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BEHAVIORAL RESEARCH THAT HAS PROMISE IN THE TEACHING OF READING.

BY- LAFFEY, JAMES L.
PITTSBURGH UNIV., PA., SCHOOL OF EDUCATION

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DATA FROM FIVE AREAS OF BEHAVIORAL RESEARCH WHICH HAVE RELEVANCE TO THE TEACHING OF READING ARE REVIEWED IN AN EFFORT TO INDICATE HOW THIS RELATIVELY NEW TYPE OF RESEARCH (1) APPLIES BASIC SCIENTIFIC TECHNIQUES TO PRACTICAL LEARNING SITUATIONS, (2) HELPS BRIDGE THE GAP BETWEEN LEARNING THEORY AND PRACTICAL APPLICATIONS, (3) REPRESENTS AN INTERDISCIPLINARY ATTACK ON EDUCATIONAL PROBLEMS, AND (4) ENCOMPASSES THE ESSENTIAL TASK OF EDUCATORS, BEHAVIORAL CHANGE. THE FINDINGS FROM 21 RESEARCH STUDIES AND THEIR IMPLICATIONS FOR READING ARE REPORTED FOR THE FOLLOWING TOPICS--(1) ELECTROMYOGRAPHIC STUDIES OF SUBVOCAL MECHANISM AND MENTAL OR BRAIN NEURAL ACTIVITY WHICH IS NOT VISIBLE TO THE NAKED EYE (EMPHASIS ON SILENT SPEECH AND NEURAL RESPONSE), (2) THE APPLICATION OF OPERANT CONDITIONING AND REINFORCEMENT PRINCIPLES TO THE READING BEHAVIORS OF INDIVIDUALS, (3) THE BEHAVIOR OF THE EYES DURING READING, (4) PAIRED-ASSOCIATE LEARNING SITUATIONS (VERBAL ASSOCIATIONS IN THE READING PROCESS), AND (5) THE EFFECT OF DRUGS ON MENTAL BEHAVIORS, AND READING AND RELATED BEHAVIORS. A BRIEF HISTORY OF THE DEVELOPMENT OF BEHAVIORISM AND NEOBEHAVIORISM IS GIVEN. REFERENCES ARE GIVEN. THIS PAPER WAS PRESENTED AT THE ANNUAL CONFERENCE AND COURSE ON READING (22D, UNIVERSITY OF PITTSBURGH, JULY 5-15, 1966), AND PUBLISHED IN A REPORT OF THAT MEETING, "PROGRESS AND PROMISE IN READING INSTRUCTION," BY THE SCHOOL OF EDUCATION, UNIVERSITY OF PITTSBURGH, PITTSBURGH, PENNSYLVANIA 15213. (LS)

A REPORT OF THE TWENTY-SECOND ANNUAL CONFERENCE AND COURSE ON READING

Progress and Promise in Reading Instruction

JULY 5-15, 1966

Program of Studies in Reading and Language Arts
School of Education
University of Pittsburgh
Pittsburgh, Pennsylvania 15213

Behavioral Research that has Promise in the Teaching of Reading

by

JAMES L. LAFFEY

A. BEHAVIORISM IN PERSPECTIVE

Behaviorism originated in the work of J. B. Watson, who conceptualized Behaviorism as a form of psychology which holds its subject matter to be the objectively observable actions of organism.

In the years from 1913-1920, the period of classical behaviorism, Watson was its chief proponent. During this period, Behaviorism was best understood as a set of orienting attitudes toward the business of psychology rather than as a completed set of explanatory principles or theories. The attitudes suggested by Watson included an Objectivism

which focused on objective techniques for securing data and rejected any form of introspection. A second attitude suggested by Watson was that of S-R Orientation. In Watson's words: "The goal of psychological study is the ascertaining of such data and laws that, given the stimulus, psychology can predict what the response will be — or . . . given a response it can specify the . . . stimulus."[1] With such a limited orientation as Watson suggested, there was destined to be a reaction to the confining spirit of classical Behaviorism.

A few years later, under the leadership of Clark Hull, Kenneth Spence, Neal Miller, Carl Hovland and John Dollard, the expected occurred — a new type or Neo-Behaviorism was introduced.

Neo-Behaviorism was characterized by a liberalizing spirit which attempted to unite behaviorism and the new model of science. The new science asserted a hypothetico-deduction system. This system involved the statement of laws believed to be fundamental. These laws later were asserted as postulates and the consequences of these were deduced by strict logical and mathematical rules. The theorems derived from the laws were then to be tested by experimentation. In essence neo-behaviorism combined the strengths of classic behaviorism with the strengths of the new science.

Probably the most important aspect of the neo-behaviorism was the pervasive liberalizing spirit. It made possible the work of Skinner, Estes, Deese and Mowrer. Even today, the liberalizing spirit of Neo-Behaviorism is felt. It is no better expressed than in the words of B. F. Skinner:

> Behaviorism, with an accent on the last syllable, is not the scientific study of behavior but a philosophy of science concerned wth the subject matter and methods of psychology. If psychology is a science of mental life — of the mind, of conscious experience — then it must develop and defend a special methodology, which it has not yet done successfully. If it is, on the other hand, a science of the behavior of organisms, human or otherwise, then it is part of biology, a natural science for which tested and highly successful methods are available. The basic issue is not the nature of the stuff of which the world is made or whether it is made of one stuff or two but rather the dimensions of the things studied by psychology and the methods relevant to them.[2]

Obviously, Skinner's definition is liberal. Implicit in this definition is the idea that any scientific study related to the mental life of the organism is relevant to Behaviorism. Studies in physiology, biology and

neurology, which deal with the mental activities of the individual, then become pertinent to Behaviorism.

B. RELEVANT DATA AND RESEARCH

Even though Skinner's definition is very broad in scope, behavioral research in reading can be limited to five specific kinds of data. The kinds of data mentioned and related research will be the subject of this presentation. These are:

1. Data from electromyographic studies of subvocal mechanism and mental or brain neural activity which is not visible to the naked eye.
2. Data from the application of operant conditioning and reinforcement principles to reading behaviors of individuals.
3. Data from studies on the behavior of the eyes.
4. Data from paired associate learning situations.
5. Data from the medical laboratory which deal with the effect of drugs on mental behaviors and reading and related behaviors.

For nearly a century researchers have endeavored to determine the effect silent speech (the habit children or adults have of saying words to themselves) has on silent reading. Unfortunately little concrete evidence has accumulated which can provide answers to such practical questions as whether silent speech should be encouraged or discouraged. Regardless of the scarcity of reliable research data some reading experts recommended earlier that students put pencils or even fingers into their mouths to prevent silent speech. Edfeldt,[3] a Swedish scholar of note, reviewed the research in the area of silent speech and then began a study with college students. He measured the silent speech of the students with electromyographic recording instruments. Edfeldt found that poor readers had higher incidence of silent speech than good readers; that the reading of an easy text results in less silent speech than does the reading of a difficult text; and that the reading of a clear text results in less silent speech than does the reading of a blurred text. From these results Edfeldt recommended that all training aimed at removing silent speech should be discarded.

In 1964 McGuigan[4] *et al.* completed a similar investigation, using electromyographic recording devices. The population of the study included 120 subjects ranging in age from six years to twenty years. McGuigan concluded that silent readng either consists of or results in covert

language responses denoted by the term silent speech. Amplitude of covert chin and lip responses are significantly greater during silent reading than during non-reading. Children differ greatly in the amount of silent speech that they engage in during silent reading and the amount of silent speech decreases as reading proficiency increases.

A second type of experimentation has used electromyographic recording instruments to measure the electrical neural potentials of the brain. The researchers engaged in this work have postulated that biologically efficient organisms should process information more rapidly than a less efficient organism and that the delay of a neural response from the brain could serve as a measure of the efficiency of the mental processes. Chalke and Ertle[5] have supported this postulate through research by finding statistically significant differences in three discrete groups of subjects selected on the basis of group intelligence tests. The latency of the neural responses in the lower group of subjects, divided on the basis of intelligence, was significantly different. Their neural response or reaction time was much slower than that of the high or average group. In the future, this kind of research may provide a foundation for further neurological research on the relationship of neurological activity and intelligence.

A second source of data in behavioral research in reading is the data available from investigations of the applications of operant conditioning and reinforcement principles to reading and related behaviors.

Staats[6] *et al* has not only shown the efficiency of utilizing operant conditioning principles in shaping children's reading behavior, but he has demonstrated also the efficiency of using extrinsic reinforcers.

Fort[7] in a discrimination experiment with kindergarten children, substantiated Staat's results on reinforcement. After reinforcing children with candy for making the correct visual discrimination, he concluded that a significant discrimination based on secondary reinforcement can be established under a variety of training procedures.

Hively,[8] in an attempt to study concept formation in children while retaining contact with research techniques in the operant conditioning of discrimination learning in animals, made use of a type of teaching machine originally conceived by B. F. Skinner. Hively found that putting children through a program of progressively difficult discriminations clearly increased the efficiency with which the children learned the matching task. He found also that the smaller the "steps" i. e., the less

difference between consecutive discriminations, the more efficient the program.

From a practical viewpoint, this experiment illustrated the efficiency of operant conditioning procedures. Hively discovered that in this training the more errors the children were allowed to make, the more they tended to go on making. And from another viewpoint he found that requiring a child to work through a truly repetitive material beyond the time when he could effectively pass on to the next task is educational "lock step" in a teaching machine situation.

In a later study, Staats and Butterfield[9] applied the principles of operant conditioning and reinforcement to a fourteen year old juvenile delinquent. The treatment included forty hours of instruction (or operant conditioning with reinforcement) over a four and one half month period. The student progressed in reading achievement from a second grade level to a fourth grade reading level. The procedures in this experiment were so organized that the student had vocabulary presented to him orally and he in turn would repeat the words in a reading situation. If the response were correct the subject was reinforced with token money which he could accumulate and later buy things that he wanted.

The results of this experiment were startling. Possibly, this is an ideal illustration of the old maxim "that nothing succeeds like success." In the forty hours of instruction the student acquired 761 new sight vocabulary words — approximately twenty new words per hour of instruction. His reading grade level increased from the second grade level to the fourth grade level. The student's rate of retention increased from 33% of the newly introduced words in a single learning period to 55% of the newly introduced words during a single learning period.

Indirect results of the instruction showed that the students over-all behavior improved remarkably. For the first time in his school life the student passed an academic course. The record of his classroom behavior showed that at the beginning of instruction he was causing at least ten disturbances a month which warranted his dismissal from class. In the fourth month of instruction he caused no disturbances at all — his record was unblemished.

This study illustrated that the principles of operant conditioning and reinforcement could be extended to adolescents. It demonstrated also that laboratory procedures can be objectively extended to deal with student misconduct.

A study by Hewett[10] even more dramatically illustrated the possibility of extending operant conditioning and reinforcement principles to practical learning situations. Hewett worked with Jimmy, a thirteen year old boy hospitalized in the Neuropsychiatric Institute in the U.C.L.A. Center for Health Science. Jimmy was an autistic child — autism being a state of mind or mental illness characterized by daydreaming, hallucinations and disregard of external reality. One of the major stumbling blocks in working with autistic children is that of forming a positive relationship between the child and therapist. Without any external relationships being established, as is the case with most autistic children, the child seldom pays attention long enough for others to teach him anything. In Jimmy's case the therapist observed that Jimmy enjoyed printing the word TEXACO that he had found on one of his toy trucks. Considering this as evidence of an interest in reading and considering the broader implications of furthering the socialization of the child, the therapist decided to attempt to teach him reading through the operant procedure. The procedure used was merely to reinforce Jimmy's writing, drawing, and oral pronunciation of words and pictures with gum-drops.

At the last report Jimmy had developed a sight vocabulary of 55 words. In addition he has been able to classify words in terms of people, objects, and animals. He has also been able to write simple sentences about some of his daily activity around the hospital. In Jimmy's case, this is a significant "breakthrough" which might make further socialization and treatment possible. The procedure has broader implications in terms of treatment and further socialization of numerous mentally ill children and adults.

Raygor[11] in still another investigation applied the principles of operant conditioning and reinforcement to determine their effects on reading rate. Raygor reported five different experiments with a total population of fifteen students. The experiments were similar except for the materials used and the directions given to the subjects. In each experiment the secondary reinforcer was a green light and the mode of response was the pulling of the handle of a cumulative response recorder. In the results, the investigator reported that all fifteen subjects increased their reading rate. These experiments illustrate the feasibility of using operant techniques and secondary reinforcement procedures to produce significant behavioral change in adult reading rate.

A third area of available behavioral research data is from research on eye movement behavior. Taylor,[12] in a recent Educational Developmental Laboratories publication entitled "Eye Movements and Reading —

Facts and Fallacy", presents a review of the literature on eye movements in reading and concludes that "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, neither does the mind dictate to the eyes where they shall look. There is an interaction between ocular motor activity and the central processes during reading, each influencing but not controlling the other.

Taylor's statement receives support in a recent study of the effect of selected purposes on the oculo-motor behavior and comprehension of third and seventh grade students of fifth grade reading ability. Brown[13] found that both the purposes and reader's ability contributed to ocular-motor behavior and comprehension scores of the subjects. Specifically the author found that advanced third grade readers read with significantly lower comprehension than retarded seventh grade readers, but advanced third grade readers excelled the retarded readers significantly in reading rate and oculo-motor efficiency. The retarded readers read with greatest efficiency and rate when directed to read in their usual manner, in contrast to the advanced readers who read with greatest efficiency and rate when asked to read for the main idea. This study lends support to Taylor's statement: "There is an interaction between oculo-motor activity and the central procedures during reading each influencing but not controlling the other." The interaction in this study is demonstrated by the various purposes of the readers and its resultant effect on ocular-motor behavior and comprehension scores of the subjects.

Conant[14] conducted an experiment to determine whether or not reading materials of an increasing difficulty produced significant changes in the eye movement behavior and comprehension efficiency of a group of mature readers at the college level. The results of the experiment revealed that with increasingly difficult material both the eye movement behavior and the comprehension scores of the subjects change significantly. As the material increased in difficulty the eye movement behavior of the subjects became increasingly more disorganized. The comprehension scores decreased as the material became more difficult. Conant indicates though that the changes were due in part to the individual differences of the subjects and the difficulty of the material. Once again this demonstrated that it is not the eyes alone nor the material, but the crucial interaction which takes place between the oculo-motor activity and the central processes during reading.

Schmidt[15] investigated the changes in eye movement behavior as a result of specific training in reading. The investigator took pre- and post-

training eye movement photographs with an electro-oculograph. He found that the eye movement patterns among the 190 subjects changed significantly during the sixteen week reading course. Both the number of fixations and regressions decreased significantly. The only gain score which was not significant was the comprehension score. This investigation appears to illustrate what might happen when an investigator loses sight of the critical interaction between oculo-motor movements and the central processes. There is a change in the mechanics of eye movements, but there is no change in the crucial facet of reading — comprehension.

This brief review of the recent research on oculo-motor movements, in reading lends support to Taylor's statement: "eye movements are neither the cause nor effect of good or poor reading."[16] Other factors, such as the difficulty of the material, the reader's purpose and the reader's ability are also crucial factors in the interaction between oculo-motor movements and the central processes.

A fourth kind of objective data for analysis in behavioral research is that of verbal associations. This can be seen if one considers that the behaviorist approaches the reading process as a chain of associated subvocal, verbal responses stimulated by the printed word or words.

Samuels[17] investigated the effect of experimentally learned word associations on textual response learning (or reading) and found support for the behavioristic view of reading as a chain of associated subvocal responses. He found that textual response learning (or reading) could be facilitated, if the same word associations learned during an introductory period were later presented visually during reading response training.

Walker[18], in a serial learning task, found that more word associations were stimulated by concrete nouns than abstract nouns and the number of associations aided retention.

Hansen[19], in a third study of paired associates, found that frequency of appearance in a list "per se" did not aid speed of learning. This study seems to lend support to the contention that meaningless repetition of a learning task fails to facilitate learning.

In a rather unique investigation of paired associate learning Koff[20] systematically paired two groups of children's responses to a selected list of paired associate stimulus items. One group of responses were made by elementary school children in 1916. The second group of responses were made by 147 public school children ages 8-12 in 1963. Koff's results reveal

that the primary responses in 1963 were significantly different from the primary responses given in 1916. Children in 1963, as a group, showed a significant increase in per cent of primary response agreement; i.e., there was a greater response homogeneity in the 1963 group of children. Also, children in 1963 responded significantly more with opposites than children in 1916 or adults in 1910. Koff suggests that these results in 1963 are indicative of a mass culture and that the results also reflect attempts at earlier socialization of children. A more conservative educator might view these results as being suggestive of the powerful educational potential and influence of television, radio, and other types of mass media.

The results of medical research on the effects of drugs on the brain is the final source of behavioral data to be discussed. This is a relatively new area in reading and the related areas and the results of research should be considered tentative.

Valusek[21] investigated the effect of drugs on reading disability cases in a mental institution. The sample population was forty-three children, nine to eighteen years of age, all retarded two or more years below chronological age-grade placement. The population was divided into medication and placebo (non-medication) groups. Initial and final tests including silent and oral reading tests and a battery of psychological diagnostic measures were administered to the group. Some of the drugs administered included Thorazine, Cytomel, Dexedrine and Micholyl. The author reported that there were no significant differences in oral and silent reading or psychological test performance between the medication and placebo (non-medication) groups. Unfortunately, the investigator in this experiment did not attempt to give any instruction in reading to determine if the drug might influence the on-going performance of the individual. Rather, the experimenter investigated the students' past repertoire of reading behaviors. If the subjects were retarded children, it was doubtful that their past repertoire of reading behaviors was adequate.

In another medical experiment reported by a Dr. Cameron of Abbott Laboratories, Cylert, also known as "Abbott's memory pills", was administered to a group of aging patients who had reverse hardening of the arteries which interfered with their memories. Twenty-four patients were divided into medication and placebo groups. On a seven-item memory test, the Cylert group showed a significant improvement in memory for visual presentation.

It has been reported further that at the University of Michigan, Dr. John Burns has been testing healthy subjects to determine whether Cylert

can improve the normal memory of the young; and/or whether it increases the power to acquire knowledge; and, if so, whether such increased power persists. This kind of medical research appears to indicate there is wider concern for the problem of educators than previously thought.

C. SUMMARY

No simple summary of the promising behavioral research in reading is possible because of the varying types of data. Nevertheless, one can indicate why this kind of research is promising. It is one of the first attempts to apply basic scientific techniques, derived in the laboratory, to practical learning problems. Secondly, these research studies are concrete evidence of an effort to bridge the gap between learning theory and practical application of the theory.

Present, also, in these research efforts is evidence of a true interdisciplinary attack on important educational problems. No longer, it seems, will the educator work in isolation on common educational problems. But, if these investigations are indicative of things to come, educators will have the assistance and direction of theoretical learning psychologists, medical doctors, and educational engineers.

Finally, this type of research is promising because it is directed toward behavioral change — the essential task of every educator.

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