I N S T R U C T I O N A L D E V E L O P M E N T

A N D

B E H A V I O R A N A L Y S I S P R O G R A M

ANNUAL REPORT

1 July 1974 - 30 June 1975

BEHAVIOR PROSTHESIS DEPARTMENT

Walter E. Fernald State School

Belmont, Massachusetts

Beatrice H. Barrett, Ph.D., Director

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Behavior Department
B. H. Barrett, Ph.D., Director

STAFF

Full-time:

Carl Binder, B.A.
Barbara Colby, B.A.
Judith Linn, M.S.

Half-time:

Gene Buchman, M.A.
Frances George, B.S.
Deborah Pease, M.Ed.
Sue Scott, M.Ed.

This year we provided ongoing training for 33 residents from six buildings (Tarbell, Kelley, East, Dowling, Farrell and Stephen Bowen).* Further, through consultation to other Fernald staff, we have been able to provide "indirect" service to another 65 specific residents. Behavior Department staff members also did 121 Title XIX evaluations. Of these, 28 were "emergency" evaluations of men from Templeton Colony done at Dr. Moser's request. The rest were evaluations for Dowling, Kelley and Farrell Hall. (We should also note that staff member Gene Buchman has devoted a tremendous portion of his own time this year to a young resident he has taken as a foster child.) Nevertheless, because of limited staffing, we have not been able to handle all residents referred to our department by other Fernald employees. Our classroom waiting list now includes 14 residents from Farrell Hall, 7 from Stephen Bowen, 5 from Dowling, and 21 from Kelley.

A later section of this report summarizes Behavior Department service to Fernald residents, Fernald staff, community personnel and others during this past year. c 87 ff

Departing from our format of previous years, we are presenting this year's report as a series of "packages" — instructional sequences, reports of studies, and other materials that we hope will be useful to others who, like us, are eager to improve the educational and habilitative opportunities afforded children and adults labeled "retarded."

As always, we would welcome comments, questions, suggestions and, especially, data to supplement our own.

Judith Linn, Annual Report Editor
for the Behavior Department staff

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*With fluorescent lighting and specially designed overhead power raceways installed in our Adult Training Area this year, we have been able to provide educational, vocational, and recreational training for a sizeable number of adult residents as well as children.

Token-Exchange Training Procedures for Severely and Profoundly Retarded Students

Gene Buchman

This program, developed for initial token training of severely and profoundly retarded children, could also be used with older retarded persons or with pre-school children of "normal" intelligence.

Prerequisite skills. Before beginning this sequence the child (or adult) should be able to sit in a chair; make eye contact; attend to and track visual stimuli; and pick up, grasp, and release whatever objects are used as tokens.

Terminal behaviors. As a result of this instructional program, the child should be able to exchange tokens for goodies or other known reinforcers (one for one) and be able to respond to the verbal commands:

- "Give me _____!"
- "Put _____ here!"
- "Wait!"

The pretest and probes allow children with some of these abilities to start at an advanced point in the program and those with adequate generalization to bypass some phases. The pretest, probes, and post-test should be run without correction procedures (that is, no consequence for wrong responses), but correct responses should be reinforced with an item previously determined to be an effective reinforcer for the student.

The following pages outline the token training procedures -- the conditions (antecedents) to be arranged by the teacher or other "trainer," the behaviors expected of the student, and the measures to be taken in response to the student's actual performance.

TOKEN TRAINING PROGRAM (PAGE 1 OF 4)

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO:	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT:	CORRECTION PROCEDURE - IF HE DOES IT WRONG:
PRETEST: RUN POSTTEST. IF CHILD PASSES, OMIT THIS PROGRAM. IF CHILD FAILS,							
PROBE PHASE 5 ----------> IF CHILD PASSES, BEGIN AT PHASE 6. IF CHILD FAILS,							NONE
PROBE PHASE 3 ----------> IF CHILD PASSES, BEGIN AT PHASE 4. IF CHILD FAILS,							NONE
PROBE PHASE 2 ----------> IF CHILD PASSES, BEGIN AT PHASE 3. IF CHILD FAILS, BEGIN AT PHASE 1.							NONE
1	1 TOKEN, KNOWN REINFORCER, TABLE, CHAIRS	SHOW REINFORCER. WHEN CHILD ATTENDS TO REINFORCER, PUT TOKEN IN CHILD'S PREFERRED HAND (RIGHT HAND IF NO OBVIOUS PREFERENCE). SAY, "GIVE ME TOKEN!" (SEE FOOTNOTE * BELOW.) EXTEND YOUR OPEN HAND WITH REINFORCER IN PALM (IF REINFORCER IS SOLID) FOR EXCHANGE.	MOVE HAND WITH TOKEN OVER YOURS, RELEASE TOKEN INTO YOUR HAND AND TAKE REINFORCER.	10 MINUTES OR 5 UN-PROMPTED TRIALS IN SUCCESSION (CN5)	REINFORCER EXCHANGED FOR TOKEN + "GOOD!"	A) IF CHILD DOES NOTHING: PHYSICALLY PROMPT: MOVE HIS HAND OVER YOURS, TAKE TOKEN, GIVE REINFORCER. B) REACHES FOR REINFORCER WITH OTHER HAND: GENTLY RESTRAIN WRONG HAND SO HE MUST REACH WITH HAND HOLDING TOKEN. C) DROPS OR THROWS TOKEN: WITHDRAW REINFORCER AND PROMPT NEXT TRIAL (HOLD TOKEN IN CHILD'S HAND).
2	SAME	SHOW REINFORCER. WHEN CHILD ATTENDS TO REINFORCER, PUT TOKEN ON TABLE IN FRONT OF CHILD. SAY, "GIVE ME TOKEN!" EXTEND YOUR OPEN HAND WITH REINFORCER IN PALM (IF REINFORCER IS SOLID) FOR EXCHANGE.	PICK UP TOKEN, MOVE HAND WITH TOKEN OVER YOURS, RELEASE TOKEN INTO YOUR HAND AND TAKE REINFORCER.	10 MINUTES OR CN10	SAME	A) IF CHILD DOES NOTHING OR REACHES FOR REINFORCER WITH PREFERRED HAND: FIRST TIME - WITHDRAW REINFORCER, POINT TO (TOUCH) TOKEN, REPEAT "GIVE ME TOKEN!" SECOND TIME - PROMPT PICKING UP TOKEN (LET CHILD COMPLETE EXCHANGE BY HIMSELF). B) REACHES FOR REINFORCER WITH OTHER HAND: GENTLY RESTRAIN WRONG HAND SO HE MUST REACH WITH HAND HOLDING TOKEN. C) DROPS OR THROWS TOKEN: WITHDRAW REINFORCER AND IGNORE CHILD FOR 10 SEC. BEFORE STARTING NEXT TRIAL.
PROBE 4: RUN PHASE 4 WITHOUT CORRECTION PROCEDURES. IF CHILD PASSES, MOVE TO PHASE 5. IF CHILD FAILS, RUN PHASE 3.							

* USE FULL, SIMPLE SENTENCES THROUGHOUT THIS PROGRAM ONLY IF CHILD'S RECEPTIVE LANGUAGE ABILITY IS KNOWN TO BE AT FULL-SENTENCE LEVEL. OTHERWISE, USE FORMS SHOWN.

TOKEN TRAINING PROGRAM (PAGE 2 OF 4)

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT:	CORRECTION PROCEDURE - IF HE DOES IT WRONG:
3	1 TOKEN, KNOWN REINFORCER, TABLE, CHAIRS	PUT TOKEN ON TABLE IN FRONT OF CHILD.	SHOW REINFORCER. WHEN CHILD OFFERS TOKEN SAY, "WAIT!" KEEP REINFORCER VISIBLE. FIVE SEC. AFTER CHILD PICKS UP TOKEN, SAY, "GIVE ME TOKEN!" AND ALLOW EXCHANGE.	PICK UP TOKEN. COMPLETE EXCHANGE AT END OF DELAY PERIOD.	10 MINUTES OR CN5	REINFORCER EXCHANGED FOR TOKEN + "GOOD!"	PHASE 2 PROCEDURES, PLUS D) IF CHILD ATTEMPTS TO COMPLETE EXCHANGE BEFORE DELAY PERIOD IS UP: KEEP REINFORCER VISIBLE, BLOCK CHILD WITH YOUR OTHER HAND. REPEAT "WAIT!" NO MORE THAN ONCE IN 5-SEC. PERIOD. (NOTE: IF CHILD DROPS TOKEN AND YOU ALLOW HIM TO PICK IT UP, START TIMING 5-SEC. DELAY PERIOD AGAIN FROM TIME HE PICKS IT UP. DO NOT ALLOW CHILD TO RETRIEVE A DROPPED TOKEN TWICE IN SUCCESSION. (SEE PHASE 2-C.)
4	SAME	SAME	AS ABOVE (PHASE 3) BUT WITH TEN-SEC. DELAY. SHOW REINFORCER INITIALLY, BUT HAVE IT OUT OF SIGHT DURING WAITING PERIOD. SHOW REINFORCER AGAIN WHEN YOU SAY, "GIVE ME TOKEN!" PRAISE CHILD FOR "GOOD WAITING!"	SAME	10 MINUTES OR CN10	SAME	SAME

PROBE 6: RUN PHASE 6 WITHOUT CORRECTION PROCEDURES. IF CHILD PASSES, MOVE TO PHASE 7. IF CHILD FAILS, RUN PHASE 5.

5	2 TOKENS CUP, KNOWN REINFORCER, TABLE, CHAIRS	PUT CUP ON TABLE IN FRONT OF CHILD AND TWO TOKENS IN FRONT OF CUP (TOWARD CHILD).	POINT TO (TOUCH) CUP AND SAY, "PUT TOKENS HERE!" DON'T SHOW REINFORCER WHEN TOKENS ARE IN CUP; SAY, "WAIT!" (YOU MAY ALSO PRAISE CHILD FOR "GOOD WAITING.") (CONT'D ON NEXT PAGE)	PUT TOKENS IN CUP.	10 MINUTES OR CN10	ONE REINFORCER FOR EACH TOKEN + "GOOD!"	PHASE 3 PROCEDURES, PLUS E) CHILD TAKES BOTH TOKENS AND DOES ANYTHING BUT THROW THEM OR PUT THEM IN CUP: PROMPT PUTTING TOKENS IN CUP. DO NOT ALLOW CHILD TO REMOVE TOKENS UNTIL END OF DELAY PERIOD. IF YOU BLOCK REMOVING TOKENS, FADE THIS. F) OFFERS BOTH TOKENS FOR EXCHANGE AT ONCE: TAKE ONE TOKEN; PUT SECOND BACK IN CUP FOR SECOND EXCHANGE. (CONT'D ON NEXT PAGE)

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO:	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT:	CORRECTION PROCEDURE - IF HE DOES IT WRONG:
5 CONT.			AFTER TEN SEC., SHOW REINFORCER. SAY, "GIVE ME TOKEN!" EXCHANGE ONE REINFORCER FOR EACH TOKEN SEQUENTIALLY (REPEAT, "GIVE ME TOKEN!" BEFORE SECOND EXCHANGE.	COMPLETE EXCHANGE AT END OF DELAY PERIOD.			G) REFUSES TO ACCEPT MORE THAN ONE TOKEN: AT END OF DELAY PERIOD, SAY, "GIVE ME TOKEN!" AND TAKE ONE TOKEN FROM CHILD. WITHHOLD REINFORCER BUT KEEP IT VISIBLE. REPEAT "GIVE ME TOKEN!" AGAIN; GIVE HIM THE SECOND TOKEN AND LET HIM EXCHANGE IT IMMEDIATELY FOR ONE REINFORCER. HAVE HIM PUT SECOND TOKEN INTO YOUR HAND NEXT TO THE FIRST TOKEN.
6	2 TOKENS, CUP, KNOWN REINFORCER, TABLE, CHAIRS	PUT CUP ON TABLE IN FRONT OF CHILD. HAVE REINFORCER AWAY FROM TABLE AND OUT OF SIGHT.	HAVE CHILD PERFORM A SIMPLE, ONE-STEP MOTOR TASK THAT HE HAS ALREADY MASTERED. SAY, "GOOD!" AND PUT ONE TOKEN ON TABLE IN FRONT OF CHILD. IF HE DOES NOT SPONTANEOUSLY PUT TOKEN IN THE CUP, POINT TO (TOUCH) CUP AND SAY, "PUT TOKEN HERE." WHEN THE FIRST TOKEN IS IN CUP, REPEAT ABOVE. SAY, "WAIT!" GO GET REINFORCER AND SAY, "GIVE ME TOKEN!" AND EXCHANGE ONE REINFORCER FOR EACH TOKEN AS IN PHASE 5. YOU SHOULD INITIATE THE EXCHANGE AT LEAST 20 SEC. AFTER GIVING THE SECOND TOKEN.	PERFORM TASK. PUT TOKEN IN CUP. PERFORM TASK. PUT TOKEN IN CUP. WAIT FOR YOU. COMPLETE EXCHANGE AT END OF DELAY PERIOD.	10 MINUTES OR CN10	ONE REINFORCER FOR EACH TOKEN + "GOOD!"	PHASE 5 PROCEDURES, PLUS H) IF CHILD REMOVES TOKENS FROM CUP BEFORE YOU RETURN TO TABLE: PUT CUP ON OPPOSITE SIDE OF TABLE FROM CHILD. I) RETRIEVES CUP FROM OPPOSITE SIDE OF TABLE: TAKE CUP WITH YOU BUT KEEP IT VISIBLE.

Sequential Contrast Effects After Discrimination Learning With and Without Errors*

Jean-Luc Lambert

Two adult residents were given repeated opportunities to learn a simultaneous discrimination task under conditions of differential reinforcement. That is, their responses in the presence of one visual stimulus were reinforced with pennies, while responses in the presence of another stimulus were not reinforced. Not surprisingly, their behavior showed a "contrast effect": their response rates during periods of reinforcement were higher when the reinforcement period followed a period during which responses were not reinforced than when it followed another reinforcement period.

Procedures which minimize or preclude errors by "fading in" the stimulus which signals nonreinforcement do not usually produce contrast effects. However, two other adult residents, who were given opportunities to learn the simultaneous discrimination task under "errorless" conditions, showed a contrast effect — suggesting yet another way in which retarded behavior may be different from normal behavior.

A detailed report of this work, the first demonstration of sequential contrast effects in human behavior during errorless acquisition of a discrimination, has been submitted for publication.

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*Supported in part by a Dybwad Fellowship from the National Association for Retarded Citizens and in part by grants from the National Association for Retarded Citizens and the National Institute of Mental Health.

Automated Sequence to Assess "Attentional" Deficits in Discrimination Learning

Jean-Luc Lambert, Carl Binder, and Beatrice Barrett

With our newest automated assessment and instruction apparatus, we have begun to examine in our students a behavioral phenomenon known as the "blocking effect" (Kamin, 1969; Williams, 1973). In brief, the blocking effect involves a procedure in which a discrimination (in this case, matching-to-sample) is taught to criterion, first with a single discriminative stimulus (visual sample) and then with the addition of a stimulus of another modality (auditory sample). Finally the discrimination is tested with the second stimulus alone. The blocking effect is said to occur when the additional stimulus, presented alone, does not control the discriminative performance, presumably because of its "redundancy." That is, because the first stimulus is sufficient to control criterion performance, the participant does not "attend" to the added cue and, therefore, does not learn that the added cue is also a discriminative stimulus signaling the availability of reinforcement.

Our instructional apparatus includes a wall-mounted console with a large panel for the sample stimulus and nine smaller choice panels (Barrett, 1973). Visual stimuli are projected onto the translucent Plexiglas panels from behind. The student responds by touching a given panel, and the response information is transmitted to the programming equipment in another room. Auditory stimuli are presented through a speaker above the teaching console. Response rates and latencies are recorded automatically on a modified cumulative recorder. Reinforcers (pennies, tokens, edibles, audio events, or visual events, depending on the student's preference) are programmed to follow correct responses.

The first objective in our matching-to-sample task is to teach the student to touch the one stimulus panel, in an array of five different panels, that matches a color presented in the larger sample panel. The student must touch the sample panel to produce the array of choices (a requirement that ensures he will attend to the sample before making a choice); then he must touch the matching panel to receive reinforcement.

The program begins with a set of five frames that provide only one choice stimulus -- the correct one. (The location of the one correct choice is varied from frame to frame to prevent position learning.) During the second set of five frames, two choices are presented; then three, four, and finally five choices. This "fading in" of incorrect choice stimuli is designed to teach the discrimination with as few errors as possible. If during a set of five frames the student makes two errors, the second incorrect response produces a time-out of variable duration. During the time-out the program is backed up to the beginning of the previous (less difficult) set.

Our first participant (R. O.) is a severely retarded young adult who, in both automated instructional situations and classroom sequences, has repeatedly shown variable and therefore protracted discrimination learning. However, with the "errorless" procedures, this student learned visual-visual matching-to-sample for green, red, and blue, in five, two, and one sessions, respectively, to the criterion of less than two errors for the entire program. His current instructional program, interrupted at the moment because of scheduling problems, includes both visual and auditory ("Green") samples presented simultaneously. If training can continue, this student will be taught the dual-sample discrimination to criterion, then matching of another color to auditory sample only. Finally, he will be tested for matching each of the two colors to auditory (only) sample.

For R. O. and other students with apparent "attentional" deficits, this prescriptive assessment sequence may provide a basis for choice of instructional modality (visual, auditory, or both) in classroom programs.

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Follow-Up Survey of Participants in Behavior Department Studies and Educational Programs

Sue Scott and Beatrice Barrett

We have been examining institution records for information pertinent to the follow-up survey we began last year. This year we went through records of more than eighty residents and former residents who, over the years, have participated in our department's long-term, typically multifaceted efforts at investigation, assessment, and instruction. We have been noting data of potential relevance to our retrospective evaluation of laboratory and classroom performance of our behaviorally retarded students. During the next few months we will be completing our "search" of the official institution records and will, at the same time, be examining school, workshop and residential records of the more than one hundred residents who have participated in our programs.

Training and Consultation Services

Summary of Consultation to Fernald Staff, Community Programs, DMH Central Office and Department of Education

This year we provided ongoing training and consultation to 30 Fernald staff members, including members of the Social Work and Psychology departments, a unit director, attendants, teachers and apartment coordinators, FLOW workshop staff, and a Chapter 766 tutor.

The Behavior Department also provided intermittent consultation to 22 other Fernald staff members, including members of the Psychology Department, the Director of Education and Training, a unit director, a physician, teachers, an LPN, a rehabilitation counselor, attendants, and members of the Templeton staff.

We also provided ongoing training and consultation to four community day-care teachers from Beaverbrook, Arlington, Belmont, and Concord, and intermittent consultation to another four day-care teachers from Worcester, Weymouth, and Belmont.

In addition, we provided consultation to the Chief of Evaluation and Training and a behavior modification facilitator from the DMH Central Office and to an evaluation specialist from the Department of Education.

Summary of Consultation to Others

Ongoing training and consultation was provided to the staff of the Perkins School in Watertown, the staff of the Lincoln (Mass.) Community Children's Center, the staff of Camp Freedom, 23 parents and eight siblings of Camp Freedom participants, and two members of the Lesley College Graduate School faculty.

We also provided consultation to the staff of Project HELO (which serves parents of special needs children in the Cambridge-Somerville area), to a speech and hearing specialist and a teacher from Mansfield (Conn.) State Training School, a British psychologist, the director of the Behavior Research Institute in Providence, and faculty of the University of Vermont, University of Western Australia, and Columbia University Psychiatric Institute.

In addition, we provided ongoing training for over 30 students including Lesley College graduate students in special education, a Boston University undergraduate special education major, and a University of Liege doctoral candidate (all described in another part of this section).

Another 35 students seeking our consultation were from Lesley (special education), Harvard (education and dentistry), Emmanuel (social work), and Boston University (special education), plus other colleges and universities in the area.

Seminars for Farrell Hall Teachers

Mr. Buchman held a series of seminars for Farrell Hall teachers and student teachers on data, uses and misuses of testing, and manual communication.

In another series of seminars, Mr. Buchman, Ms. George, and Ms. Pease discussed broad strategies as well as specific methods of teaching receptive language to nonverbal children. The emphasis was on hierarchical arrangements of skills to be taught, that is, the sequencing of objectives to give direction to the instructional process so as to end up with "products" (or sets of behaviors) that are both functional and "normalizing." Seminars covered specific instructional objectives ranging from basic classroom entry requirements (sitting, attending, etc.) to some of the more complex skills taught to normal elementary school children (for example, word-recognition, rational counting, and simple addition).

Unfortunately, because of limited staffing, we were unable to meet requests for another three seminars for Farrell Hall and a seminar for Dowling Hall staff.

Formal Instruction for Lesley College Master's Candidates

Dr. Barrett and Mr. Buchman taught three courses this year to students in Lesley College Graduate School's program in severe developmental disabilities and severe multiple handicaps. Approximately thirty master's candidates, a majority of them DMH employees, were enrolled in one or more of the courses, all of which were taught in our department during the evening so that students could directly observe our facilities and activities and take advantage of the resources we have developed over the years.

All three courses focused on applications of behavior analysis to broad areas of behavior management, programmed instruction and precision teaching with special needs pupils, especially those with extreme learning handicaps and behavioral problems. In one course, Dr. Barrett emphasized self-change and self-management techniques, measurement strategies, and analysis of the components of behavior-environment interactions being manipulated. In a complementary course, Mr. Buchman introduced students to specific behavioral and task analytic methods and materials applicable with retarded students. Mr. Buchman also taught a practicum course involving direct observation of pupils with severe developmental disabilities.

Materials for Professional and Paraprofessional Training

At the invitation of Dr. Joseph Wortis, editor, Dr. Barrett has been preparing a chapter for the 1976 Annual Review of Mental Retardation and Developmental Disabilities. This chapter should serve as an introductory professional-training

tool for special education graduate students and others who wish to familiarize themselves with applications of behavior analytic procedures to retardation. A considerable number of books and articles on "modification" of retarded behavior have appeared in recent years, but this chapter should be one of the few publications (if not the only one) to define domains of application in terms of the components of operant behavior being measured and manipulated. The chapter will also include a brief history of behavior analysis and an extensive bibliography.

In a paper recently submitted for publication, Mr. Binder provides a rationale for the design and implementation of staff training procedures. The paper reviews the status of current efforts by applied behaviorists to establish criteria for professional competence, ethical guidelines, and effective communication with the public. Legislative and judicial issues, as well as the efforts of professional behaviorists to clarify these matters, are surveyed. And in an attempt to provide a methodology for the solution of issues concerning professional ethics, competence, and communication with the public, Mr. Binder has proposed an outline for a behavioral analysis of the practices and verbal statements of applied behaviorists. He points out the need for clarity (discriminability) of language in the description of behavioristic methodology and, particularly, focuses on the inadequacy of terms such as behavior modification that do not specify the means by which behavior is changed in specific instances. Suggestions for the behavioral definition of professional skills have implications for the training and maintenance of those skills among professionals and paraprofessionals as well.

Training for University Students

Jean-Luc Lambert, a doctoral candidate at the University of Liege, Belgium, joined us this year for four of his six months in the United States as a Dybwad Fellow. M. Lambert, who has been appointed director of a residential treatment center in Belgium, came to Fernald to learn about new instructional methods, behavior management techniques, and staff training procedures. After spending a brief time at the Shriver Center and some time on other parts of the grounds, he was referred to the Behavior Department by Mr. Eric Ward.

M. Lambert decided to spend the remainder of his fellowship period in our department. While here he involved himself in a number of our ongoing projects and worked on several papers, including part of his doctoral dissertation. M. Lambert took advantage of our department's resource and reference materials to familiarize himself with precision teaching techniques, which form the basis of many of our instructional procedures. One result was an article on precision teaching, which M. Lambert has prepared for publication in a French journal. M. Lambert also reviewed the literature on "normalization" and, as a result of his observations of the prosthetic procedures essential for training severely handicapped residents, wrote a paper (also for submission to a French journal) discussing the implications of normalization with regard to behavior management and applied behavior analysis.

M. Lambert's studies of errorless discrimination learning in adult Fernald residents are summarized on p. 82 of this report. Along with this work, M. Lambert carried out tabletop teaching sequences in our classroom, took part in consultations with Farrell Hall teachers about the design of a workshop-skills training program, and took major responsibility for designing a prescriptive procedure for assessment of "attentional" deficits in residents (see p. 83).

Barbara Pixley, a Lesley College graduate student in special education, spent part of the year in our department under the supervision of Frances George and Deborah Pease. As a student teacher, Ms. Pixley assisted in teaching our classroom pupils. She also received course credit (Independent Study) for designing games in which retarded students can apply (and enjoy!) basic numerical skills learned in the classroom (see p. 61).

Other teachers-in-training supervised by Ms. George and Ms. Pease this year were Joanne Sassone and Judy Beltis, both Lesley College master's candidates, and Debbie Dumas, a special education major at Boston University.

Vocational Training for Adult Residents

G. B. continues to receive on-the-job training in our department in the mornings. He is learning to do general janitorial work (sweeping, emptying wastebaskets and ashtrays, cleaning the sink, vacuuming, etc.) and picks up our mail. In order to use his OJT stipend most effectively for reinforcing good work, we have arranged to pick it up and pay him for his work daily as a consequence of specific tasks. Tina Beckman of the OJT program has been especially helpful in this regard, making an exception to the usual once-per-week pay schedule. Behavior Department staff members encourage G. B. to save his money, and have accompanied him on trips to purchase a watch, strings for his guitar, and personal items of various sorts.

Of particular concern to us during the past year was a series of events concerning G. B.'s glasses. He appeared for work one morning with the bridge of his glasses broken and rather loosely taped together. After several weeks without any apparent attempt by residential staff to arrange for repair of the glasses, we made an appointment for G. B. to see an optometrist in Waltham. After a number of mix-ups regarding the time of the appointment, a Behavior Department staff member accompanied G. B. to the optometrist's office and the frames were replaced.

P. S., whose gradual but impressive progress we had been reporting for many years, went to live with his mother at the end of 1973. He returned to Fernald the following July. His condition at that point was so bad that his unit director

asked us to "put him back together again." Shortly afterwards, we arranged for P. S. to return to the CEP program in which he had previously participated and to spend the afternoons in our department under the OJT program. As the months went by, P. S. gradually regained his self-confidence, was no longer depressed, and once again was taking evident pleasure in being a "member" of our staff. In January, following an OJT evaluation, P. S. was transferred to a greeting-card workshop. In May, for reasons unclear to us, his mother withdrew him from Fernald. P. S. continues to call us occasionally. He is living at home and, as far as we know, is not working at this time.

TOKEN TRAINING PROGRAM (PAGE 4 OF 4)

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT:	CORRECTION PROCEDURE - IF HE DOES IT WRONG:
7	2 TOKENS, CUP, KNOWN REINFORCER, TOY CHILD IS KNOWN TO PLAY WITH, TABLE, CHAIRS	PUT CUP ON TABLE IN FRONT OF CHILD. HAVE REINFORCER AWAY FROM TABLE AND OUT OF SIGHT. HAVE TOY OUT OF SIGHT.	PROCEED AS IN PHASE 6. WHEN CHILD HAS EARNED SECOND TOKEN AND HAS PUT IT IN CUP, PUT CUP AWAY FROM CHILD BUT VISIBLE AND GIVE HIM TOY. SAY, "WAIT!" GO GET REINFORCER, ALLOWING AT LEAST 30 SEC. PLAY TIME WITH TOY BEFORE YOU RETURN. GRADUALLY INCREASE PLAY TIME TO ONE MINUTE PER TRIAL IN THIS PHASE. COMPLETE EXCHANGE AS IN PHASE 6.	SAME AS PHASE 6.	15 MINUTES OR CN10	ONE REINFORCER FOR EACH TOKEN + "GOOD!"	SAME AS PHASE 6.
POST-TEST	SAME AS PHASE 7, BUT 3 TOKENS	SAME AS PHASE 7.	SAME AS PHASE 7, BUT CHILD EARNS 3 TOKENS AND PLAY TIMES, ALL ONE MINUTE MINIMUM.	SAME AS PHASE 7.	CN5 WITHIN 10 MINUTES	SAME AS PHASE 7.	NONE

Communication

Our department continues, as always, to welcome visitors — be they employees of other Fernald departments, DMH central office staff, teachers from other DMH regions, parents of residents, residents themselves, university students, dentists concerned with behavior management techniques applicable to their retarded patients, psychologists, special educators, psychiatrists . . . or whatever. We also continue to send out copies of our articles and reports to anyone requesting information. While our small staff (half of whom are part-time employees) sometimes feels stretched beyond reason, we try as we have in the past to share our resources, our experience, and our expertise with those who seek our consultation. In earlier sections of this annual report we outlined our consultation and training efforts of the past year. Here we offer a brief listing of other areas of "communication" we have been involved in this year.

New Articles

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Formal Presentations

Dr. Barrett presented a paper, "The Course of Behavioral Acquisition: Implications for Assessment and Training of the Severely Retarded," at the annual meeting of the American Academy on Mental Retardation held in Portland, Oregon, in May.

Mr. Binder participated in a panel discussion on "Professional Issues in Behavior Modification" at the fall meeting of the Massachusetts Psychological Association held in Worcester in October. (Other panelists were Dr. Dennis Upper of the Brockton VA Hospital, Dr. Matthew Israel of the Behavior Research Institute in Providence, and Dr. Ralph Schwitzgebel of Harvard Medical School.)

Mr. Buchman was invited to give a guest lecture on "Parent Training" at Lesley College Graduate School, Cambridge.

At Camp Freedom, Mr. Buchman presented a paper, "Stimulus Compounds and Selective Attention in Word Recognition."

Presentations to Fernald Staff

This year Behavior Department staff members conducted two series of seminars for Farrell Hall teachers on topics ranging from receptive language to uses and misuses of testing (see p.88).

Seminars for Parents and Siblings

Mr. Buchman conducted a series of ten seminars on behavior management and related topics for parents and siblings of Camp Freedom students.

Participation in Film on Behavior Analysis

Mr. Binder and Dr. Barrett were invited to take part in the planning and filming of "B. F. Skinner and Behavior Change: Research, Practice, and Promise," a 45-minute educational film produced by Research Press (Champaign, Illinois).

Information-Seeking Visits to Other Facilities

This year Deborah Pease, Frances George, and Jean-Luc Lambert visited the Benhaven School in New Haven to observe applications of precision teaching techniques with "special needs" students.

Carl Binder and two Farrell Hall teachers visited the Behavior Research Institute in Providence. As a part of ongoing consultation to Farrell Hall teachers, Mr. Binder arranged the visit primarily to discuss with BRI staff and director Dr. Matthew Israel the possible transfer of a Farrell Hall resident to the Providence school.

Gene Buchman visited the Learning Center for Deaf Children in Framingham to evaluate their present curriculum and to discuss with staff members their tentative plans for a new program for multihandicapped children. Mr. Buchman also took an advanced course in signing at the Framingham school.

Attendance at Professional Meetings and Workshops

In August Deborah Pease spent a week at York University in Toronto where she participated in a summer institute on precision teaching. While in the Toronto area, Ms. Pease visited the Lincoln Developmental Center in Beamsville, Ontario -- a unique setting in which precision teaching techniques are the basis for an entire curriculum for developmentally delayed children. In meetings with Lincoln Center teachers and director Mary Kovaacs, Ms. Pease obtained details of their unusual program and, in turn, shared her expertise on task analytic techniques that might make their efforts even more effective. During the week Ms. Pease also had opportunities to meet with precision teaching experts Ogden R. Lindsley, Ph.D., and Eric Haughton, Ed.D., both of whom have often served as consultants to our department.

Gene Buchman participated in a one-week advanced professional workshop on Behavior Modification and Mental Retardation at Camp Freedom.

Staff members also attended meetings of the American Association on Mental Deficiency, the American Academy on Mental Retardation, the Massachusetts Psychological Association, and the Behavior Therapy Interest Group (Boston branch, Association for the Advancement of the Behavior Therapies).

Special Appointments and Consultantships

Dr. Barrett was reappointed an advisory editor of the American Journal of Mental Deficiency. She was also appointed to the editorial board of the Massachusetts Journal of Mental Health.

Dr. Barrett and Mr. Buchman were both part-time members of the faculty of Lesley College Graduate School's programs in severe developmental disabilities and severe multiple handicaps (see p. 88).

Mr. Binder was appointed a member of the executive committee of the Behavior Therapy Interest Group, the Boston branch of the Association for the Advancement of the Behavior Therapies.

Mr. Buchman continued to serve as a consultant to the Perkins School in Watertown, Mass. During the year he conducted for Perkins staff a series of seven seminars on such topics as behavior modification, precision teaching, the DISTAR program, use of tokens, maintaining student attention, and classroom discipline.

Mr. Buchman also served as a consultant to the Lincoln (Mass.) Community Children's Center and this spring was appointed to the center's Board of Directors.

Consultation with Other Professionals

James L. Hamilton, Ph.D., continued to serve as a consultant to our department this year until he left for Washington, D. C., to join the Office of Education's Bureau for the Education of the Handicapped. Dr. Hamilton had been assistant professor at Lesley College and coordinator of Lesley's programs in severe developmental disabilities and severe multiple handicaps.

Jay S. Birnbrauer, Ph.D., of the University of Western Australia also served as a consultant to our department. Dr. Birnbrauer's early publications described the first programmed instruction classroom for retarded students, at the Rainier State School in Washington. His contributions to the academic skills programs developed there (including the Edmark Reading Program) made his counsel particularly valuable to us at this time.

Manual for Distance-Fading Procedure to Teach Visual Discrimination Skills to Retarded Students

Gene Buchman

This procedure has been developed to its present state through considerable field-testing and revision. The instructions should be followed closely. If difficulties in applying the procedure persist, please report them to the author, to allow for further refinement.

This distance-fading procedure is an "errorless" technique to teach simultaneous visual discrimination skills to retarded students. That is, when it is used to teach skills that are reasonably matched to the students' entering behaviors, most retarded students make few or no errors in learning. Be sure that your student has the basic functional prerequisites for this procedure: the ability to track and attend to visual stimuli, and sufficient eye-hand coordination to touch, or preferably to hand you, a stimulus object.

Discriminations along any visual dimension may be taught with this procedure. Be sure to teach gross discriminations along any dimension before attempting to teach finer ones. Oddity problems may be taught, but only after the student has acquired the simple discriminations involved.

Although adaptable to any number of choices, the procedure is best utilized in three-choice problems.

This procedure is designed to separately teach operant and attending responses. First, teach by prompting or by drawing the student's attention with a reinforcer, the operant response of touching or, preferably, handing you the correct choice for the task. Do this with only the correct choice present on the table top, close to the student. Focus the student's attention on the correct choice by varying its lateral position across his visual field, and do this while no other visual stimuli compete for his attention. Do not at any time change the distance of the correct choice from the student. Immediately reinforce every correct response.

As soon as the student is reliably tracking and touching or handing you the correct choice, on command but without further prompting, introduce both of the incorrect choices about 18 inches beyond the correct choice, away from the student. (If the student reaches for the incorrect choices, move them back immediately to arms' length away from him.) The incorrect choices will be gradually "faded" toward the student, a little on each trial, until they are the same distance from him as the correct choice (Fig. 1).

Vary the lateral (right, left, center) positions of the correct and incorrect choices on each trial throughout the fading steps and subsequent practice. Use a sequence that is unpredictable, and has the correct choice in each position the same number of times, but never have the correct choice in the same position twice in a row. Such a pseudo-random sequence may be had from the Gellerman (1933) series, a random number table, or your local friendly behaviorist, and will prevent the student from basing his responses on position. It is possible to use this procedure casually, with impromptu sequencing of the correct and incorrect choices, but if you have not planned in advance what the positions will be on every trial, unrealized perseveration or sloppy randomizing on your part may disrupt your student's learning.

The distance-fading is carried out in progressively smaller steps. The sequence that has proved appropriate for most retarded students is to halve (approximately) the "vertical" center-to-center distance between the correct and incorrect choices after each correct response. When you reach a trial on which the bottoms of the incorrect choices are even with the top of the correct choice, the incorrect choices should next overlap the correct choice half-way, and then next be even with it (distance cue eliminated).

In case of an error, you must back up in the fading sequence to recover your student's visual attending. Always use the back-up procedure when an error occurs. Go back to a distance between the correct and incorrect choices at which the student performed well. If the student responds correctly, halve the size of the fading step you used before the error, then proceed. If another error occurs, back up again. Do not correct errors in any way (other than withholding reinforcement). If the student persists in making errors, halt the task.

You must have a known effective reinforcer for your student. You should reward every correct response until the distance cue has been eliminated and the student is performing smoothly without it. Thereafter, you must thin out gradually to partial or intermittent reinforcement in order for your student's performance to be maintained. Do not omit this final step!

Record as complete a response pattern as possible. If you have planned the position of the choices for each trial in advance, you can do this by circling on your planning sheet the position and choice for each response. This will not only aid in tracking your student's progress, it will also permit an analysis of error patterns and remediation of the problem, if the student has difficulty.

If you teach your student several different discrimination tasks along the same dimensions, you will find that the number of fading steps needed for him to master a new problem decreases. Eventually, only one trial with a distance cue will be necessary to teach him a new task. Reducing the number of fading steps in the sequence is best accomplished by starting with the incorrect choices closer to the student, rather than by increasing the size of the steps.

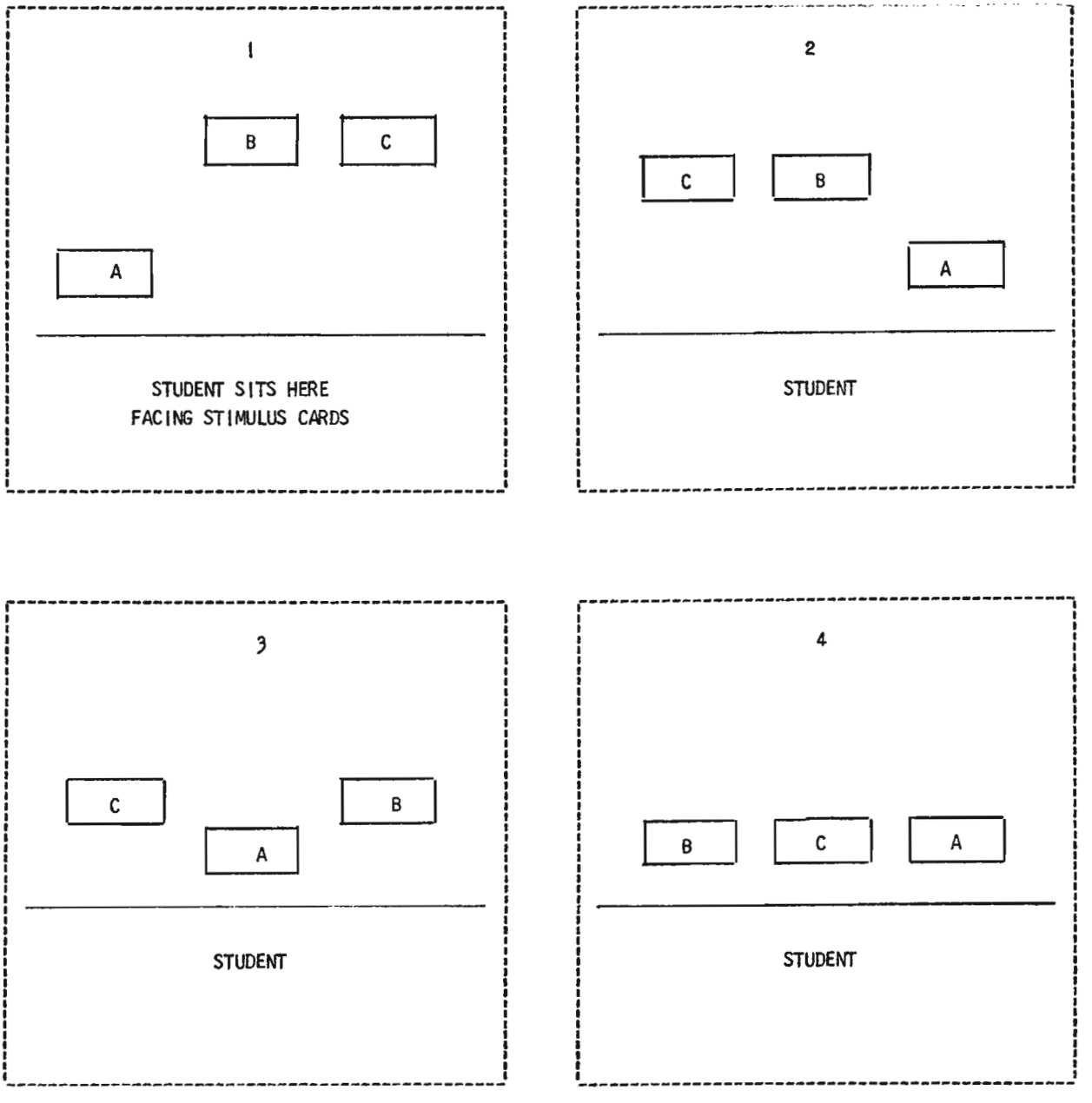
Reference

Gellermann, L. W. Chance orders of alternating stimuli in visual discrimination experiments. Journal of Genetic Psychology, 1933, 42, 206-207.

FIGURE 1

DISTANCE-FADING PROCEDURES FOR TEACHING VISUAL DISCRIMINATIONS

THE CORRECT STIMULUS (CARD A) IS ALWAYS PLACED NEAR THE STUDENT, WHILE THE INCORRECT STIMULI (CARDS B AND C) ARE MOVED CLOSER TO THE STUDENT ON EACH TRIAL UNTIL, AS IN BLOCK 4, THE THREE CHOICES ARE LINED UP.



Procedures for Assessing Skills Prerequisite to Introductory Reading (Word Recognition) Sequence

Gene Buchman

In last year's report we described a diagnostic-prescriptive sequence to assess and teach word recognition to retarded, mute students. Pretests for the required entering skills (color, size and form discrimination), as well as for the terminal skill, have been refined and are outlined in the following pages. (The distance-fading procedures used in the pretests and in the word-recognition sequence itself are elaborated in the manual which begins on p. 8 of this report.)

WORD RECOGNITION ASSESSMENT PROCEDURES

TITLE: PRE-SKILL ASSESSMENT FOR WORD RECOGNITION AUTHOR: GENE BUCHMAN BEHAVIORAL OBJECTIVE: SIGHT-READING

PREREQUISITE SKILLS: AUDITORY COMPREHENSION (OBJECT RECOGNITION, AUDITORY-VISUAL MATCHING) OF NOT LESS THAN 20 DIFFERENT STIMULI DETERMINED BY DIRECT ASSESSMENT, OR RAW SCORE OF 25 OR MORE ON EITHER FORM OF PPVT. NOTE: STUDENT MAY BE MUTE. IF HE IS ALSO DEAF, SIGN-TO-OBJECT MATCHING OF NOT LESS THAN 20 DIFFERENT STIMULI IS REQUIRED.

LONG-TERM OBJECTIVE: THIS PROGRAM CONTRIBUTES TO: READING PROGRAM SELECTION

PROGRAMS TO FOLLOW THIS: WORD RECOGNITION

CRITERION TO ADVANCE TO NEXT STEP WITHIN THIS PROGRAM: NOT LESS THAN 3 SUCCESSIVE CORRECT RESPONSES TO EACH S+, WITHOUT CUEING. SEE PROGRAM SHEETS.

PROCEDURAL SUGGESTIONS:

1. BE CERTAIN THE STUDENT CAN PERFORM THE PREREQUISITE SKILLS. IF HE CANNOT, DO NOT USE THESE ASSESSMENT PROCEDURES.
2. DO NOT ALTER ASSESSMENT SEQUENCES, PRESENTATION OF MATERIALS, OR CORRECTION PROCEDURES. GO ON TO NEXT SUBTASK IF DISTANCE CUES FOR ANY S+ CANNOT BE FADED WITHIN 10 TRIALS.
3. WHEN A STUDENT COMPLETES THIS SEQUENCE, PLEASE INFORM THE BEHAVIOR DEPARTMENT SO THE VALIDITY OF THIS PROGRAM CAN BE EVALUATED AND SECTIONS CAN BE REWRITTEN WHEN INDICATED BY THE DATA.

ADDITIONAL INSTRUCTIONS (CONSTRUCTION OF MATERIALS, ETC.):

THIS ASSESSMENT IS A SEQUENCE OF 4 LEARNING TASKS COMPOSED OF 10 SUBTASKS. PASSING A SUBTASK REQUIRES THAT DISTANCE CUES BE FADED OUT WITHIN 10 TRIALS, FOLLOWED BY NOT LESS THAN 3 CONSECUTIVE CORRECT RESPONSES TO S+. IF THE STUDENT PASSES TASK 1, DISCONTINUE TESTING. IF THE STUDENT FAILS TASK 1, TEST ALL OF THE REMAINING TASKS, IN THE FOLLOWING SEQUENCE ONLY*:

TASK 1. WORD RECOGNITION PRETEST
TASK 2. COLOR DISCRIMINATION
TASK 3. FORM DISCRIMINATION
TASK 4. SIZE DISCRIMINATION

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*NOTE: FORM & SIZE DISCRIMINATION TASKS UTILIZE FIXED-COLOR STIMULI. TESTING THEM FIRST MAY DISRUPT STUDENT'S PERFORMANCE ON COLOR DISCRIMINATION TASK BECAUSE OF IMMEDIATE REINFORCEMENT HISTORY.

OUTCOMES:

- FAILURE ON TASK 1 & SUCCESS ON TASKS 2, 3, & 4: STUDENT'S ENTERING SKILLS ARE APPROPRIATE FOR WORD-RECOGNITION PROGRAM.
- FAILURE ON TASK 1 & FAILURE ON ANY OTHER TASK: STUDENT LACKS (AND SHOULD BE TAUGHT) ENTERING SKILLS FOR WORD-RECOGNITION PROGRAM.
- SUCCESS ON TASK 1: STUDENT MAY HAVE ENTERING SKILLS FOR HIGHER LEVEL READING PROGRAMS (AND THIS SHOULD BE ASSESSED).
- WITHIN TASK 1, SUCCESS ON PHASE 2 BUT FAILURE ON PHASE 3: STUDENT MAY HAVE ENTERING SKILLS FOR HIGHER LEVEL READING PROGRAMS, BUT LOW VISUAL ACUITY (WHICH SHOULD BE ASSESSED AND CORRECTED IF POSSIBLE).

WORD RECOGNITION PRETEST

NOTE: "V" IS THE VERTICAL CENTER-TO-CENTER DISTANCE BETWEEN WORD-CARDS.

PRETEST CRITERIA: V=0 IN 10 TRIALS OR LESS, 3 SUCCESSIVE CORRECT RESPONSES AT V=0 ON EITHER PHASE 2 ALONE OR PHASE 2 AND PHASE 3. (SEE COVER SHEET - OUTCOMES.)

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO:	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT	CORRECTION PROCEDURE - IF HE DOES IT WRONG
ALL	WORD-CARDS FOR BALL, CUP, CHAIR (SEE BELOW)	3-CHOICE SIMULTANEOUS DISCRIMINATION. RANDOMIZE RIGHT, LEFT, CENTER POSITIONS OF STIMULI BETWEEN TRIALS. MAINTAIN LATERAL SPACING BETWEEN SIDES OF ADJACENT CARDS IN RANGE OF ½" TO 2".					
1	#10 SET FROM BUCHMAN WORD-RECOGNITION PROGRAM. (3X5" CARDS; WORDS IN LOWER-CASE; "TAIL-LESS" LETTERS LIKE e ½" HIGH)	BALL (S+) CLOSE TO STUDENT'S EDGE OF DESK; CUP & CHAIR (BOTH S-) ABOUT 9" DISTANT (THE TOP EDGES OF S- CARDS ABOUT 12" FROM BOTTOM EDGE OF S+.)	SAY, "GIVE ME BALL. BALL." (IF NO RESPONSE OR STUDENT REACHES FOR S-, POINT TO S+ OR PRIME.) IF STUDENT IS VERBAL PROMPT HIM TO REPEAT WORD ALOUD WHEN HANDING YOU CARD.	HAND YOU CORRECT WORD-CARD.	1 OR 2	BELL + PRAISE (FR-1). ALSO GIVE TOKEN OR PRIMARY REINFORCER IF APPLICABLE (FR-1).	BLOCK INCORRECT RESPONSE AND PRIME. IF STUDENT PERSISTS IN REACHING FOR S- CARDS, MOVE THEM BACK TO 18" (OR FURTHER).
2	AS IN PHASE 1	AS IN PHASE 1, BUT HALVE V AFTER EACH CORRECT RESPONSE (OR TWO), UNTIL LOWER EDGES OF S- ARE EVEN WITH UPPER EDGE OF S+. AFTER CORRECT RESPONSE, REDUCE V TO 1½" (CARDS OVERLAP HALF WAY).	SAY, "GIVE ME BALL."	AS IN PHASE 1	1 OR 2 FOR EACH V-SPACING; NOT LESS THAN 3 SUCCESSIVE CORRECT TRIALS AT V=0.	AS IN PHASE 1	BACK UP TO V-SPACING OF LAST CORRECT TRIAL, HOLD V CONSTANT FOR 1 OR 2 TRIALS, REDUCE V IN DECREMENTS OF ONE-QUARTER ON ALL SUCCESSIVE TRIALS.
3	#12 BUCHMAN CARDS. (AS ABOVE BUT "TAIL-LESS" LETTERS ¼" HIGH.)	CARDS AT V=0	AS IN PHASE 2	AS IN PHASE 1	AS IN PHASE 2	AS IN PHASE 1	AS IN PHASE 2, BUT BACK UP AFTER FIRST ERROR SO LOWER EDGES OF S- ARE EVEN WITH UPPER EDGE OF S+.

COLOR DISCRIMINATION

PRESKILL FOR WORD RECOGNITION

NOTE: "V" IS THE VERTICAL CENTER-TO-CENTER DISTANCE BETWEEN RECTANGLES.

CRITERIA AS PRETEST FOR WORD RECOGNITION: V=0 IN 10 TRIALS OR LESS, 3 SUCCESSIVE CORRECT RESPONSES TO EACH S+ AT V=0.

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO:	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT	CORRECTION PROCEDURE - IF HE DOES IT WRONG
ALL	TEACHING RESOURCES ATTRIBUTES SET 36-120: SMALL RED, BLUE, YELLOW RECTANGLES	3-CHOICE SIMULTANEOUS DISCRIMINATION. RANDOMIZE RIGHT, LEFT, CENTER POSITIONS OF COLOR STIMULI BETWEEN TRIALS. MAINTAIN ABOUT 5" BETWEEN CENTERS (ABOUT 3" BETWEEN SIDES) LATERAL SPACING.					
1		RED (S+) CLOSE TO STUDENT'S EDGE OF DESK; BLUE & YELLOW (BOTH S-) ABOUT 9" DISTANT	SAY, "GIVE ME RED." (POINT TO S+ OR PRIME IF NO RESPONSE OR IF STUDENT REACHES FOR S-.)	HAND YOU RED RECTANGLE.	1 OR 2	BELL + PRAISE (FR-1). ALSO GIVEN TOKEN OR PRIMARY REINFORCER IF APPLICABLE (FR-1).	BLOCK INCORRECT RESPONSE AND PRIME. IF STUDENT PERSISTS IN REACHING FOR S-, MOVE THEM BACK TO 12" (OR FURTHER).
2		AS IN PHASE 1, BUT HALVE V AFTER EACH CORRECT RESPONSE (OR TWO), UNTIL LOWER EDGES OF S- ARE EVEN WITH UPPER EDGE OF S+. AFTER CORRECT RESPONSE, REDUCE V TO 0.	SAY, "GIVE ME RED."	HAND YOU RED RECTANGLE.	1 OR 2 FOR EACH V-SPACING; NOT LESS THAN 10 TRIALS AT V=0.	AS IN PHASE 2.	BACK UP TO V-SPACING OF LAST CORRECT TRIAL, HOLD V CONSTANT FOR 1 OR 2 TRIALS, REDUCE V IN DECREMENTS OF ONE-QUARTER ON ALL SUCCESSIVE TRIALS.
3,4		REPEAT PHASES 1 AND 2 USING BLUE AS S+.	SAY, "GIVE ME BLUE."	HAND YOU BLUE RECTANGLE.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.
5,6		REPEAT PHASES 1 AND 2 USING YELLOW AS S+.	SAY, "GIVE ME YELLOW."	HAND YOU YELLOW RECTANGLE.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.

FORM DISCRIMINATION

PRESKILL FOR WORD RECOGNITION

NOTE: "V" IS THE VERTICAL CENTER-TO-CENTER DISTANCE BETWEEN FORMS.

CRITERIA AS PRETEST FOR WORD RECOGNITION: V=0 IN 10 TRIALS OR LESS, 3 SUCCESSIVE CORRECT RESPONSES TO EACH S+ AT V=0.

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO:	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT	CORRECTION PROCEDURE - IF HE DOES IT WRONG
ALL	TEACHING RESOURCES ATTRIBUTES SET 36-120: SMALL RED SQUARE, RECTANGLE, TRIANGLE	3-CHOICE SIMULTANEOUS DISCRIMINATION. RANDOMIZE RIGHT, LEFT, CENTER POSITIONS OF FORMS BETWEEN TRIALS. MAINTAIN ABOUT 5" BETWEEN CENTERS (ABOUT 3" BETWEEN SIDES) LATERAL SPACING.					
1		SQUARE (S+) CLOSE TO STUDENT'S EDGE OF DESK; RECTANGLE & TRIANGLE (BOTH S-) ABOUT 9" DISTANT.	SAY, "GIVE ME SQUARE." (POINT TO S+ OR PRIME IF NO RESPONSE OR IF STUDENT REACHES FOR S-)	HAND YOU RED SQUARE.	1 OR 2	BELL + PRAISE (FR-1). ALSO TOKEN OR PRIMARY REINFORCER IF APPLICABLE (FR-1).	BLOCK INCORRECT RESPONSE AND PRIME. IF STUDENT PERSISTS IN REACHING FOR S-, MOVE THEM BACK TO 12" (OR FURTHER).
2		AS IN PHASE 1, BUT HALVE V AFTER EACH CORRECT RESPONSE (OR TWO) UNTIL LOWER EDGES OF S- ARE EVEN WITH UPPER EDGE OF S+. AFTER CORRECT RESPONSE, REDUCE V TO 0.	SAY, "GIVE ME SQUARE."	HAND YOU RED SQUARE SQUARE.	1 OR 2 FOR FOR EACH V-SPACING, NOT LESS THAN 10 TRIALS AT V=0.	AS IN PHASE 1.	BACK UP TO V-SPACING OF LAST CORRECT TRIAL, HOLD V CONSTANT FOR 1 OR 2 TRIALS, REDUCE V IN DECREMENTS OF ONE-QUARTER ON ALL SUCCESSIVE TRIALS.
3,4		REPEAT PHASES 1 AND 2 USING RECTANGLE AS S+.	SAY, "GIVE ME RECTANGLE."	HAND YOU RED RECTANGLE.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.
5,6		REPEAT PHASES 1 AND 2 USING TRIANGLE AS S+.	SAY, "GIVE ME TRIANGLE."	HAND YOU RED TRIANGLE.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.

SIZE DISCRIMINATION

PRESKILL FOR WORD RECOGNITION

NOTE: "V" IS THE VERTICAL CENTER-TO-CENTER DISTANCE BETWEEN RECTANGLES.

CRITERIA AS PRETEST FOR WORD RECOGNITION: V=0 IN 10 TRIALS OR LESS. 3 SUCCESSIVE CORRECT RESPONSES TO EACH S+ AT V=0.

PHASE	MATERIALS	HOW TO SET UP MATERIALS	WHAT YOU SAY AND DO	RESPONSE - TRAINEE HAS TO:	TRIALS - HOW OFTEN	REINFORCEMENT - IF HE DOES IT RIGHT	CORRECTION PROCEDURE IF HE DOES IT WRONG
ALL	TEACHING RESOURCES ATTRIBUTES SET 36-120: BLUE RECTANGLES, LARGE AND SMALL	2-CHOICE SIMULTANEOUS DISCRIMINATION. RANDOMIZE RIGHT AND LEFT POSITIONS OF STIMULI BETWEEN TRIALS. MAINTAIN ABOUT 5" BETWEEN CENTERS (ABOUT 3" BETWEEN SIDES) LATERAL SPACING.					
1		BIG RECTANGLE (S+) CLOSE TO STUDENT'S EDGE OF DESK; LITTLE ONE (S-) ABOUT 9" DISTANT.	SAY, "GIVE ME BIG." (POINT TO S+ OR PRIME IF NO RESPONSE OR IF STUDENT REACHES FOR S-)	HAND YOU BIG RECTANGLE.	1 OR 2	BELL + PRAISE (FR-1). ALSO TOKEN OR PRIMARY REINFORCER IF APPLICABLE (FR-1).	BLOCK INCORRECT RESPONSE AND PRIME. IF STUDENT PERSISTS IN REACHING FOR S-, MOVE IT BACK TO 12" (OR FURTHER).
2		AS IN PHASE 1, BUT HALVE V AFTER EACH CORRECT RESPONSE (OR TWO), UNTIL LOWER EDGE OF S- IS EVEN WITH UPPER EDGE OF S+. AFTER CORRECT RESPONSE, REDUCE V TO 0.	SAY, "GIVE ME BIG."	HAND YOU BIG RECTANGLE.	1 OR 2 FOR EACH V-SPACING, NOT LESS THAN 10 AT V=0.	AS IN PHASE 1.	BACK UP TO V-SPACING OF LAST CORRECT TRIAL, HOLD V CONSTANT FOR 1 OR 2 TRIALS, REDUCE V IN DECREMENTS OF ONE-QUARTER ON ALL SUCCESSIVE TRIALS.
3,4		REPEAT PHASES 1 AND 2 USING LITTLE RECTANGLE AS S+.	SAY, "GIVE ME LITTLE."	HAND YOU LITTLE RECTANGLE.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.	AS IN PHASES 1 AND 2.

A Task Analytic Approach to Designing Curricula for the Behaviorally Retarded

Deborah Pease and Jean-Luc Lambert

Abstract

A task analytic approach can provide precise diagnostic and prescriptive tools as well as evaluative feedback to aid in selecting, sequencing, and assessing the effectiveness of instructional methods and objectives. This paper outlines the content and processes involved in task analysis.

Educational technology has focused increasingly on elements of the teaching/learning process in attempts to empirically determine how we can optimize the effects of our teaching investments. The influences of operant conditioning, applied behavior analysis, and task analysis have perhaps been greatest in habilitation efforts with the behaviorally retarded. While "behavior modification" (as a limited application of Skinner's reinforcement theory) is employed by many special education teachers and psychologists, widespread application of learning principles to aid in the selection and programming of skills to be taught has yet to occur. If professionals wish to take full advantage of these principles in engineering the environment to support and sustain the acquisition of new skills (Skinner, 1968), they must extend their expertise to these areas.

Duncan (1972, p. 53) has noted that behavior usually described as "experienced, expert, or skilled probably is a hierarchy of subroutines." The planning of antecedent and consequent stimuli to shape the subroutines and combine them into skillful behavioral chains is the objective of the instructional design methodologies subsumed under the rubric "task analysis." The task analytic approach to designing instructional programs, which breaks down complex skills into sequences of operationally defined subskills (prerequisites and components), enables educators to teach with greater efficiency and effectiveness. In this model, mastery of each component facilitates learning of the next, and programmatic deficiencies are more easily pinpointed than in traditional instructional programs. Behavioral analyses of the interactions among teacher and pupil, including the arrangement and utilization of instructional materials, allow educators to plan and monitor the learning process with greater precision, and thereby come closer to ensuring success for all students.

In this paper, we will use Merrill's (1973, p. 123) broad definition of task analysis: " . . . the entire process of behavioral and content analysis instead of merely descriptions of real world jobs as (the term) was originally intended." Ideally, a task analysis will reflect " . . . information about prerequisites and conditions, behaviors and processes, relevancy and utility . . . (to determine the most advantageous instructional) decisions and priorities . . . " (Davies, 1973, p. 74). Hence, the task analyst combines plans for a sequence of instructional steps ("strategy" *), student performance, and teacher intervention ("tactics" *) in a unified presentation. An instructional system must

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* (Davies, 1973, p. 75)

include specifications of instructional goals, entering behavior, instructional procedures, and methods for assessing performance (Glaser, 1964).

While the latter components are familiar to many teachers, most presentations of task analysis for teachers are overly vague or simple and may therefore give teachers a premature confidence in their instructional design skills.

Teachers are generally advised to select instructional goals (behavioral objectives) based on the general requirements of situations the student will likely experience; the "normal" behavioral repertoire is the goal. However, as Duncan pointed out, to " . . . select training objectives on the basis of what (one) does in that situation . . . is . . . to become involved in a superficially simple exercise which may in practice be far from straightforward" (Duncan, 1972, p. 25). Duncan has cautioned his readers that normal performance of a task may be inefficient. In addition, one cannot fail to note that most tasks can be learned and performed in a variety of ways, as long as critical elements (cues and sequences) are discriminated. Once one has delineated the critical elements, the content, scope, and sequence of instructional programs can be best determined empirically.

Performance data can provide useful information for decision-making in the refinement of instructional programs. During design and preliminary use, such "formative evaluation" may be maximally helpful (Baker & Alkin, 1973). Teachers can analyze inadequate pupil performances to determine what elements or aspects require additional attention. Comparison of interim performances with criterion performance requirements will indicate appropriate instructional changes if the designer/evaluator has previously articulated alternatives and designed data collection tools to yield information along pertinent dimensions.

Though many authors have addressed aspects of task analysis, we have been unable to find a single source which clearly delineates relevant considerations and offers a sequence of component steps to enable teachers to select appropriate behavioral objectives, and to design and refine instructional programs. Much has been written about applying knowledge of learning and teaching principles to instructional design and implementation, but most of the literature is either overly simplified (to the point of prohibiting generalization of basic principles to other skill areas), or too broad in presentation to allow the classroom or resource teacher to make discriminations prerequisite to designing and implementing effective programs for behaviorally retarded students.

The following outline is offered as an instructional format that may be used as a diagnostic and prescriptive checklist by teachers and psychologists whose aim is the habilitation of individuals who require our most precise and educated teaching efforts.

I. Decide what skill (task) to teach:

A. Describe setting in which it will be taught.

B. List behavioral requirements for independent functioning in the setting.

C. Assess pupil"s (S's) entering skills in relation to B.

D. Assess S's physical limitations.

E. List skills S must learn to fulfill requirements of B.

F. List gross behavioral components (stimulus-response segments) of each task (set of subtasks, the elements, and sequence of which can later be altered to perform a different task).

G. Select from list E task to teach, making certain that:

1. Task will be functional (it will have a high probability of reinforcement from the natural environment).

2. S appears physically capable of performing the task.

3. It is the task which requires the fewest additional components S has not yet mastered.

II. Define the task operationally:

A. Describe conditions under which the task is to be performed (S's new behavior must be brought under the control of environmental cues so that it is performed only when appropriate according to place, time, or situation):

1. List places (where stimulus control must be established).

2. List other aspects of the environment which must serve as signals to perform the task (discriminative stimuli, or S^D).

3. List total variety of materials: S's new behavior must be performed with all appropriate materials ("stimulus generalization").

4. Are people necessary? Determine whether or not task is ultimately to be performed in the presence of other people ("stimulus control" or "generalization").

a. If people are necessary, list whom.

b. If not, plan to "fade" people out (gradually decrease their interaction and presence) and arrange for some method of recording S's performance (e.g., spot-checking or self-recording)

B. Describe the conditions under which the task is to be taught:

1. Describe task performance:

a. Select one setting (for initial training) which:

1) Is relatively free of possible distractions.

2) Closely approximates the final setting in which the skill is to be performed.

3) Contains all materials needed to perform the task.

b. Test for reinforcer (S^{R+}) preference (consequent event which will increase S's frequency of performance of a behavior which it follows closely).

1) Select potential reinforcers from:

a) Edibles.

b) Social interactions.

c) Free-time activities. (According to the Premack Principle, if a low-frequency behavior is followed by an activity in which an individual frequently chooses to engage, the frequency of performance of the rare behavior will increase).

2) Record responses (on a simple, already mastered task) obtained when the potential reinforcers (one type per session) are delivered immediately following each successful response execution ("contingent" consequence delivery).

3) Determine from data (II-B-1-b-2) which potential reinforcers yielded greatest frequencies of responding.

4) Plan to begin reinforcing successive approximations of the new response on a continuous (FR1) schedule. (On a fixed ratio of 1:1, a reinforcer will follow every response which meets minimal stated criteria.)

C. Describe what S will do as a result of instruction (instructional objective):

1. Mode of instructional cue (S^D):

a. Visual,

b. Auditory,

c. Kinesthetic, or

d. Tactile.

2. Response mode:

a. Gross motor,

b. Fine motor, or

c. Verbal.

3. Describe each component as a sequence of stimulus→ response→ reinforcement.

III. Arrange the sequence of subtasks to be taught:

A. Based on previous research and following the requirements of the learning outcome, e.g.:

1. Visual match to identical sample.

2. Visual cue→ motor response (imitation).

3. Auditory cue→ motor response (receptive).

4. Visual cue→ verbal response (expressive).

B. Test the sequence derived in III-A:

1. Select first subtask of sequence to be taught.

2. List all S^D→ R variations of subtask (based on examples presented in III-A-1 through 4).

3. Select materials.

4. Delimit dimensions of response criteria in terms of requirements for independent performance in the natural environment:

a. Accuracy.

b. Rate.

5. Determine adequate response sample. (Account for the fact that too few trials constitute an unreliable performance sample, and too many may lead to reduction of accuracy, rate of performance, or both.)

6. Record data of responses to stimuli on a standard chart which illustrates all dimensions of response criteria.

C. Rearrange the sequence following results of III-B, simplest to most difficult in terms of relevant dimensions (III-B-2).

D. Baseline recording (pretest) of skill (behavioral chain):
Given stimulus, does S perform entire chain independently and meet all dimensions of response criteria?

E. Baseline recording of the components of the chain:
Given stimulus, does S perform components independently?

IV. Teaching program:

A. Teach each component the student does not perform independently when presented with the stimulus:

1. Schedule reinforcement.

2. State dimensions and levels of response criteria (e.g., response latency, accuracy, or rate).

3. Reinforce successive approximations of the component, decreasing prompts:

a. Stimulus presentation—→ physical guidance—→ S^{R+}.

b. Gradually fade physical guidance, making certain performance is sustained.

c. Build performance rate if appropriate.

4. Record and analyze data on relevant response dimensions.

5. Post-test each component by presenting stimulus to S:

a. If S independently performs component meeting all criteria, return to IV-A-1 until all components of the sequence are exhausted, then proceed to IV-B.

b. If S does not independently perform the component, determine what criteria have not been met:

1) If accuracy, return to II-C-1 (alternate program: smaller steps or begin with different response mode).

2) If response latency or response rate, present appropriate verbal cue and retest.

a) If success, continue to exhaust components sequentially.

b) If failure, return to IV-A-3.

B. Chain responses by following steps of either 1 ("backchaining"), or 2 ("forward chaining") below:

1. In behavioral chains of a finite set of elements, e.g., a dressing skill (final performance will consist of $R_1 + R_2 + R_3 \ldots R_n$):

a. Set up materials, give verbal instruction (e.g., "Put on the sock"), and assist S in performing final behavioral link ($Response_n$ or R_n) in chain.

1) If success, give S^{R+}.

2) If failure, repeat IV-B-1-a.

b. Gradually reduce assistance until:

c. Given materials and verbal cue, S performs final component (R_n) independently.

d. Repeat IV-B-1-a through c, adding preceding components of final chain sequentially (i.e., $Response_n \rightarrow S^{R+}$; $R_{n-1} + R_n \rightarrow S^{R+}$; $R_{n-2} + R_{n-1} + R_n \rightarrow S^{R+}$; . . .; $R_1 + R_2 \ldots R_n \rightarrow S^{R+}$) until:

e. Given materials and verbal cue, S completes the behavioral chain independently, i.e., $R_1 + R_2 + R_3 \ldots R_n \rightarrow S^{R+}$.

2. In open-ended behavioral chains (e.g., rote counting from 1 to N):

a. Set up materials, present verbal cue, assist S in performing first behavioral link (R_1) in chain.

1) If success, give S^{R+}.

2) If failure, repeat IV-B-2-a.

b. Repeat a, gradually reducing assistance until:

c. Given materials and verbal cue, S performs initial component (R_1) independently.

d. Set up materials, give verbal cue, then, following S's successful performance of R_1, assist S in performing R_2, then give S^{R+}.

e. Repeat d, gradually reducing assistance on R_2 until:

f. Given materials and verbal cue, S performs $R_1 + R_2$ independently.

g. Repeat IV-B-2-a through f, adding components sequentially until:

h. Given materials and verbal cue, S completes the behavioral chain independently.

C. Post-test: Given materials in training setting, S performs entire

chain independently.

1. If success, proceed to IV-D.

2. If failure, go to remedial loop #1 (see below).

D. Maintenance of acquired skill:

1. Environmental conditions:

a. People present

1) If task is to be performed with no person present, fade other people out of setting.

2) If task is to be performed in presence of a variety of people, reinforce S contingent on performance in presence of other people.

3) Post-test in presence of new people or absence of all people.

a) If success, proceed to IV-D-1-b.

b) If failure, go to remedial loop #2.

b. Setting

1) If task is to be performed in a slightly different environment or in a variety of environments,

2) Gradually introduce other environmental components.

3) Reinforce S contingent on performance in these other environments.

4) Post-test under new environmental conditions:

a) If success, proceed to IV-D-2.

b) If failure, go to remedial loop #3.

2. Reinforcement schedule - must be gradually changed if necessary, to conform with contingencies available in the natural environment. (Change schedule gradually enough to avoid causing reduction in strength of behavior.)

a. If success, proceed to IV-D-3.

b. If failure, go to remedial loop #4.

3. Data (e.g., accuracy and rate) - must be analyzed to ascertain

that response is being maintained.

a. If maintained, recheck periodically.

b. If not maintained, go to remedial loop #5.

Remedial Loop #1:

1. Note at what point in the sequence the chain breaks down (step after which next component is not performed).

2. Present auditory stimulus for next component, record response.

   a. If S independently performs component, return to IV-B-1-d, or IV-B-2-g, as applicable.

   b. If S does not perform the component independently, return to IV-A-3-a.

Remedial Loop #2:

1. Return to environmental condition under which S last independently performed skill and retest.

   a. If success, proceed to remedial loop #2, step 2.

   b. If failure, back up further.

2. Introduce change more gradually and:

3. If skill is to be performed in absence of other people,

   a. Arrange for trainer to re-enter area after small variable intervals to reinforce S.

   b. Increase variability of intervals between reinforcer delivery.

      1) If success, go to IV-D-1-a-3.

      2) If failure, arrange for contingent reinforcement to be made available to S at variable intervals, delivered while the trainer is out of sight (e.g., a bell could signal reinforcer delivery at a prearranged location).

      3) If success, go to IV-D-1-b.

      4) If failure, maintain trainer (for a longer period) within the environment.

4. If skill is to be performed in presence of a variety of people:

a. Make certain stimulus and reinforcement delivery by all trainers are as identical as possible.

b. Introduce a new trainer only after independent responding has been well established in the presence of each preceding trainer.

1) If success (independent performance in presence of new trainer), go to IV-D-2.

2) If failure, repeat procedure (remedial loop #2, step 4) introducing change more gradually.

Remedial Loop #3:

1. Return to environmental condition under which S last independently performed skill and retest.

a. If success, go to remedial loop #3, step 2.

b. If failure, back up further.

2. Add new environmental changes more gradually, adding each only after independent responding has been well established in the presence of each addition.

a. If success, go to IV-D-2.

b. If failure, it may be necessary to retain a simpler environment, without additional changes, for S to maintain independent performance.

Remedial Loop #4:

1. Return to schedule of reinforcement under which S last performed skill independently.

a. If success, go to remedial loop #4, step 2.

b. If failure, back up further.

2. Gradually increase the average interval between reinforced responses after independent performance has been well established on an FR schedule.

a. If success, go to IV-D-2.

b. If failure, go to remedial loop #4, step 3.

3. Establish a reinforcer (e.g., tokens or points) which can be

delivered at smaller intervals and exchanged for the preferred reinforcer:

a. Present tokens or points contingent on independent performance,

b. Immediately exchange the tokens or points for the preferred reinforcer,

c. Gradually increase the delay between response and exchange making certain increases occur only after independent performance has been established,

d. Gradually increase the variability of delay between response and token or point delivery until the normal environmental contingencies are established,

4. Retest.

a. If success, go to IV-D-3.

b. If failure, repeat remedial loop #4, step 3.

Remedial Loop #5:

1. Contingent on decrease in accuracy:

a. Observe performance: determine which components fail to meet minimum accuracy criteria,

b. Return to IV-A-3.

c. Go from IV-A-3 to IV-C to IV-D-3.

2. Contingent on decrease in rate:

a. Observe performance and determine if decrease is due to intercomponent pause or to decrease in rate of component performance.

b. If due to intercomponent pause,

1) Prompt next component verbally or physically.

2) Fade prompt.

c. If due to decrease in rate of component performance,

1) Prompt faster performance of the component with physical guide or auditory cue,

2) Fade prompt.

d. Require that rate criteria be met for reinforcement to occur.

e. Return to IV-C, then go to IV-D-3.

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Flashcards to Worksheets:

Transitional Training in Normalization of Academic Behavior

Deborah Pease and Frances George

Teachers find flashcards appropriate and useful for initial instruction in visual-visual, auditory-visual or visual-oral matching, but as a rule they quickly wean their students from such individual attention and expect them to function more independently. To enable students to practice academic skills they have learned, teachers often use worksheets and workbooks.

In special education classes, however, where the need for individual attention is undoubtedly greater than in other classes, teachers may overlook the importance of teaching independent classroom skills. As a result, special education teachers lose opportunities to free their time for concentrated individual instruction, and their students never get a chance to learn to pace and monitor their own behaviors.

In the Behavior Department classroom, we have found that various worksheet activities used in elementary education can be successfully adapted for many behaviorally retarded students following their acquisition of component skills.

Two concerns motivated us to consider worksheets. First, on teacher-paced tasks (e.g., reading numerals on flashcards), our verbal students were attaining relatively low ceiling rates of performance — below the normal range for elementary school children (Kunzelmann, 1973). Secondly, our nonverbal students were requiring a great deal of individual attention while practicing skills they had already acquired.

This year we devised a number of worksheet activities in beginning reading, printing, and quantitative skills for our nonverbal and verbal students, whose psychometric classifications range from moderate to severe retardation. We begin worksheet-training when a student has acquired some rudimentary (prerequisite) academic skills (e.g., labeling numerals, letters or words, or counting a set of objects and selecting the appropriate numeral). While modifying our approach in response to the demonstrated competencies and needs of the individual student, we follow a basic strategy exemplified by the sequences outlined in this report.

Sequence I: Symbol Reading

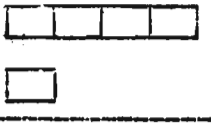
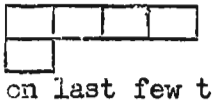
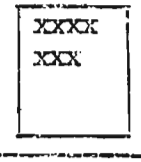
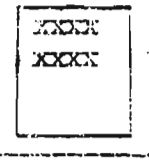
Prerequisite: Student reads or manually signs three or more printed symbols.

Step	ANTECEDENT Materials to set up & instructional cue to give on each trial	BEHAVIOR Student's (S) response	CONSEQUENCE Teacher's (T) response
1	T presents one symbol card and asks S to read it.	S reads symbol.	T presents reinforcing consequence (SR+).

Sequence I: Symbol Reading, continued

Step	ANTECEDENT	BEHAVIOR	CONSEQUENCE
2	Repeat Step 1.	S reads symbol #1.	T immediately places symbol #2 just to the right of #1.
	T aska S to read symbol #2.	S reads symbol #2.	SR+.
3	T asks S to read the cards; T presents one card.	S reads card.	T places another card to right of first card.
		S reads second card.	SR+.
4	T presents additional trials of Step 3 for practice.	On each trial, S reads the cards with little delay between the two responses (response + criteria).	SR+ following every correct trial.
5	T asks S to read the cards and presents two cards in horizontal array.	S reads both cards, left to right, and meets response criteria stated in Step 4.	SR+.
6	Repeat Step 5.	S meets response criteria stated in Step 4.	T immediately places a third card to right of others.
		S reads third card.	SR+.
7	T presents additional trials for practice.	S meets response criteria stated in Step 4.	SR+ following every correct trial.
8	T presents trials with three cards in horizontal array.	S meets response criteria stated in Step 4.	SR+ following every correct trial.
9	T presents four cards in horizontal array.	S meets response criteria stated in Step 4.	SR+ following every correct trial.

Sequence I: Symbol Reading, continued

Step	ANTECEDENT	BEHAVIOR	CONSEQUENCE
10	Repeat Step 9.	S meets response criteria stated in Step 4.	T immediately places fifth card under first with 1 to 2 in. between.
		S reads fifth card.	SR+.
11	T presents additional trials of Step 10 for practice.	S meets response criteria stated in Step 4.	SR+ following every correct trial.
12	T presents five-card array: 	S meets response criteria stated in Step 4.	SR+ following every correct trial.
13	T presents additional trials of Step 12, moving fifth card a bit closer to first on each trial until array is:  on last few trials.	S meets response criteria stated in Step 4.	SR+ following every correct trial.
14	T presents six-card array: 	S meets response criteria stated in Step 4.	SR+ following every correct trial.
15	T presents worksheet: 	S meets response criteria stated in Step 4.	SR+ following every correct trial.
16	T presents: 	S meets response criteria stated in Step 4.	SR+ following every correct trial.

Sequence I: Symbol Reading, continued

Step	ANTECEDENT	BEHAVIOR	CONSEQUENCE
17	T presents: xxxx xxxx x	S meets response criteria stated in Step 4.	SR+ following every correct trial.
18 to 24	T presents worksheets adding one symbol each time until 16 stimuli are presented at once.	S meets response criteria stated in Step 4.	SR+ following every correct trial.
25	T presents worksheets of 16 stimuli each, reducing size of stimuli gradually, step by step, until they are ¼ inch or until S's accuracy decreases (because of limited visual acuity).	S meets response criteria stated in Step 4.	SR+ following every correct trial.
26	T repeats Step 25, adding stimuli to the rows, one per row per trial.	S meets response criteria stated in Step 4.	SR+ following every correct trial.
27	T gradually decreases distance between rows until 20 ¼-inch symbols are presented.	S reads randomized symbols left to right, top row to bottom, 20 to 100 per min. correct with no more than 1 error (learning opportunity) per min. (Aims range for grades 1-2, Kunzelmann, 1973).	SR+ following every increase in response rate per page.
28	T presents worksheets of Step 27.	S reads symbols, left to right, top to bottom.	SR+ following every page which meets criteria of stable performance rate.

Sequence I: Symbol Reading, continued

Step	ANTECEDENT	BEHAVIOR	CONSEQUENCE
29	T continues fading procedure along these dimensions: a) size of stimuli, b) number of stimuli per row, c) number of rows per page, d) number of different stimuli.	S maintains or increases rate and accuracy of performance.	SR+ following every page which meets criteria of stable rate performance.

Sequence II: Arithmetic Computations

Example: horizontal addition.

Prerequisite: Given one horizontal addition problem (e.g., 2+4=), S states or manually signs answer providing own cues.

Step	ANTECEDENT Materials to set up & instructional cue to give on each trial	BEHAVIOR Student's response	CONSEQUENCE Teacher's response
1	Given one problem at top of page, T asks S to answer the problem.	S states or signs answer.	SR+ following response.
2	Given one problem at top of page, T asks S to answer the problem.	S states or signs answer.	T writes another problem a few inches below the first.
		S states or signs answer.	SR+ following correct response.
3	T presents additional trials of practice on Step 2.	Same as Step 2.	Same as Step 2.

Sequence II: Arithmetic Computations, continued

Step	ANTECEDENT	BEHAVIOR	CONSEQUENCE
4	T presents two problems per page, one a few inches below the first.	S states or signs answers, proceeding from top to bottom of page.	SR+ following correct completion of two problems.
5	T presents two problems per page, one a few inches below the first.	S states or signs answers, proceeding from top to bottom of page.	T writes a third problem a few inches below the second problem.
		S states or signs answer to third problem.	SR+ following correct response.
6	T presents additional trials of practice on Step 5.	Same as Step 5.	Same as Step 5.
7	T presents three problems per page: x+y= a+b= c+d=	S states or signs answers, proceeding from top to bottom of page.	SR+ following correct completion of three problems.
8	T presents three problems per page.	S states or signs answers, proceeding from top to bottom of page.	T writes a fourth problem below third.
		S states or signs answer to fourth problem.	SR+ following correct response.
9	T presents additional trials of practice on Step 8.	Same as Step 8.	Same as Step 8.
10	T presents four problems per page.	S states or signs answers, proceeding from top to bottom of page.	SR+ following correct completion of four problems.

Sequence II: Arithmetic Computations, continued

Step	ANTECEDENT	BEHAVIOR	CONSEQUENCE
11	T presents additional trials of practice on Step 10.	S states or signs answers, proceeding from top to bottom of page, until response rate stabilizes at or surpasses 3/min. correct with no errors.	Same as Step 10.
12	T continues fading procedure along these dimensions: a) size of stimuli, b) number of problems per page, and c) number of different problems per page, until:	S answers problems (¼" symbols, 15 to 30 per page, 10 to 40 correct responses per minute, and no more than 2 incorrect responses per mimute.)	SR+ following correct completion of each page.

Sequence III: Rational Counting

Prerequisite: Given horizontal row of zero to three or more pictures, S selects numeral flashcard which describes the number of pictures (or marks).

Fading procedures similar to those used in Sequence I (Symbol Reading) and Sequence II (Arithmetic Computations) can be used to teach students to select and mark appropriate numerals.

Example of rational counting worksheet:

. .	0 1 2
. . . . .	5 3 4
.	0 4 1
	2 0 5
. . . .	2 3 4
. . . . .	1 5 6

Correction procedure

When a student does not proceed smoothly from one step to the next in a sequence, we simply back up until the student performs successfully. At that point we present a reinforcing consequence and again proceed forward through the sequence. If necessary, we repeat steps. (Setting a more stringent response criterion for each step might be another way to facilitate acquisition.)

Results with our students

This year we used the worksheet "fading" procedures described above (and on p. 39) to "worksheet-train" eleven students in our department's classroom. Only one student required a remedial modification. For this student, before beginning Sequence I, we presented white counting tiles (instead of symbol cards), and followed procedures similar to those of Steps 10 through 15 in the sequence. Initially the last tile was red. Then, gradually, tiles of other colors were introduced. After that, the student proceeded through Sequence I with ease.

For all our students, worksheet training resulted in performance rates considerably higher than those observed when a teacher presented the same tasks. The students gained independent classroom skills which enabled them to practice already acquired tasks. Further, by increasing their performance rates to automatic, fluent levels, the students could use their skills (e.g., reading or adding) as tools to perform more complex tasks.

Discussion

As a result of our experience with worksheet training, we feel it is important to consider two points. First, even though during skill acquisition a student's performance rate may accelerate substantially while the teacher presents each word or problem (as on flashcards), such teacher-paced methods place a limit on a student's learning. The student's performance rate can increase only to the level of the teacher's rate of presentation. Such external response pacing may also hamper generalization of the skill to the natural environment, in which competent people must pace themselves and perform complex tasks accurately and quickly.

In addition, the worksheet training sequences presented here instruct pupils on two important skills which are components of reading: proceeding with ease from page left to right, and from top to bottom. Thus further transfer can be expected to facilitate acquisition of textual reading following acquisition of single word reading.

Our results also suggest the need to reconsider an age-old assumption: that "retarded" means slow. For we have demonstrated that "slow responding" is not an inalterable dimension (or "trait") of our retarded students. We are certainly behooved to continue to explore tactics for modifying nonadaptive dimensions of retarded behavior.

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Rate Building in Flashcard-to-Worksheet Transition with Behaviorally Retarded Students

Frances George

In teaching new skills to severely handicapped students, teachers use such techniques as modeling, prompting, and fading of prompts; they carefully select the types of materials used; and they monitor the accuracy of students' responses to their cues. Most teachers aim for their students to perform accurately without assistance. But independent functioning also requires efficiency, which necessitates a modicum of speed.

Skills such as printing, doing simple computations, reading numerals and words, or counting objects may be taught to a high degree of accuracy. However, for the student to perform independently, skills such as these are not functional unless they are performed fast enough. By including both accuracy and rate criteria in defining the objectives of instruction, the teacher ensures that students will be able to use their skills in a more efficient and, hence, more independent manner.

The majority of studies dealing with performance speed have been oriented toward workshop applications, where production rate is important to the economic survival of the enterprise (Evans & Spradlin, 1966; Huddle, 1967; Brown et al., 1972). While industry-competitive production rate criteria are likely easy to obtain, we have seen no studies comparing sheltered workshop production rates with rates on similar tasks in industrial settings. There are, however, rate norms on some of the basic and tool academic skills of nonretarded children in public schools (Kunzelmann, 1970; Starlin & Starlin, 1973), and standardized worksheets are available (Precision Teaching Project, Special Education Center, Great Falls, Montana).

To provide improved instruction for people with retarded behavior, it has been suggested that the performance speeds of "normal" children be used as "aims" or mastery criteria toward which to individualize the rate-building training of students with academic "problems" (Haughton, 1971). It has also been suggested that rate building in basic skills facilitates acquisition of more complex skills (Haughton, 1971). Students who learn to read faster comprehend more (Shelton & Warner, 1971). Speed training on paper-and-pencil tasks has shown positive transfer to performance of eleven other tasks (Hoyer, Labouvie & Baltes, 1973). And increasing the rate of printing letters (by scheduled access to a playroom) was accompanied by decreasing error rates, for which no contingency was programmed (Hopkins, Schutte & Garton, 1971). Thus, it would seem reasonable to expect that rate training could produce not only more normal and therefore more functional speed among those called "retarded" but might, as a byproduct, produce increased accuracy as well.

In determining rate criteria in academic performance one should be familar with "precision teaching." In 1969 the idea of specifying individual aims evolved from a philosophy to a technology of teaching (Haughton, 1971). An "aim" specifies the number of responses per minute required and the number of errors (called "learning opportunities") allowed before a skill is considered to be mastered (e.g., reading a story at the rate of 80 words per minute with 0-2 errors per minute; computing addition problems at 30 correct per minute with 0-2 errors per minute; copying randomly ordered upper-case letters at 90 correct per minute with 0-2 errors per minute). The rate of performance is observed and recorded. As a student learns to perform a basic skill at a high rate he can move to a more complex skill (e.g.,

from printing simple strokes to printing stroke combinations that form letters). There are minimum rates of performance at which basic skills must be performed in order to ensure success in acquiring the next composite skill. Performing at 30 digits (problems) per minute in math computation, for instance, allowed a student to move towards more complex tasks, while a student performing below 20 digits per minute decelerated as he moved to more complex problems (Haughton, 1971).

In precision teaching, accuracy and rate are used together in decision-making. Ranges of proficiency are being established in the areas of reading, printing, and math (Starlin & Starlin, 1973). Within a task analytic hierarchy of subskills in these areas, rate building of component skills may facilitate acquisition of the composite skills. If so, at each step in composite skill training, rate building methods adapted for handicapped students might assist the teacher in producing the motor and verbal fluency that approaches the norms of nonretarded pupils. Thus, to adapt this approach to students with special needs, rate aims should be incorporated into each step of the task analysis of the composite skill. For example, as one trains accuracy in components such as the labeling of upper-case letters in random order, the labeling of lower-case letters in random order, the labeling of the two cases combined in random order, and the labeling of the letters of words as a series of spelling skills, rate building should be incorporated at each step to ensure the fluent spelling and printing of the words by the student. We have incorporated rate building in the transfer of learning materials (for example, numerals, upper-case letters, or words) from flashcards (where the student's rate of responding is dependent upon the teacher's rate of presentation) to worksheets (where rate is dependent solely upon the student's own pace) (see p. 30).

Seven adults and five children received this form of instruction in our classroom this year. Transitional training begins when a student can respond 100% correctly to flashcards presented one at a time by the teacher with a verbal cue (i.e., the student can label or "read" the stimulus). The student then moves to flashcard presentation by the teacher without verbal cues, because eliminating a verbal cue (for example, "What is it?") brings the student closer to independent labeling of the stimuli. A "fading" procedure, using the same flashcards gradually built into a worksheet-like array on a tabletop, facilitates transfer from teacher presentation to student self-presentation. As the student progresses, we introduce actual worksheets and begin reducing the size of the stimuli (numerals, letters, or words) from about 1¼ inches tall to as small as one-half inch, one-quarter, or even elite type size. The decision to reduce stimuli is dependent upon the student's first reaching a predetermined rate on the original set of materials. The teacher can then probe ahead to see if perhaps the student can perform as efficiently with the smaller size materials.

This report outlines the progress of three adult residents, whose acquisition of independent skills is representative of the performance of the 12 students who have had "worksheet-training" in our classroom.

STUDENT	AGE	ENTRY IQ	CONTENT OF FLASHCARD-TO-WORKSHEET INSTRUCTION
S1	58	unknown	numerals; clockfaces (3D to 2D)
S2	24	33-45	letters (upper-case)
S3	39	50	words; addition problems

Labeling numerals

S1 was first taught to touch numerals in a horizontal array of flashcards and then to label (i.e., say the word for) 1¼-inch numerals (0 to 10) on flashcards presented one at a time by the teacher, first with verbal cues and eventually without them. When the student could label flashcard numerals at a rate of 40 numerals correct per minute with 0 to 2 errors per minute, we reduced the numerals from 1¼ inches to ½ inch in height. The reduction in size did not decrease the student's rate of labeling the numerals.

Next, by the same procedure, S1 was taught to label numerals on flashcards arranged in horizontal rows on a table. Transfer to a worksheet where S1 was required to label the numerals from left to right, top to bottom, resulted in five consecutive sessions in which the rate remained at 40 numerals correct per minute with 1 to 2 errors per minute. After the initial five sessions, S1 maintained a rate of 40 numerals per minute with no errors. He gradually accelerated to the criterion of 50 numerals per minute without error.

Now the numerals 11 to 15 were introduced on flashcards. The numerals were one-half inch high as S1 had the stimuli reduced to that size on the numerals 0 through 10. S1 was first required to touch the numerals on flashcards on a tabletop on teacher cue. On teacher-presented flashcards, the student got 58% correct, which converted to rate was 5.4 correct and 3.8 incorrect per minute. S1 was responding slowly as well as inaccurately. When receptive control was established (three consecutive sessions at 100% accuracy), S1 was required to label the numerals as the teacher presented the flashcards one at a time.

The next step was for him to label the numerals 11 through 15 on a self-pacing worksheet. Transitional instruction from flashcards to worksheet was not necessary as S1 generalized from one worksheet to the next on labeling numerals from left to right on the row and from top row to bottom row on the page. Fifteen sessions later S1 was performing at a rate of 15 correct responses and 2 incorrect responses per minute on teacher-presented materials and at a rate of 17 responses correct and 2 responses incorrect per minute on self-presented materials. Four sessions later, his rate rose to 38 correct responses and one incorrect responses per minute on self-presented worksheets and 26 responses correct and one incorrect response per minute on teacher-presented flashcards. The teacher-presented flashcards were terminated at session 22, when S1 reached five consecutive sessions with a rate of above 30 responses per minute without error. S1 was becoming more "fluent" and independent on the self-presenting worksheets. After 36 sessions, he could label the half-inch numerals at the rate of 40 per minute without error.

At that point the numerals 11 through 15 were combined with 0 through 10 in random order. At present S1 can label 0 through 15 in random order on a self-pacing worksheet at a rate of 45 correct responses and 0 to 2 errors per minute. When he attains a rate of 50 responses per minute with 0 to 2 errors, instruction of the numerals 16 through 20 will begin.

While this student is acquiring the ability to label numerals (obviously an important prerequisite for further instruction in elementary quantitative skills), he has also gained the advantage of learning left-to-right scanning and the return sweep to the next row of printed material, from the top of the page

to the bottom of the worksheet -- a skill necessary for the more complex task of reading words, phrases, and sentences.

With S1, as with all our students, rate data have been much more sensitive to progress than percent correct. Although S1 had maintained 100% accuracy over several sessions during initial instruction, his rate of labeling had yet to stabilize at the predetermined criterion. Until rate and accuracy both reached criterion S1 continued to label the numerals 0 through 15 as part of his daily math lesson.

Our decision to advance this student to new numerals or to combine a new set of numerals with a previously learned set was based on his attaining the criterion of 50 responses per minute with 0 to 2 errors for five consecutive sessions. The rate criterion is based on Starlin and Starlin's (1973) estimates of the lower limit for beginning reading. The need for five consecutive sessions of criterion performance is based on the amount of day-to-day variability shown by this student.

Another important factor in rate building is the schedule of reinforcement. Initially when S1 was learning to touch numerals in response to the teacher's cue, he was given a token for every correct response. When he began labeling the numerals on both flashcards and worksheets he was given a token for every fifth correct response. By reviewing his progress and noting stabilization in the data, which were recorded on a Detailed Pupil Record form (see p.66) and then transferred to six-cycle semilog graph paper, a decision to change the schedule of reinforcement could be made. Token delivery was eventually "thinned" to a requirement of 16 correct responses per token. As S1 adjusted to the schedule requirements, he learned that he had to talk faster if he was to earn as many tokens as he had in earlier sessions.

We chose a fixed ratio (FR) schedule because FR schedules of moderate value are characterized by a pause after reinforcement, followed by a quick change to a steady, increased rate of responding (Ferster and Skinner, 1957). In our students the pause has been minuscule, even with an FR50 schedule. With pauses so slight that there is no noticeable interruption in the rate of responding, the FR schedule is easily administered and has proved to be an effective tool. As the teacher says "Go," she starts the stopwatch and silently counts each response of the student. When the required number of responses is reached, the teacher places a token on the table. When the task is completed or when, at the end of a predetermined time period, the teacher says. "Stop" and stops the stopwatch, she records the time and the number of responses, both correct and incorrect. Meanwhile, the student may collect his tokens and place them in a clear plastic tube (his "bank"). At a later time in the day, the teacher calculates the student's rate per minute, and at the end of the week, she plots each day's rate on semilog graph paper. From the graph we can readily make empirically-based decisions to change the schedule, reduce or increase the size of the materials, eliminate verbal cues, or make other modifications.

Labeling letters

S2 received instruction in labeling upper-case letters, a basic component of spelling. When S2 first came to our classroom she could say the letters of the alphabet by rote in serial order — so well, in fact, that the "skill" interfered with acquisition of more functional skills. Even though letters were arranged on a worksheet in random order, S2 would say the letters in serial order. For example, if the first row of the self-presenting worksheet had the letters CFKLOR, she would say "C," then follow with "D" and "E." She might then label the fourth letter correctly but follow it with "M" rather than "O."

After 35 sessions of the teacher presenting one-inch tall upper-case letters one at a time on flashcards, S2 reached the predetermined criterion of 20 responses correct per minute and less than two responses incorrect per minute. Upon transferring to a self-pacing worksheet of half-inch letters (8 per row, 10 rows) S2 began labeling at the rate of 38 letters correct and 2 incorrect per minute. Fifteen sessions later she had not made significant improvement.

Her present rate is 44 responses correct and 6 responses incorrect per minute. The data show a pattern of consistent errors indicating need for a remedial program on the labeling of the letters G, E, M, N, O, and Q. When the student demonstrates receptive control by touching the letter on the teacher's cue, the demand to label (say the name of) the letters will be re-introduced. This student's failure to accelerate to the minimum criterion of 50 letters correct with 0 to 2 errors per minute could be a function of our having reduced the size of the stimuli too soon or a function of the reinforcement schedule. At this time her schedule is FR15; a probe should show us if she responds faster on an FR10 or FR20 schedule.

Telling time

S1 is learning to tell the time. We began with a three-dimensional clockface, ten inches in diameter. The hands are changed manually for every trial. Although this is a time-consuming procedure (on top of being unnatural), S1 learned to label the numerals on the clockface and tell time on the half-hour and hour. Each session had 72 trials of "What time is it?" Each hour and half-hour was "presented" three times in random order. The sessions averaged seven minutes each. After 76 sessions of responding to a teacher-presented clockface, S1 reached the criterion of five consecutive sessions of responding at a rate of 10 per minute without error. He could now begin self-pacing on two-dimensional clockfaces.

The first worksheets had clockfaces, three in a row, reduced from the 10-inch diameter to $3\frac{1}{4}$ inches. The clockfaces were permanently adhered to 8X11 inch paper and covered with transparent acetate, which allows the materials to be used over and over. (We use the protective covering on all worksheets that require an oral response.) The second set of worksheets had three clockfaces in a row, with a fourth clockface making the beginning of a second row. S1 generalized to the smaller clockfaces and the tabletop positions without error. The last step of transition from three-dimensional teacher-presented materials to self-presenting two-dimensional worksheets was to introduce two rows with three clockfaces per row.

Four sets of hour and half-hour clockfaces were made to prevent the student from memorizing a particular order.

At this time rate building began. S1 was required to complete the entire worksheet (six clockfaces of randomly arranged hour and half-hour times) correctly in order to earn a single token. After 37 sessions (2,664 trials) S1 had doubled his rate to more than 20 responses per minute without error for more than five consecutive sessions. The amount of time per session (72 trials) varied from 2.5 to 3.0 minutes. The student's rate with self-paced worksheets was two to three times faster than his rate with teacher-presented clockfaces. The entire instructional sequence, from the labeling of numerals on the clockface to the telling of the time on the hour and half-hour on a self-pacing worksheet, took about 11 hours of instruction spread over a year and three weeks (115 sessions, and 8,386 trials). As a result of teacher and student time, energy, and involvement, S1 is functioning independently of a teacher's prompts, presence or praise in a situation that approximates the requirements of time-telling in S1's environment outside the classroom.

Reading words

In another application of rate building, we taught a sight word vocabulary to S3. His first words were red, blue, green, white, orange, brown, purple, black. With flashcards, presented by the teacher one at a time, S3 was able to label the color words at a rate of 60 responses per minute without error. With self-pacing worksheets, his rate of labeling was 104 words per minute without error -- slightly above Starlin and Starlin's (1973) suggested aim of 50 to 100 words per minute correct and zero to two errors per minute for the beginning reader.

S3's next words were the seven days of the week. With teacher-presented flashcards, he reached a rate of 44 words per minute without error from a starting rate of 15 words correct and 23 words incorrect per minute.

Similarly, his rate increased and errors decreased on the self-pacing worksheets. S3 started at a rate of 46 correct words and 9 errors per minute. Six sessions later he was labeling words from left to right, top to bottom, at a rate of 62 responses per minute without error. The rate for days of the week is lower than that for colors, possibly because the color words except for purple are all one-syllable words while all the days of the week are two- or three-syllable words. S3 was required to maintain a rate above 50 words correct and 0 to 2 errors per minute on the worksheet for three consecutive sessions before moving on to a new set of words.

The next set of words was the months of the year. Again this student succeeded in reaching the minimum rate. In ten sessions he was labeling all the one-, two-, three- and four-syllable months at a rate greater than 50 words correct and 0 to 2 errors per minute.

Up to this time S3 had been labeling isolated words on flashcards presented by the teacher and then labeling the same words arranged randomly on a worksheet. S3 had not yet read a series of words in a sentence structure. The isolated words were arranged on a worksheet in a manner resembling a sentence: left to right in a row,

with a series of rows on a page.

The words the, The, is, was, name, and date were prerequisite to the oral reading of sentences. The flashcard presentation of these words began immediately after initial instruction using a distance-fading procedure (see p. 8).

The initial rate with flashcards was 31 words correct and four words incorrect per minute. Nine sessions later the rate of labeling flashcards had accelerated to 38 words correct per minute without error. The change in rate was considerably greater on the self-presented worksheets. S3 started at 52 words correct and 12 words incorrect per minute. Ten sessions later, he was labeling the words on the worksheet at a rate greater than 90 words per minute with zero to two errors per minute.

The words name and date were then used on the student's arithmetic computation sheets and on his library card application. The responses required of him were to print his name without assistance and to print the date with cues when necessary in the space provided next to the printed stimuli.

Now S3 was ready to learn the nouns hat, table, coat, window. Ten sessions after the initial instruction, which again used the distance-fading procedure, S3 went from 33 words correct and seven words incorrect per minute to 50 words correct per minute without error on the teacher-presented flashcards. On the self-presenting worksheet, S3 went from an initial rate of 44 words correct and 1 word incorrect per minute, to a rate above 80 words per minute. Then, to probe for generalization of the left-to-right labeling of words and the return sweep to the next line of print, we gave the student two-word and three-word phrases on worksheets (worksheets #1 and 2). He was able to label correctly and to point to a picture described by the phrase. For example, S3 would label (read) "red coat" from left to right and then color a line drawing of a coat or touch a drawing of a red coat, the one picture in an array of five that could be described by what he had just read aloud.

Since S3 had no problem labeling phrases and demonstrating comprehension, we taught him the verb go and Go. The first sentence structure was, "Go to the (noun)" (worksheet #3). Following S3's performance at greater than 50 words correct and 0 to 2 errors per minute, we began instruction on the words make and Make (worksheet #4). From the very beginning S3 was required to demonstrate comprehension of the written material. The teacher would randomly select a word, phrase, or sentence from the worksheet, and S3 would again label the word(s) and then perform the action stated, touch the picture of a described object, or make an object the correct color.

When the words book, Push, push, chair, open, and close were introduced, in only five sessions S3 climbed from 16 words correct and 5 incorrect per minute to 31 words correct and 1 incorrect per minute in labeling teacher-presented flashcards. His rate on a self-presenting worksheet (worksheet #5) went from 58 correct and 6 responses incorrect per minute, to 113 responses correct per minute without error.

At this point we introduced a new worksheet (worksheet #6), with the same sentence structure but two sentences per line. S3 labeled the sentences at a rate above 90 words per minute with 0 to 2 errors per minute and, as with previous worksheets, S3 demonstrated comprehension by following the direction of the printed material.

Now S3 had to label two sentences from left to right; then the sentences were removed from his view and he had to perform the actions stated in the sentences in the order in which he had read them. (At the same time, the size of the lettering was gradually reduced until S3 was labeling typewritten copy.) This worksheet prepared S3 for compound sentences.

The word and was introduced first on flashcards and then on the worksheet. The first session in which and was included on the self-pacing worksheet resulted in a rate of 66 words correct and 4 words incorrect per minute (worksheet #7). In just five sessions more, S3 accelerated to 99 words correct and 1 word incorrect per minute. During the six sessions, S3 was labeling (reading) each compound sentence and following the directions(e.g., Push the red chair and close the door or Make the hat green and open the window).

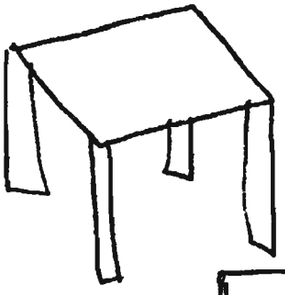
We then introduced the words big and little, one at a time. In five sessions S3 went from selecting the word from an array of four words (with initial acquisition again facilitated by distance-fading cues), to pairing the words to the appropriate objects, to reading the words in compound sentences and following the directions. The words big and little were then incorporated into compound sentences typewritten on a worksheet. With his new worksheet (worksheet #8) S3 had no difficulty at all. The first session resulted in a rate of 110 words per minute without error.

With the ability to read typewritten sentences at a useful rate, with a sight word vocabulary of greater than 40 words, and with demonstrated comprehension of the vocabulary, S3 is now ready for a commercial reading program.

As we noted earlier, we make decisions to change a student's reinforcement schedule on the basis of acceleration or deceleration curves plotted on semilog graph paper. For S3 we developed a general procedure of reinforcement, shown by his performance to be effective for him. When a new worksheet was presented, he received a token for each line of printed material read correctly. The next session he received a token for completing every two lines of print. Depending on his performance at that point, the teacher could decide to continue gradually "thinning" reinforcement by increasing the requirement to three lines per token, or to probe ahead to see if a "maintenance" schedule would suffice. (By increasing the number of tokens as the student's rate approaches criterion, but delivering the tokens only upon completion of the timed sample, the teacher moves the student that much closer to independent functioning.) S3 is now receiving tokens at the end of the reading task. He can label more than 100 words per minute, and he is prepared to read a story in a primer and be reinforced at the end of the story rather than for each page.

For easy tabulation of the number of words labeled by the student, we noted the total number of words on the bottom of each worksheet and the words in each line were totaled at the far right. (The numbers did not interfere with the student's

WORKSHEET #1



red hat

green table

blue coat

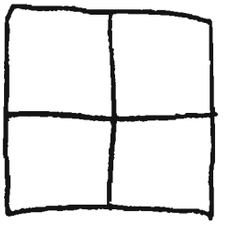
yellow window

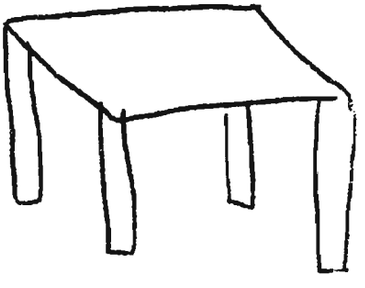
black table

orange coat

blue hat

brown window



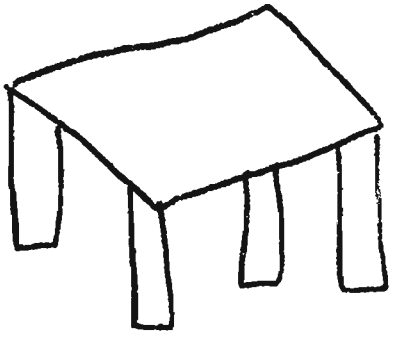
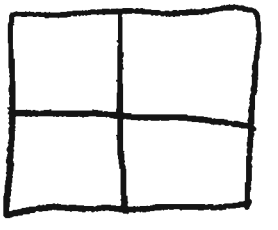
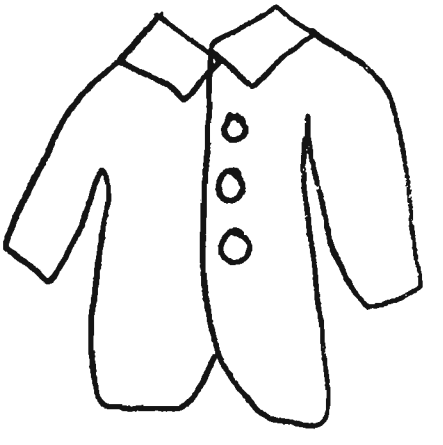
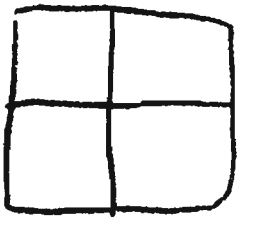
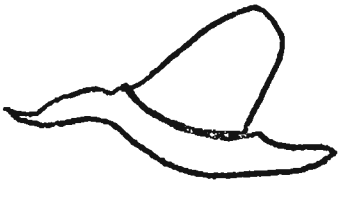


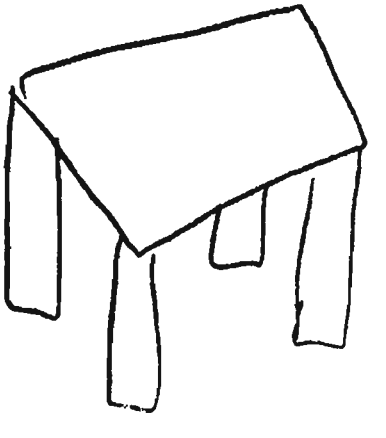
WORKSHEET #2

Go:

the red coat
the blue hat
the yellow table

the green window
the blue table
the purple window
the green hat
the yellow coat

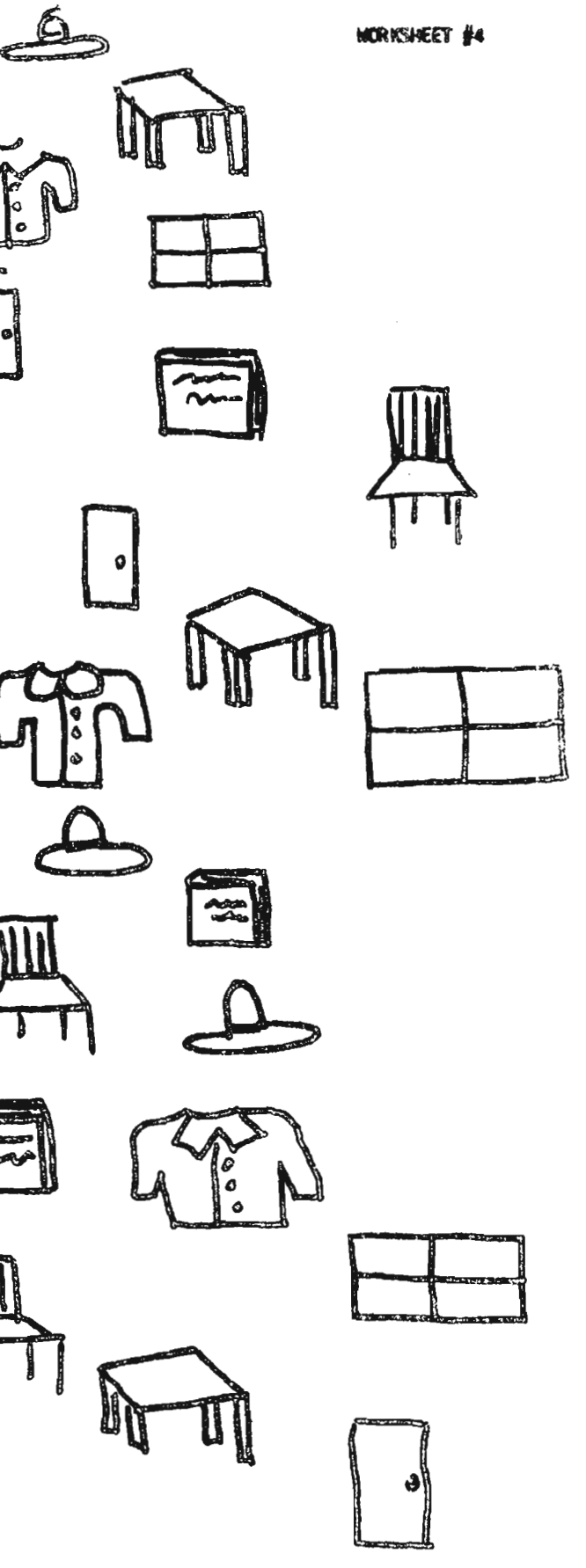


Go to the window.
Go to the table.
Go to the coat.
Go to the hat.
Go to the table.
Go to the coat.
Go to the window.
Go to the hat.

32 words.

WORKSHEET #4

Make the hat blue.
Make the table yellow.
Make the coat orange.
Make the window black.
Make the door purple.
Make the book red.
Make the chair green.
Make the door yellow.
Make the table purple.
Make the coat blue.
Make the window orange.
Make the hat black.
Make the book red.
Make the chair green.
Make the hat yellow.
Make the book blue.
Make the coat purple.
Make the window red.
Make the chair black.
Make the table green.
Make the door orange.



84 words

Push the hat.

Make the window blue.

Close the door.

Open the window.

Make the hat green.

Close the window.

Push the table.

Open the door.

Close the door.

Make the table yellow.

Open the window.

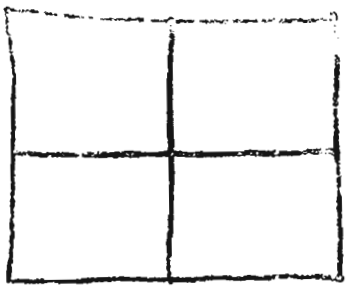
Push the hat.

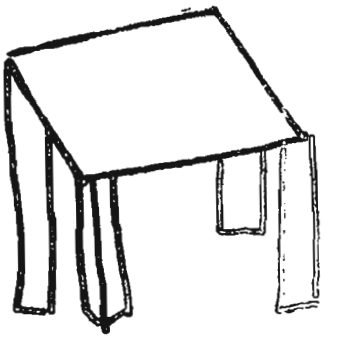
Make the coat green.

Close the window.

Open the door.

Push the table.





Go to the window. Close the window.
Go to the book. Close the book.
Go to the hat. Make the hat red.
Go to the chair. Push the chair.
Go to the table. The table is blue.
Push the table. Push the chair.
George, push the window. Close the window.
Make the hat red The hat is red.
Go to the book. Open the book.
The book is yellow. Close the book.
George, open the green book. Close the book.

total: 80 words

Go to the chair and the table. The coat is blue. 11
Push the green door and the yellow book. 8
Make the window and the table purple. 7
Close the window and open the door. The hat is red. 11
The coat is black and white. The red book is open. 11
Push the red table to the green door. 8
Open the blue door and go to the orange chair. 10
Make the chair black and the door blue. 8
Go to the brown window and close the window. 9
The door is green and the table is white. 9
Push the black chair to the black table. 8
Close the blue door and open the black window. 9
Make the door green and the coat yellow. 8

total: 117 words

Go to the big brown window. Close the window.	9
Push the little green table. Push the big chair.	9
Go to the yellow door. The door is open.	9
The door is yellow and the coat is red.	9
Close the blue book and open the orange book.	9
Make the little hat blue and close the door.	9
Go to the purple coat and push the window.	9
Go to the blue table and make the book brown.	10
Make the little book green and make the big book red.	11
Go to the green table and push the little chair.	10
Open the brown door and go to the orange coat.	10

104 words

performance,) Errors were recorded on the Detailed Pupil Record in the column headed "notes." We ignored errors during the timed sample but afterwards we pointed out consistent (or repetitive) errors and modeled the correct response. The student did not lose tokens for making an error because we found that, without special remediation, errors decreased in frequency as his rate of labeling went up. The following were counted as errors:

1) omission of a word on the worksheet
2) substitution for a word on the worksheet
3) inclusion of a word not on the worksheet
4) on making a return sweep to the next line of print, the omission of an entire line or the repetition of a line
5) repetition of a word

Simple addition

While acquiring basic reading skills, S3 has also been learning to add single-digit numerals. So far, he has learned to add the numerals 0 through 9 to the numerals 0, 1, 2, 3, and 4.

The composite skill of addition includes the essential basic component skills of labeling numerals and printing numerals. At entry S3 was able to label the numerals 0 through 10 at a rate above 100 per minute both by rote (by repeating the serial order for one minute) and by labeling quarter-inch numerals randomly ordered on a worksheet with 15 numerals per row. He could also print the numerals 0 through 9 in serial order at a rate greater than 50 per minute in half-inch squares (the space allowed for answers on the addition worksheet). Thus, S3 had the prerequisite skills to begin elementary arithmetic instruction.

In teaching beginning addition skills to S3, we took the following steps:

1. Given a numeral orally, S3 counted out the correct number of objects (paper clips, blocks, tiles, etc.) from a set.

2. Given a written numeral, S3 counted out the correct number of objects.

3. Given an addition problem orally ("two and three"), S3 counted out each set using the objects, then recounted the two sets, giving the total sum.

4. Given a written horizontal addition problem (the plus sign is labeled "and") S3 counted out each set using the objects as in Step 3, then printed the correct answer in a space provided.

5. The horizontal addition problems were converted to conventional vertical addition problems.

6. The teacher presented the problems orally and the student learned them on a rote basis. In this step, objects were used only to correct errors. The teacher

provided the correct answer if the student hesitated — better to have him imitate the correct answer than to produce an incorrect one.

7. We introduced a worksheet with three rows, ten vertical addition problems per row (30 problems).

The aim is for S3 to do the addition problems at the rate of 30 correct per minute with 0 to 2 errors per minute (Haughton, 1971). This worksheet has three sliding tabs. Every problem has the correct answer directly below the space provided for the student to print his answer. Each tab covers the answers of an entire row of problems. When the student finishes computing the 30 problems, he removes the three strips and compares his answers to the ones provided by the teacher to see if they are the same. (Occasionally, the teacher even gets one wrong, much to the student's delight!) The student circles all problems that have answers that are different from the teacher's. The problems are then quickly repeated using objects. Objects are otherwise not available to the student.

We followed steps 1 through 7 for the addition of 0 to the numerals 0 through 9 until S3 could complete 30 problems per minute without error. The steps 3, 6, and 7 were used to teach the other "families": +1, +2, +3, +4.

S3 reached the criterion rate for +0 in six sessions (40 per minute correct without error). He learned to add one (+1) to the numerals 0 through 9 in just three sessions. When +0 and +1 problems were arranged on the same worksheet, he performed computations at the rate of 46 correct per minute without error. However, proceeding to the +2 family resulted in a drop in rate. In the first +2 session, S3 performed at the rate of 7 problems correct and 5.5 problems incorrect per minute. Over 13 sessions he gradually built up his rate to the criterion. The conversion to vertical problems, made at +2, did not affect the acceleration.

The combination of +0, +1, +2 randomly arranged on a single worksheet yielded a rate of 23 correct per minute without error. Instead of building rate on this task, we introduced S3 to the +3 family, and he took 14 sessions to reach criterion.

Next, S3 was given random combinations of the +0, +1, +2, +3 families. After three sessions of 30 problems per minute correct without error S3 suddenly decelerated and needed another 15 sessions to reach criterion again.

When S3's addition of +0 and +1 was reassessed, he performed at the criterion rate. But his +2 performance was at the rate of 23 problems per minute without error, and +3 at 27 problems per minute without error. These modest rates apparently resulted from our failure to build the combined +0, +1, +2 to criterion from 23 problems per minute before starting the instruction of +3. S3 was backed up to the +2 and +3 families. When criterion was attained, +0, +1, +2, +3 problems were combined. Recognizing that rote response to the orally presented problem plays an important role as a basic skill in the computing of the written problem, in the +4 family instruction, we did not introduce the vertical worksheet until S3 could answer randomly presented oral +4 problems at 100% accuracy. As a result of the change in procedure, S3 was able to approach the criterion in only six sessions. At that time he could compute 37 problems per minute without error on the self-pacing worksheet.

S3 earned one token for every ten problems completed correctly and an additional token for completing the 30 problems within a minute. With the change in procedure, S3 shoudl be able to continue to the rest of the families in single digit addition with greater success in fewer sessions.

Comment

The progress of these three adult students illustrates how a teacher can arrange the learning environment to increase students' rates of responding. Rate is increased and accuracy maintained as the teacher transfers a student from materials that depend on teacher presentation to materials that depend only on the student's rate of responding. Through continuous monitoring of the rate (most easily seen as a curve on graph paper), the teacher can make decisions about changing the schedule of reinforcement, reducing stimuli size, increasing the number of stimuli presented, or otherwise modifying the instructional program to help the student to become a more efficient, more independently productive person.

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Quantitative Skills Curriculum for Behaviorally Retarded Students

Deborah Pease

Commercially available quantitative skills curricula do not teach the basic, prerequisite skills lacking in behaviorally retarded pupils. Therefore, we have continued to adapt for our students the skill hierarchy developed by Resnick, Wang and Kaplan (1973). Modifications in sequence as well as in content and process analyses have proved to be necessary.

The sequence outlined below has been used with good results to teach basic quantitative skills to our pupils. This sequence has also been modified to teach pupils who lack a verbal mode of communication. One nonverbal pupil has completed the sequence and others are progressing without difficulty. We have also successfully taught generalization skills such as reading time on a clock face and linear measurement.

We are continuing to design sequences to teach more advanced skills and to further refine the existing sequence.

Quantitative skills sequence

1. Given set of numerals 0-5 and verbal cue, student (S) selects correct numeral.

2. Given numeral, S says or signs same.

3. Given verbal or hand-signed model, S counts by rote from 1-5.

4. Given cue "Count," S counts by rote from 1-5.

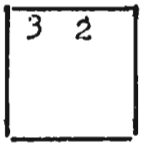
5. Given set of 3D objects (0-5), S touches each and counts how many.

6. Given numerals and set of 3D objects (0-5), S counts how many and selects appropriate numeral.

7. a) Given spoken number (0-5) and set of 6 objects, when told to count out N, S counts out appropriate set of objects, one by one.
   b) Given numeral (0-5) and set of 6 objects, when told to count out N, S counts out appropriate set of objects, one by one.

8. Given numeral (0-5) on a page and set of 6 objects, when told to count out N, S counts out appropriate set of objects, one by one, and arranges them in a vertical or horizontal row.

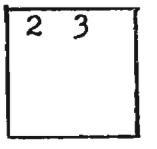
9. Given 2 numerals per page (example to right) and 11 objects, S performs Step 8 for each numeral.



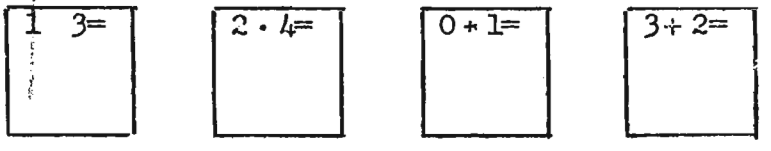
10. Given a numeral (0-5) with equal sign after it, and set of 6 objects, S selects appropriate number of objects and places them to the right of the equation.

11. Given a set of objects (0-5) in a vertical or horizontal array, with equal sign after, and set of 6 objects, S counts out same number to balance equation.

12. Given 2 numerals which total up to five (example to right), an array of numerals, and 11 objects, S counts out and places appropriate set of objects under each numeral, counts both sets together, selects appropriate numeral from array, and places numeral to right of equal sign.



13. Teacher (T) presents additional problems as in Step 12, gradually "fading" in a plus sign between the numerals until: given horizontal addition problem in which plus sign is half as large as numerals, S completes problems as in Step 12. For example:



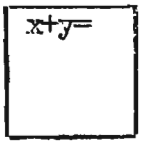
14. Given line of numerals (0-10), T points to numeral and says "Touch the number after," S responds as requested.

15. Given line of numerals (0-10), T points to numeral and asks S what number comes "after," S reads numeral after.

16. Given line of numerals, T asks "What number comes after N?", S replies correctly.

17. T asks "What number comes after N?", S replies correctly.

18. Given problem as in example to right, T covers x; S counts out objects under y; then T uncovers x and asks what number comes after it (x+1); T models counting up from x one number per object under y and placing answer after the equal sign.



19. Given problem as in Step 18, S counts out objects under y only, imitates model presented in Step 18, and completes equation.

20. Worksheet fading procedure (see p. 30) is followed until: given four problems per page and container of objects, S successfully completes page.

21. Steps 1-8 are repeated for numbers, numerals and sets 6-10.

22. Worksheets of problems with sums to 10 are presented.

23. Worksheet fading procedure (see p. 30) is followed until: when presented sheet with approximately 13 problems, S successfully completes sheet.

24. Differential reinforcement procedure is followed:
    a) Sheets of already mastered problems are presented without 3D objects as prompts.
    b) T models answering problems without 3D prompts.
    c) S imitates model.
    d) Sheets of already mastered (memorized) problems are mixed with other problems; more reinforcers follow problems completed without use of 3D prompts than those completed with 3D prompts.

25. Practice worksheets are presented until S completes problems (by writing, signing, or selecting from array), at a rate of about 30 per minute correct with no more than 1 inconsistent error per page.

26. Steps 1-8 and 14-25 are repeated with numbers, numerals, and sets to 20 and above.

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Sequence to Extend Newly Acquired Quantitative Skills to Linear Measurement

Frances George

While students are progressing through the quantitative skills curriculum outlined on p52, they can begin to apply or generalize their newly acquired skills. This year we designed a sequence to extend our students' basic numerical skills to rudimentary linear measurement.

As a result of their participation in the quantitative skills curriculum, our students had the prerequisite skills for this sequence:

- Imitating verbal behavior ("long," "short," the spoken numbers "one" through "twelve") and fine motor movements (pointing, arranging one-inch squares into a linear array).
- Labeling the numerals 1 to 12, either $\frac{1}{4}$-inch high or the size of the numerals on the ruler to be used for instruction.
- Counting 1 to 12 fixed objects laid out horizontally on a table.
- Counting out 1 to 12 objects and arranging them in a horizonal array on a table.

Before beginning this sequence, a student should also be able to sustain eye contact for at least 30 seconds, sit quietly in a classroom situation for about 15 minutes, follow simple directions, and grasp a pencil.

An outline of the steps in the linear measurement sequence follows.

Steps		
1	Teacher (T) presents short object and long object of same set and says, "Touch the long (name of object)." T models response for S.	Student (S) touches long object.
2	Same as Step 1 but T does not model response.	S touches long object.
3	T presents short line and long line drawn on paper and says, "Touch the long line."	S touches long line.
4-6	Steps 1-3 are repeated for "short."	
7	T presents short object and long object of same set, points to long object and asks, "What is it?" T models response for S.	S says, "Long."
8	Same as Step 7 but T does not model response.	S says, "Long."

Linear measurement, continued

9	T presents short line and long line drawn on paper, points to long line and asks, "What is it?"	S says, "Long."
10-12	Steps 7-9 are repeated for "short."	
13	T presents paper and pencil and says, "Make a long line."	S draws a long line.
	T says, "Make a short line."	S draws a short line.
14	T presents array of objects including 12-inch ruler and says, "Touch the ruler."	S touches ruler.
15	T presents ruler and asks, "What is it?"	S says, "Ruler."
16	T presents ruler and asks, "What do you do with a ruler?"	S says, "Measure."
17	T presents one-inch squares (1 to 12) in a horizontal row and asks, "How many inches?"	S says appropriate number.
18	T presents set of one-inch squares and says, "Make _____ inches."	S counts out appropriate number of squares and arranges them in a row.
19	T presents row of one-inch squares and says, "Touch the end."	S touches end.
20	T presents row of one-inch squares, exactly lined up with ruler, and says, "Touch the end."	S touches end of row.
	T says, "Touch the ruler."	S brings finger down from end of row to numeral on ruler.
	T says, "How many inches?"	S labels (says) numeral.
21	T presents horizontal row of one-inch squares and ruler.	S lines up ruler to row.
	T says, "How many inches?"	S touches end of row, brings finger down to ruler, and says number.

Linear measurement, continued

22	T presents half-inch wide line drawn on paper and ruler.	S lines up ruler with line.
	T says, "How many inches?"	S touches end of line, brings finger down onto ruler, and says number.
23	Step 22 is repeated with vertical rows.	
24	Step 22 is repeated with diagonal rows.	
25	T presents object (e.g., pencil, book, shoe) and ruler.	S lines up ruler with object.
	T says, "How many inches?"	S touches end of object, moves finger down onto ruler, and says number.
26	T presents pencil, paper, and ruler and says, "Make _____ inches."	S uses ruler to draw line of correct length.
27	T presents pencil, paper, and ruler and says, "Make _____ inches."	S draws line of correct length.
	T says, "Make _____ inches."	S draws second line of correct length.
	T points to one of lines and asks, "What is it?"	S answers either "Long" or "Short" as appropriate.

Four of our students are now at various phases and one has successfully completed the entire sequence. Although the students have, for the most part, been moving from phase to phase with ease, when a student has difficulty, we assist him by modeling and priming or by backing up a step until he can again proceed smoothly. For one student with visual problems, we simply glued larger numerals onto the ruler and experienced no further difficulty.

Upon completion of this sequence, students have at least rudimentary linear measurement skills. Perhaps equally important, while students are proceeding through our quantitative skills program, they have an opportunity to see that their numerical skills can be applied to other tasks.

As students learn to label higher numbers and to count larger quantities, the sequence could readily be extended to "feet" and "yards." Further extension of the sequence to the concepts of "more/less" would help the student to understand that "long" means "more" and "short" means "less." And, eventually, the ruler could become a number line useful in helping students solve simple addition problems (for example, "Six inches and two more inches . . . ").

While a teacher could easily modify the sequence to teach metric units, we feel it makes more sense to teach the measurement units commonly used in the student's environment. Too, metric units (millimeter, centimeter, meter) would likely prove more difficult to discriminate because of greater similarity in sound than "inch," "foot," and "yard."

Recreational Activities:
Games for Students Who Are Acquiring
Quantitative Skills in the Classroom

Barbara Pixley, Frances George, and Deborah Pease

Students in our classroom are learning basic quantitative skills such as rote counting, one-to-one correspondence, object counting, time-telling, simple addition and subtraction, measuring with a ruler, and so on. For residents to qualify for more advanced educational programs on the grounds or in the community, such skills are essential. Furthermore, they permit "special needs" students to engage in normal recreational activities that involve numerical skills.

This year, we modified three popular games for residents who were acquiring quantitative skills in our classroom. Our versions of bingo, dominoes, and dice-and-ladder give students a better understanding of how numbers can be used. The games also provide opportunities to play (and "compete") with one another in a reasonably normal way.

We designed the games so that they could be introduced to students on an individual basis, and then played by a group. In each game, the "rules" ensure that every player will win tokens (later exchangeable for goodies) so that, even though one player may win more tokens than the others, no one can be a "loser." Three Farrell Hall residents who participated during the year were able to play the games successfully and appeared to enjoy them.

The games could easily be simplified or made more complex to be appropriate to the academic skill level of other students. Too, they can be "run" by parents, siblings, peers, or anyone else who wishes to include retarded persons in leisure-time activities.

Descriptions of the three games follow.

BINGO

Prerequisite skills

A player should be able to
- visually match the numerals 1, 2, 3, 4, 5 when presented with a sample of each,
- match the colors red, green, blue, black, yellow,
- locate (touch) colored numerals on a bingo-type grid when the color and numeral are named,
- pick up a one-inch square card and place it on top of a numeral on a grid,
- pick up a penny and place it on top of a numeral on a grid.

Materials

To "run" the bingo game, you will need
- "introductory" bingo cards (blank five-by-five inch grids, laminated with clear contact paper so they can be written on and later wiped clean),
- five soft-tip pens (red, green, blue, black, yellow),

- 25 one-inch square numeral cards (a sequence of 1, 2, 3, 4, 5 in red, one in green, one in blue, one in black, one in yellow),
- pennies (25 per player, to cover the numbers on the bingo grid),
- "regular" bingo cards (five-by-five inch grids permanently marked with five of each of the numerals 1, 2, 3, 4, 5, those in the first column written — in random order — in red, those in the second in green, those in the third in blue, those in the fourth in black, and those in the fifth in yellow to facilitate scanning of the card).

Game procedures

Introduce players to the game individually, by the following "fading in" procedure. Place the set of one-inch square numeral cards in front of the player and give him or her the introductory bingo card, on which you have written one red numeral in the first row of the first column. Tell the player to find the card that matches the numeral, to place it on the grid, and then to place a penny on the numeral. Add numerals one at a time until the first row of five spaces is filled, at which point give the player a token (FR-5). Then present a card with two rows filled, three rows filled, and finally a completely numbered card. Continue to give the player a token for each row completed. (Later the player may exchange the tokens for a cooky, a Coke, or whatever else may be appropriate.)

When the player has matched all the numerals on the introductory grid, present a permanently numbered bingo card to him or her. Put the one-inch numeral cards in a small box, draw them out one at a time, and say the color and number of each card: "Red-4," "Blue-1," "Yellow-2," and so on. The player must find the numeral on the bingo grid and cover it with a penny. When he or she completely covers a horizontal row, give him or her a token (VR-5). (As in the initial introduction to the game, the player may later exchange the tokens for a goody.)

Once two or more players have learned the bingo game, it can be run as a group game with each player getting a token when he or she completes a row.

As the players further develop their quantitative skills in the classroom, you can modify the bingo game to include additional numerals. The color cues could eventually be faded out. And undoubtedly players could be taught to "run" the game as well as play it.

DOMINOES

Prerequisite skills

A player should be able to
- count 0, 1, 2, 3, 4, 5 dots,
- match two like sets of dots,
- read numerals 0, 1, 2, 3, 4, 5,
- identity-match numerals 0, 1, 2, 3, 4, 5.

Materials

You will need a set of 36 domino cards, one inch by two inches, laminated on both sides with clear contact paper to protect them. The dominoes should include all combinations of 0, 1, 2, 3, 4, 5 dots on one side, and they should be marked on the reverse side with the corresponding numerals.

Game procedures

You can use either side of the domino cards, dots or numerals. Give each player five dominoes. (With 36 dominoes, up to five people can play.) Use the 0-0 card as the starter domino and place it on the table in front of the players. Explain that the players will all get a turn to try to match one of their dominoes to the ones on the table. Then the players try, in turns, to place one of their dominoes on the table, matching the dominoes end to end. When a player makes a match, give him a token. Then the player draws another domino so that he always has five, until the supply of dominoes runs out. The first player to use all of his dominoes and get the most tokens is the "winner."

DICE-AND-LADDER

Prerequisite skills

A player should be able to
- toss oversized dice,
- count dots on dice,
- move a playing piece from space to space on a game board,
- count spaces as he or she moves the playing piece,
- label pictures on the game board.

Materials

For this game you will need two dice and a game board. The dice should be two-inch cubes (or larger), marked with the usual arrays of one to six dots. You can make the game board on the inside of a manila folder, which can be unfolded for playing. For the "ladder" or playing area, draw a rectangle 2 inches wide and 16 inches high, ruled into 32 one-inch squares. In 15 of the squares put pictures of different objects such as a bird, car, cat, dog, flower, airplane, cherries and rooster.

Game procedures

In the introductory phase of the game, familiarize the players with the game board and with the tasks of reading the dice and moving their playing pieces from

space to space, up and down the ladder. Give every player a playing piece. Taking turns, each player rolls the dice and counts the dots on the top faces. Then he moves his playing piece up the right side of the ladder the number of spaces indicated by the dice. When a player reaches the top of the ladder, he starts down the left side.

In the second phase of the game, the player has to say the name of the picture in the space on which the playing piece lands. When a player labels a picture correctly, give one token. The first player to reach the end gets two extra tokens and is the "winner."

Detailed Pupil Record:

A Form to Aid in

Recording and Evaluating Student Performance

Frances George and Deborah Pease

We have been using a Detailed Pupil Record form as an aid in recording the academic performance of individual students. The following types of responses could be observed and noted on the form: correct (+), incorrect (-), no response (O), teacher modeled the correct response (M), teacher primed or physically guided the student through the required response (P). The column headed "Consequence" provides space for the teacher to note what reinforcers, if any, were given (e.g., token or edible) and another column allows room for noting the schedule of reinforcement used by the teacher. From the length of the session and the number of correct and incorrect responses, the teacher can later compute the rate of correct and incorrect responses for each task. The number of correct responses divided by the number of minutes in the session, or elapsed time, yields the rate of correct responses per minute. If for some reason rate is not of interest, the teacher can easily tabulate the cumulative number of trials at any point along the way. A column is available for noting the criterion the teacher has set for each task, and on any given day the teacher can quickly compare the student's performance to the intended goal. The "Notes" column leaves room for notations on a student's specific errors, behavior problems encountered, changes in teaching procedure, etc. The Detailed Pupil Record can be used for a single task (e.g., labeling a clock face) or for lessons in a broad subject area (e.g., rote counting, labeling numerals, counting fixed objects, making sets, and other math skills).

The information on the Detailed Pupil Record provides a quantitative description of a student's performance. The teacher can transfer the information to a summary chart and then to graph paper for a complete picture of the student's performance and an empirical basis on which to make decisions about changing an instructional procedure, changing the materials used, or advancing a student within an instructional sequence.

The following is a replica of the 8½ x 11 form we have been using.

DETAILED PUPIL RECORD

Student:_____ Curricular Area:_____
Sheet no.: _____

Session # Day/Mo./Yr. Location Teacher	Time Stop	Time Start	Elapsed Time	Task Program Phase	Movement Cycles + - O M P	Consequence Schedule	Movements/ Minute or # of Trials	Criterion	Notes

Survey of Acquisition and Mastery Criteria Used in Educational and Habilitative Programs for Behaviorally Retarded Students

Deborah Pease and Beatrice H. Barrett

We have begun a mail survey of behaviorally oriented retardation specialists throughout the country (and from other countries as well) to determine what specific response criteria or "standards" of learning and performance are being used in classrooms and other training programs for developmentally disabled students.

Copies of the covering letter and the questionnaire appear on the following pages. To date we have received about twenty replies. During the next few months we will continue to send out questionnaires, and we hope that by late fall or early winter we will have enough information to prepare a detailed report.

Ms. Deborah Pease and Dr. B. H. Barrett
Behavior Prosthesis Laboratory
Walter E. Fernald State School
Box 158
Belmont, MA 02178

Dear

We are currently exploring different methods of setting instructional criteria and would like to have your thoughts on the matter. We're concerned about the relative advantages and disadvantages of the various criterion measures and the conditions under which each might best be employed.

Below are some questions that we are particularly concerned with, and we'd appreciate your responses to them as well as to any other questions which you think relevant. Enclosed is a form which specifies some critical dimensions of criterion measurement. Please feel free to use the back of the form, if necessary, in providing any and all information you consider relevant.

Thank you for your time and effort,

What criteria do you use to define acquisition? Mastery? Rationale?

Is there a maximum percentage of errors you will tolerate before requiring a change in your instructional plan?

If you set different criteria for different skills and/or different populations, what are your major considerations in doing so?

PLEASE DESCRIBE		PLEASE CHECK RELEVANT COLUMNS									PLEASE DESCRIBE	
TARGET POPULATION	INSTRUCTIONAL OBJECTIVE OR SKILL AREA	STIMULI PRESENTED BY			RESPONSE DIMENSIONS MEASURED						CRITERIA	
		TEACHER	STUDENT	MACHINE	LATENCY	% CORRECT	%INCORRECT	ELAPSED TIME	R/MIN	TRIALS/SESSIONS AT CRITERION	FOR ACQUISITION	FOR MASTERY

Course of Acquisition:

Accuracy and Frequency Comparisons*

Beatrice H. Barrett

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*Working paper based on a presentation to the American Academy on Mental Retardation, Portland, Oregon, May 1975.

Supported in part by a grant from the National Association for Retarded Citizens and a grant from the National Institutes of Mental Health.

In developing our methodology for assessing behavioral retardation, we have considered one of the fundamental tasks to be that of amplifying individual behavioral differences. This seems to be especially important among a population that has become homogenized as a result of insensitive assessment methods, assumed upper limits of behavioral competence, and uniform societal rejection. Over the years our studies have revealed varieties of reliably different individual behavior patterns ranging from "normal" (as shown by presumably normal children and adults) to severely defective or deficient. We have found this broad range not only among people classified as moderate to borderline in retardation (Barrett, 1965, 1969) but also among those classified as severely and profoundly retarded (Barrett, 1973). These reliable individual differences have emerged when each participant was given enough exposure to a constant program of differential reinforcement to reach his or her own maximally efficient performance.

However, since efficiency of habilitative endeavors is generally thought to be enhanced by supposedly homogeneous groupings, another task of assessment methodology is to locate among individualized behavior patterns the commonalities that describe functionally useful behavior subgroups. In an automatically programmed environment that differentially reinforces both response differentiation and stimulus discrimination, we have found that six distinct acquisition "states" eventually emerge from the behavior of retarded participants. Our participants' psychometric classifications were not related to their asymptotic performance accuracy. However, when performing at maximum accuracy, the severely and profoundly retarded participants did so at significantly lower rates than the less retarded participants. In addition, they took significantly longer to show their maximally efficient levels (Barrett, 1973).

In this report, we will briefly describe the six acquisition subgroups. We will then compare the acquisition patterns and frequency distributions of severely and profoundly retarded participants with those of moderately to borderline retarded participants at successive stages of emergence. More detailed information about the course of acquisition should help to increase the prognostic efficiency of assessment procedures and contribute to formulation of more "normalizing" training objectives.

Participants were 64 residents ranging in age, at entry, from 4 to 20 years and in duration of residency from one day to 14 years. Of the 64, 28 (44%) were classified as moderate to borderline in degree of retardation and 36 (56%) were classified as severely or profoundly retarded. Classifications (Heber, 1959) were based on the most recent psychometric evaluations in the official institution records. Institution psychometrists considered 31% of the group to be "untestable." The only residents deliberately excluded were those whose physical handicaps prevented them from operating the apparatus.

Our behavior analytic environment consists of a sound-attenuated cubicle with a wall-mounted console that provides two plungers (operable with 300 grams of force through a 1-cm excursion) and an aperture into which objects are automatically delivered. Two display panels, one above each plunger, are alternately illuminated for one-minute periods throughout one-hour sessions. A candy or a token (later exchangeable for soft drinks) can be earned by every tenth operation of the left

plunger only during periods when the left light is on. When the light on the right side is on, nothing can be earned by operating either of the plungers. Since no penalties are programmed for nonreinforced responses, a participant may obtain reinforcement in a variety of ways.

There is no "pretraining." Introduction to the apparatus consists of demonstrating plunger operation when the power is off. The conditions remain in effect throughout successive sessions until the participant's record shows clearly that asymptotic performance accuracy has been reached, that is, that he or she has learned as much as possible with the contingencies provided.

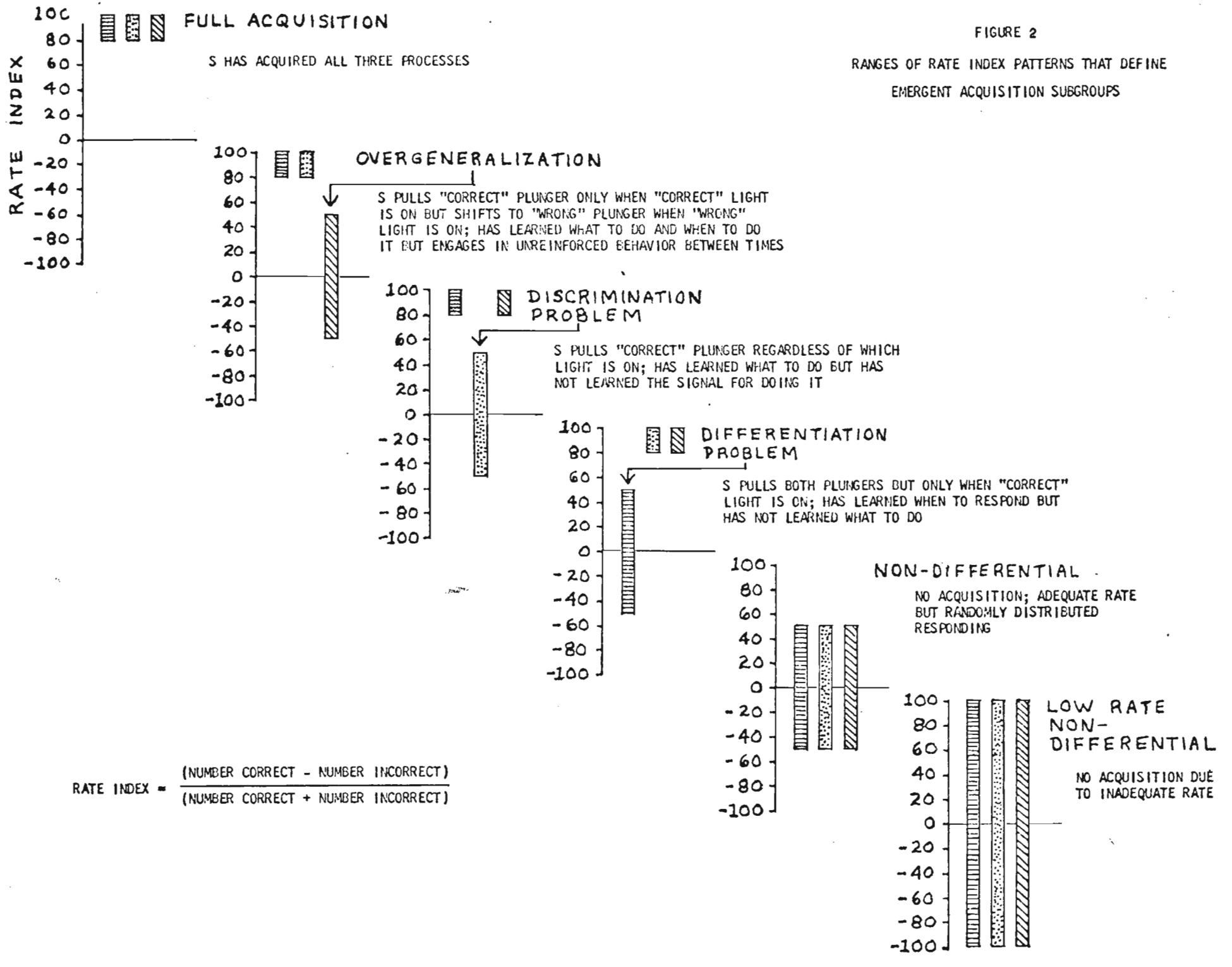
With two plungers and two lights, four potential stimulus-response combinations are available. Acquisition is shown by an increase in the rate of the one reinforced combination relative to the rates of each of those that are not reinforced. These rate relationships are quantified by a rate index, defined as the difference between two rates divided by their sum. In this case, the difference between the reinforced rate and each of the unreinforced rates yields three rate indices for each participant for each session.

Figure 2 shows the ranges of rate indices that describe the six subgroups that have emerged from repeated studies of retarded behavior. These patterns of behavior represent criteria of acquisition, specific deficit and deficiency that are empirically determined and calibrated functionally by the behavior of the target population rather than by a nonretarded normative population (Barrett, 1965). "Differentiation problem," "discrimination problem," "overgeneralization," and "full acquisition" describe four states of process acquisition and are the focus of the present report. Sixty-four per cent of the less retarded group and 62 per cent of the severely and profoundly retarded group (63 per cent of the total group) reached asymptotic acquisition described by these four patterns of rate indices (Barrett, 1973). Neither psychometric classification, age, age at admission, duration of institutionalization nor sex was significantly different for the group who demonstrated acquisition as compared with those who did not. Whether or not children displayed long-term disrupting behavior (Barrett, 1971) was not related to their acquisition. Similarly, whether or not a child showed acquisition was unrelated to being psychometrically "testable." In fact, 28 per cent of those who showed acquisition were "untestable," and 52 per cent of the "untestables" showed acquisition of one state or another. Of those, 36 per cent reached full acquisition without special training.

In comparing the course of acquisition shown by the two psychometrically defined groups, we asked three principal questions: 1) Do the distributions of the two groups among acquisition states differ at any successive stage, i.e., do they start off looking different and then begin to look more alike as more individuals reach asymptote? 2) What percentage of eventual "learners" appear as "nonlearners" at successive stages? Or, put another way, if we had set arbitary time limits, what percentage of learners would have been misclassified? 3) When do differences in reinforced response rates first appear? Are the great absolute rate differences gradual in their emergence or do they appear very early?

FIGURE 2

RANGES OF RATE INDEX PATTERNS THAT DEFINE EMERGENT ACQUISITION SUBGROUPS



$$\text{RATE INDEX} = \frac{(\text{NUMBER CORRECT} - \text{NUMBER INCORRECT})}{(\text{NUMBER CORRECT} + \text{NUMBER INCORRECT})}$$

In this analysis, we have considered repeated opportunities in the differentially reinforcing environment as repeated opportunities for individuals to be "sifted" into the various acquisition subgroups. For each individual, sifting is completed only when maximally accurate performance has been maintained for four consecutive one-hour sessions. The accuracy distributions of the two psychometrically defined groups were compared at the end of successive blocks of five sessions throughout the time necessary for all participants to show maximally stable rate index patterns. Once sifted into a subgroup, individual participants remain in the subgroup throughout analysis of subsequent session blocks. Thus, the percentages from distribution to distribution are cumulative, and the number of individuals remains the same throughout. Those individuals who were still in the process of reaching maximal acquisition during a given block of five sessions were assigned to an acquisition subgroup on the basis of their median rate indices for the session block.

Distributions of individual median rates of reinforced responding (pulling the left plunger when the left light was on) accompanying emergent acquisition were then compared for each successive block of five sessions.

Acquisition distributions through time

Figure 3 shows the block-by-block distributions of the two psychometric groups as the individuals within each group sift themselves according to their own "best" acquisition state. In no case are the distributions within session blocks significantly different for the two psychometrically defined groups. That is, when repeated opportunities in a constant, differentially reinforcing environment permitted individuals to acquire their maximum accuracy, the severely and profoundly retarded were distributed similarly to the moderately to borderline retarded participants throughout the course of acquisition. There appears to be no significant "funnel" effect; that is, there did not appear to be progressively less difference between groups as a function of time in the learning environment. Since these distributions include only those individuals who showed some stage of acquisition without special training, no one shows up in States 5 and 6. The reason that one state appears without a number is that, in this design, acquisition of only differentiation of the plungers or only discrimination of the light positions is a transitional stage in the emergence of more enduring behavior patterns.

Since it is common practice to set arbitrary limits on the number of behavior samples obtained for assessment purposes (usually only one!), we summarized these distributions in terms of percent of individuals showing any stage of acquisition after an arbitrary number of sessions. Or, put the other way, we determined the percentage of people who would likely have been misclassified as "nonlearners" because their full performance accuracy had not yet emerged. We discovered that:

- If we had set a limit of five one-hour sessions, there would have been 28% "false negatives" in the total group: 11% among the psychometrically less retarded and 41% among the more severely retarded.

- After 25 hours, there would have been no false negatives among the less retarded but still 18% among the psychometrically more severely retarded.

- After 40 sessions, full acquisition of response differentiation and stimulus discrimination was attained by 36% of the severely and profoundly retarded participants and 44% of the less retarded.

Whether one looks at these data as representing repeated testing or development of baseline performances as individuals adapt to a differentially reinforcing situation, the same question arises: Are the behavioral assessments obtained for purposes of placement in habilitative and educational programs based on reliable behavior samples representing each individual's full array of behavioral assets and deficits?

False negatives can have long-term and perhaps irreparable effects on the opportunities for behavioral development offered to disabled people. If repeated measurement of the same behaviors under constant conditions can reduce the prevalence of false negatives, it should be considered in whatever behavioral appraisals are made -- and most especially those focusing on individuals who have been psychometrically classified as severely or profoundly retarded.

Concomitant rate distributions during acquisition

We have just considered development of accuracy patterns or relative rates of different behaviors as a function of repeated opportunities in a differentially reinforcing environment. Our next analysis focuses on the absolute performance rates that accompany the stages of acquisition. Figure 4 compares the two psychometrically defined groups in terms of how rapidly they were doing what they got reinforced for (that is, operating the left plunger only when the left light was on). Medians are based on the same blocks of five sessions that we looked at for successive accuracy comparisons. Median tests comparing the reinforced response rates of the severely and profoundly retarded with those of the less retarded yielded p values of .03, .06, .05, .03, .0067, .0067, .0067, .0067 for the successive blocks of sessions. As more individuals reached maximum accuracy (that is, as more stable accuracy patterns emerged), the rate differences between the two groups yielded successively lower p values. The overall relation of rate to psychometric category yielded p less than .001.

This comparison of psychometrically defined groups suggests that, in a differentially reinforcing environment, severity of retardation may not determine the upper limits of accuracy. But without procedures designed to increase behavior frequency, no matter how accurately a person performs, the more severely retarded will still show a substantially greater rate deficit than the less retarded.

Rates of reinforced responding were not significantly related to age, sex, or degree of acquisition. They were significantly positively related to age at admission and duration of residency. The older a person was when admitted, the higher his or her reinforced rate (p less than .01). And the longer the person was an institutional resident, the lower his or her rate of reinforced behavior

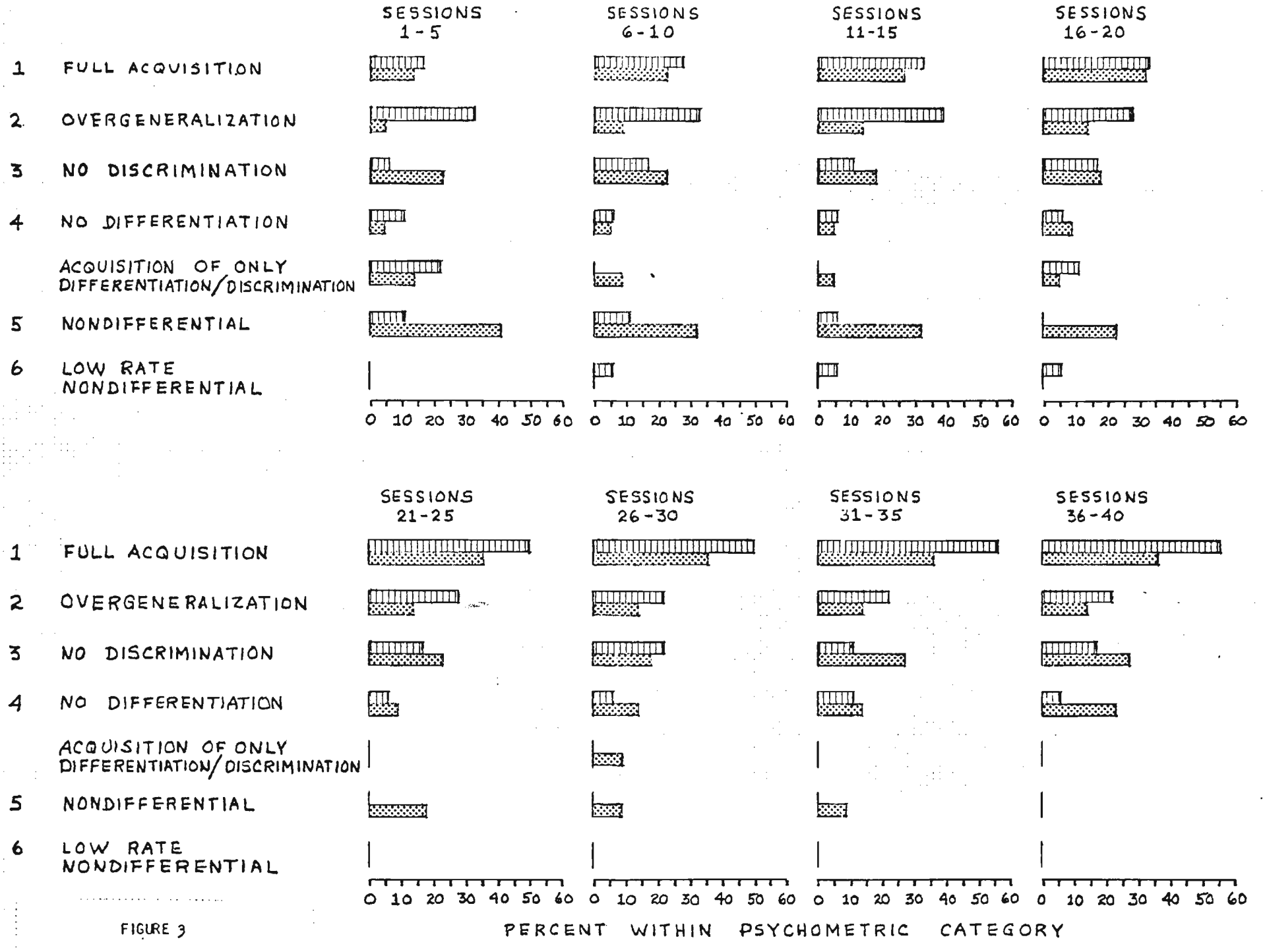


FIGURE 3

STATUS OF ACQUISITION SUBGROUPS AT SUCCESSIVE STAGES OF EMERGENCE

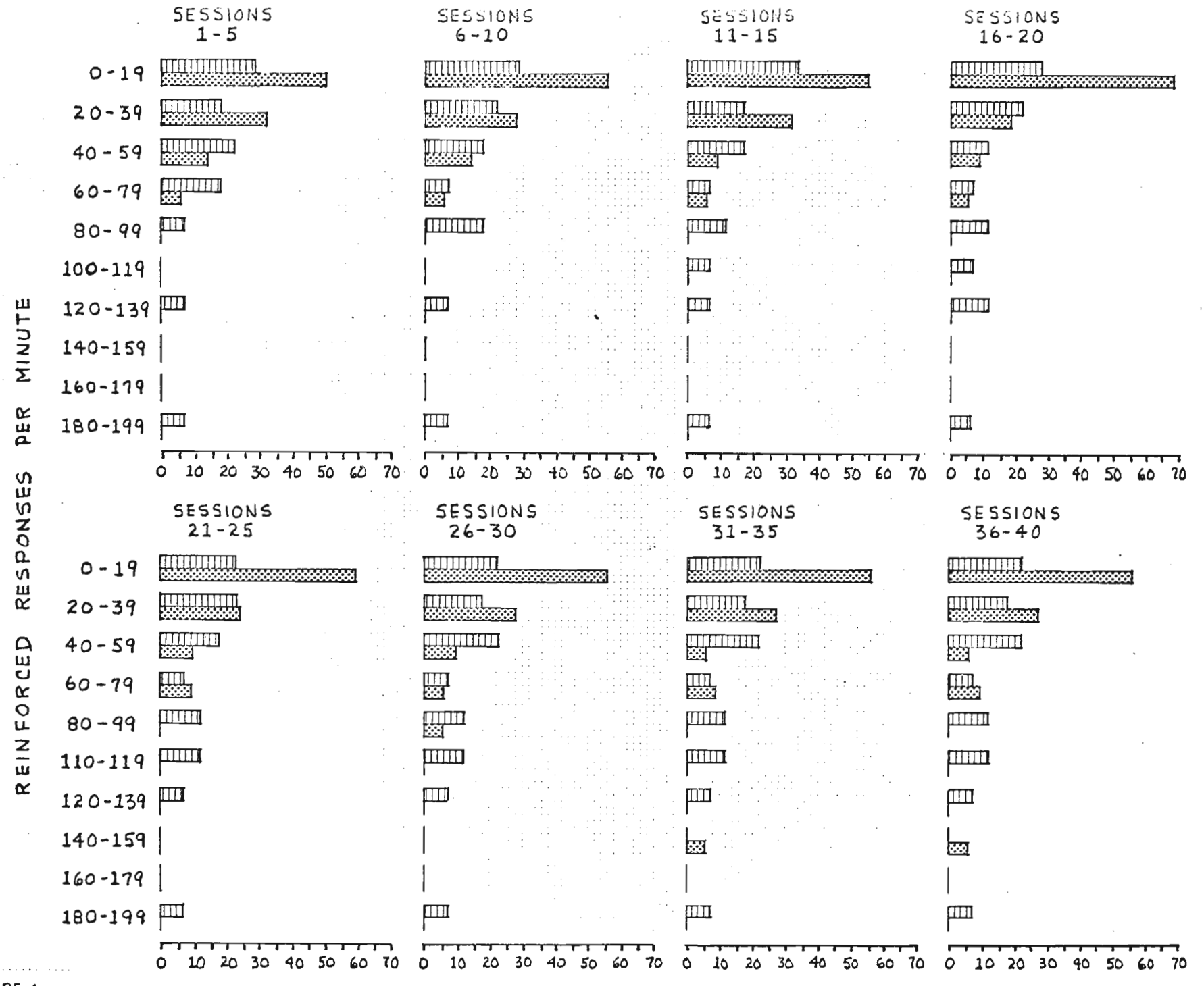


FIGURE 4

RATE DISTRIBUTIONS ACCOMPANYING EMERGENCE OF ACQUISITION SUBGROUPS

(p=.048). These findings are not surprising in view of a previous study (Barrett, 1971) which suggested that institutions may, inadvertently, differentially reinforce low rates. We found that more heavily staffed and more protective living environments were associated with lower rates of performance.

Comment

Clearly assessment should ask not only "How well can the individual do something?" but also "How rapidly?" If only accuracy of performance is taught, severely and profoundly retarded persons will continue to exhibit behavioral retardation, for they will not have learned to perform accurately at a more normal rate. Behavioral normalization must consider multiple dimensions of behavior to produce a credible product.

To avoid misclassifying individuals with more severe behavioral retardation and thus inadvertently limit their opportunities for habilitation, repeated measures should be obtained. Prior analyses suggest that this practice is especially important for individuals who were admitted at young ages and for those who have been in an institution for a long time (Barrett, 1973). A recent clinical example offered rather dramatic support for this conclusion. A young man was given the PPVT under standard procedures for administration. When the test was repeated, without pause, his IQ score rose from 13 to 30 -- a difference well beyond chance fluctuation due to error of measurement.

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Transfer of Rate Training from an Automated Simple Instructional Environment to Classroom Tasks

Frances George

Our department's facilities include automated devices for teaching a variety of basic and complex skills. One rudimentary instructional environment offers students the opportunity to earn "goodies" (candies, tokens, pennies, or other small objects) by operating a single wall-mounted plunger. The reinforcing goodies are automatically dispensed according to a predetermined schedule, while the student's rate of responding for the reinforcers is automatically recorded as a cumulative graph. The number of responses required for each reinforcer can be increased so the student has to respond faster to receive the same amount of reinforcement in a given period of time.

As we have become more attuned to the importance of building rate (or speed) as well as accuracy of responding, we have begun to explore the utility of automated devices for training students to perform at increasingly normal rates -- rates that, theoretically, should show a facilitating or "transfer" effect in the student's performance of academic work requiring topographically similar movements.

Two students have been participating in a study to evaluate such transfer effects. While receiving training in rate-building in the automated situation, the students are learning in the classroom to draw half-inch vertical lines (a prerequisite to printing letters). Operating a plunger and using a primary pencil have in common a gripping and pulling motor response, although the movements differ to the extent that making lines requires frequent relocation of the pencil.

So far, one student has shown a positive transfer from plunger-pulling to line-drawing. While undergoing training in the automated environment, the student's rate of line production rose to 100 per minute as his rate of plunger-pulling rose even higher. And the student maintained his high rate of line-drawing even after plunger-pulling sessions were discontinued.

Concurrent Performances in Retarded Children *

Carl V. Binder

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One frequently observed characteristic of retarded behavior is variability in absolute response rates. Severely retarded children, working for simple schedules of reinforcement, often show bursts of responding interspersed with frequent and sometimes long pauses — a behavioral phenomenon not usually displayed by "normal" humans or "normal" laboratory animals. This same behavioral variability is often observed in classroom instructional settings, and teachers find it difficult to deal with.

Several hypothetical explanations for the variability of retarded behavior might be offered. The teacher (or investigator) may not have enough control over the daily schedules of such children to ensure maintenance of consistent motivation with respect to the reinforcers used. "Attentional deficits" have sometimes been presumed to account for extremely variable responding by retarded persons. And strong sources of reinforcement for alternative behavior (especially the effects of self-stimulation) are often said to account for variations in rate of "on-task" behavior.

Whatever the explanation may be, response-rate variability presents a serious problem: how to establish a baseline against which to assess effects of programmatic changes. A possible solution to this dilemma is the use of concurrently available schedules of reinforcement and the measurement of relative rather than absolute rates of responding. Whatever factors account for variability in absolute response rates might be expected to equally affect performances under two or more schedules of qualitatively equivalent reinforcement. Thus, by measuring relative distributions of behavior among alternatives, as we vary the relative rates of reinforcement associated with them, we may be able to abstract a stable relative rate of response despite variation in absolute rates.

Participants

Most participants are from the Children's Unit (Farrell Hall). They range in chronological age from about 9 to 18 years, and have been classified according to conventional psychometric scales as severely or profoundly retarded. We excluded only children with serious sensory or motor deficits, or for whom we could not find an automatically dispensible functional reinforcer.

General Procedure

A console in a small room includes a plywood panel on which two response plungers, two rear-projection picture screens, and two trays for delivery of edible reinforcers are mounted. There are also two speakers for presentation of music or other auditory reinforcers.

Concurrent schedules of reinforcement were automatically programmed. In general, a separate variable-interval schedule of reinforcement (Fleshler & Hoffman, 1962) was arranged for pulling or pushing each of the two plungers mounted on the console. A change-over delay (COD), during which reinforcers could not be received, was arranged to follow the first response after the child switched responding

from one plunger to the other in order to prevent the explicit reinforcement of change-overs per se, which would establish the "superstitious" behavior of rapid alternation. The children, then, were presented with a situation in which operating one or the other of two plungers -- but not both simultaneously -- was reinforced (e.g., with 10 seconds of music or projected pictures, or with an M&M), with some characteristic average inter-reinforcement interval assigned to each alternative.

Potential participants were brought to the room individually, on schedules arranged with their teachers. They were shown how to operate the plungers to receive reinforcers. Within the first 30- to 45-minute session, most children learned to operate the apparatus without assistance and were then left alone to play with it while we watched through the periscope and monitored the apparatus from another room. Daily sessions were scheduled whenever possible.

Procedural variations and results

Typically, concurrent schedules of variable-interval reinforcement are programmed by entirely independent devices. As a result, reinforcement set up for operation of a given plunger is "saved" until the individual operates that plunger. Thus, there is no guarantee that the programmed relative rates of reinforcement will actually be received since the participant may continue to respond on only one of the plungers, receiving reinforcers as they are set up, without changing to the other plunger. If the rate of change-over from one response to the other is not sufficiently high, significant differences between programmed and obtained relative rates of reinforcement will accrue, and between-session relative rates will vary substantially. Unlike small animals and "normal" humans, retarded children do not change over very frequently (even without the COD) and tend to perseverate on one alternative. Given this response characteristic, stable control of the independent variable (relative rate of reinforcement) is not achieved and baseline conditions cannot be established.

For the two children (S. M. and T. H.) who participated in the greatest number of sessions (43 and 70, respectively), and who are representative of the entire group, most sessions were programmed to deliver 50% of the reinforcers on each side. Because these children tended to perseverate on one or the other alternative, relative response rates did, in fact, differ significantly from 50-50, and they varied considerably from session to session. In order to gain greater control of the independent variable we modified the program so that the children were required to obtain the most recently set up reinforcement by changing to its associated response alternative before obtaining further reinforcers by perseveration. This was accomplished by use of a single variable-interval programming device, the output of which was distributed to one alternative or the other by a probability randomizer (Stubbs & Pliskoff, 1969). With "normal" people this modification produces results equivalent to those obtained by the usual means (fully independent schedules). And it ensures the equivalence of obtained and programmed rates of reinforcement.

With the new procedure, we introduced the children to a 50-50 relative rate of reinforcement for a large number of sessions in the hope of observing stabilization in their relative response rates. Such stability, however, did not occur. The apparent cause of this failure was low overall intrasession response rates (mean = 35.5 responses per minute) combined with high local rates. That is,

although the children spent about the same amounts of time responding at reasonably stable, characteristic absolute rates from session to session, cumulative records reveal that their responding consisted of high-rate bursts interspersed with periods of no responding. During the inter-response periods the children spent time in a variety of activities including idle sitting, various stereotyped movements and vocalizations. The original assumption may still be true — that over time the children's non-responding would be distributed equally over periods of responding on one plunger or the other, and that stable relative response rates would arise in the presence of variable absolute rates. But the sessions were limited to 30- to 45-minute periods in the midst of the participants' normal daily schedules, and this may not have been long enough for the non-responding to be averaged over the two alternatives. If the children's plunger-pulling had occurred at higher rates and thus filled the sessions more completely (to the exclusion of non-responding), stable relative response rates rates might have been observed, as they were with two adult participants (see below).

Several points can be drawn from a behavioral analysis. First, one might question whether the programmed reinforcers are functional for these children. Finding reinforcers for retarded children is often a problem, and if those programmed by the apparatus were "stronger," the children might spend more time involved in the programmed activity. A look at the cumulative records of the children's performances, however, suggests that the programmed consequences were functional reinforcers. A number of Farrell Hall children were unable to take part in the experiment for lack of a reinforcer which could be automatically delivered. But for at least two of the children, acquisition of the plunger-pulling operant for audio-visual consequences was rapid, and maintenance was stable. It is clear that other sources of reinforcement in the situation were also strong (e.g., the effects of self-stimulation), but the programmed consequences were effective to the degree that any extrinsic reinforcer could be. Perhaps the best indication of this was the apparent eagerness with which the children participated. (One of them even danced and sang along with the music portion of the reinforcing events.)

Perhaps a more fruitful line of analysis concerns the topography of the required behavior. Plunger-pulling is a rather discrete response and, even within the confines of the small room, is rather "focused" in a way that such alternatives as rocking, vocalizing, or walking from one part of the room to another are not. Experiments with concurrent schedules of reinforcement have used time-allocation to each of two halves of a chamber as the response measure (Baum & Rachlin, 1969). Thus, for example, time spent by pigeons in one or the other half of a chamber was measured, and stable relative time-allocations were obtained. The topography of such a response is so broad that subjects, of necessity, spend all of their time at one alternative or the other, and non-programmed responses do not compete with the programmed activities. It thus seems appropriate to adapt this procedure to the study of concurrent performances in retarded children. In the next year, with construction of a sensing floor-mat, we will be able to measure the time children spend in each half of the room for the consequences available there.

Concurrent performances in retarded adults

For purposes of comparison, and because previous work with concurrent performances

in the retarded (Schroeder, 1975) has been carried out with adult institutional residents, we have invited several adult residents to participate in this study. These men, already students in our classroom educational program, have expressed interest in the "music and picture shows" that they know are available. So far, the men have participated in only a few sessions, except for G. M., a Kelley Hall resident, who is now a state employee. G. M. spent 18 sessions (10 to 20 minutes each) working for music and pictures combined. His absolute rate of responding was consistently very high (100 to 150 responses per minute) and steady, and his relative response rates were reasonably stable. Since we had no problem in obtaining a stable baseline with G. M., we decided to assess his "adaptability" to a range of different relative rates of reinforcement.

Herrnstein's (1970) "matching law," an empirical generalization obtained from a vast amount of basic research with both humans and small animals, indicates that normal organisms tend to "match" relative response rates or relative time allocations to relative rates of reinforcement on concurrent schedules. That is, they apportion responding to two or more simultaneously available alternatives according to the ratio of obtained reinforcement. Thus, for example, about 70% of the responses or time will be allocated to an alternative that provides 70% of the total reinforcement. Replication of these findings with a retarded population is especially interesting for several reasons. "Matching" of behavioral effort and time to payoff is adaptive in that it tends to maximize reinforcement from the environment. If, as Schroeder (1975) seems to have demonstrated, the retarded do not maximize reinforcement in this way, then they have a peculiar and debilitating deficit. A behavioral analysis of this deficit may provide a means of remediating it. The problem may involve a failure to discriminate among different densities of reinforcement, or it could involve various competing or perseverative behaviors such as have been commonly found among the retarded.

G. M.'s laboratory performances demonstrated good matching of relative response rates to relative reinforcement rates when 50% of the reinforcement was obtained on each alternative and when all reinforcement was programmed for responding on one alternative or the other. At values in between, however, when reinforcement was unequally distributed between the two alternatives, he responded more on the alternative from which fewer reinforcers were obtained. These performances are accounted for by a perseverative pattern of responding, according to which G. M. responded on one side until he received a reinforcer, then changed over to the other alternative, responding until reinforced, and so on. As a result, when the average inter-reinforcement time was greater on one side than on the other, obtaining reinforcement required a longer period (and therefore produced a greater relative rate) of responding to that alternative than to the other higher-density reinforcement schedule. The exceptions to this pattern (50%-50% and 0%-100%) can be explained as follows: In the 0%-100% case, responding on one side was never reinforced, and thus extinguished, breaking up the reinforcement-change-over pattern. In the 50%-50% case, the perseverative response pattern resulted in matching since the average times to reinforcement after change-over were equal and thus the average number of responses required to receive reinforcement was the same for both sides.

G. M.'s program began with the 50-50 relative reinforcement distribution and that

may have encouraged acquisition of the reinforcement-change-over response pattern. Future participants will be introduced first to unequal relative reinforcement distributions as a control for this possibility. G. M.'s performance was similar to that of one retarded adult who participated in Schroeder's (1975) studies.

Plans

In addition to the work on concurrent schedules of qualitatively equivalent reinforcement, we plan to determine reinforcer preference as measured by relative response rates to alternatives associated with qualitatively different reinforcers (music vs. money, pictures of people vs. pictures of numbers, etc.). As we have mentioned, finding functional reinforcers is often a problem for teachers and others who work with retarded students. We hope to provide a quick and reliable means of determining reinforcer preference (and its stability over time) by means of concurrently programmed schedules of reinforcement.

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