjusted, mentally retarded youngsters indicated that the treatment produced not only a significant improvement in reading skill, but also a marked reduction in daydreaming, incorrigibility, inattentiveness, and negativism.

More recently, two investigators reported efforts to measure personality changes in late-elementary school boys who required remedial instruction in reading. Seay (13) administered the California Test of Personality and the reading sub-test of the California Achievement Tests to a group of seventy-two boys with average IQ's but deficient reading skills. The tests were also administered to a group of matched controls who were normal readers. The experimental group received individual remedial instruction several times each week for seventeen weeks. The tests were then re-administered to both groups. The experimental group snowed a greater positive change in social self-concept and in total self-concept. There was also a positive change in personal self-concept, but this was not significantly greater than that found in the controls. Dunham (4) developed a scale to measure attitude toward reading, and administered it to twenty nine-year-old retarded readers who subsequently received twenty-two hours of small-group remedial instruction over a six-month period. The scale was also used to measure the attitudes of an equivalent control group who were on the waiting list for remedial training at the same clinic. There was a significant difference in reading gain between the experimentals (6-10 months) and the controls (0-4 months). A slightly greater positive raw score

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change in attitude among the experimentals was
not statistically significant.

At the college level the hypothesis that develop-
ment of a higher level of reading and study skill
in reading improvement classes would be accompan-
ied by positive changes in self-concept and in re-
lated personality variables was tested by two
investigators. Englander (5) developed an instru-
ment to measure self-concept in academic areas.
The scale was administered to forty-six college stu-
dents before and after a one-semester credit course
in developmental reading, and to thirty controls
before and after participation in a one-semester
elementary public speaking course. For the exper-
imental group, differences between means on pre-
course and post-course administration of the scale
were positive and significant in areas of self-
concept as a student, self-concept in reading
ability, and attitudes toward reading. No signif-
icant changes were observed in the control group.
These results appear to support the investigator's
hypothesis. Examination of the data, however,
reveals that, in the three areas in which the read-
ing group showed significant changes, the controls
had significantly higher scores both at the begin-
ning and at the end of the semester. The two
groups were clearly not equivalent in this respect.
The experimental group consisted primarily of self-
referrals anxious about their ability to succeed,
and the results of the study would have been subject to less equivocal interpretation had the con-
trol group also consisted of anxious self-referrals
to satisfy the requirements of a rigorous design.

Raygor's (10) investigation of a similar problem
involved a somewhat more complex approach. The
reading skills of eighty-eight college students
were measured before and after a non-credit,
seven-week reading improvement course with equiv-
alent forms of the DRT Survey. Responses on
Factors C (Emotional Stability), F (Surgency),

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O (Anxious Insecurity), and Q_4 (Nervous Tension)
of the 16 Personality Factor Test were obtained
to measure anxiety symptoms at the beginning and
completion of the reading course. Each of the
subjects was placed in one of four personality
categories as measured by responses on the SA-S
Senior Scale. At the end of the course it was
found that substantial gains in reading skill had
occurred for all four of the SA-S types. There
was also a significant increase in Factor C (Emo-
tional Stability) for SA-S Type I subjects (ex-
troverted and stable), and for Types I and IV com-
bined (extroverted). Positive changes in Factor
F (Surgency) were observed for the total group at
the 5% level of confidence, and for SA-S Types
II and III (introverted) at the 1% level. No
significant changes in Factors O or Q_4 were found.
On the basis of these findings it was concluded
that increases in reading skill are accompanied
by personality changes in the direction of de-
creased anxiety and increased emotional stability
and self-confidence, but that these changes are
specific to personality-type sub-groups rather
than to the total population studied. Again, how-
ever, our interpretation of reported results must
be tempered by realization that they were obtained
from subjects who were not compared with a matched
control group which received no skill instruction.
It would be instructive to know what, if any,
changes in anxiety responses would occur in a
similar group of college students who pursued
their regular academic and social activities with-
out benefit of a developmental reading course.

An interesting and imaginative study was carried
out by Jack (6) three decades ago, and, although
not dealing with reading skill, it is relevant to
the concept of skill therapy under consideration.
Jack developed a highly reliable observer-rating
scale for estimating degree of ascendance and
submission. In a series of carefully contrived
play situations, trained observers rated the be-
havior of eighteen pre-school youngsters with

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average or above-average IQ. On the basis of
these ratings, the youngsters were divided into
three groups: ascendant, moderately ascendant,
and non-ascendant. The mean difference between
scale scores of the ascendant and non-ascendant
groups was 50 (SE = 6.3). The five youngsters
with the lowest ascendancy scores were then given
experience and skill training in three different
situations. Two of these situations involved
learning to make the visual discriminations and
motor responses required for accurate and rapid
assembly of a block design and a jig-saw puzzle,
while the third necessitated learning to tell a
story as accompaniment to a series of pictures
in a book. All these tasks were practiced to a
criterion of five consecutive perfect performances.
Each of the five subjects was then placed with
one other untrained child four times in each of
the three situations for which he had been trained.
Ascendant behavior was rated by concealed obser-
vers in these situations as before. Finally, all
subjects were again rated in the series of initial
play situations for which none had received speci-
fic training. It was found that ascendancy scores
for four out of the five non-ascendant subjects
showed a marked increase in the situations for
which they had been trained. More important, how-
ever, is the finding that this increase in ascen-
dancy transferred to other situations in which no
training was provided, as indicated by the follow-
ing ratings on the ascendance scale:

ASCENDANCE

Group	N	Initial	Final	Difference
Trained	5	38.4	77.8	39.4
Untrained	13	79.8	87.0	7.2

It can be seen that all subjects showed increases
in ascendancy scores with age and experience dur-
ing the months of the study, but the trained

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group made gains which were significantly greater
than those of the controls. It is assumed that
these gains were a result of the training received
during the second phase of the investigation.

The studies discussed above tend to confirm, in
varying degrees, the validity of the concept of
skill therapy. There are, of course, questions
concerning the extent to which skill therapy can
be expected to be effective in alleviating certain
kinds of degrees of maladjustment, particularly
maladjustment resulting from factors other than
skill deficiency. These reservations are reflect-
ed in the literature. Lipton and Feiner (8),
for example, found that a group of severely dis-
turbed fourth grade boys simply could not respond
to remedial instruction in reading until after a
period of group psychotherapy had reduced the
anxiety evidenced in aggressive or withdrawing
behavior. The well-known studies of Axline (1),
Bills (2), and others also suggest that direct
remedial instruction is far less effective than
various kinds of psychotherapy with some problem
readers. The skill therapist would argue here
that, since control of attention is the first step
in therapy, an adequate stimulus array would obvi-
ate the psychotherapy. Nevertheless, many studies
raise doubts concerning the universal applicabil-
ity of the concept of skill therapy, and even
those investigations which tend to support this
concept provide little more than a strong sug-
gestion that it is valid in some cases. It is
interesting to note, for example, that in Raygor's
study the only subjects who showed significant
increases in emotional stability were those SA-S
types who were already stable and outgoing. We
are justified in wondering, therefore, whether
skill therapy is indeed an adequate approach with
our most anxious clients. Is a more conventional
form of psychotherapy required in these cases? Or
is it necessary to develop more appropriate tech-
niques for instructing the entrenched problem
student in reading skills?

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Additional research in this area is clearly war-
ranted. Rigorously controlled experimental pro-
cedures can undoubtedly help to provide answers
to some of our questions. Adequate methods for
measuring change in affect also need to be employed.
And, of course, remedial techniques and materials
which are the most effective we can develop must
be used. Perhaps in this last category, at least,
we are progressing to the point where we will be
able to probe the question with new insight and
skill, and to come forth with some surprising ans-
wers.

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SKILL THERAPY: A TREATMENT RATIONALE FOR EDUCATORS

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Mental health thinking permeates educational prac-
tice. Most teachers, for example, have a nodding
acquaintance with Freudian thought, and most in-
clude in their lexicon such terms as adjustment,
rapport, tensions, defenses, and the like. Spec-
ialized educational workers reflect the bias even
more clearly. Psychometrists frequently qualify
their intelligence estimates with references to
anxiety, obsessive behavior, disturbance, autism,
withdrawal, etc. Furthermore, we are now training
de facto mental health workers, among which visit-
ing teachers, teachers of the disturbed, crisis
teachers, and critical incident teachers are the
most apparent examples.

An increased sensitivity to the affective state
of the learner has enhanced our teaching effective-
ness. Witness, for example, the number of useful
techniques which have become available for manip-
ulating the learning environment. On the other
hand, we have also paid a price. "He doesn't
learn and he is disturbed" slips easily into the
casual construction, "He doesn't learn because he
is disturbed." Thus the mental health movement
has given us another diagnostic category with
which to justify avoidance of teaching. In his-
torical perspective genetic explanations ("His
father was the same way") have given way to moti-
vational ones ("He's too lazy"), succeeded by
intellectual aphorisms ("He's too stupid") and,
finally, to the personality epithet ("He's sick").

The strongest justification for such explana-
tions is the comfort they afford the teacher.
They are of little value to the learner. At

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best, they sometimes lead to an appropriate refer-
ral But the referral procedure has its own prob-
lems. It is commonplace for a child to be referred
from one child-care agency to another until he
reaches school-leaving age; then other agencies
must take over, rehabilitation workshops, county
welfare, family aid, or the courts.

But the purpose of this paper is not simply to de-
plore the use of diagnostic labels. Rather, the
purpose is to describe a way of thinking about
learning and emotionality which may lead to edu-
cational techniques for improving both school
achievement and mental health. Three brief reports
of reading clinic clients will provide illustra-
tions of the therapeutic process. An analysis
of these in terms of skill therapy will then be
evaluated.

CASE REPORTS
Consider the following referrals:

1. Alicia, aged 10, Stanford Binet IQ, 60, 69,
62; "special room" (retarded) placement for two
years; she is "severely disturbed" according to
her teacher, who also reports that she is highly
distractible. She has made no apparent academic
gains, and when given a reading test, she failed
to report any words. Tests of auditory and visual
memory, visual discrimination, closure and visual
alternation revealed a primitive condition, per-
haps a five year perceptual retardation. During
an interview, she sat close to her 11 year old
sister (also retarded) and remained immobile and
unresponsive.

Her behavior suggested a fear-related withdrawal.
The mother was asked whether the children were
mistreated by the father. She reported a history
of paternal violence.

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Treatment: Alicia was given a letter discrimina-
tion task, progr mmed so that it becomes pro-
gressively more ifficult, but in such small
increments that the learner is usually unaware
of the increase. She was hesitant, but having
started she continued at a steady (successful)·
rate until stopped. She looked disappointed at
having been stopped and was assured she could do
more at another time.

Result: She arose, skipped to her mother and be-
gan discussing the office and adjoining room with
vivacity and clarity of detail which was diffi-
cult to reconcile with her previous behavior or
with her reported intelligence. Three psycho-
metricians in attendance expressed disbelief at
the changed behavior. (This was the first step
in a treatment currently in progress.)

2. Jonas, aged 11, Stanford Binet IQ, 96, was
referred as reading retarded (low comprehension).
He had been encopretic (soiling) since age six,
shortly after his parents' divorce. His mother,
an alcoholic, had been declared an unfit mother.
He had since been in the care of his father and
paternal grandmother and later, of a stepmother.
His encopresis had not been alleviated during two
years of psychotherapy. He was a clinging, intru-
sive, "loving" (manipulating) boy. Perceptual
test results were similar to those of children who
alternate between extreme fear of persons, fol-
lowed by anger, followed by fear of the conse-
quences of their hostility, in turn followed by
anger, etc.

Treatment: During tutoring, limits were stated
and enforced consistently. Manipulative be-
haviors received a neutral response. Primary
target was comprehension, so the cloze technique
was used, with simple materials becoming pro-
gressively more complex. Gains were rapid;
increased skill was accompanied by apparent
increased confidence and brashness; encopresis

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was arrested with no recurrence. Jonas was returned
to school reading at grade level after two semes-
ters of tutoring.

3. Bob, aged 24, engineering student at the Univer-
sity; history of reading and spelling disability;
two years in Navy at rank of Chief. Bob was self-
referred after having been placed on the "home-list"
for academic failure and appealing for another
semester. He insisted that he knew his material,
even tutored other students, but panicked on exam-
inations. Furthermore, one instructor refused to
pass him until he learned to spell. His reading
skills were primitive, far below the norm limits.
He reported that he had studied spelling several
hours each day for six months while in the service.
His attempts had been unsuccessful.

Treatment: The relationship between spelling dis-
ability and tension was explained; he was assured
that he could succeed; he was then taught the
Fernald "hand-kinesthetic" procedure and required
to learn thirty words per week. As the weeks
proceeded, a long-term retention increased. He
was then given speed reading training on simple
materials and difficulty was gradually increased.

By semester's end, he read at a first year college
level. Spelling had stopped giving trouble. He
reported only one experience of panic on an hour
examination. His semes er average was slightly
above B and he was reinstated. He subsequently
completed his degree.

DISCUSSION

These youngsters were chosen for discussion
because of certain similarities. Each demon-
strates emotionality: Alicia's distractibility
and pseudo-catatonia; Jonas' clinging dependency
and manipulatory behavior; Bob's exam panic.

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Each also demonstrates symptoms in the cognitive
realm: Alicia's apparent mental retardation;
Jonas' low comprehension; Bob's spelling disabili-
ty and academic failure.

Furthermore, each responded to training in per-
ceptual skills.   I do not mean to imply that they
would not have responded also either to psycho-
therapy or to chemotherapy. It is quite possible
that they would. Choice of treatment, however,
was dictated by two considerations: First, the
immediate adjustment problem was in the education-
al realm (school achievement); second, the major
competency of the agency at which they appeared
was in educational skills.[1]

Training in perceptual skills rather than in some
other content was not entirely adventitious. It
was based on the following rationale. <u>Discrimina-
tion and Emotionality</u>: All organisms, when placed
in a novel environment, exhibit "emotional" be-
havior. That is, behaviors may be   either

---

[1]If this argument appears quixotic to those who
know the writer's prior work, the reasoning is as
follows: the human organism may be viewed as a
system, physiological, psychological, pedagogical,
etc. With adequate techniques, workers in each
discipline can facilitate adjustment of the system
to its surround. In so doing, they inevitably
change the appearance of that system to workers in
other disciplines. For example, the child treated
with Dexamil appears less neurotic and achieves
academically. The child in successful therapy has
better eating and sleeping habits and achieves
academically. The child who overcomes academic
handicaps subsequently has better eating and sleep-
ing habits and appears less neurotic. For, after
all, the child as system is unaware of scientific
discipline.

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diffuse, non-specific, even hyper-active, or they
may be catatonic: The organism may remain immobile
for a time before venturing out to explore the
environment Which kind of reaction occurs may be
species-specific, or perhaps a function of the in-
dividual organism's history, or both,

The exploratory period which follows appears to
entail discrimination of the parts of the surround-
ing environment or stimulus array, Each part of
the surround becomes an entity as a result of its
consequences: "This place is safe"; "There is
food here"; "Here is a place to sleep," In verbal
organisms, we might hear: "There is a window";
"Those are desks"; "That is where the teacher sits";
"That's a big blackboard like my little one." The
consequence, in the latter case, might be a reduc-
tion in tension, i.e,, uncertainty, each time a
part of the environment stands out and is recognized,
i.e,, named, The process described appears to
fit Skinner's term, "habituation,"

Within the educational environment, the first
discrimination task is that of habituation to the
room, the teacher, and other students, The second
task is the discrimination; recognition or naming
of letters, words, numbers, and other symbols,
Aside from its effect on self-concept, failure in
these discrimination tasks leaves the learner in
his original state of emotionality. Each time
he is faced with print, he becomes emotional, i.e.,
he has yet to learn the necessary tension-reducing
response. In brief, he has not discriminated
the parts of the array. He may, in fact, find
that looking away from the page to familiar
objects is tension-reducing, and thus learn to
withdraw from print,

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If such is the case, discrimination of letters,
words, and, later, sentences and longer units,.
would appear to be the principal "content" of
therapy for children with reading problems. A
mental health point of view suggests, then, that
emotionality be reduced so that discriminative
learning can take place. The skill therapy point
of view requires that discriminative learning
take place so that emotionality can be reduced.

Analytic Theory:
Let's look at the thoughts of personologists on
the need for and the contents of therapy. Most
assume some positive force toward growth, a life-
instinct (4, p. 132), or more commonly, self-
actualization (2, 5, 7). A counter-force is pro-
vided by the environment (2, 5) usually interpreted
in terms of social demands (1, 3, 8, 9). Anxiety
is thought to result from an abrupt change in the
balance between force and counter-force, in which
the environmental force threatens to immolate the
ego (5, 6, 7). The result, according to Lewin,
is a "tendency toward encapsulation and an in-
crease in the rigidity of tension - system boun-
daries". (6, p. 110)

Psychotherapy is required when a state of anxiety
persists. Its persistence is thought to result
from early learning occurring in the parent-
child relationship, so that all later interpersonal
relationships are affected. Presumably, then,
the "contents" of therapy should be interpersonal
transactions. But, according to Rank, the specif-
ic contents are of negligible importance:

> "This release from an overcome
> piece of one's own past, no matter
> in what content it is incorporated,
> represents the authentic therapeutic
> task and the meaning of every ex-
> perience."
> (8, p. 72)

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Whether or not "released from th past" required
resolution of early traumas appears to be the criti-
cal question Such a resolution seems to be an
impossible goal if viewed as a "working through" of
the original problem as in analytic theory. Rather
the aim should be to keep the learner's perception
of the present from being contaminated by generali-
zations no longer relevant. To accomplish this aim,
skill therapy emphasizes discrimination of the pres-
ent as a new situation, different from the past,
rather than improved discrimination of factors in-
volved in previously experienced problems. Thus,
any means for facilitating learning might be con-
ceived as therapeutic. Relationship therapy, which
facilitates social learning, is one such means.
Skill therapy, which facilitates academic learning,
may well be another.

Donald E. P. Smith

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TECHNIQUE: THE INTENSIVE WORKSHOP

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The attempts to teach study skills in reading effi-
ciency classes very often fails. Self-defeating
habits persist and the desired skills are not de-
veloped. The same result often occurs when indi-
vidual tutoring is undertaken; One reason for our
failure may be inadequate feed-back to the student,
If he is unaware of specific self-defeating behav-
iors, he will be unable to replace them. There-
fore, we planned a study session which would allow
skills counselors to observe the learner and to
"reflect" his behavior.

An intensive one day session might bring about a
change in behavior superior to that of spaced in-
struction, particularly if conditions approximating
a classroom situation could be created. The plan
was to present two capsule "courses" to the stu-
dents. During the first "course," study behaviors
would be observed and "reflected." Then, skills
necessary for effective performance would be pre-
sented prior to the second "course." The "courses"
would consist of useful information on the learn-
ing process. (See appendix for plan.)

The objective was to bring about necessary changes
in behavior so that failing and near-failing stu-
dents could achieve academic success. Ten staff
members participated.

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SUBJECTS:

Students involved were three males and seven fe-
males referred by academic counselors after term
examinations. Eight were on academic probation.
Seven had had a grade point average of less than
2.0 (based on a 4.0 scale) for the preceding sem-
ester. Included in the group were five freshmen,
three sophomores, and two juniors. Participants
were required to registe at the Reading Clinic
prior to the workshop and to pay a three dollar
fee for expenses (materials and food). Partici-
pants were also informed that they must report to
the clinic before 7 a.m. on a particular Saturday
morning and that they would be released by 5 p.m.

PROCEDURE: (see appendix)

A rigid time schedule was followed; an alarm clock
served as a reminder of limits. The day began with
diagnostic testing of reading proficiency (Diagnos-
tic Reading Test, Form A). Brief introductory re-
marks concerned the reasons for the participants'
presence (academic failure), objectives of the work-
shop (academic success through effective study tech-
niques), common motivational problems (concern about
home or self, anger towards parents), and probable
reasons for failure (lack of skill to make effect-
tive use of known ability). Students were also
told that if they were confused at any time the
fault was that of the staff. The solution was to
let us know about the confusion so the problem
could be clarified.

First Course:

Brief instruction was given in the techniques of
surveying and skimming. Students proceeded with
the "course" relying on whatever skills and

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procedures they employed in the learning process,
The initial instruction was designed to give them
a speed set in doing the assigned readings, After
a pre-reading they heard a fifteen minute lecture
and carried out a post-reading, Then they prepared
for an exam, The staff was silent during this pro-
cedure Each member observed two students and
made notes on self-defeating habits and useful tech-
niques After the examination, the "charge" was
made Effective and ineffective habits common to
several students were pointed out, What was good
was stressed; what was detrimental was severely
challenged, Students participated in this discus-
sion and defended or explained why they employed
the techniques they did,

Instruction:

Following a recuperative break, intensive instruc-
tion began, Individual staff members presented
skill training within their particular competence,
The rest of the staff interrupted, elucidated,
raised questions of their own, and suggested alter-
native approaches, The result was an interaction
of staff and students seeking answers, During the
training exercises, staff circulated among students
answering questions, observing progress, suggesting
approaches, and insuring that instructional exer-
cises were being carried out properly.

Second Course:

The design here was to follow instruction with ap-
plication, Thus, the pre-reading assignment fol-
lowed the presentation of study techniques employed
in textbook reading. During the pre-reading, staff
circulated among the students checking their prog-
ress and helping the students in their note-taking
and organization. For the balance of the course

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the students were on their own to process and or-
ganize material in their own way. After the exam
a post-mortem was held on examination problems.
The examination was corrected immediately and re-
turned to the students. Evaluation of their own
progress was done by comparing scores on the Course
1 and Course 2 examinations.

Instruction:

Exam-taking techniques were now presented followed
by instruction in time scheduling. Each student
set up a time schedule for the following week. Rec-
reation hours were included with a very strong ad-
monition that they be adhered to. Finally, appoint-
ments were made with individual staff members for
the following week. These sessions were held to go
over problems encountered in applying techniques
and to answer questions concerning particular sub-
ject matter areas.

Follow-up Session:

A two-hour meeting was held on the following Satur-
day. While the first meeting had been entirely
directive, this was non-directive. The students
responded well. There was excitement, anger, a num-
ber of insights, and an air of optimism. One young
woman discovered and verbalized her subtle limits--
testing, a kind of academic "brinkmanship" which
accounted for her borderline standing. Another
raged at the academic system, and followed it by
four counseling sessions during which she discovered
that her displaced anger originated from her symbi-
otic role. Others simply reported increased confi-
dence. To what extent "halo" was operating we did
not determine. Our concern was strictly confined to

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the academic success of these ten students.

RESULTS:

Mean grade point averages (GPA) are reported for
both overall standing and for the semester during
which the workshop took place. "Pre" indicates
averages at the end of the fall semester. "Post"
indicates average computed at the end of the
spring semester. The workshop took place during the
third week of the spring semester. Averages are
reported on the basis of a 4.0 scale.

Period			GPA (mean)	
	N	Pre	Post	Gain
Semester	10	1.61	2.19	+.58
Overall	10	1.70	1.89	+.19

Period	GPA (range)		Total Class Hrs.	
	Low	High	Pre	Post
Semester	-.26	+2.01	155	154
Overall	-.13	+1.53	399	553

DISCUSSION:

Nine of the ten students involved raised their aver-
ages sufficiently to remain in school. The tenth,

a freshman, came to us with a GPA of .93. At the

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end of the spring semester she had a GPA of .67
and an overall average of .80. She informed us
that she had been commuting 60 miles by bus the
week previous to the workshop since her father had
been in an automobile accident. She arrived in
Ann Arbor at 4 a.m. the morning of the workshop,
walked 2 miles to the reading clinic, and waited
for someone to appear. Despite this, achievement
during the workshop was significant (she showed
the highest gain in performance as measured by the
difference between Course 1 and Course 2). She
failed to keep four subsequent appointments with
her counselor.

Of the remaining nine students, one did not return
to school the following fall. Curiously, this
sophomore male made the most significant gains.
His change in semester GPA was +2.01 (1.07→3.08),
and he was one of two persons who removed them-
selves from probation on the basis of overall
record (1.69→2.00). Of interest is his comment
made at the follow-up group session: "My life has
been altered; it's difficult to explain." Perhaps
there was more therapeutic value involved in this
skill therapy then we have recognized. Along this
line, another student presently seeing her counselor
has suddenly recognized her anger towards her par-
ents. Her present plans include dropping out of
school, seeking a job, and becoming self-support-
ing. Her grades are adequate.

One other student showed no significant change. A
sophomore, he suffered a loss in GPA of .12 for the
two semesters. His overall GPA dropped .01 points
and he remains in school. It is possible that the
real effect of the workshop, if any, may not mater-
ialize for a time. One example of this is a fresh-
man girl. She attended the workshop with a GPA of

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1,47. At the end of the spring semester she had a
GPA of 2.00 and an overall average of 1 74 She
enrolled in summer school and compiled a GPA of
2,71, raising her overall average to 1 92.

Of the total of ten students, only one failed to
raise or maintain his average sufficiently to re-
main in school Six of the seven students with pre-
vious semester averages below 2,0 raised them to
or above the 2,0 level. Two of the eight on aca-
demic probation removed themselves completely from
that status, and two of the ten students failed to
show any appreciable gain in GPA,

IMPLICATIONS:

This academic "shock treatment" cannot be evalu-
ated with precision. It was designed to try out
an idea; that an intensive learning experience, one
designed to drive the student to exhaustion, would,
if completely task-oriented with maximum feedback
provisions, have an appreciable effect on the stu-
dents. It seems to have done so. Perhaps other
procedures would have a like effect,

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APPENDIX

7:00 Diagnostic Testing
7:30 Orientation
7:45 Surveying and Skimming

8:15 1. Pre—Reading Assignment
          "Frustration As a Factor In Behavior,"
            Norman R. F. Maier,
          Psychology in Industry, Chap. 4
          "Anxiety," D. E. P. Smith (unpubl. paper)

8:25 2. Lecture
          "Emotional Components of Reading, Learn-
            ing, and Remembering"

8:40 3. Post-reading Assignment
          "Habit," W. James, The Principles of
            Psychology, Chap. IV
          "How to Concentrate," Ruth Strang, Study
            Type of Reading Exercises, College Lev-
            el, Chap. 12
8:50 4. Review
8:55 5. Exam
9:05 The "Charge":
          (Self defeating habits observed by staff)

9:30 BREAK

9:50 Learning From Textbooks
      SQ4R (an adaptation of SQ4R as presented in
      Smith, et. al. Learning to Learn)

10:50 1. Pre-reading Assignment
          "Word Power As Concept Formation" (Smith,
          et. al., Learning to Learn, Chap. 11)

11:00 LUNCH

11:30 To Learn From a Lecture
      Smith, D. E. P., A Mathematical Program
      (Experimental)

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APPENDIX (continued)

12:30 Integration: SQ4R, Note-taking, and Exams

12:50 2, Lecture
           "Organizing and Memorizing"
 1:15 3, Post-reading Assignment
           "The Development of Concepts" (a selec-
           tion from Kingsley and Garry, The Nature
           and Conditions of Learning)
 1:25 4, Review
 1:35 5, Exam

 1:45 BREAK
 2:00 Taking Exams
 2:20 Time Scheduling
       Assignment to Counselors
 3:00 Prepare Time Schedule
       Individual Problems

 4:00 DISMISS

TASK ANALYSIS - THE CRUX OF PROGRAMMING

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Task analysis is, I'm quite sure,.the crux of
programming, I'd like to begin a definition of
task analysis by giving some examples of things
that are similar to it,

Task analysis has much in common with writing
an outline before writing a paper, It has much
in common with writing the final examination for
a course first, then outlining the course to teach
the material required by the test, It has much
in common with preparing lesson plans,

Task analysis differs from these activities: it
is more systematic and more detailed. It differs
in another very important respect: when carrying
out a task analysis, one always and at every
point asks, "Why am I teaching that?" If someone
says, "I want to teach algebra," the task analyst
asks, "Why?" "What is the end, the goal? Can
you get there without algebra or can you get there
more efficiently with less algebra or by some
other means?" If someone says, "I want to teach
students atomic weights and numbers," the task
analyst asks, "Why?" "Why do students need them?
Wouldn't it be more efficient, and, indeed, more
accurate to look them up in a reference manual
when they're needed?" We always ask, "Why?"

It's a little frightening how frequently the
only reason we can dredge up to justify teaching a
content is that someone taught it to us, or that
everyone else is teaching it, A careful task an-
alysis would probably show that most of the so-
called "information explosion" is just a dust
cloud being carried by the wind in the lecture hall,

Dale M, Brethower

One way of illustrating the importance of task
analysis is to explore its relationship to task
synthesis--to instructional programs which are the
vehicles of synthesis in an instructional system.
A few years ago, Dr. Bekesy received the Nobel
Prize for his research in the area of hearing. He
was asked why he thought he received the prize, He
said, in effect, "You stay in your laboratory and
you do your research and, after a while, they give
you the prize," This is a simple technique but it
doesn't work for everyone, so we question further,
When asked what he does in the laboratory, his re-
ply is somewhat more informative, "First you make
the analysis, then you make the synthesis." When
I heard Dr, Bekesy say that I must confess I didn't
understand its import,

I understood the import somewhat better when Dr,
G, A. Miller explained his interest in construct-
ing a voice-operated typewriter, Dr. Miller's main
interest at that time was in speech perception, not
in engineering or manufacturing. He explained it
this way: in order to build an electronic device
which "understands" speech, you have to analyze--
speech carefully. And you have a very good check
on the quality of your analysis if you try to use
the results of the analysis to build a device which
perceives speech. The test of the analysis is in the
adequacy of the synthesis, Whether the synthesis
is by means of a machine which types or a machine
which talks is of lesser importance. The crucial
thing is in the interplay between analysis and syn-
thesis as a device for furthering research objec-
tiv s.

The same interplay is crucial in furthering ed-
ucational objectives we are continually re-
discovering in working with programmed instruction.
One of the frightening things about programmed
instruction is that, with a fair-to-middling pro-
gram, students are quite likely to learn what's in
it, It gives you pause, Maybe you'd better an-
alyze further to make sure that what you are
teaching is accurate and worthwhile.   But be   of

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good cheer. You can now check some of your assump-
tions about what is important. If your synthesis
is adequate, you can determine whether your stu-
dents are changed in ways that you want them to be
changed. If they're not, you can re-analyze and,
with a better analysis, come closer to your edu-
cational objective.

To summarize, task analysis is a set of techniques
for doing the planning that you've all thought
should be done in the development of courses.
Coupled with the program, the vehicle of synthesis,
it affords a check on the quality of an analysis
and even on the value of one's educational goals.
Task analysis, then, is a set of techniques for
setting goals and for discovering what is neces-
sary to achieve them. Furthermore, the techniques
of analysis and of programming are becoming re-
fined enough so that one can learn them and apply
them. Thus, one can receive enough reinforcement
to continue doing very critical, exhaustive and
exhausting analysis.

Now let me talk with you about a sample task anal-
ysis for a Reading Service such as the one at the
University of Michigan.

Let's start by asking, "Why?" "Why have a reading
service at all?" Perhaps it's to help produce
successful students. That's a desirable goal.
"What's a successful student?" Let's say it's an
undergraduate who, upon graduation, can enter the
graduate school or job of his choice, providing
that the choice is for one of the best schools or
jobs. Let's also say that we want many of those
who go on to graduate school to go there on one
of the major fellowships available, such as the
National Science Foundation, Woodrow Wilson, Rhodes
or Danforth fellowships.

In doing a task analysis, one needs to find his
own goals, whatever they may be, and to use them
to guide his efforts. They serve, so to speak, as
one's personal Occam's razor. Does some activity

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serve to get you closer to your goal? No?   Then
out it goes! Discovering that some of your pet
notions are irrelevant to your goal is perhaps even
more painful than finding that your favorite cold
remedy doesn't really work.

Let's adopt as our criterion of success the goal
of getting more people into good graduate schools
(or jobs) and having more students get fellowships.
Now, let's determine the criteria which admissions
committees and fellowship committees use in making
their decisions: grades; types of courses; scores
on exams like the Graduate Record Exam, the Miller
Analogies Test, etc.; information on the applica-
tion form; letters of recommendation; the reputa-
tion of the school; and probably some others I
haven't thought of. We'd have to do some investi-
gating to find out exactly what criteria are used.
Task analysis gets one out of the arm chair.

We now have our goal and we have the criteria.
How do we fulfill the criteria? When we find out
what patterns of courses are needed, we might
cooperate with the counseling service (or set one
up) to help get the students into the right courses
and to let them know about fellowships, entrance
requirements, etc.

Next are the letters of recommendation and the
application forms. Let's find out what committees
look for in these documents and prepare a brief
self-instructional course which the applicant can
use in filling out the application. Let's prepare
another for people who write the letters. Maybe
we could consult with counseling and guidance on
this, i.e., lead them into doing much of the work.

The reputation of the school? We'll probably have
to take it as it is. But let's make the most of
what we have by making sure our students take
courses from some of the highly respected individ-
uals on the faculty. However, if we do our work
well, the reputation will grow.

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Grades and exams? Now we seem to be in an area in
which a reading service is more at home. What are
our goals? Let's agree that the goal is the pro-
duction of students who study efficiently and who
get high grades. You know why high grades are an
important goal, but, as long as they get good
grades, why is it important to us that students
study efficiently? Part of the answer is that we
are attempting to build our school's reputation
and to get our students into the best graduate
schools. We want them to be able to survive when
they get there. Let me foreshadow the rest of
the analysis a bit to give you another part of the
answer. We want them to study efficiently so that
they will have time to get good grades and to get
an education. We all know that you can have one
without the other. You can get a good education
and poor grades. You can get good grades and a
poor education. Our present goal is to see that
students get good grades. We'll concentrate on
that. However, we'll try to achieve it as effi-
ciently as possible without subverting our stu-
dent's goal of getting an education. In so doing,
we may be able to give them more time to do it.
We'll call the course we are going to develop by
the descriptive title "coursemanship" or "How to
Get Good Grades Efficiently".

What are the criteria for course grades? Perfor-
mance on tests, projects, discussions and papers
are some of them. Let's take a look at testman-
ship. What is the most efficient way of getting
good grades on a test? Get the questions and answers
in advance and learn the answers. Well where do
the instructors get the questions? They find them
by thumbing through the textbook and their lecture
notes trying to formulate questions. Why don't we
teach our students to do that? If they're going
to be asking questions, the questions should be
good ones. What are the criteria for good ques-
tions? Three major criteria come to mind: 1) It
must cover a crucial aspect of the subject matter;
2) it must require integration of large amounts of

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the subject matter, and 3) it must be one the in-
structor is likely to ask, After we've taught
cur students to ask questions satisfying one or
more of these criteria, we need to teach them to
find good answers to them, Armed with good answers
to the questions, they should have little reason
to fear an exam.

What are the criteria for good answers?   Again
three come to mind: 1) completeness; 2) accuracy;
and 3) conformity to the bias of the textbook and/or
the instructor, I grant that the application of
one of the criteria for questions--the one the
instructor is likely to ask--is going to result in
the student's asking some questions which appear
useless as judged by the criteria of importance
and integration, And they'll have to do some vi-
olence to the subject matter in writing answers
in conformity with instructor and text bias, But
success smells sweet and our techniques of task
analysis force us to take the world as we find it,
not as we wish it were, Fortunately, in order
to know what a good question is, a student must
know what a bad one is, To separate fact from
fiction and emphasis from inhibiting bias,. the
student must see examples of both, So, in teach-
ing our student to apply the criteria, we are merely
teaching him a useful skill, We are not leading
him astray.

But I am straying, The student needs to predict
questions and to be able to write good answers.
How can he tell when he has predicted enough and
answered enough? That is, how can he tell when he
is adequately prepared? Here we are as close to
synthesis as the student usually gets. He will
have arrived at several principles or general con-
cepts in answering the questions, His criterion
now is, do these principles relate to one another
and do they organize all the facts? If not, is it
because the principles are inadequate? If they do
organize all the facts, can he synthesize, can he
use them to generate new examples and to predict
new facts? And can he classify all the examples

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using the principles he has developed? For example,
if his sociology instructor makes a distinction
between a group and an organization, can he produce
an example of an organization which is not a group?
Of a group which is not an organization? Of both
a group and an organization? Of neither?

These are checks on completeness. If a student
were to apply them thoroughly, he would probably
be in a better position to assess accuracy than are
most of his instructors If he is working with
inaccuracies, he ll never attain completeness

The student's task, then, is to predict questions,
to organize information, and to write nswers.
What are the sources of information a ailable to
the student undertaking this task? Lectures and
class discussion comprise information coming in
mostly through his ears; the printed page-- lec-
ture notes, reading assignments, etc --comprise
information coming in mostly through the eyes. Now
we are in more familiar territory--the printed
page, But notice how long it has taken us to get
there. Our task analysis has led us to seek an-
swers to some more basic questions about why we
want to get information from the page in the first
place, what sort of information we want, and what
to do with it once we ve gotten it. Rather than
our more usual tendency to start our analysis
with the printed page, and to view reading as a
task of absorbing everything on the page, we view
reading as a task of asking questions, finding
answers, and organizing information

To summarize, in task analysis we determine where
we want to go and why--always why Then we start
working backwards from that goal to find an effi-
cient way of getting there We do what we have
to, even if it means getting out of our arm chair,
even if it means we have to cooperate with new
people and to tackle new problems We keep set-
ting up criteria whereby we and our students can
measure progress. We keep looking for better
criteria and better ways of fulfilling them

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Think for a moment of the impact an effective course
in coursemanship would have on your university.
First of all, some of the faculty would be upset if
they heard about it--as they eventually would. They
would feel that it was merely a course in beating
the system. They'd be right. However, it contains
some skills that would be extremely useful to the
students in getting an education, skills that would
have positive merit such as detecting biases, un-
supported facts, and the like.

Coursemanship techniques are of value in beating
a system. If tests can be beaten by testmanship,
let's do the testmakers a favor and provide stu-
dents who can do it. Then the testmakers can
develop better tests. If courses can be beaten by
coursemanship, let's provide students who can do
it so the instructors can find the weaknesses in
their courses and correct them. If instructors
were to do adequate task analyses of their courses
and to teach them well (or provide good instruc-
tional materials), much of a course in courseman-
ship would be obsolescent. The self-same techniques
would be techniques of achieving the goals of an
adequate system instead of being, as they are now,
techniques of beating an inadequate system.

STRUCTURE OF A PROGRAM FOR
COLLEGE COMPOSITION

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Writing an essay has much in common with design-
ing a cross-word puzzle. Drawing such an analogy
reveals the architectural nature of the writer's
task. He must construct an inter-related frame-
work from a limited repertory of words, concepts
and experiences. Apart from the extent and nature
of the materials, the measure of a puzzle's worth
is not its size. Rather, it is the frequency and
extent of its "overlap", i.e., the degree to which
the puzzler avoids "blacked-out" spots by substi-
tuting integrated content. The writer's task, as
puzzle-maker, consists of constructing a cloze
exercise. The framework which determines the cloze
response is mainly one of logical and rhetorical
form, i.e., the "grid", within whose constraints
the writer defines his thoughts.

The program for college composition teaches the
basic forms of logic and rhetoric by providing var-
ied examples of writing. Each sequence contains
examples of a common sort. As a sequence progresses,
each example is rendered less complete, requiring
the student to create any parts necessary for its
completion. Little by little, the example is re-
moved while, piece by piece, the student restores
it to completeness, until finally the student him-
self invents the entire example. To replace the
missing parts of any given complex, the student
first learns to recognize the genuine complex
among imposters by comparing them with a model.
The student learns to produce the parts of any com-
plex by selecting from two alternatives (one cor-
rect, the other almost correct) the one part needed
to complete an unfinished model. Subsequently,
the student invents the required completions, then
the entire complex.

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The following pages will give part of the program
structure, with a few examples taken out of the
many kinds included in the complete program.

I. ORIENTATION TO WRITING

Technique: Discrimination and cloze exercises.

Given: Context and choices.

Behavior: Choose the word which yields the
            more precise message.

Example:

                    involvement
In my past   in training
              experience
dogs, I have discovered a certain
relationship between the dog and

    companion.
its

    trainer.

Terminal
Behavior: Given imprecise or illogical sen-
            tences or paragraphs, student will
            rewrite correctly.

II. CRGANIZATION

Structure of a syllogism (a paragraph requiring
three interrelated definitions).

Technique: Cloze exercises on the logical rel-
            evance of a word or term.

Given: A three-part deductive form and
            choices for completion.

Behavior: 1) Determine which of two terms
            represents the more general class;
            2) determine correct sequence of
            terms; 3) discriminate relevant
            terms; 4) reverse sequence to write
            a three term essay. In the follow-

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> ing example of (3), (discriminate rel-
> evant terms from irrelevant terms)
> "relevance" is defined as "validity".

Example: (3)
> Circle the valid third term defini-
> tion of Jack.
> 1) Some animals have fleas.
> 2) Jack is an animal.
> 3) Therefore, Jack is-
>   A. -one who sometimes has fleas.
>   B. -one who could have fleas.

Example: (4)
> Reverse the order of the three terms
> above in writing them below,
>   Jack is one who could have fleas,
>   2) because_____
>   1) and _____

III.   DEFINITION

The paragraph viewed as an analogy requiring def-
initions, The definitions will reveal the similar
and dissimilar characteristics of two things.

Technique: Discrimination task in selecting sim-
             ilar parts from various complexes,.

Given: Things and characteristics of things.

Behavior: Analyze by asking check-list of
             questions demanding a number of defi-
             nitions; discover similar and dis-
             similar components of things,

Example: III_1
> In its overall performance, which
> one (A or B) would probably function
> most like the model?
>
>   Model
>
>   E F G
>   A.   H I J   B.
>   D E F G   A B C
>   H I J K   D

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Example: III$_2$

> To best describe a truck to someone
> from a backward country who has
> never seen one, which (A or B) would
> you choose?
>
>   A.   B.
> A donkey-cart   A hay wagon

Terminal
Behavior: Given the name of a thing, the stu-
            dent will provide names of things
            which possess similar characteris-
            tics.

IV.   PROOFS

A。 BY CONGRUITY

Demonstrating the congruity of a statement about
a thing with the characteristics of the thing it-
self.

  Technique: Discrimination task in determining
              structural and functional implica-
              tions of statements about things;
              cloze exercise in relating function
              to structure.

  Given: A list of random thoughts about
              things (characteristics in sentence
              form), and choices among statements
              about the same things.

  Behavior: Justify a statement about a thing
              by listing the relevant character-
              istics of that thing.

  Example: Ambitious, cruel dictators through-
              out history have attempted to sup-
              press open disagreement with their
              policies.

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My new teacher is:

    1. cruel
    2. ambitious
    3. dictatorial
    therefore:

       A.   B.
He probably will- He probably will
                       not-

-attempt to suppress open disagree-
ment with his policies.

Complete the Essay

My new teacher will probably attempt
to _____ because he
is _____, _____ and
_____ and throughout his-
tory _____
_____.

Example: Which thing (A or B) would probably
function like the model?

               __Model__
          Characteristics:
            1. porcelain
            2. color: blue
            3. small handle
            4 water-tight
            5. cylinder, closed
               at one end

A.	B.
1. plastic	1. porcelain
2. color: red	2. color: blue
3. small handle	3. small handle
4. water-tight	4. extremely porous
5. cylinder, closed at one end	5. cylinder, closed at one end

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Complete the Essay

_____ should probably func-
tion like the model because they share
the essential characteristics of
_____, while _____
_____, on the other hand, lacks
the property of _____.

Terminal
Behavior: Given a statement about a thing,
            the student will produce those char-
            acteristics which would justify its
            membership in a class.

B. BY ANALOGY

Describing an unknown in terms of a known, with an
evaluation of their points of difference.

 Technique: Cloze exercise in selection of rele-
             vant characteristics.

 Given: Statements implying similarity be-
             tween things and lists of their
             characteristics.

 Behavior: Determine which characteristics
             are relevant in establishing a given
             basis of similarity.

 Example: While tool X is not a hammer, it has:

                1. A steel head
                2. A flat face
                3. A wooden handle
                4. A similar size

         A.   B.
so it would probably   so it would probably not
function as a hammer.   function as a hammer.

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Complete the Essay

While tool X is not a hammer, it
has, (1)_____ (2)_____
_____ (3)_____ (4)_____
_____ and the characteristics
essential to a hammer's function
are_____ _____
_____

Example: Choose with (A or B) in the middle
           term.

           1) All people having characteris-

               tics A B C are good fellows,
                     D E F

           2) Jack has-   A.   B.
                            A B C   A B C
                            G H I   D E F

           3) therefore, Jack is a good fellow,
                   Reverse the order and write
                   a three term essay,

Terminal
Behavior: Given a thing and a statement about
           it implying a cause and effect   re-
           lationship, the student will:
           1) analyze characteristics of the
               given thing;
           2) find a second thing with similar
               characteristics;
           3) specify the basis of similarity
               and inter-action relevant to
               the statement, then draw a con-
               clusion about the probability of
               or the degree to which the state-
               ment is justified.

V. SUPPORTING THE ASSERTION

Demonstrating similarities between general state-

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ments and specific statements.

Technique: Cloze exercise in composing an argu-
ment from a list of statements.

Given: Assertions and list of relevant and
irrelevant thoughts.

Beh ⸱ior: Select those thoughts relevant to
proving the assertion correct.

Example: Thoughts on Drug Addiction:

1. law enforcement lowers supply
2. hence drives selling price up
3. so makes running risks more
profitable
4. and success of avoiding law
increases
5. thus increasing expenditures
by law
6. which in turn are rendered
ineffective by counter-measures
7. drains police resources
8. to make illegal business unprof-
itable, another source needed
9. but physicians couldn't handle
discreetly
10. addicts will want increasingly
larger doses
11. and can supplement prescription
from illegal market
12. most addicts wouldn't go to
a doctor
13. addicts are afraid of discovery
14. administering drug program drains
medical manpower
15. ease of availability will in-
crease addiction
16. legal prescription would be con-
doning an immoral practice

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Which assertion would all the
thoughts support?

A.   B.
No single step   Addiction can b, controlled
will resolve the   by increased law enforce-
problem.   ment and prescription prac-
                      tices,

Which thoughts support the follow-
ing assertions?

_____1, Increased law enforcement
         can remove illegal drug
         traffic.
_____2, Doctors could control the
         addiction increase.
_____3, Increased law enforcement
         cannot reduce traffic.
_____4, Management of drug addiction
         will be costly.

Terminal
Behavior: Given an assertion, the student will
           list thoughts supporting it.

VI.   ORDERING

Working from uncertainty towards certainty, ex-
plaining the unfamiliar in terms of the familiar,
Fulfilling the promises of an assertion.

Technique: Discrimination task in placing
            thoughts in correct relative
            sequence,

Given·   A prescription for ordering; exam-
            ples of prescribed order; partially
            completed examples and choices for
            insertion,

Behavior: Identify the prescription and the
            model essay; select correct inserts
            offered to complete essays; invent
            inserts for incomplete essays,

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Example: 1   Rhetorical Form

The reader will ask the following questions:	Answer the reader's questions with:
a) What are you about to do?	a) Assertion
b) What do you mean?	b) Definition
c) How do you know?	c) Examples
d) So what?	d) Conclusions

Example: 2

Steps of Definitional and Logical Form

1. (assertion) A statement which one intends to prove true.

2. (nominal definition) Classify all key words of assertion.

3. (descriptive definition) Describe characteristics of key words.

4. (examples) Illustrate general assertion by listing specific instances of it.

5. (conclusions) Restate assertion, this time in terms of the specific examples in step #4.

Number each sentence according to the step it illustrates.

An Essay

Every individual is prejudiced toward some thing in his environment. Prejudice is a mental leaning in favor of, or against, something. It is displayed when a person judges a class with an unwillingness to make exceptions within the class. A mental leaning can have widespread repercussions as in the integration issue, or almost none at all, as in the form of a mere bias towards dachshunds. The dachshund's proportions make him appear awkward. His short,

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stubby legs do not look long enough to support his
body. His sausage shape invokes associations with
"hot dogs" or "wieners", thereby winning the scorn
of even the most well-meaning person, who will-
ingly jokes about his appearance, while ignoring
the many other qualities by which the dachshund
might endear himself to man.

FINDING ANSWERS BY READING

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From the administrative aspect of my job, I suffered
an irritation every time I was faced with the in-
efficient use of our live staff. I have also
observed students in a class patiently waiting for
the instruction to catch up with what they needed,
while other students weren't even started. In
other words, the classic problem, individualized
instruction, stimulated the current interest in
programmed instruction at our Center.

The immediately useful step to take was to follow
the lead of other centers by making available to
students an index of materials offering various
kinds of practice so that work could begin that
was directly applicable to individual needs. How-
ever, when examining the materials closely from
the viewpoint of <u>independent</u> study, we found that
they simply were not adequate for many of our stu-
dents, particularly in the area of techniques for
finding answers. The complaint was that the dis-
cussion and suggested procedures made sense to
someone who already possessed some degree of skill
in finding answers but were not sufficiently
specific to the student who needed to start from
scratch, that is, the student who had no concept
of how to locate and read only relevant material.
There was too much talk <u>about</u> techniques for find-
ing answers and not nearly enough talk specifying
what to do in order to find them. Perhaps the
fault lies in the practical commercial limits one
book can have. In contrast, the range and control
provided by a program can permit a student to
learn and practice in a non-risk situation and
then transfer the technique to reading where the
grades count.

A brief quotation belongs here to illustrate the
basis on which we can teach how to find answers
by reading. Although this passage is directed to

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personality maladjustment, the terms used--be-
fuddlement, conflict, inefficiency, and unhappi-
ness--describe these students who need specific
instruction, not just general talk. The quota-
tion is from Wendell Johnson (1964) and reads:

> "What the maladjusted person cannot do--
> and what he must learn to do--is to
> specify the sort of answers he needs. This
> is a way of saying that he has a con-
> spicuous lack of ability to ask ques-
> tions in such a way as to obtain answers
> that would be relaxing, or satisfying,
> or adjustive. As soon as he develops
> such ability, he can take care of him-
> self for all practical purposes.
>
> There cannot be a precise answer to a
> vague question. The terminology of the
> question determines the terminology of
> the answer. Scarcely any other prin-
> ciple is more important in relation to
> a consideration of the befuddlement and
> conflict that make for personal ineffi-
> ciency and unhappiness."

But where to begin? The starting point to find-
ing an answer is to have a question which is in
answerable form. Therefore, assume that an an-
swerable question is available, what then is the
process for quickly and accurately finding an
answer? Rather than trying to identify what the
unsuccessful students could or could not do, we
turned attention to trying to establish the
successful model so that imitative learning
could occur.

"What is in this article?" is a kind of question
requiring attention to the clues which permit a
statement as to the content covered. These clues
are distributed throughout the material and can
be identified by location, such as a table of
contents, or by physical distinctness, such as
topic headings or illustrations. Once located,

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the content of the clues can then be comprehended.
A useful analogy is a radar screen. The question
"What is there?" requires searching the entire
range, then attending to whatever appears

In contrast to the question requiring a search of
the entire range is the question requiring an
answer contained within relatively narrow limits
of the content and indicates a different strategy.
Attention is given to an entirely different set
of clues, those that will locate the limits within
which one can find the answer.

A useful question in this instance is "Where is
it?" Attention is now directed toward clues which
will identify what is going on but the reader does
not yet comprehend content. Not until the correct
location is reached does comprehension begin.   The
distinction between identification and comprehen-
sion must be made explicit for students who have
not made such a distinction for themselves.

This breakdown into two distinct steps is nec-
essary for training purposes. Data from explor-
atory studies failed to show a high correlation
between skimming or selective reading and compre-
hension. In an extensive and intensive analysis
of the nature of skimming, Grayum (1952) showed
that a high score in total reading ability did
not assure the ability to skim. A student may
have a grasp of the technique but forever come
up with incorrect answers through poor comprehen-
sion, contrasted with the student who comprehends
at an adequate level but who holds no concept of
an appropriate strategy.

This strategy takes the general form:

   1.   Select a key word from the question,
        that is, the sort of answer the question
        requires.

   2.   Select a second word which will serve
        as a reference point for the correct

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location.

3. Identify what is going on in order to
    know when you are near the location if
    material is longer than a few paragraphs.
    In the case of short-length material,
    look for the key word and reference word.

4. When the location is found, read for
    comprehension of content.

5. Read just beyond to verify that all of
    the answer has been included, if more
    than a name or figure.

Going through the motions of the procedure is easy
enough; the difficulty, of course, lies in attend-
ing to the correct clues, that is, the smallest
clue with the biggest pay-off. The fullest use
is made of a small amount of information.

Instruction is planned from simple to complex use
of each step of the strategy with periodic review
and combining the steps to perform the entire task.

Step 1 states, "Select a key word from the ques-
tion, that is, the sort of answer the question re-
quires." Training in specifying the sort of answer
is a proper starting point. Questions which call
for specific short answers and which contain inter-
rogative pronouns, adjectives, or adverbs consti-
tute a simple first stage. For example, "Who?
Where? At what time? In what place? By what
amount?"

Consider a question of this type: "In what part
of the brain does CO_2 affect respiration?"   The
sort of answer required is the name of a part of
the brain. Our successful model indicates that
"what part" is the clue attended to, that is, the
interrogative, and the attraction of the symbol
CO_2 is ignored. Physical distinctness of print,
such as a name, figure or italics, is useful when
such items constitute the correct clue but they
can be powerful distractors to the reader who does

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not have a strategy under control. Magicians certainly appreciate the power of attractive distractors, but the person who knows where to look comprehends the trick.

Training in recognizing the sort of answer required can progress to a question such as "What was the pattern of events leading up to the decision?" The successful model indicates using the smallest clue with the biggest pay-off. In this instance searching directly for the words "pattern of events" might pay off since it is rather standard practice for authors to summarize at the end of their meanderings. If the simple and direct clue is not present, not much time is lost by the reader who has perceptual speed, perceptual memory, and perceptual accuracy. This statement implies, obviously, that if a student lacks any of these perceptual skills, training is indicated. However, such training can accompany the program on techniques for finding answers.

Another kind of task students encounter is an assignment such as "Compare authors A and B." To find answers one must have questions in answerable form. "On what point are they to be compared?" "What did A have to say?" "Where?" and so on. If the correct interrogatives are chosen and then attended to, the form of the answer is known and can be searched for without reading irrelevant material.

Step 2 requires the selection of a word which will serve as a reference point for the correct location, and poses no particular difficulty if the first step is mastered. It is more a matter of acquiring a habit of a sequence of procedures.

Step 3 mastery--identifying what is going on in any particular part of an article--is relatively easy to acquire because students already have available the knowledge required. But once again, these students don't know that they know, at least not at a level of deliberate use. The materials

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I searched tell students to note signal words.
But telling is not enough. Students need to per-
form under the control of feedback whether by live
teacher or machine in order to learn to use fully
the information available in the words that are so
common in our language that their worth is not
appreciated,

An example is the presentation of a six-line pas-
sage composed of two sentences. The question asked
is, "Is the main idea in this paragraph contained
in the first sentence, in the second, or in both?"
Even when cautioned that one does not have to know
the main idea in order to answer the question, few
students arrive quickly at the correct answer
that both sentences are needed to convey the main
idea, One merely has to notice that the second
sentence begins with "yet"--one of those common
but overlooked words, Exercises are needed that
demand attention to this part of our language.
Passages in which all words have been deleted·that
give any clue to the substance of the message are
useful, for a surprising number of questions can
be answered about the message from the remaining
information No one knows what the message is,
but a source of information about the message has
been recognized. A helpful discussion about this
class of language is found in Skinner (1957), under
Autoclitics.

Class sessions brought out another instance of
attending to the best clue, An example of the
form of question is "Is a marked discrepancy usu-
ally obvious?" We concluded that the pay-off
clue is the word "marked" and that the word "dis-
crepancy" can be ignored since the essence of be-
ing marked is to be distinguishable from another,
Any number of items can be substituted for "dis-
crepancy" and not change the base on which the
question is answered. When a student's attention
is directed to such clues, he can see the sense of
it and with directed practice can become skillful.

Step 4 in the strategy--reading just beyond to

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verify that you have included the entire answer--
was added to the model as a result of a small study
using eye-movement photography. One thing we were
seeking was visual evidence of the reading behavior
we call "flexibility." As we expected, an ex-
amination of our photographs verified they were
in accord with eye-movement research. As Taylor
(1963) reported, "When readers stop searching and
start to read, they read in a very characteristic
manner."

Calculating average fixations per line or rate of
covering material, then comparing results on oral,
silent and skimming type reading sorts out people
but does not show the actual performance. Photo-
graphs of the three tasks by a flexible reader
and by the one-style reader demonstrate clearly
the differences in procedure and will be used in
the program to illustrate the strategy being
taught. Enlargements of the photographs have
been used with classes and I feel that they have
added to the instruction as visuals often do.

Examination of the photographic records showed
that those readers finding the answer rapidly and
correctly read just beyond, which behavior was
interpreted as verification. This step also
showed up when successful strategies were discussed
in class. The two safeguards to finding the cor-
rect answer apparently are step 2, selecting the
reference word, and step 4, verifying that the
complete answer has been obtained.

Those readers locating the key word rapidly but
failing to find the correct answer were probably
examples of premature closure as discussed by
Rankin (1963).

Two other types can be classified: those who
found the correct answer by reading the entire
passage and those who read the entire passage then
re-read probably because they missed the question
in the first place.

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The highest level training in this program as now
planned is to give a sta. ement to be evaluated
along with the book containing the needed evidence.
The statement must be turned into a question or
questions in answerable form, attention given to
clues for locating the several places containing
evidence, then comprehending and composing answers.
When we review the successful procedures for com-
pleting such an assignment, the distinction be-
tween technique and comprehension must again be
recognized.

A final aspect to be considered in this program-
ming of how to find answers relates to this dis-
tinction between technique and comprehension. In
the same way that one general model of a systrm-
atic study procedure can be used by students dif-
fering in personality characteristics through
emphasizing selected steps of the procedure, so
do we believe that the general model for a strat-
egy of finding answers by reading can be adapted
to the differing needs of students. The set or
appropriate emphasis can be made at the time of
the diagnostic conference.

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SURVEY Q3R: SYSTEM OR SUPERSTITION?

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In the fall of 1963 a large-scale study skills
training project was carried out in the residence
halls of the University of Minnesota. The train-
ing program, and the beneficial effects it would
presumably produce, was described in dorm-wide
meetings early in the quarter. Students who asked
for guidance from their trained residence hall
counselors, and agreed to make daily reports, were
taught the Survey Q3R study method (Survey, Ques-
tion, Read, Recite, Review) (12). This set of
specific techniques has been widely copied in var-
ious study skills manuals, either in toto or with
minor modifications (3), (5), (6), (9), (10), and
(14). The almost universal endorsement of the
system augured well for the success of the project.

The students' daily reports were collected and an-
alysed to evaluate the total project. The attempt
to teach study skills was surprisingly ineffective.
Even considering possible weaknesses in the over-
all program, the results raised the heretical sus-
picion that the Survey Q3R system may not be en-
tirely reliable. Perhaps its ubiquitous advocacy
has been due to its face validity, rather than any
demonstrable effectiveness. A review of the re-
search on Survey Q3R was undertaken to evaluate its
empirical foundations.

The research support for the published Survey Q3R
method is at best inadequate. The method is most
exhaustively described in Effective Study, (12).
Each one of the four steps, (survey, question,
recite, and review) is justified by specific cited
research. These original sources were reviewed.

1. Survey.
The student is told to:

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> "Glance over the headings in the chapter
> to see the few big points which will be
> developed. Also read the final summary
> paragraph if the chapter has one. The
> survey should not take more than a min-
> ute and will show the three to six core
> ideas around which the discussion will
> cluster. This orientation will help you
> organize the ideas as you read them
> later" (12, p. 29).

There is only one study offered in support of the
Survey step (8). Two groups of 58 students each
were equated on the Otis SA Test of Mental Ability,
form A and Burgess Reading Scale. The experimen-
tal group was given 15 minutes training in _skimming_.
Then each group read a 611 word passage on "Women
and Marriage". The experimental group was given
25 seconds for a pre skim. However, this pre skim
period was not counted as part of total reading
time. The results are presented in Table 1.

	No Skim	Skim
Otis	57.8	57.9
Burgess	13.72	13.52
Reading time	2:54	2:12
Reading rate	210	277
Comprehension	77%	76.6%

Table 1

Rate and comprehension mean scores for matched
groups of skimmers and non-skimmers. (Adapted
from 8)

It seems that the pre skim group did read slightly
faster than their well matched peers. The differ-
ences hold up even if the 25 second pre skim is
added to the mean reading time (210 w/m vs. 233
w/m). However, the conditions of this research
make a generalization to text book study highly

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premature. It was carried out under frankly ex-
perimental conditions (a psychology laboratory)
and therefore probably contaminated by Hawthorne
effect. A few minutes of timed reading on a short
non-technical passage is hardly similar to reading
the headings and summary of a text book. There
is no evidence that the higher rates for the ex-
perimental group would generalize. In fact, Ran-
dall (11) reports that "Knowing a person's rate on
a test, one can predict his rate of reading during
apparently untimed study only 5 per cent better
than just guessing" (12, p. 74). Moreover,
there clearly is no evidence in this study that a
pre survey had any effect on a student's ability
to organize the ideas contained in a text book chap-
ter. The comprehension test scores were almost
identical for both groups.

2. Question.
For the second step, the student is instructed:

> "Now begin to work. Turn the first head-
> ing into a question. This will arouse
> your curiosity and so increase compre-
> hension. It will bring to mind infor-
> mation already known, thus helping you to
> understand that section more quickly.
> And the question will make important
> points stand out while explanatory detail
> is recognized as such. Turning a heading
> into a question can be done on the
> instant of reading the heading, but
> it demands a conscious effort on the
> part of the reader to make this a query
> for which L. must read to find the
> answer" (12, p. 29).

What are the data that support the step? The
major support for the Question technique is a
study done with six groups of college students,
equated for reading ability on the Whipple High
School and College Reading Test (4). The experimen-
tal group was given 20 questions (Q) before reading

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a 2000 word passage on either English literature or science. The control groups received no pre questions. Following reading, both groups took a 40 item test, containing the 20 Q items, plus 20 new (q) items. Two groups for each topic had immediate tests; one had a delayed test. Unfortunately the results are not reported in mean scores, but in ratios of Experimental to Control. A critical ratio, significant at .05, is given as 4.0 or greater. The results are presented in Table 2.

		LITERATURE		
group	test	Q	q	Q+q
1	immed.	E/C 6.8*	C/E 2.2	E/C 3.2
2	immed.	E/C 14.5*	C/E 4.5*	E/C 5.3*
3	delay 2 weeks	E/C 12.8*	E/C .05	E/C 9.0*
		SCIENCE		
4	immed.	E/C 10.0*	C/E 4.6*	E/C 2.1
5	immed.	E/C 8.5*	C/E 4.3*	E/C 1.5
6	delay 2 weeks	E/C 11.2*	E/C 1.1	E/C 10.3*

*p < .05

Table 2

Critical Ratios of Scores for Experimental (pre question) and Control (no pre questions) groups on pre question (Q) and new (q) items, and total test (Q+q). (Adapted from 4)

Clearly, on the Q items, pre questioning helped comprehension, since the Experimental group earned higher scores. But it also appears that having pre questions lowers a reader's comprehension on new (q) items, since the significant differences all favor the control group. Overall, the pre questions seem to be an aid.

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<u>But they also serve to interfere</u>. If a student
makes up the "wrong" question from a section head-
ing, he may not learn a necessary response.   In
fact, no matter what question he develops, he will
miss some information. A more searching study by
Washburn (16) supports the same conclusion. Pre-
questions just before reading a section were   an
aid in answering pre-reading questions. But they
were associated with a drop in ability to answer
new items, especially about specific facts. There
does not seem to be good evidence for the conclu-
sion that "As might be expected, the group which
had been given a list of questions before reading
did better on these questions, but they also did
as well as the other group on the new questions"
(12, p. 18).

3. <u>Read</u>

After doing a survey and making up his question,
the student is told:

> "Read to answer that question, i.e., to
> the end of the first section. This is
> not passive plodding along each line,
> but an active search for an answer."
> (12, p. 29)

There is no specific research cited to support the
notion of active, non-plodding reading. Moreover,
these are hardly clear, unambiguous instructions.
It would seem well nigh impossible to differentiate
"active" and "plodding" reading without referring
to simple rate measures. But "active" reading, in
the loose sense it is used above, clearly implies
more than fast reading. The notion of "an active
search for an answer" appears to be critical. Yet
there are many different ways of looking for an
answer. Skimming rapidly over a page is one. So
is slow reading and re-reading. The instructors
would seem to be metaphorical, and have only quasi
inspirational effects, if any, on study skills.

4. <u>Recite</u>

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> "Having read the first section, look
> away from the book and try briefly to
> recite the answer to your question.
> Use your own words and name an example.
> If you can do this you know what is
> in the book; if you can't, glance over
> the section again. An excellent way to
> do this reciting from memory is to jot
> down cue phrases in outline form on a
> sheet of paper. Make these notes very
> brief." (12, p. 29)

The emphasis of this step in the Survey Q3R pro-
cedure is on a specific form of note taking--cue
phrases jotted in outline form from memory. The
basic support for the "working notes" format is a
study by Arnold (1). His well matched students
read and summarized material in one of four ways:
outlining, precise writing, underlining and re-
reading. There were no significant comprehension
differences using a variety of test item forms, on
immediate and delayed testing. However, there was
a slight, non-significant tendency for underlining
and re-reading to be more effective. Arnold be-
lieved that since the students were not sufficiently
trained in their assigned method, the results are
inconclusive. In any case, the data do not support
endorsement for outlining from memory. Two further
studies (2, 13) demonstrate that students can in-
deed be trained to outline effectively. But there
are no reported studies of the comparative effect-
iveness of students trained in all four methods. Un-
til such a study is carried out, the question of
the best type of recitation technique will be unans-
wered.

5. The final step in the procedure is to <u>review</u>
the content of the working notes.

> "When the lesson has thus been read
> through, look over your notes to get
> a bird's-eye view of the points and of
> their relationship and check your memory
> as to the content by reciting on the

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> major subpoints under each heading.
> This checking of memory can be done
> by covering up the notes and trying to
> recall the main points. Then expose
> each major point and try to recall the
> subpoints listed under it." (12, p. 29)

No attempt was made to review even the cited stud-
ies. The literature of recitation, memory, for-
getting, spaced vs. massed review, interference
effects, etc., is so vast that a survey of even
the relevant studies would have been both time con-
suming and unnecessary for the purpose at hand--
evaluation of Survey Q3R. The review to this
point seemed conclusive enough. More searching would
have been interesting, but hardly worthwhile.

CONCLUSION

The literature survey indicated some of the funda-
mental problems with Survey Q3R. The Survey step
is based on an overly generous extrapolation from
a short passage to a whole text. The Question
step is advocated in the face of data which show
that pre question may be a detriment to compre.en-
sion. The working note form of Recitation is pro-
bably effective, but no evidence is given that it
is any better than simple re-reading.

A recent study by Wooster (17) investigated the
whole Survey Q3R approach, taught in a 10 week
"How to Study" course. Presumably the students in
the course would have time to become well trained
in the method, and would be able to demonstrate
increased speed and comprehension or some similar
measure of effectiveness. Most regretfully, the
author used no control group. All comparisons
are therefore pre and post measures on the same
groups of students. The data of the Wooster study
offer very little encouragement for the supporters
of SQ3R. The students showed no increase in read-
ing rate, and no increase in comprehension. Nor
were the students uniformly enthusiastic about the
method. At the 10th week of the course, only 65.5%

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reported making a survey when they studied, and
55.3% reported making questions. (These data agree
with 3 independent studies made by Wark (15). The
only measurable change was in "work note" format,
judged by the instructor to have become more effect-
ive. Clearly Survey Q3R was not highly successful
in changing student achievement, or in maintaining
student interest.

Where do we stand regarding Survey Q3R? It is a
widely advocated method. Increasing numbers of re-
cent high school graduates come to campus and say
they have heard about it from their teachers. For
the instructors who can enthusiastically espouse it
and students who conscientiously apply it, Survey
Q3R is probably not a waste of time. But there is
no body of data to demonstrate that any other inte-
grated package of skills would not work just as
well. Like the legal age for marriage, Survey Q3R
seems to be supported by tradition, rather than a
rigorous consideration of the data on productivity.

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THE "NEW LOOK" IN SKILLS TRAINING - A CRITIQUE

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One comment that I feel pleased to make about the
papers in this section is that together they pre-
sent what may be called the "New Look" in the
teaching of study. A week ago I wouldn't have be-
lieved that there could have been a new look. We
have in the Developmental Reading Program at Notre
Dame shelves of books on how to study, some of
which date back 50 years and more. Reading them
over had led me to believe that everything that
could be said about study had been said. I sus-
pect that the last important development in study
technique was Robinson's work on SQ3R. In the
generation since Robinson we have seen permutations
and combinations of his formulations, but little
that was really new. It appears to me that the
current papers signal a new cycle. Initiated by
the exciting new developments in programmed in-
struction, it is a cycle that will probably be
extremely productive in a few years. I could not
see in what was offered today anything that we
could immediately apply when we go home. Neverthe-
less, I am convinced that we have a beginning
that will certainly be productive.

One of the things most notable in this new look is
the frequency with which the expression "model."
comes up. As these papers were read I was sur-
prised to see how psychologists and teachers are
now studying far more precisely than formerly the
desired response in specific parts of the study
situation. Some speakers can be commended more
than others, but all of them in my opinion im-
proved upon the language, model, and teaching
methods we inherited from Robinson.

It is worth noting that although the language
is different, the older inherited study model
can be made to fit in with some of the

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other formulations of study presented here. We
have, for example, the work being done at Indiana
by Dr Davis, Her paper indicates the extent to
which modern workers in the field of study are mak-
ing much more precise the pre-reading activity of
study, It presents detailed procedures that stu-
dents should follow, Also notable in her paper are
the suggestions about research procedure in vali-
dating new study techniques, To sum up my first
general comment: we appear to be entering a stage
in studying the matter of study which has already
produced a refinement in the concept of what study
is and further has produced new methods of teach-
ing it, These methods are closely tied up with
programmed instruction, and it is encouraging to
see how rapidly these techniques are reaching soph-
istication.

My remaining remarks are somewhat more critical.
I shall begin them by saying that in the field of
study training there should exist a law which says
that any study method taught students to get their
work done ought to be simpler and more efficient
in producing results than reading without the
method. As a reading teacher, I too have study
methods to teach students. I sometimes wonder
whether my methods are harder to learn and apply
than the reading was to begin with. I wonder if
some of the approaches to study presented this
afternoon are not subject to the charge of being
unduly complex. We may find that we are making
the steps in reading and study so numerous and
complicated that a student would need a lengthy
check list to guide him through the reading of a
simple paragraph.

Another comment that I would like to make amounts
to a cry for responsibility in "model making".
Do I need to define what I mean by model? Let's
call it a way of understanding reading which
leads to methods of doing it. In my plea for re-
sponsibility in model making, I would like to ask
that there should be some further attempt to vali-
date them and the study methods they suggest.

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It is worth pointing out that the "New look" study
methods at present tend to leave little or no
room for a personal response. Concerned only with
a student's getting information, they ignore all
questions and relations which are not matters of
fact. What about questions of value, questions
concerning how the reader feels about the material,
about how he will use it, or whether he should
argue with the ideas, or in some manner reorganize
and restructure them according to a set of relations
not contained in the text? I have long held the
opinion that productive people and productive read-
ers read well because they read personally, be-
cause they read to use and read to become. I be-
lieve good readers, even of textbooks, do not read
just with a set of soaking up information.

To sum up my second comment, researchers and teach-
ers of reading should exercise caution in their
new models and methods of reading and study. They
should take care lest they create a multiplicity
of methods which are overly complex and detailed.
They must further take care to assure all of us
that the methods of study they recommend are valid
in concept as well as productive in practice.

VISUAL MOTILITY

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In many professional texts, reading improvement
workbooks, and popular articles on reading, one
finds expressed many misconceptions about the fun-
damental visual-functional and perceptual acts that
initiate reading. In a survey of twenty of the
more widely distributed reading improvement books
and workbooks, eighteen contained statements about
the visual-functional and perceptual acts that
were in direct contradiction to the findings of re-
search. The purpose of this paper is to explore
the facts and fallacies relating to eye movements
and reading and to answer certain basic questions
related to visual functioning and the perceptual ac-
tivity.

1. <u>How much can the eye see</u>? The art below graph-
ically represents the results of a study by Fein-
berg (5), who measured the fall off-of visual acui-
ty for the emmotropic, or normal eye.

As a reader's eyes stop at any given point along a
line of print, only four to five letters immediately
around the fixation point are seen with 100% acuity.
From this point of clearest vision outward to
either direction, words and letters are seen with
decreasing clarity. For example, portions of
words that extend one-half inch outward from
the fixation point are normally seen with less
than 50% acuity. Words that occur one inch from
the fixation point are seen with only 30%
acuity. If the reader's vision is less than
"normal", this fall-off is more pronounced. Of
course, the reader will attempt to "use" some of
the print seen with reduced acuity, but the small
amount that he is able to use will be in direct
proportion to the amount of visual discrimination
(accuracy and orderliness) and visual memory

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ANGLE	% OF ACUITY
6° 30'	25
5° 15'	27
4°	32
2° 45'	45
1° 28'	75

the ship's wheel was the inspiration for the revolving shell
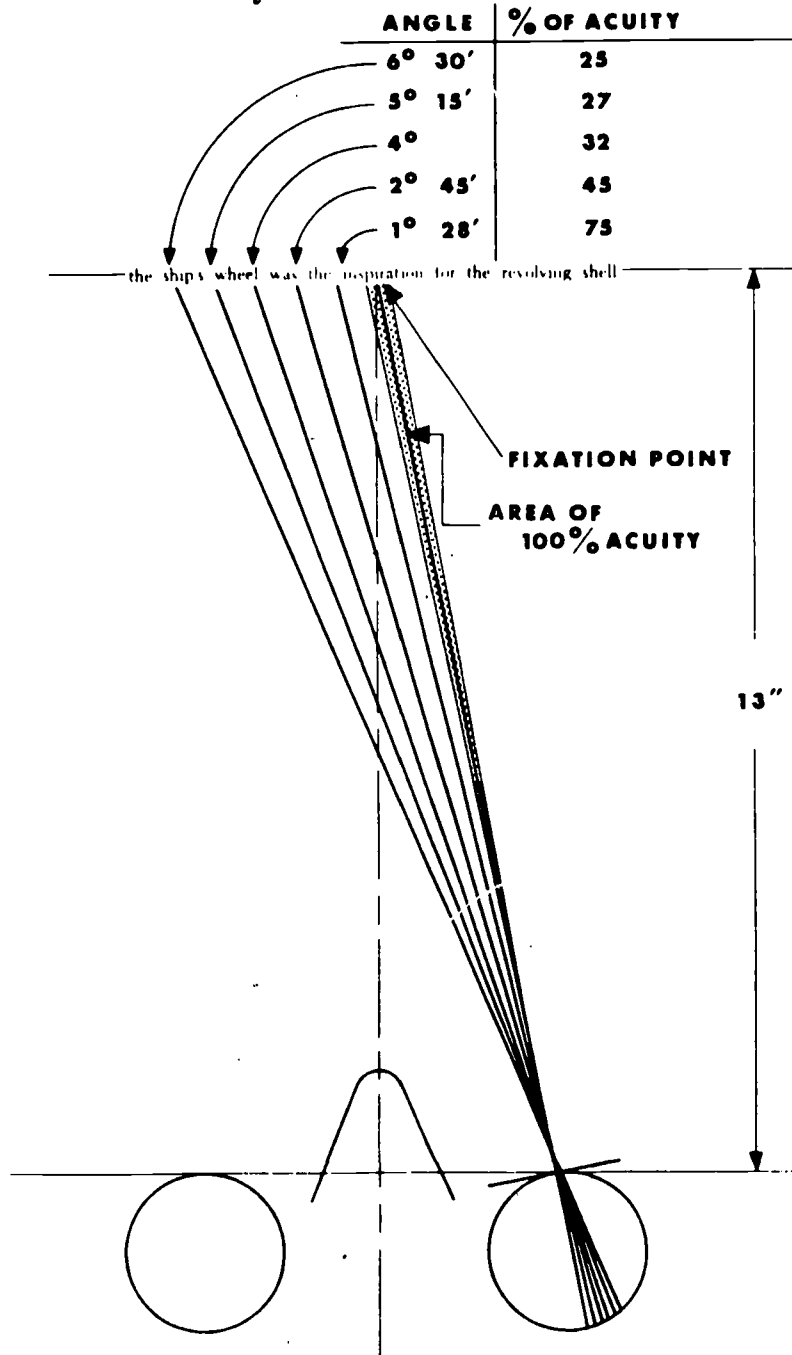
FIXATION POINT

AREA OF
100% ACUITY

13"

Figure 1. Visual acuity, percent of normal, as a function of
visual angle.

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(retention) that he possesses.

This typical fall-off of visual acuity explains in
part why the average college reader has a usable
span of recognition (average amount seen during
an eye stop in reading) of only 1.1 words and why
even superior readers, trained or untrained, sel-
dom achieve a usable span of recognition of over
2.5 words. Norms (Table 1) based on eye-movement
photographs of over 12,000 students (14), reflect
the growth in usable span of recognition, which
increases as the number of fixations per hundred
words decrease.

2. Do we see only when our eyes are stopped, or is
it possible to absorb print while our eyes are in
motion? Research to date shows that vision is so
reduced while the eyes are in motion that it is
impossible for recognition to occur. In a study by
Thomas (18), projected images were activated elec-
tronically so that they would appear only when the
subject's eyes went into motion and disappear when
the movement ceased. All of the subjects failed
to see the material that was presented while
their eyes were in motion. This study and others
indicated that all persons identify and recognize
visual material only during eye pauses, or fixa-
tions.

3. In reading, is it necessary to see all of the
words? For complete accuracy, yes. When people
question the need to see all of the words, they
are suggesting that some words are more important
as carriers of meaning than others. While this is
undoubtedly true, it is not possible to read with
a system of omitting words, for a reader cannot
reliably decide which words are important until
he first "sees" them. Any random omission can only
yield incomplete comprehension.

4. What is the relationship between efficient
oculo-motor performance and effectiveness in read-
ing? Without exception, all eye-movement

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Table 1

AVERAGES FOR MEASURABLE COMPONENTS OF THE FUNDAMENTAL READING SKILL (14)

Grade*	1	2	3	4	5	6	7	8	9	10	11	12	Col.
Fixations/100 w.	224	174	155	139	129	120	114	109	105	101	96	94	90
Regressions/100 w.	52	40	35	31	28	25	23	21	20	19	18	17	15
Av. Span of Recog.	.45	.57	.65	.72	.78	.83	.88	.92	.95	.99	1.04	1.06	1.11
Av. Dur. of Fix.	.33	.30	.28	.27	.27	.27	.27	.27	.27	.26	.26	.25	.24
Rate with Comp.	80	115	138	158	173	185	195	204	214	224	237	250	280

*First grade averages are those of pupils capable of reading silently material of 1.8 difficulty with at least 70% comprehension. Above grade 1, averages are those of students at mid-year, reading silently material of mid-year difficulty with at least 70% comprehension.

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studies that have compared good readers with poor
readers, whether on the basis of standardized test
scores, grade level, or ability to read with flex-
ibility, have shown that more effective readers
make fewer fixations, fewer regressions, have a
larger span of recognition, and display a shorter
duration of fixation than do less effective readers.

The tables provided by Taylor (11, 12), Gilbert (6),
and Buswell (3), in addition to the table of norms
previously cited, provide eye-movement data on
students at all grade levels which supports the
fact that the better reader possesses more oculo-
motor efficiency.

5. How does an individual acquire the oculo-motor
activity that he employs in reading? The study by
Taylor and Robinson (16) suggests that a child en-
ters kindergarten with certain existing oculo-
motor habits born out of his accumulated "looking"
experiences. These are modified or built upon as
he learns to read.

During the readiness stage of reading instruction,
he is given a small amount of instruction in vis-
ual discrimination, and usually just verbal dir-
ections to help him form his directional attack.
Throughout the beginning grades, his struggle with
word recognition encourages an excessive number of
fixations and regressions. Oral reading, though
valuable in some respects, has the effect of en-
couraging an excessive amount of random ocular
movements. Perhaps, too, he is handicapped with
inadequate vision, poor binocular coordination and
mobility. And so, through constant but unconscious
experimentation, he evolves an oculo-motor activity
that enables him to realize a reasonable degree of
meaning from print.

6. Does the average reader alter his oculo-motor
activity to suit the reading task? In professional
books and articles on reading, there are many
references to the importance of flexibility--the

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need to vary rate and performance according to the
nature of the content and the reader's purpose.
While flexibility is undoubtedly a desirable goal,
the fact remains that the average reader is quite
inflexible in the way he copes with various reading
situations. There have been many studies of the
effects on reading performance of interest, type
and difficulty of content, and purpose. From
these studies, several conclusions have emerged:

a. Most people are not efficient readers and, as
    such, do not vary their reading approach to
    any great extent when reading for different
    purposes. Only the most efficient readers
    find that changes in approach come easily and
    naturally, Studies by Letson (7), Taylor, et.
    al. (13), McDonald (8), Sister Theophemia (17),
    among others, have shown this to be the case.
    The least efficient readers may actually find
    themselves incapable of altering their reading
    performance even when they set their minds to
    it. Others can force a change at will but do so
    with a significant loss of comprehension and an
    excessive expenditure of energy.

b. Variations in the difficulty of content within
    reasonable limits appear to produce little
    appreciable change in the performance of aver-
    age (relatively inefficient) readers, as shown
    by the studies of Anderson (1), Morse (9),
    Ballantine (2), Letson (7), and Taylor, et.al.
    (13). Generally speaking, as long as a reader
    is not reading material too far above or below
    his level, he will maintain a fairly character-
    istic pattern. Material that contains difficult
    vocabulary and concepts can cause the reader
    to interrupt his reading to reread, stare or
    ponder. At the other extreme, when the content
    is so simple that it departs significantly from
    familiar linguistic patterns, variations will
    also occur.

c. Variations in subject matter have been found
    to produce less change than would have been

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suspected. Seibert (10) found some change in
oculo-motor performance on the part of eighth
grade subjects as they read geography, science,
history, etc., but this change was so slight
that it can be considered educationally insig-
nificant.

d. The physical condition of the reader produces
little effect on oculo-motor behavior. Car-
michael (1) and Dearborn (4) found that pro-
longed reading produced mental fatigue but did
not significantly alter oculo-motor character-
istics.

In many of the studies citeu above, it was found
that only the better, or more mature, readers al-
tered their performance significantly when approach-
ing different types of content with different pur-
poses in mind. The average reader, who is not very
efficient, tends to maintain the same oculo-motor
activity in approaching most types of reading un-
less extraordinary conditions interfere.

Many reading specialists, being aware of the rela-
tionship between the oculo-motor activity and read-
ing effectiveness, seek ways and means of improv-
ing it. Unfortunately, many work towards <u>changing
the eye movements themselves</u> rather than <u>training</u>
the underlying skills that the eye movements re-
flect.

7. <u>Can the oculo-motor activity be changed through
the conscious control and self-discipline of the
reader?</u> It is interesting to note that almost all
of the currently available reading improvement
texts and workbooks tell the reader how to go about
controlling and redirecting his eye movements,
though they offer no evidence to support their
assumption that this can be done. The following
quotations are taken from some of the more widely
used reading improvement workbooks:

"Make your eyes divide the type lines into
word groups--units of type--and you will
quickly develop the faculty of seeing units

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of type pass swiftly before your eyes and be-
come units of thought. Divide the type lines
in the way word groups form naturally for
you."

"If regressions become noticeable in your
reading, shorten the eye span or slow your
pace until meaning and essential relation-
ships are clear."

"In fast reading of easy material, try to
have no more than one regression every sever-
al paragraphs. In fast reading of solid mate-
terial, try for no more than one regression
per paragraph."

"Run your eyes down each column, making one
fixation per line."

"Read forward. Let your eyes sweep across
each line. Try not to look back and reread."

"Under no circumstances should you allow your
eyes to go back to pick up something they
missed the first time."

It is appealing to think of the eyes as being
smoothly and precisely directed by the mind in the
process of reading. In reality, however, this is
not the case. All available eye-movement research
to date suggests that we do not and cannot con-
trol our eyes in each and every fixation; at best,
we direct our eyes along the lines of print in a
general way.

To understand why precise control over eye move-
ments is not possible, it is necessary to realize
that you make from three to five eye movements
per second. In other words, in the time it takes
to say "one thousand and one", you could have made
five eye movements while reading. You are not
aware of these movements because the shifts of the
eyes are slight and produce little kinesthesia
(sensation of movement). Because so many move-
ments occur in so short a time, you experience
only a general feeling of movement.

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Most people who attempt to control their eye-move-
ment patterns find that they defeat their own pur-
poses. They must concentrate so hard on trying to
"feel" what they are doing that they lose the
thread of thought.

8. <u>Is it possible to learn to read in large word
groups or "phrases"</u>? The theory, though fallacious,
sounds logical: widen span, and thus decrease the
number of fixations needed, and as a result, in-
crease rate of reading. This theory is reflected
in many reading improvement texts by such state-
ments as these:

>"Skillful reading requires wide eye spans
>which encompass phrases and thought sequences
>rather than isolated words."

>"Good readers are not word-by-word readers.
>Rather they are phrase readers....They have
>developed a span of vision sufficiently
>large to enable them to take in a group of
>words at each fixation."

>."Read meaningful groups of words. Take in
>several words instantly, at a glance. Don't
>read word by word. This slows you down."

>"The truth is, your eye span is adjustable,
>and you can easily control the adjusting.
>'See wider,' quickly capturing long words
>and phrases at a glance."

>"Practice looking down quickly at a line of
>print, lifting the eyes and checking to see
>how many words you saw in the fixation. Do
>this until you are actually aware that the
>span is increasing."

>"You should read ideas, not words. For in-
>stance, the phrase <u>into the house</u> should
>not be read as three words but as a single
>unit. Each unit should be picked up at

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one pause or fixation "

No studies to date have shown that training to
widen span has resulted in the ability to "see"
in phrases during continuous reading. Feinberg's
study, mentioned above, suggests that the physio-
logical limitations of the eye will probably pre-
vent the readers from ever accomplishing this goal.
It is rather startling to note that despite the
findings of over one hundred eye-movement studies,
writers of reading improvement texts have persisted
in this misconception Perhaps they have done so
because they know a person can "see" three or four
words by staring at print or when words are flashed
tachistoscopically.

This is possible because this seeing situation is
static, and there is time to assimilate the less
distinct impressions that occur in the periphery
where visual acuity is reduced This is in direct
contrast to the situation that occurs during read-
ing, in which image is superimposed on image at
the rate of three to five per second. In addition,
the demands of continually organizing the ideas
presented in reading material are not present in
such static situations. These conditions explain
why the span of recognition as it occurs in read-
ing is distinctly smaller than that occurring in
static seeing situations (12).

9. <u>Can the eye be trained to move down the center
of a column of page of print, to make only a few
fixations per page, permitting reading rates of
thousands of words per minute?</u> To answer this, one
must first clarify what is meant by "reading."
If one is referring to the act in which the reader
contacts all of the words visually and strives for
complete comprehension, reading rates of thousands
of words per minute are impossible.

For even the most efficient readers, 800 w.p.m. is
the practical limit for thorough and inclusive
reading, based on the fact that few if any readers
have displayed a span of over 2.7 words while

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simultaneously averaging more than 5 eye stops per
second (2 7 words per eye stop X 5 stops per sec-
ond X 60 seconds = 810 w.p.m.). This is not to say
that people cannot be taught to skim and scan at
apparent rates of thousands of words per minute,
but skimming and scanning are distinctly different
acts in which only part of the material is actually
read, or dealt with, and in which comprehension is
invariably reduced. Eye-movement photographs tak-
en of persons involved in skimming and scanning
show that only certain lines are read, and even
those may not be read in total. In other words,
skimming and scanning can be described as process-
es of looking and reading. The intermittent read-
ing occurs resembles the person's usual reading per-
formance.

Thus far, no photographs, even of proficient skim-
mers, have shown a person's eyes moving straight
down the center of a column or page of print.

To summarize, eye movements are neither the cause
nor the effect of good or poor reading. In other
words, the eyes do not dictate to the mind what
it shall understand, and neither does the mind dic-
tate to the eyes where they shall look. Instead,
there exists an interaction and interdependence
between the oculo-motor activity and the central
processes, each function indirectly influencing
the other.

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MICRO-MOVEMENTS DURING APPARENT
FIXATIONS IN READING

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Saccadic eye movements, the ballistic motion and apparent stops or fixations during reading, have been studied extensively (1, 2, 3). Observation of the oral reading errors of problem readers led to the hypothesis that small, extremely rapid visual excursions to adjacent lines of print must occur during or between fixations resulting in the processing of extraneous letters and/or words. The Mackworth Optiscan camera (4) was modified to provide film records of the reading behaviors of normal and retarded readers.

The Optiscan consists of a miniature light source, a periscope, and a movie camera. Its purpose is to record the scene as viewed by the observer (0), along with a small eye position marker (spot of light) superimposed to indicate where 0 is looking (fixating) from moment to moment. The image of a miniature lamp is reflected from the cornea of the left eye into the periscope which then superimposes this marker onto the scene image. Thus the eye movements are recorded from the left eye, while only the right eye is "seeing".

Both head movement and displacement of the eye from a roughly constant rotational axis when moved produce distortion in the record. These were reduced by modifying the recording and analysis procedures. 0 sat in a specially constructed chair topped by a camera platform. The head was secured to a headrest and a bite-board provided a rest for the upper jaw while still allowing oral reading.

The visual display, a paragraph from an oral reading test (5), appeared on a screen at eye-level, 116" from 0, and print size was equated to near-

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point reading. Prior to and following the read-
ing, O fixated coordinates superimposed on the
display, The locus of the coordinates of the fin-
ished film allowed determination of the amount
and direction of error due to head movement. Since
the task was brief, several records were made and
those with least head movement selected for analy-
sis Distortion due to shifts in the rotational
axes of the eye was reduced by using a small field
(less than 6° of arc in radius) and by adjusting
the size of the image on playback so that the dis-
tance between coordinates remained the same as in
the display condition Thus lateral distortion
was minimized by using a small field and reduced
further through counter-distortion in the analy-
sis procedure

A frame by frame analysis provided the results
appearing in Figure 1 Line A is the record of
a college student, reading at a high third grade
level; line B is his record after perceptual
training (6); line C is the record of a normal
reader Each circle has a latency of 07 seconds
or less Squares represent three or more frames
too close together to allow differentiation The
following points are worthy of note:

    1   Fixations in the traditional sense (lat-
         encies of .24 to .33 sec (2,3)) consist
         of three or more micro-fixations The
         slow speed of the camera (14 frames/sec)
         makes latencies less than ,07 difficult
         to detect. Exposure time of the film is
         about .03 sec, per frame Movements
         within a .03 sec, interval are not ob-
         served except for an occasional light
         trace,

    2,   The amplitude of micro-movement within
         a letter ranges from 5 to 15 minutes of
         arc on the size of print used (the max-
         imum visual angle subtended by an indiv-
         idual letter was 26 minutes of arc),
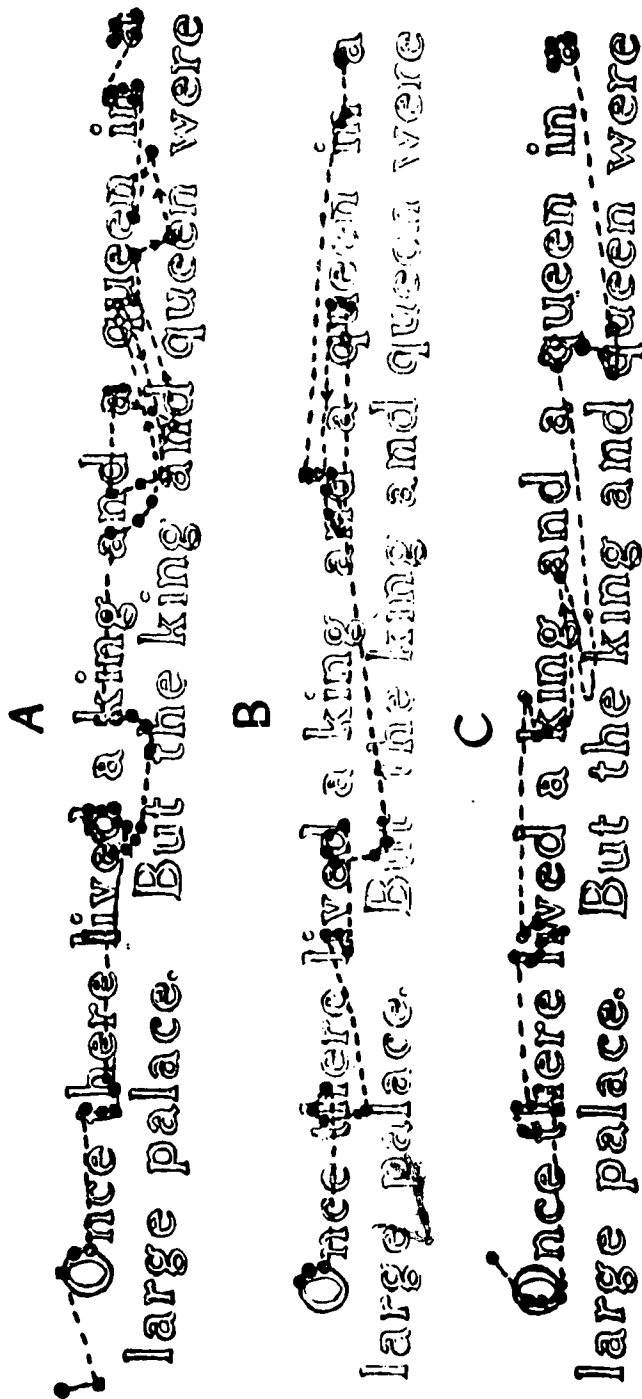
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FIGURE 1.

Micro-movements of the eye during reading as recorded by a corneal reflection technique. Circles are of .07 sec. duration or less; squares indicate three or more circles. Lines A and B are the records of a college student with a reading disability, before and after perceptual training. Line C is the record of a normal reader. Stimulus material consisted of solid black letters on a white field; only outlines of letters are shown here.

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3. Micro-movements during a fixation appear
   to follow gradients forming vertical
   straight contours and curved ones. (Stim-
   uli consisted of black letters on a white
   field).

4. Excursions occur when a similar word, let-
   ter, or perhaps, identifying character-
   istic of a letter is adjacent to the fix-
   ated word (note and and queen)

5. After perceptual training, excursions con-
   tinue to occur but with less frequency
   and shorter latency   Total time on line
   A is 7 0 sec , on line B, 2 45 sec

6. Excursions of extremely brief latency oc-
   cur also in the record of the normal read-
   er (total time: 2 52 sec)

To provide a more accurate analysis of a single
letter perception, width of the field was reduced
to $4°$ of arc in radius, and size of the print was
increased by about 60%   Brightness of a point
source of light was decreased and a faster film
was used, The pattern was superimposed on the
print with the result appearing in Figure 2   The
following points are notable:

1. The amplitude of micro-movements within
   letters of this size ranges from 5 to 25
   minutes of arc (maximum visual angle sub-
   tended by an individual letter was 39 min-
   utes of arc).

2. Fixations tend to occur in the middle let-
   ters whereas, in Figure 1, they tend to
   occur on beginning and ending letters of
   words. This difference may be a function
   of the familiarity of the material.

3. Attack usually begins on the right side
   and midway in the letter (note no and

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FIGURE 2.

Pattern of micro-fixations of a normal reader while reading familiar material. For clarity, dotted lines between groups of micro-fixations are not included. Filled circles are initial fixations; latencies are similar to those in Figure 1. Curved dotted lines represent excursions inferred from light traces on single frames of film.

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<u>little</u>).

4. Movement follows the contours, with curves, verticals and terminals receiving equivalent attention. Note the excursion of the <u>e</u> of <u>the</u>.

5. While the accuracy of the record is limited, there appears to be an alternation between fixations on black-white gradients and white-black gradients (e.g , the right and left sides of a vertical.) The reproduction here shows only the outlines of the letters.

A possible relationship between the micro-movements observed during reading in this study and the slower "jerky" forms of physiological nystagmus should be considered. Ratliff and Riggs (2) reported motions with amplitudes between 1 and 5 minutes of arc occurring at the rate of 2-5 cycles per second during fixation of a small black dot.

They concluded that the shape of the fixation object had no effect on the nature of the physiological nystagmus in their study. However, their data was not obtained during an active perceptual search task such as reading.

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