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REPORT OF THE FOURTH RESEARCH PLANNING CONFERENCE HELD UNDER THE AUSPICES OF PROJECT LITERACY IN PRINCETON, NEW JERSEY, DECEMBER 11-13, 1964--PROJECT LITERACY REPORTS, NO. 4.

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REPORT NUMBER CRP-F-034-4   PUB DATE   DEC 64
REPORT NUMBER BR-5-0617-4
CONTRACT OEC-4-10-113
EDRS PRICE MF-$0.18 HC-$2.36   59P.

DESCRIPTORS- *READING, *LITERACY, *LANGUAGE DEVELOPMENT, *COGNITIVE DEVELOPMENT, ITHACA, NEW YORK, PROJECT LITERACY

PROVIDED IN THIS REPORT ARE COMPLETE TEXTS OF THE PAPERS PRESENTED AT THE FOURTH RESEARCH PLANNING CONFERENCE OF "PROJECT LITERACY." THE CENTRAL THEME OF EACH PAPER IS BASIC RESEARCH AND/OR CURRICULUM DEVELOPMENT IN AREAS OF EDUCATION RELEVANT TO THE ACQUISITION OF READING SKILLS. TITLES OF THE EIGHT PAPERS PRESENTED ARE (1) "RESPONSIVE ENVIRONMENTS," (2) "AN ABSTRACT OF PROPOSED RESEARCH DIRECTED TOWARD DEVELOPING SELF-INSTRUCTIONAL READING PROGRAMS," (3) "EMPIRICAL DEVELOPMENT OF A BEGINNING READING SKILL," (4) "COMPUTER-BASED INSTRUCTION IN INITIAL READING," (5) "BEGINNING READING--AN ECLECTIC PHONIC APPROACH," (6) "A FRAMEWORK FOR THE ANALYSIS OF EARLY READING BEHAVIOR," (7) "EFFECTS OF COMPENSATORY PRESCHOOL PROGRAMS," AND (8) "PROPOSAL FOR STUDY OF VARIOUS ASPECTS OF TEACHING EFFECTIVENESS WITH CHILDREN OF DIFFERING CHARACTERISTICS." (JH)

REPORT OF THE

FOURTH RESEARCH PLANNING CONFERENCE

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CONTENTS

RESPONSIVE ENVIRONMENTS

Omar Khayyam Moore
Rutgers University

The Responsive Environments Project, which is the topic under discussion here, is an interdisciplinary effort involving the close cooperation of specialists representing four distinct areas of competence: the behavioral sciences, education, engineering, and the formal sciences.

The goal of the Project:

(A) from the standpoint of its behavioral scientists, is to formulate and test a broad theory of human higher-order problem solving and social interaction. A number of papers are now available (or forthcoming) which report the progress made thus far in this direction (1)(2)(3)(4)(5)(6)(7)(8)(9).

(B) from the standpoint of its educators, is to test new learning environments in the context of public and private schools, and institutions devoted to exceptional children. Thus far, programs have been run in seven places:

(1) Boston University, Department of Special Education, Dr. Burton Blatt.

(2) Freeport, Long Island public schools, Dr. John Martin, now superintendent of the Mount Vernon, New York, public schools.

(3) Hamden Hall Country Day School (private), Edward I. McDowell, Jr., now president of the Responsive Environments Foundation, Inc., 20 Augur Street, Hamden, Conn.

(4) Mary Imogene Bassett Hospital in Cooperstown, New York, Mary and Campbell Goodwin, M.D.s in pediatrics.

(5) New York City's Harlem's P.S. 175, Dr. Edward G. Bernard, President, The Council of Directors, Board of Education of the City of New York.

(6) The Responsive Environments Foundation, Inc., Joseph R. Dunn, Jr., Administrative Director of Research, 20 Augur Street, Hamden, Conn.

(7) Trenton, New Jersey Settlement House, Dr. David Rosenhaun of the Educational Testing Service, Princeton, New Jersey.

Studies conducted at each of the locations mentioned above differ in terms of focus of interest, design of research, and duration of project. These investigations taken collectively range over children from the top to the bottom of the social class system, from the physically sound to the physically handicapped, from the gifted to the educable retardate, from the school drop-outs to two-year olds. Reports are now available pertaining to work at the various locations. At the moment a complete bibliography is not available and the best procedure is to write to the person in charge.

(C) from the standpoint of its engineers, is to design, test and make production models of semiautomated and automated learning devices which satisfy the following criteria:

(1) they permit the learner to explore freely.

(2) they inform the learner immediately about the consequences of his actions.

(3) they are self-pacing, i.e., events happen within the environment at a rate determined by the learner.

(4) they permit the learner to make full use of his capacity for discovering relations of various kinds.

(5) their structure is such that the learner is likely to make a series of interconnected discoveries about the physical, cultural or social world.

The first major product of the engineering team is E.R.E., the Edison Responsive Environment--the talking typewriter. A patent has been issued for this invention and other patents are pending (10)(11).

Inquiries about E.R.E. should be directed to Norman Kriesman, The Responsive Environments Corporation, 21 East 40th Street, New York City. (None of the educators, behavioral scientists or formal scientists connected with this project have any commercial interest in the sale or distribution of the E.R.E. instrument.)

(d) <u>from the standpoint of the formal scientists,</u> is to develop new branches of formal logic that are mathematically interesting in their own right and that are likely to be of help to behavioral scientists in clarifying problems and constructing theories. Research in two branches of mathematical logic have been stimulated by the Project's work--deontic logic and the logic of entailment (12)(13)(14).

Inquiries about these developments should be directed to Professor Alan Ross Anderson (formerly of Yale; as of September 1, 1965, The University of Pittsburgh, Department of Philosophy, Pittsburgh, Pa.).

Up to the present time, most of the empirical research has been carried out with children ages 2 through 8. The basic intellectual skills that the children have acquired are reading, writing, taking dictation, and publishing newspapers. However, there are no theoretical reasons why other content areas, e.g., mathematics, foreign languages, cannot be handled in similar ways. Plans and some pilot studies have been made for widening the scope of the program to cover these other content areas.

The financial support for the research has come from many sources but the principal donors have been the Carnegie Corporation of New York, and the Office of Naval Research, Group Psychology Branch. The cost of research and development in engineering has been borne by the Thomas A. Edison Laboratory at West Orange, New Jersey, a division of the McGraw-Edison Company. Inquiries pertaining to engineering should be directed to Mr. Richard Kobler, Manager.

I serve as the general director of the Project. (Presently, Rutgers University, Department of Psychology, New Brunswick, New Jersey. As of July 1, 1965, University of Pittsburgh, Department of Social Psychology, Pittsburgh, Pa.)

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AN ABSTRACT OF PROPOSED RESEARCH DIRECTED TOWARD DEVELOPING SELF-INSTRUCTIONAL READING PROGRAMS

Douglas Porter, Helen Popp, and Joann Robinson
Harvard University

Objectives

The major objective of the proposed research is to develop a set of self-instructional reading programs that will teach essentially all individuals who meet specified program entry requirements. General increase in the average reading skill of a group is not the objective, rather, uniformly high standards of performance are sought in each and every individual.

Programs will start at the pre-reading level and attempt to take individuals to the point of "independent" reading. "Independent readers" are defined as individuals who have attained a level of skill and interest in reading which can be maintained and increased from that point on by the contingencies of the usual school and community environment.

In order to maximize the usefulness of the programs with diverse populations such as adult illiterates, children from backgrounds far different from those used in the developmental activities, and non-native English speakers, certain special features will be incorporated:

a) Entry requirements -- insofar as possible, entry requirements will be minimal and will consist only of those behaviors likely to be in the repertoires of individuals from a wide range of cultures and of diverse abilities. b) Flexible entry -- assessment procedures will be developed that will make it possible to place individuals into the programs despite having started instruction under different systems. c) Metastable procedures -- instructional procedures will be designed to be as little subject to the accidents of individual teachers and situations as possible.

To the degree that it has been possible to develop programs with the above special features, they should be relatively successful with many sub-groups of individuals under a variety of circumstances.

Procedures

Basic research in reading is not proposed: knowledge for its own sake will not be pursued; interesting side-issues will not be followed; experimentation will not conform to the conventional experimental-control group paradigms of hypothesis testing. Rather, there will be deliberate application of behavioral technology to a specific job. This is not to deny that there are many unresolved issues in the relevant areas of child development, linguistics, reading methodology, and psychology, but such issues will be dealt with only insofar as they bear directly on the task at hand and where current knowledge does not provide adequate guidelines for action.

Developmental Research. In general, detailed behavioral analyses will be made of various aspects of reading performance. Initial program segments will be developed from these analyses and tried on suitable subjects. Trial of the segments, revision, re-trial, and so on, will continue until each program segment produces a uniformly high level of student performance. These initial program segments will provide the baselines upon which subsequent segments will be developed. The success of later program segments, and the entire set of programs, will depend upon the degree to which the earlier segments teach consistently what they are designed to teach. In other words, a final program of many segments will be built-up through a series of successive approximations in which success of the later sections will rest upon perfections of prior sections. Within each section, student performance will be clearly analyzable and perfectible because disrupting differences in the degree of student preparation (commonly found in conventional instruction) should be non-existent.

Such programs of experimentally demonstrated validity will be constructed through the careful and systematic application of sophisticated behavioral analysis and technology.

Field Validation. Relatively large segments of the programs developed according to the above carefully controlled procedures will be validated by "field testing" the materials under the relatively uncontrolled conditions of practical use. Two aspects of the proposed validation activities are of special interest: follow-up of students to determine success in producing "independent readers" and trials of the programs on special populations not used in the program development (e.g. adult illiterates, children from deprived backgrounds, the mentally defective, and certain non-native English speaking groups). To the degree that it has been possible to develop programs with the special features (a,b, & c), described above, the programs should be relatively successful with such groups. To the degree that such trials are not successful, data will be made available for further development of suitable programs.

End Products. The major product will be a set of self-instructional reading programs along with supporting validation data that specify the results to be expected from use of the programs on specified populations. The necessary instructions for program administration, including detailed diagnostic and criterion measures for guiding students through the programs according to their individual requirements, will accompany the programs.

(A series of journal articles is anticipated describing the program rationale and presenting details and data from the experiments undertaken during program development. A final report, in the typical sense of the word, is not anticipated since all relevant data and rationale will be available with the programs and in the articles planned. If such a report were desired, however, it could be readily assembled from the above materials.)

EMPIRICAL DEVELOPMENT OF A BEGINNING READING SKILL* (11)

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System Development Corporation
Santa Monica, California

The general purpose of this study was to develop a self-instructional reading program as a vehicle in identifying variables that are crucial in the design of effective materials. The specific objective of the program was to teach children to sound out and read aloud combinations of four initial consonants (f, r, s, and m) and four vowel-consonant word-endings (an, it, at, and in). The sample consisted of children from the lowest quartile in reading readiness in the low first grade at a school in a culturally deprived neighborhood.

The original version of the program was based on the assumption that children would automatically induce the grapheme-phoneme correspondences if given sufficient exposure to minimal pairs of the trigrams (e.g., fan-fin). The task was perceived as a sequencing problem: in what order should the words be presented? Initially words were grouped according to common endings, e.g., man, fan, ran. When confronted with a new ending, such as fit, the child tended to respond with fan, since he had learned with the previous word group that it was sufficient to respond only to the first letter. Grouping words according to common initial letters, e.g., fit, fat, fan, resulted in high error rates and accompanying avoidance behavior. Discrimination items were then inserted that required the child to distinguish word pairs differing on the following letters: the first, last two, final, and then the middle ones, in that order of difficulty. This proved

* The research reported herein was conducted under a grant from the Office of Education, U.S. Department of Health, Education and Welfare.

only moderately helpful, so a new cumulative sequencing procedure was used. Each new word was contrasted with all preceding words and then added to the list. This technique yielded increasingly larger repetition intervals as one proceeded through the list.

Since criterion performance (the ability to read novel combinations that had been excluded from the program) was still not obtained with the latest version of the program, a different strategy was tried. The trigram elements (initial consonants, and vowel-consonant endings) were taught explicitly; it was no longer assumed that the children would automatically induce the letter-sound relationships. The sounds of the beginning letters and the vowel-consonant word-endings were taught independently. But teaching the children to blend or amalgamate the elements to produce the whole word was very difficult.

A wide variety of techniques were tried such as: repartitioning the words at the final consonant, gradually increasing the time interval between the presentation of the sound elements while children responded with the pronunciation of the whole word, and using cardboard aids. A rhythmic sound game proved effective in bringing children's word pronunciations under control of their phoneticization of the word elements. However, they still could not read the novel criterion words.

The transfer problem was finally solved by giving the children practice at unlocking novel combinations (other than the criterion words) within the program. If children had difficulty with these "novel-words-within-the-program," they were branched to remedial exercises designed to assist them in generalizing the decoding skill to the word pattern that was giving them trouble. This procedure was effective and two/thirds of the children subsequently read at least three of the four criterion words.

Three hypotheses were obtained from the empirical development of these materials and were subsequently verified with another set of material and with a different age group:

1. All skills comprising the instructional objective must be developed <u>explicitly</u> within the program.

2. Directions and items requiring responses that are irrelevant to the instructional objective should be eliminated from the program.

3. The child should not be permitted to continue through a program until subskills in previous segments of the program have been completely mastered.

It was proposed that the empirical development of self-instructional reading materials using the iterative procedures described in this study be extended to include letters, words, and sentences.

COMPUTER-BASED INSTRUCTION IN INITIAL READING (14)

Duncan Hansen
Stanford University

The intent of the project is to explore the manipulative variables that affect reading performance in the primary grades. The experimental work will take place within the confines of a computer-based instructional system. The computer system will provide for complete control of the stimulus materials (audio and visual) via specified performance criteria embedded in the decision network of the program; it also will permit detailed recording of all the students' responses and response times. These fine-grained behavioral histories will be of sufficient duration so that a normative description of initial reading behaviors will be possible. It is anticipated that these empirical findings will provide the basis for the development of quantitative learning models that can describe and interpret the initial reading behaviors in terms of the variables incorporated into both the stimulus materials and the programming structure.

Description of the Stanford computer-based instructional system

This system consists of a medium sized computer and six instructional booths. Each booth is a small 7' x 8' room that contains three input-output devices: (1) an optical display unit, (2) a cathode-ray tube display unit, and (3) an audio system. The main computer controls the presentation of the visual and auditory materials; the students respond with either a light-pen device, a typewriter keyset, or a microphone. The computer evaluates the responses and selects new audio and visual material according to the outcome of the evaluation.

The optical display unit is a rapid, random-access projection device that presents visual material to the student on a 10" x 13" screen. The source of the materials (any 8-1/2" x 11" page of text) is photographed on microfilm and is stored in a small projector cell that has a capacity of 256 pages. Since each display unit has two projectors, each instructional unit has a total capacity of 512 individual pages. Moreover, additional combinations are possible by constructing composite images from both projectors on the common screen or by using the shutter system that divides the screen into eight equal sections by various masking arrangements. The student responds to the display and sends information to the computer with a light-pen. As the pen is touched to the screen, the coordinates of the position are sent to the computer for evaluation according to predefined areas of correct and incorrect responses. Most of the evaluation operations of the optical display unit will occur in approximately one second.

The cathode-ray tube display unit, commonly called a "scope," can present any of 120 prearranged alpha-numeric characters or line vectors on a 10" x 10" screen. A light pen is available for sending information to the computer for evaluation via the specified coordinate system as described for the optical display device. In addition, a typewriter keyboard is attached to each scope and may be used to send information from the student to the computer.

The random-access audio system can play any prerecorded message to the student. The messages are recorded on a 6" wide magnetic tape. Two tape transports are available to each instructional booth. Each transport has a capacity of approximately 17 minutes that can be divided into any combination of message lengths from 1020 one second messages to one message of 17 minutes duration. The student may record onto the tape and then have the recording played back for comparison purposes or retained as response data. The random-access time to any stored message is less than two seconds.

The various control and switching functions between the different input-output terminal devices are handled by a medium sized computer that has a 16,000 word core memory. An additional 4000 word core can be interchanged with any of 32 bands of a magnetic memory drum. All input-output devices are proceeded through a time-sharing program that services them only when necessary. Two high speed data channels permit simultaneous computation and servicing of terminal devices. Additional back-up in computational power, storage, and increased input-output speed is obtained through connections to a larger computer system located at the Stanford Computational Center.

We are now in the process of developing a similar computer-assisted instructional system that will be located in an elementary school. Sixteen instructional stations will be available on the school site. The main computer will be located on the Stanford campus. Telephone lines will be utilized for transmission of information between the computer and the terminals. We plan to provide instruction for approximately 90 students per day with this system.

Current and proposed research activities

The predominant activity of the project during the recent months has been the planning and preparation of reading materials for the computer system. This includes the visual display pages and the audio script necessary for the extensive branching structure planned for each reading lesson. Instead of attempting an extensive description of these reading lessons, a brief resume of the experimental variables that we plan to incorporate into the lesson materials will give a better sense of the project's activities and plans.

Criteria for word mastery. We plan to study the relationship between word mastery and four types of dependent measures: 1) specific correct or error responses to a word in a given lesson, 2) latencies of responses, 3) relative frequencies of correct or error responses to a homogeneous class of words, and 4) sequences of correct and error responses. Numerous combinations of these four dependent measures can be incorporated into the decision structure of the program at various branching points for the purpose of controlling the level of mastery of a given word. In calculating these dependent measures for each individual student and in utilizing them to determine the student's path through the lesson material, one can begin to assess the amount and type of repetition necessary for stipulated levels of mastery. Moreover, the degree of learning may continue to be sensitive to latencies after the student has begun a long sequence of correct responses to a given word (i.e., we have latencies data from young children in a paired-associate task that indicates the continued decrement of latencies even after a given S-R pair has been correctly mastered). Thus we plan to investigate how these four dependent measures reflect different stages in learning in order to gain some understanding of the relationship between repetition and word mastery.

Optimum presentation strategies. The investigation of optimal presentation strategies through the use of mathematical learning models has been a recent theoretical development (Dear and Atkinson, 1962). The typical situation involves teaching a list of words where only a fixed number of presentation is allowed. Contrasting presentation strategies can be formulated in terms of the assumptions about the terminal reward structure and a given learning model. For example, one can distribute the practice equally over all the words or distribute it according to some function defined over the previous response history. Different theoretical formulations about the acquisition and retention processes dictate different presentation strategies. We plan to test a number of different optimization strategies on various word lists that will be included in the lesson material.

Word recognition acquisition rates. A current longitudinal study (Suppes and Hansen, in press) on the acquisition of mathematical concepts by a homogeneous group of bright primary-level students indicates a surprising variation of learning rates. We expect to find similar variation in word recognition rates when students are allowed to proceed at their own pace through the reading curriculum. A more important aspect of acquisition concerns the variations of rates over different classes of words (e.g., how much do the acquisition rates decrease when a child must learn words with vocalic digraphs like year, read, deaf, etc.). Developments in this area may provide behavioral basis for scaling the relative difficulty of certain word classes.

Linguistic units in the initial vocabulary. We have in progress a number of experiments that deal with the relative difficulty of certain graphemic sequences. For example, are final consonant clusters more difficult than clusters in the initial position (e.g., trap vs rapt or stop vs pots)? Do consonant reversals in contrasting words pose a serious learning problem (e.g., pin - nip or tub - but)? Are the letter-to-sound variations due to pre-and-post vocalic "r" (e.g., brad vs bard) a serious learning task? Experiments like these will allow us to assess the relative contribution of proposed linguistic propositions about letter-to-sound correspondence rules, the phono-tactic restrictions of consonants and vowels in words, and the influence of morphophonemic transformation rules.

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BEGINNING READING: AN ECLECTIC PHONIC APPROACH (21)

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University of Pittsburgh

It is widely accepted that the number of stimuli presented to beginning readers should be limited or controlled in some fashion. Even Levin and Watson (1963) in their investigation of the "set for variability" hypothesis state "we still would be reluctant to say that the total range of variation should be imposed on the beginning reader at the same time." Control may be gained by limiting graphemes (e.g., Gibson-Richards-MacKinnon), by limiting phonemes (e.g., Buchanan-Sullivan), by limiting number of words (e.g., Scott Foresman readers), or by introducing special stimuli that regularize the grapheme-phoneme relationships (e.g., Pitman's ITA or Gattegno's sound-color system). The proposed system represents an eclectic approach drawing from each of the above and adding certain modifications to facilitate transfer from the special symbols to the standard English orthography.

The proposed symbol system is presented in Table 1. Although it greatly resembles the Pitman system, it differs in the following ways:

1. It is closer to the standard orthography than is the ITA.
2. Fewer symbols are used.
3. Standard orthography is altered to make the symbols more discriminable from one another.
4. No symbol is a mirror image of any other symbol. Nor would any symbol be a mirror image of another if the table were rotated 90°.
5. Special symbols generally correspond to sounds which occur infrequently and in every case bear some resemblance to the "usual" spelling of a particular sound.

Superimposed upon the above system to facilitate transfer from reading in the special orthography to reading in the standard orthography would be a color system where each vowel, diphthong, and certain phonemes which are spelled in a variety of ways would be presented in a specific color. Also, very early in the training procedure, the child would be taught that empty letters, e.g., b , are silent. Thus, if the thirty-first entry, ae, in Table 1 were colored green, a child might learn to read the word GATE as follows:

	(green)
Stage 1:	gaet
	(green)
Stage 2:	gate
Stage 3:	gate

The word EIGHT would be taught:

	(green)
Stage 1:	aet
	(green)
Stage 2:	aeghat
	(green)
Stage 3:	eight
Stage 4:	eight

Early in the training phase, the child would be taught that color is primary so that this method would not teach explicitly all specific sound-symbol combinations, as in the Gattegno system, but rather the color would be expected to act as a mediator in the new learning situation.

In addition to the special symbols, it is proposed that the difficulty of the initial reading tests be further reduced by controlling the introduction of stimuli. The practical alternatives here are phonemes, graphemes, bigrams, trigrams, syllables, and words. Although the frequency of elements in these categories are correlated, the relationship is less than perfect and complete simultaneous control is not possible. Maximum transfer to the "real world situation," for example reading the newspaper, could probably be accomplished by teaching the most frequent elements from each of the above categories first. In the total system, this would result in the child being introduced first to a few phonemes (see Tables 1 and 2) where words are presented in the standard orthography, with which he already has some familiarity, and gradually he would be introduced to the rarer phonemes which are characterized by the special orthography.

The following questions would be most relevant before the system is finalized:

1. What weights should be attached to the various possible frequency controls?

2. At what rate should new material be introduced?

    a. graphemes (special)
    b. phonemes
    c. irregular spellings (color coded)
    d. standard orthography
    e. reading vocabulary

3. What physical characteristics will make graphemes most discriminable?

4. What role should stimulus predifferentiation play in the learning procedure?

5. What kinds of pretraining would facilitate early reading?

6. What mechanical devices or techniques can be produced to facilitate blending?

7. What facilitation can be brought about by context?

Table 2. Rank of letter frequency in prose material. Data from Baddeley (1960)

Rank	Letter
1	E
2	T
3	A
4	O
5	I
6	N
7	S
8	R
9	H
10	L
11	G
12	D
13	C
14	M
15	U
16	F
17	P
18	W
19	Y
20	B
21	V
22	K
23	X
24	Q
25	J
26	Z

Table 1. Special orthography and relative frequency of associated phonemes. Phoneme frequency averaged from Dewey (1923) and Tobias (1959).

a	b	c	d	e	f	g	h	i	j
bat	bat	cat	dog	get	fat	get	hat	bit	jet
3.3	1.63	2.83	4.05	3.10	1.69	1.07	1.65	8.88	0.36

l	m	n	o	p	r	s	t	u	v
log	mat	net	on	pat	rat	sat	at	up	vat
3.66	2.97	7.09	2.06	1.71	6.12	4.15	8.12	2.33	2.02

w	y	z	wh	ch	th´	th	sh	ng	au
wet	yet	zip	white	chat	thick	that	ship	sing	paw
2.41	1.50	2.55	0.20	0.42	0.59	3.53	0.66	1.12	2.48

ae	ee	ie	oe	ue	oo	o͞o	ou	s´
hate	eat	by	doe	use	book	spoon	out	vision
1.89	1.99	2.10	1.62	0.31	1.12	1.20	0.63	0.02

a´	oi
sofa	oil
6.61	0.07

A FRAMEWORK FOR THE ANALYSIS OF EARLY READING BEHAVIOR 1/

Wells Hively
University of Minnesota

This paper presents a rough classificatory scheme in which the behavior of elementary reading is broker down into a set of interrelated "repertoires" along the general lines of B. F. Skinner's analysis of Verbal Behavior (Skinner, 1957).

Tables 1 and 2 present the basic categories in the taxonomy. The glossary preceding Table 1 explains the symbolism used in the tables. The general scheme is based upon a distinction between referents and symbols. A referent is a nonverbal stimulus: a physical object or event. A symbol is a word or sequence of words. In the present scheme there are two kinds of symbols: spoken and written. Symbols may, of course, occur as stimuli or as responses. A symbol is a verbal stimulus, and a response which produces a symbol is a verbal response. Pointing to a symbol is also a verbal response. Pointing to a referent is considered to be a nonverbal response, and responses which produce objects or events which match referents in one or more properties are also considered to be nonverbal. The basic elements of the taxonomy are thus referents, spoken symbols, and written symbols, and behavior is classified according to the combinations in which these can occur as stimuli and as responses. Each of the nine resulting categories is in turn subdivided into two general types of tasks: selection, or multiple-choice tasks, and free, or constructed-response tasks. These yield the eighteen classifications

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1/ This is an abridged version of a longer paper available, upon request, from Project Literacy.

shown in Tables 1 and 2. "Matching" tasks are collected together in Table 1 and "Association" tasks in Table 2.

Figure 1 shows examples of matching tasks which involve nonverbal stimuli and responses, that is, the stimuli are referents and the responses produce objects or events which match them in one or more properties (A-A, Table 1). Shown in the figure are representative items drawn from sets of items which might define various kinds of behavior falling within this general category. In the multiple-choice tasks the sample is displayed at the top. The instructions are phrased in such a way as to indicate the task as clearly as possible to the present reader. In practice, the context and previous training would probably result in the use of instructions which are more elliptical. Although pictures are used as referents in these examples, other tasks might involve actual objects, models, movies and so forth as nonverbal stimuli.

There are many kinds of behavior in this large and fascinating category. Subjects can be required to select or produce matching objects according to various properties or dimensions such as color, shape, size, spatial relations, weight, etc., while other properties are allowed to vary. Auditory stimuli can be matched on the basis of such properties as pitch, rhythm, tone-color and so on. (The task of repeating words in an unknown language falls into this same subgroup.) Complex objects can be matched on the basis of zoological and biological classifications. Note that imitation and mimicry are also in this category.

Figure 2 shows some examples of matching tasks involving written or spoken symbols (a-a and <u>a-a</u>. Table 1). In the first three lines of the figure are tasks of varying complexity involving written symbols. The bottom line of the figure shows a corresponding set-up for spoken symbols. In general these tasks have to do with matching graphemes and sequences of graphemes or phonemes and sequences of phonemes.

Figure 3 shows examples of association tasks which involve nonverbal stimuli and written or spoken responses (A-a and A-$\underline{a}$, Table 2). Lines 1 and 2 of the figure show tasks in which the responses are written out at two quite different levels of complexity. Line 3 shows the spoken response task which is parallel to the written response task in line 2. Tasks such as those shown in lines 2 and 3 offer excellent opportunities to study multiple control by verbal and nonverbal stimuli.

Figure 4 shows examples of association tasks involving written or spoken stimuli and nonverbal responses (a-A and $\underline{a}$-A, Table 2). Again, the spoken cases in line 3 parallel the written cases in line 2. This kind of material is closely related to conventional tests of paragraph comprehension.

Figure 5 shows examples of association tasks involving written and spoken stimuli and responses (a-$\underline{a}$, and $\underline{a}$-a, Table 2). In line 1 the stimuli are written and the responses spoken. In line 2 the stimuli are spoken and the responses written.

Figure 6 shows a schematic diagram in which some of the interrelationships among these types of tasks, or classes of behavior, can be examined. In this diagram, the multiple-choice and free-response tasks have been thrown together, leaving nine categories based on the classifications of stimuli and responses (Tables 1 and 2). Tasks in which the responses fall into the same category have been tied together to form small triangles, and these have been arranged so that the symmetrical tasks - those in which the stimuli of one task are the responses of the other and vice versa - are placed close together. This leaves the matching tasks at the outside corners of a large triangle composed of the three smaller triangles. The right-hand side of the large triangle thus includes categories of behavior which are involved, in general, in speaking and listening. For example, a small child learns to sort and classify referents (A-A); to point to, or produce, referents under the control of spoken instructions (a-A); to name and describe referents (A-a); and to echo spoken symbols (a-a). The left-hand side of the large triangle is symmetrical with the right but involves written symbols rather than spoken symbols. (There is thus a strong analogy between the deaf-mute child learning to read and the normal child learning to speak.) The base of the large triangle includes categories of behavior which are involved in transcription from spoken to written symbols and vice versa.

The categories of behavior which are diagrammed as pairs of circles at the midpoints of the sides of the larger triangle are those which are ordinarily considered as most important in reading. Taken together, the pair at the left and the pair at the bottom constitute the general classes of criterion behavior for reading. The pair at the right defines behavior which is assumed as prerequisite in most reading programs.

Many kinds of behavior, which have been placed in different categories in the model, are shaped at once by the contingencies of reinforcement in the "natural environment" which establish the complex repertoire of the normal speaker, listener, and reader. The program of research suggested by the model involves attempts to set up these (hypothetical) sub-components in isolation and to observe their interactions with one another. To take "reading behavior" apart, in other words, and put it back together. For example, in the natural environment the repertoires of the speaker (A-a) and of the listener (a-A) are probably never developed separately, but it might be possible to separate them in the laboratory. One might train a subject until he had acquired a small repertoire of the form a: A,B (that is until he could choose among referents under spoken instructions). One might then test to see to what extent he automatically, as a result of such training, had acquired the repertoire of the form A: a,b (choosing among the spoken symbols in the presence of the referent). One might also test the repertoire of the form A→ a, B→ b. The latter depends for its existence upon a previously established echoic repertoire (a→a, b→ b) and one could test or teach it as part of the experiment. A similar experiment would concern "transfer" in the reverse direction.

It is instructive to compare the elements in the foregoing experiments with their counterparts on the left-hand side of the triangle (Fig. 6) where the symbols are written rather than spoken.

One can, of course, design miniature programs of instruction to set up specific, isolated repertoires of behavior. This activity is closely related to the above research. Beyond this, the model suggests other possible programs based on transfer of stimulus control (c. f. Skinner, 1957, p. 67). A previously established stimulus is used to evoke a given response in the presence of new stimulus. The response is then reinforced, and control is shifted to the new stimulus. If, for example, a child can echo spoken words, one can present a written word in conjunction with a spoken word and thus evoke the spoken response in the presence of the written stimulus.

During subsequent training the spoken stimulus may be removed and the text comes to control the spoken response. The general paradigm for this transfer of stimulus control may be diagrammed as follows:

	Diagram	Example
Step 1:	$\underline{a} \rightarrow \underline{a}$	Stimulus: say "mad" Response: mad
	$\underline{b} \rightarrow \underline{b}$	Stimulus: say "sad" Response: sad
Step 2:	$\{\underline{a}, a\} \rightarrow \underline{a}$	Stimulus: [This is the word "mad"; say it. MAD]
		Response: mad
	$\{\underline{b}, b\} \rightarrow \underline{b}$	Stimulus: [This is the word "sad"; say it. SAD]
		Response: sad
Step 3:	$a \rightarrow \underline{a}$	Stimulus: [Say this word MAD]
		Response: mad
	$b \rightarrow \underline{b}$	Stimulus: [Say this word SAD]
		Response: sad

The transfer of control in this diagram can be seen in Figure 6 as a "move" from the lower right-hand corner to the lower left-hand corner of the spoken-response triangle. Some programs of this type have been studied by Popp and Hively (Hively, 1964).

The general paradigm for transfer of stimulus control may be applied to "moves" between any two connected points in the diagram of Figure 6. Such programs may be used for analytical, or for practical, purposes. Few of them have been systematically investigated. Some relevant methodological problems are discussed elsewhere (Hively, 1964).

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Glossary

Capital letters represent nonverbal stimuli (referents).

Lower-case letters represent verbal stimuli (symbols).

Underlined letters represent spoken symbols.

Letters not underlined represent written symbols.

A colon is used to indicate a multiple-choice task. For example, in the situation represented by "<u>a</u>: A, B", the subject chooses between nonverbal stimuli A and B in response to spoken stimulus <u>a</u> (Fig. 4).

An arrow indicates a free response task. For example, in the situation represented by A→<u>a</u>, B→<u>b</u>, the subject emits spoken response <u>a</u> in the presence of nonverbal stimulus A and <u>b</u> in the presence of B (Fig. 3).

A dash indicates a general classification based only upon properties of the stimuli and responses. To compose a particular task the dash must be transformed into a colon or an arrow. For example, the category a - a consists of tasks in which stimuli and responses are written symbols: this category includes both a: ab and a→ a, b→b, (Fig. 2).

Table 1

Matching Tasks

General Stimulus and Response Classifications	Multiple-choice Tasks	Free-response Tasks
A - A Nonverbal stimuli and nonverbal responses.	A: A, B Matching-to-sample with nonverbal stimuli.	A→A, B→ B Stimuli are nonverbal. Responses produce objects or events which match stimuli in one or more properties.
a - a Written stimuli and written responses	a: a, b Matching-to-sample with written symbols	a→a, b→ b Copying written symbols
$\underline{a}$ - $\underline{a}$ Spoken stimuli and spoken responses	$\underline{a}$: $\underline{a}$, $\underline{b}$ Matching-to-sample with spoken symbols	$\underline{a}$→$\underline{a}$, $\underline{b}$→ $\underline{b}$ Echoic speech

Table 2

Association Tasks

General Stimulus and Response Classifications	Multiple-choice Tasks	Free-response Tasks
$A - \underline{a}$ Nonverbal stimuli and spoken responses	$A: \underline{a}, \underline{b}$ Selecting broken symbols to fit referents	$A \rightarrow \underline{a}, B \rightarrow \underline{b}$ Producing spoken symbols in the presence of referents.
$\underline{A} - a$ Nonverbal stimuli and written responses	$A: a, b$ Selecting written symbols to fit referents	$A \rightarrow a, B \rightarrow b$ Producing written symbols in the presence of referents.
$\underline{a} - A$ Spoken stimuli and nonverbal responses	$\underline{a}: A, B$ Selecting referents to fit spoken symbols	$\underline{a} \rightarrow A, \underline{b} \rightarrow B$ Stimuli are spoken symbols. Responses produce objects or events which match <u>referents</u> in one or more properties.
$a - A$ Written stimuli and nonverbal responses	$a: A, B$ Selecting referents to fit written symbols	$a \rightarrow A, b \rightarrow B$ Stimuli are written symbols. Responses produce objects or events which match <u>referents</u> in one or more properties.
$\underline{a} - a$ Spoken stimuli and written responses	$\underline{a}: a, b$ Selecting written symbols to fit spoken symbols	$\underline{a} \rightarrow a, \underline{b} \rightarrow b$ Spoken-to-written transcription
$a - \underline{a}$ Written stimuli and spoken responses	$a: \underline{a}, \underline{b}$ Selecting spoken symbols to fit written symbols	$a \rightarrow \underline{a}, b \rightarrow \underline{b}$ Written-to-spoken transcription

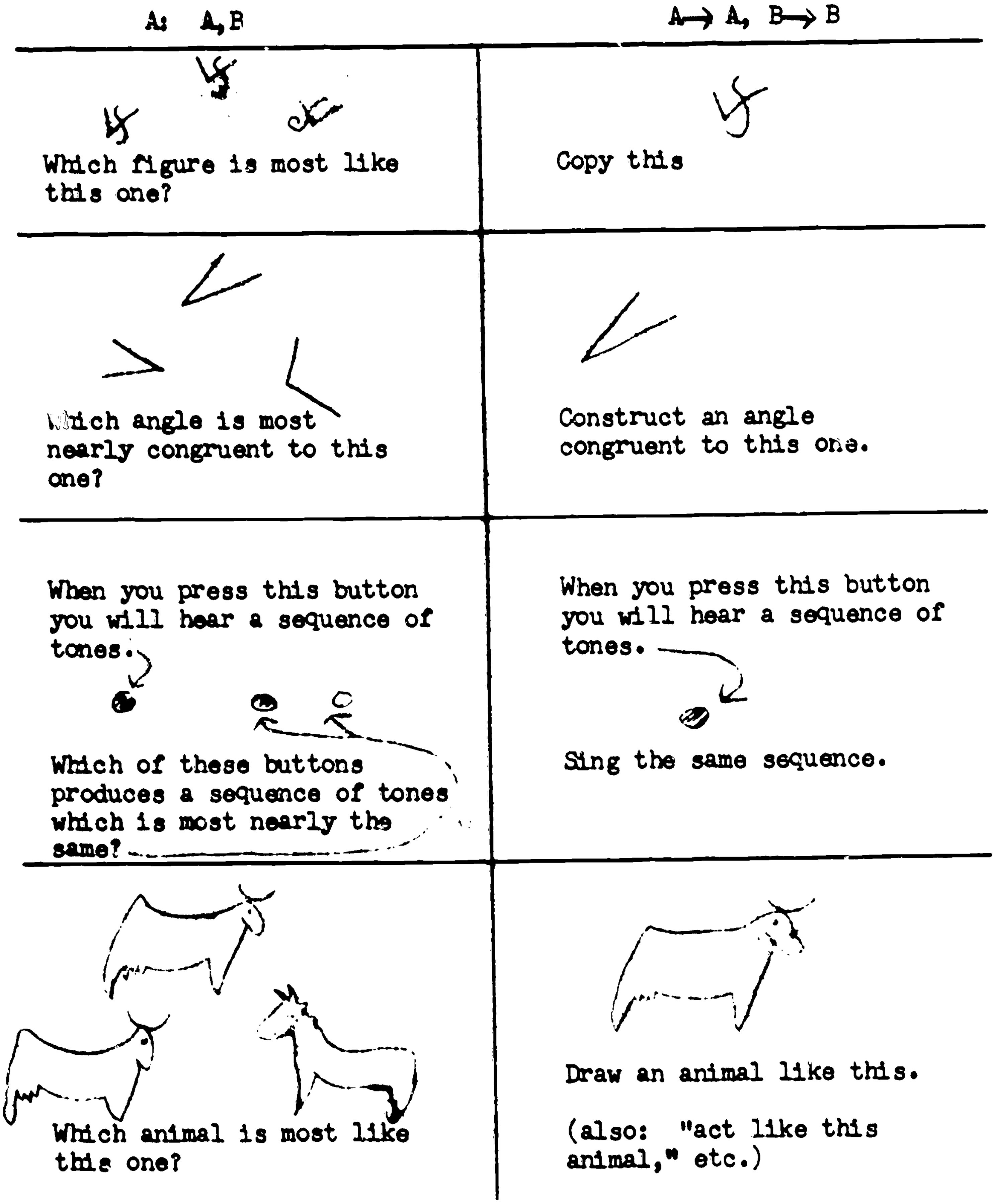


Figure 1: Examples of matching tasks involving nonverbal stimuli and nonverbal responses.

a: a,b	a→a, b→b
E E F Which letter is the same as this one?	E Make this letter
MAT MAT MAP Which word is the same as this one?	MAT Write this word
THE BOY SAW A DOG A BOY SAW THE DOG THE BOY SAW A DOG Which sentence is the same as this one?	THE BOY SAW A DOG Write this sentence

$\underline{a}$: $\underline{a}$,$\underline{b}$	$\underline{a}\rightarrow\underline{a}$, $\underline{b}\rightarrow\underline{b}$
When you press this button you will hear an utterance. Which of these buttons produces the same utterance?	When you press this button you will hear an utterance. Repeat it.

Figure 2: Examples of matching tasks involving written or spoken symbols.

A: a, b

A→a, B→b

COW HORSE

Which word tells what kind of animal this is?

What kind of animal is this? (write the answer)

THE MAN HAS BEEN FIXING HIS CAR. HE IS DIRTY.

THE MAN HAS BEEN FIXING HIS CAR. IT IS DIRTY.

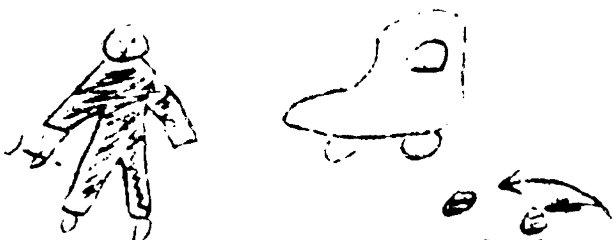
Which paragraph fits the illustration?

THE MAN HAS BEEN FIXING HIS CAR. _____ IS DIRTY.

Put in the missing pronoun. (write the answer)

A: a,b

A→a, B→b

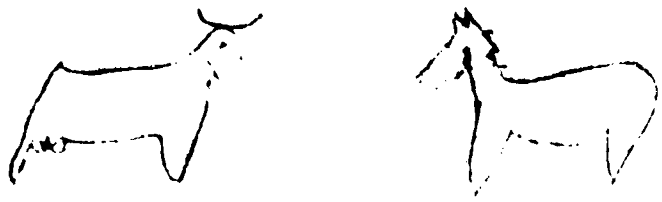
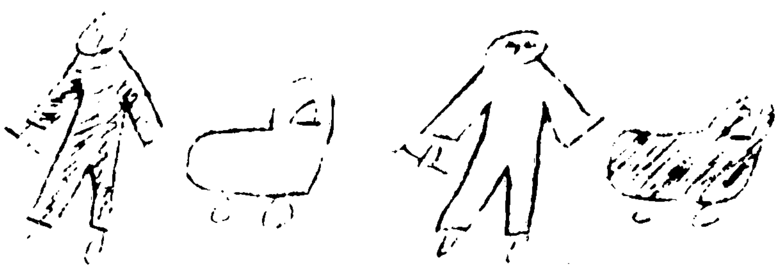


When you press one of the buttons you will hear an utterance. When you press the other one you will hear a different utterance. Which one fits the illustration?

When you press this button you will hear an utterance. Finish it.

(The man has been fixing his car. It is clean but...)

Figure 3: Examples of association tasks involving nonverbal stimuli and written or spoken responses.

a: AB	a→A, b→B
COW  find the picture that fits the word.	COW Draw one (also: "act like one," etc.)
THE MAN HAS BEEN FIXING HIS CAR. HE IS DIRTY.  find the illustration that fits the story	THE MAN HAS BEEN FIXING HIS CAR. HE IS DIRTY BUT IT IS CLEAN. draw a picture to fit this story.

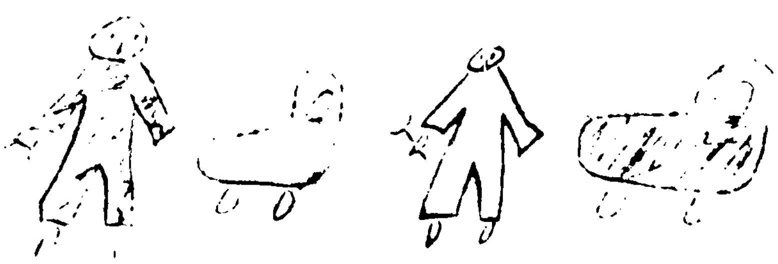
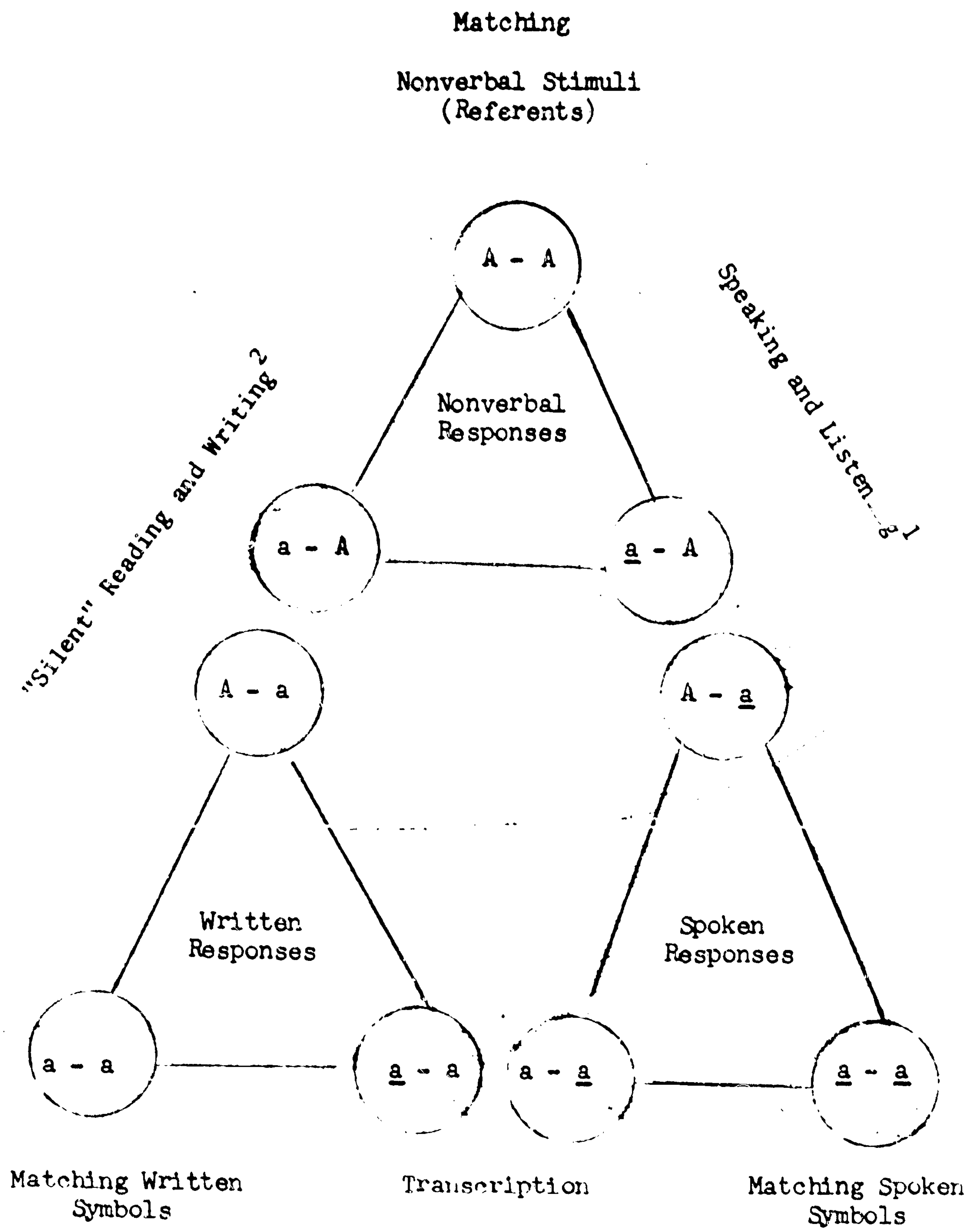
a AB	a→A, b→B
When you press this button you will hear a story. Find the illustration that fits it. 	When you press this button you will hear a story. Draw a picture to fit it.

Figure 4: Examples of association tasks involving written or spoken stimuli and nonverbal responses.

a: a, b	a→a, b→b
MAT When you press one of the buttons you will hear an utterance. When you press the other one you will hear a different utterance. Which one fits the written word?	MAT Pronounce this word.

a: a, b	a→ a, b→ b
MAT MAP When you press this button, you will hear an utterance. Which of the written words fits it?	When you press this button, you will hear a word. Write it.

Figure 5: Examples of association tasks involving written and spoken stimuli and responses.



1. First language learning.
2. Reading for the deaf.

Figure 6: Interrelationships among the tasks in reading.

EFFECTS OF COMPENSATORY PRESCHOOL PROGRAMS

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During the past year there has been an enormous surge of interest in preschool programs for children from "culturally disadvantaged" environments. The first intensive programs of this sort were launched in the fall of 1962 in Ypsilanti (Weikart, et al., 1963) and New York City (Feldmann, 1964). At about the same time a briefer and less intensive program was begun in Chicago (Strodtbeck, 1964). Progress reports from Chicago and Ypsilanti indicated average gains of five or ten points in Stanford-Binet I.Q. in experimental group children as compared with those in control groups. These results with urban, Negro, lower class children living in their own homes have been taken very seriously because they are consistent with the findings of a number of earlier studies involving either orphanage children or children with initial diagnoses of mental deficiency (Barrett and Koch, 1930: Skeels, Updegraff, Wellman, and Williams, 1938: Dawe, 1942: Kirk, 1958). The Economic Opportunity Act of 1964 makes possible federal financial support for compensatory preschool programs, and as a result hundreds and hundreds of communities are planning such programs. In July, 1964 twelve different programs were already in operation in New York State alone (Roberts, 1964).

The raging torrent of action programs is being accompanied by a slender trickle of research on their effects. All three of the action programs begun in 1962 contain some provision for continuing research on their effectiveness. The New York State Bureau of School Programs Evaluation is attempting to compare the effectiveness of the various programs now in operation in that state. No other active research projects are known to this writer, though it is probable that much planning is going on.

My own research plans call for an investigation of the effects of a program of the Ypsilanti type on Negro and white children in a small city, probably Ithaca, N.Y. The major goal of the research is to build up a body of information on the effects of a well-defined type of program on two well-defined groups of children in a carefully specified educational and community setting. The results will then be available for comparison with those achieved by other programs, with other children, in other community settings. The end result of a series of coordinated studies in this area should be a fairly solid body of knowledge regarding the short-range and long-range effects of compensatory preschool programs under a variety of circumstances.

The basic features of the Ypsilanti operation are (1) the introduction of heavy doses of direct teaching into a conventional nursery school program, and (2) regular home visits by nursery school teachers with an attempt to involve mothers in a home teaching program. In its original form this program employs one experienced nursery school teacher for every six children and involves weekly home visits planned around the current interests and intellectual development of each individual child. The general form of the Ypsilanti program is determined by two assumptions, both of which are extremely well supported in the research literature: (1) the major area of intellectual and academic deficit for the culturally disadvantaged child is language (Milner, 1951; Sexton, 1961; Barton, 1962; Riessman, 1962); (2) language skills develop mainly through sympathetic verbal interaction with a loved and trusted adult (Milner, 1951; McCarthy, 1954; Irwin, 1960).

A question of great practical importance is whether it is possible to preserve the essential features of the Ypsilanti program while reducing its operating costs. I plan to investigate a program with a ten to one child-teacher ratio. During the morning school sessions each teacher would be assisted by one or two middle class community volunteers, or by college girls enrolled in child development courses requiring extensive participation with children. Afternoons would be reserved for home visits; each one would be lengthy and carefully planned, as in the Ypsilanti program, but they would be made at bi-weekly intervals.

The simplest objective criterion of cultural disadvantage is number of school years completed by the mother. This measure correlates as well with child's I.Q. as any other index based on family background or current environmental circumstances (Jones, 1946). I would expect the relationship to be even closer between maternal education and child's school achievement, but I have not had time to search for evidence on this point. The program I am planning would involve children whose mothers had completed eight years of schooling or less, and whose fathers (if present in the home) had not attended college.

A geographical area large enough to include forty or fifty such children in the four year old age bracket is to be defined within the limits of a central city. The children are to be identified in the course of the census made by most New York State school districts each year for planning purposes. At the time of the census arrangements will be made for initial administration of the WISC and Stanford-Binet.

Two programs will actually be operated at the preschool center. The morning program, for twenty children, has already been described. An afternoon program will also be available for a maximum of twenty children. This program will be of a minimal nature, with one experienced teacher assisted by community volunteers. No home visits or parent activities will be included for children in the afternoon program. Free transportation will be provided for children in the morning program, but not in the afternoon program.

In discussing these programs with parents two major points will be made: (1) the goal of each program is to help a child to get off to a good start in kindergarten, with the expectation that this in turn will help him to do well in school later on; (2) we are trying to find out how much difference these programs make, so it will be necessary to give the children some tests before they start and leave to the school staff the decision about which program a child is assigned to. If a child is assigned to the morning program he will be expected to attend regularly throughout the year except when he is sick. If he is assigned to the afternoon program he may attend as frequently or infrequently as he and his parents wish.

Actual assignment of children to the two programs will be on a random basis, subject to frequency matching of the two groups on sex, color, and distance from the preschool center. The morning group with its twenty children will be the basic experimental group for the research. Both groups will be followed for a five year period, with individual intelligence tests repeated at the end of the first year and at the end of five years. For the experimental group there will be repeated administration of various kinds of perceptual and language tests during the nursery school program.

Records of activities in the nursery school will be kept by the teachers and by two graduate assistants. The two teachers in the experimental group will keep records of their home visits and will make systematic ratings of home atmosphere on eight or ten of the Fels Parent Behavior Scales. As the final part of the experimental program the nursery school teacher who has been working with a particular family will accompany the child's mother on her first visit to the kindergarten to which her child will be assigned during the following year, and will attempt to aid in the establishment of a good relationship with the kindergarten teacher.

Three groups of children will be available for comparison with the experimental group. First, there will be the matched children from the same neighborhood enrolled (at least nominally) in the preschool afternoon program. Second, there will be all the children in the same age bracket as the experimental group and with the same level of maternal education but living outside the district served by the preschool center. Third, there will be older children from culturally disadvantaged homes in the district served by the preschool center. For groups two and three the only test results available will be those on the group test regularly administered in the school program. Fortunately this program is an extensive one, at least in the Ithaca school system. It includes both group intelligence tests and a wide variety of achievement tests.

It is planned to continue the preschool program on the same basis for a number of years -- probably three -- to permit pooling of data for successive years. At least fifty cases will be required to enable tentative conclusions to be drawn about the effects of this particular type of program on culturally disadvantaged Negro and white children in a community without any obvious Negro ghetto.

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PROPOSAL FOR STUDY OF VARIOUS ASPECTS OF TEACHING EFFECTIVENESS WITH CHILDREN OF DIFFERING CHARACTERISTICS (49)

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The development of teaching effectiveness requires a firm undergirding of sound knowledge in a) what kinds of teacher behavior (or other instructional media) are associated with b) what kinds of learnings in c) what kinds of children. Study of the development of literacy in children of differing characteristics in terms of social class and home language experience was proposed at the conference. Three types of work were proposed as examples.

1. Language experience of socially underprivileged children:

Currently the relation of preschool children's language experience to their later school performance is of much interest. This question involves comparison of the so-called "culturally deprived" with middle-class children at the earliest stages of language development, with emphasis on the motivational origins and correlates of such development in the early years, in both family and community. One hypothesis is that patterns, or networks of thinking and communication are established by age two or shortly thereafter, and may not be easily subject to modification by primary grade teachers (four years later) who use current methods of teaching perhaps better suited to middle-class than to lower-class children. The proposed work would involve development of observational methods for measurement of young children's language interaction with parents, teachers, and peers. A good start has been made on this by Bernstein of the University of London, who, although a linguist, has made some shrewd observations of language development within the social context of the family. Also, Roger Brown of Harvard, Ruth Weir of Stanford, Robert Hess of Chicago, and Susan Gray of George Peabody, have contributed a number of provocative suggestions concerning the influence of family inspired language habits on thinking patterns. The work contemplated would extend this type of analysis to young California Negro children and their mothers and teachers. Slobin's paper in a previous report is of interest here.

2. Teacher behavior and children's divergent thinking:

What teacher behaviors are associated with gains in children's so-called "creative thinking" abilities, i.e. originality, flexibility, fluency, productivity, etc.? Earlier work (Sears, Spaulding, Sherman) has shown promising relationships between teacher behaviors and gains in divergent thinking in the children exposed to such behaviors, some of these relationships being replicated on two or three different samples. New work is needed in which experimental adoption of high frequencies of categories of behavior shown earlier to relate to divergent thinking is tested against experimentally assumed low frequencies of such categories of behavior by role-playing teachers. Further, the earlier work showed relationships of these kinds to obtain only in bright (above the class median in intelligence) children. This point needs further clarification.

Other questions in this area relate teacher behavior to other goals of elementary education in addition to so-called creativity: gains in academic achievement, attitudes toward academic activities, self-concepts, liking for other children, task-oriented classroom behavior. Techniques for measurement of these, as well as for measurement of teacher behavior, are available from the earlier work.

3. <u>Sex differences in academic achievement:</u>

There is by now clear evidence that five- to eight-year-old girls make a much readier adjustment to school, and achieve considerably more, than boys at the same ages. However, a recent study (McNeil, Amer. Educ. Res. J., 1964, 113-121) finds boy kindergarteners learning to read equally as well as girls under auto-instructional procedures. The same boys did less well than the girls when instructed by teachers in small reading groups. Why is this, if it is indeed true? A question under this rubric involves the development of sex-appropriate behaviors as seen by children and by teachers. Various types of instructional procedures may prove beneficial. Previous research by Anastasi has provided material here. Work now progressing at Stanford, directed by Patrick Suppes and Richard Atkinson on computer based learning with different kinds of children, will be of value in this connection. This research promises to make a real breakthrough in possible provision for individual differences in instructional procedures for children of different sexes, abilities, and past experiences (including poverty of language usage).

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WHAT IS PROJECT LITERACY?

Project Literacy was organized at Cornell University on February 1, 1964, by a developmental projects award from the Cooperative Research Branch of the United State Office of Education. This project represents one of the major commitments of the Office of Education to basic research and curriculum development concerning both child and adult literacy.

The purpose of Project Literacy is to organize, in various universities, laboratories and state departments of education, research which is essential to understand the acquisition of reading skills. The major initial effort is to bring together researchers and educators from a variety of disciplines to plan research which, when taken as a whole, will give us more substantial results than any single study can provide. Each investigator in the research consortium will be completely responsible for his own activities. The project will provide mechanisms whereby the individual scientists can communicate their research strategies, problems and results to each other and when necessary they will be able to meet together. The research findings will be brought to bear on curriculum developments. When called upon, Project Literacy can provide technical research consultation. The group at Cornell University will also undertake a program of studies similar to those which will be initiated in other settings.

We believe that much current and potential research in learning psychology, visual perception, cognitive behavior, neurophysiology of vision, child development, descriptive linguistics, psycholinguistics, the sociology of educational innovation, research with culturally disadvantaged children and programmed instruction (to cite some examples) are essential to understanding literacy. Consequently, we are endeavoring to locate research interests which heretofore may not have been considered relevant to this crucial educational research area.