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THE OHIO STATE UNIVERSITY, PH.D., 1979
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THE EFFECTS OF TWO METHODS OF PRESENTATION
UPON THE ACQUISITION OF AN ASSEMBLY TASK
BY PERSONS FUNCTIONING AT THREE LEVELS OF RETARDATION

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Carole McFerran Johnson, B.S., M.Ed.

* * * * *

The Ohio State University

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CHAPTER I
BACKGROUND TO THE PROBLEM

Introduction

Education and training for persons who are mentally retarded are relatively recent phenomena in American education. Prior to the mid-nineteenth century, little effort had been expended to provide education and training opportunities for retarded persons in this country (Best, 1965). In 1848, the first public institution for the retarded opened in South Boston and began the proliferation of residential facilities throughout the country (Burton, 1976). Initially, the goal of such institutions was to "overcome if not entirely cure mental retardation by application of the physiological method" (Davis & Ecob, 1962, p. 23).

The physiological method was developed by Seguin in France and transported to the United States by him in 1848 (Wilbur, 1976). This method emphasized an integration of concepts and focused upon physiological functions. A person who was retarded was to be "cured" through movement training, education of the senses, speech instruction, and academic training coupled with socialization skill development (Burton, 1976). This instructional procedure was
later applied to the public school programs for the retarded which were initiated in 1896 in Providence, Rhode Island (Farber, 1968).

Concurrent with the establishment and expansion of public school programs for the retarded in America, investigations began in Europe into means for measuring intellectual functioning. The early investigations by psychologists like Galton, Kraepelin, and Ebbinghaus established "the trends which were eventually to lead to the development of the famous Binet intelligence scales" (Anastasi, 1968, p. 10).

The first edition of the Binet-Simon Intelligence Scale appeared in France in 1905. It was followed by a second edition in 1908 when the concept of mental age was introduced. The final Binet-Simon Scale was published in 1911. In 1916, L. M. Terman at Stanford University published an American version of the Binet-Simon Scale known as the Stanford-Binet. Terman was the first to use the intelligence quotient (IQ), the "ratio between mental age and chronological age" (Anastasi, 1968, p. 11).

Terman's revision of the Simon-Binet made it "possible to more accurately determine levels of retardation, the educable considered as those in the fifty to seventy-five IQ range, and the trainable in the twenty-five to fifty IQ range" (Gearhart, 1974, p. 11). The identification of IQ ranges led to further redefinition of the types of
educational services to be provided to persons with varying degrees of retardation. Persons identified as educable mentally retarded (EMR), to a large degree became the responsibility of the public schools, while those identified as trainable mentally retarded (TMR) were retained in residential or private schools (Gearhart, 1974).

The type of education received by the mentally retarded residing in institutions and those enrolled in public schools differed considerably. The physiological or curative methods discussed above, failed to produce the desired results. Thus, institutions began to take on a custodial function. With the exception of the Colony Plan, designed to train the retarded to be farm workers during the period between 1920 and 1935, this custodial function predominated in residential facilities until after World War II (Burton, 1976).

Retarded individuals enrolled in public schools were taught in separate classes or schools by methods which emphasized manual, concrete work rather than academic, abstract subjects. Educators of the period felt that through such instruction "the retarded could be trained to be useful to the society" (Farber, 1968, p. 226). This trend continued until the mid-1960's. Curricular approaches within these separate classes for EMR's evolved through several stages. The first stage was identified as
the craft-centered approach. The second stage was a watered-down curriculum approach, while the third stage was "an adapted curriculum approach which included emphasis on practical social skills, family and citizenship responsibilities, and vocational competence (Gearhart, 1974, p. 12).

During this same period, from 1950 to the mid-1960's, educational practices affecting those identified as TMR also underwent considerable change and redefinition. Two of these changes were the provision of educational services within public school settings and the inclusion of the TMR in sheltered workshops. Public school programs became available to these persons largely through the legislative lobbying and litigative actions undertaken by parents and educators through the National Association for Retarded Children [Citizens]. Curricula, during this period, focused upon "self-care, social adjustment, and economic usefulness" (Burton, 1976, p. 114).

As an adjunct to public school programs for the school-aged TMR, programs designed to serve the needs of adult members of this population were also implemented during the 1950's. These programs took the form of sheltered workshops similar to those which had been available to other handicapped adults since the mid-1800's (Burton, 1976). The National Association for Retarded Children [Citizens] initiated and conducted these workshops,
which were designed to provide vocational training and employment for the TMR.

Since the mid-1960's, education and training programs for the handicapped have come under considerable criticism by persons within and outside of the field of special education. These criticisms initially focused upon programs for the mildly retarded, but have been extended to all programs for the handicapped. Many of the criticisms of education and training programs for the handicapped have been addressed by recent federal legislation.

Several pieces of legislation have been enacted. The Education for All Handicapped Children Act of 1975 (P.L. 94-142) delineates processes and procedures designed to insure due process, curtail discriminatory testing and labeling of children, provide access to educational programs by all handicapped youngsters, and insure that handicapped persons are educated with nonhandicapped persons to the greatest extent possible for the individual in the least restrictive educational environment. The Vocational Education Act of 1976 (P.L. 94-482) requires compliance with the Education for All Handicapped Children Act and provides set-aside monies which are to be matched by like amounts of state funds to assist in increasing vocational education opportunities for handicapped individuals. The Rehabilitation Act Amendments of 1973 (P.L. 93-112) require that affirmative action policies
for hiring handicapped persons be instituted by employers receiving contracts from the Department of Health, Education, and Welfare and contain provisions similar to the Education for All Handicapped Children Act for individuals enrolled in pre-school through adult education programs. The Architectural Barriers Act of 1968 (P.L. 90-480) requires that newly constructed public buildings be free from architectural barriers which limit access to buildings by handicapped persons.

These pieces of legislation contribute considerably toward improving the quality of life of the majority of handicapped persons. In addition, these legislative mandates may facilitate an alteration in current employment forecasts for handicapped persons. One such forecast for the employment of handicapped youth four years after graduation from high school is:

- 21 percent (525,000) employed or in college
- 40 percent (1 million) underemployed and living at the poverty level
- 8 percent (200,000) in their home communities and mainly idle
- 26 percent (650,000) unemployed or on welfare
- 3 percent (75,000) totally dependent and institutionalized

(The White House Conference on Handicapped Individuals, 1976, p. 24)

The employment figures cited above do not specify the category in which persons employed in sheltered workshops
fall; however, current research conducted by Huddle (1969) and Gold (1969, 1972, 1973a, 1973b, 1976) indicates that such persons should, at best, be considered unemployed.

A study by Greenleigh Associates, Inc. (1975) found that sheltered workshop employees (clients) spent the majority of their time in supervised production for which little or no training of new skills is offered or required. This report also states:

Jobs allocated to workshops are generally so low skilled, tedious, unrewarding, and unremunerative that they are seldom found in the competitive sector. Frequently, the operations are so inefficient that, if employers had to pay full labor costs, they would automate the process instead (p. 14).

In addition, Gold (1972) states:

Workshops presently accept subcontracts that require little in terms of ability. As a result, it is a low level of habilitative training and a low level of remuneration. This restriction is a major cause of the unprofitable operation of most sheltered workshops. Increasing sheltered workshop income, both for the clients and the workshop, would allow for improved services and programs, and a better quality of life for those served (p. 524).

If the abilities of workshop clients are to be more fully utilized and the income which both clients and the workshop receive are to increase, it would seem that contracts which bring higher remuneration than the typical handicrafts, minor manufacturing (e.g., placing dividers in cardboard whiskey cartons) and salvage and repair
activities should be sought (Burton, 1976). Assembly contracts exemplify the type of jobs which can meet these needs. However, production of assembly items requires the acquisition and utilization of precise discrimination skills.

**Statement of the Problem**

One method for training adult retardates to acquire and utilize the necessary discrimination skills has been a focus of the research conducted at the Institute for Child Behavior and Development, University of Illinois, Urbana-Champaign, for the past eight years. This method applies Attention Theory, non-verbal training, and precise task analysis to the training of retarded persons in sheltered workshop settings (Gold, 1969, 1972, 1974, 1976).

This experimental training research, with retarded individuals in sheltered workshops, has emphasized: (1) the utilization of the training and transfer aspects of skill acquisition in which different cue dimensions are used (form-only and color-form) to produce complex assemblies (Gold, 1969); (2) the use of incremental task analysis in a simple-to-complex training sequence (Gold, 1969, 1976); (3) the effect of minimal reinforcement on the rate of acquisition and production of complex assembly tasks (Gold & Barclay, 1973a); and (4) the use of an easy-to-hard learning sequence versus a hard-only method of presentation in a bolt sorting task (Gold &
Barclay, 1973b). This research has demonstrated that retarded sheltered workshop clients are capable of learning to perform complex assembly tasks at a rate comparable to the non-retarded when highly individualized methods of presentation are used.

In addition, others interested in the work potential of the mentally retarded (Brown & Pearce, 1970; Brown, Johnson, Gadberry, & Fenrick, 1971; Brown, VanDeventer, Perlmutter, Jones, & Sontag, 1972; Chaffin, 1969; Cleland & Swartz, 1969; Crosson, 1969; Crosson & DeJung, 1967; Huddle, 1969; Hunt & Zimmerman, 1969; Lados, 1961; Neuhaus, 1967; Parker & Fleishman, 1961; Tate & Baroff, 1967; Wright, 1970; Zimmerman, Overpeck, Eisenberg, & Garlick, 1969; Zimmerman, Struckey, Garlick, & Miller, 1969) have substantiated that the retarded can learn a variety of tasks under a variety of conditions. These researchers have primarily focused upon the effect of reinforcement contingencies upon task production and the use of task analysis in training retardates to acquire specific skills. Most of these studies have required a close one-to-one relationship between an individual trainer and an individual trainee. Such highly individualized methods, while effective, are costly. Costs include number of trainers required, trainer time factors, and trainee acquisition time.
Still other researchers have utilized autoinstructional devices (e.g., 8mm film loops, slides, teaching machines) and programmed instruction in training the retarded (Bitter & Bolanovich, 1966; Eldred, 1965; Hull, Barry, & Clark, 1976; Screven, Straka, & LaGond, 1971; Vergason, 1966). These studies used the principles of behavior modification and task analysis through alternative delivery systems. The use of alternative delivery systems requires less one-on-one instruction and supervision of retarded trainees. However, each of these systems requires individual pretraining in the use of the system and/or machinery involved. In addition, many of these systems require the provision of individual machines or materials for each trainee. While these systems require fewer trainers, they could be viewed as costly in terms of the expense and number of machines needed or programs to be developed. Furthermore, pretraining in system or machine use could frequently be necessary.

All of the studies cited above have demonstrated effective methodologies for facilitating the acquisition of skills by retarded trainees. None of these studies, however, attempted to demonstrate the differential facilitative effects of their treatments for persons with differing degrees of retardation. Differential facilitating effects of treatments may be significant
for persons with differing degrees of retardation. In other words, the optimal method of presentation may differ for persons with different degrees of retardation. According to Reynolds and Davis (1971):

The traditional predictive model of the school is not useful in making the placement or allocation decision and neither is simple categorization by handicaps; rather, we must learn to interpret variables that produce interaction effects with instructional systems. In other words, children should be placed in special programs on the basis of demonstrated aptitude-treatment interactions. . . . There is a great need for research that shows how aptitudes and instructional systems can be joined optimally in educating exceptional children (pp. 59-60).

Therefore, there is a need to determine the differential effects of method of presentation upon the acquisition of assembly tasks by persons with differing degrees of retardation in a sheltered workshop setting. Such information could assist sheltered workshop personnel in determining the most effective methodology for training persons with differing degrees of retardation to perform assembly tasks.

In addition, there is a need to determine methodologies which are less expensive to implement than predominantly individually administered systems. Such systems should allow instruction of more than one individual by one trainer or auto-instructional device.

The problem of training retarded sheltered workshop clients is multi-faceted. There is a need to identify
delivery systems which are simple and cost effective. Cost effectiveness includes the cost of machinery or system, trainer time, and trainee time. There is also a need to determine the facilitative effects of various methodologies for persons with different degrees of retardation.

**Purpose of the Study**

The purpose of the present study was to examine the extent to which acquisition of an assembly task was facilitated by the use of auto-instructional methods (video tape) as compared to live presentations with small groups of persons functioning at three levels of retardation employed in a sheltered workshop.

**Objectives**

The specific objectives for this study were:

1. To examine the degree to which two methods of presentation (video tape versus live presentation) affected the acquisition of an assembly task by small groups of persons functioning at three levels (or ranges) of retardation.

2. To examine the differential (interaction) effects of two methods of presentation (video tape versus live presentation) for persons functioning at three levels (or ranges) of retardation on acquisition of an assembly task.
Hypotheses

The following hypotheses were tested in this study:

1. There is a significant difference in rate of acquisition of an assembly task between groups functioning in the upper, middle, and lower ranges of retardation.

2. There is no significant difference in rate of acquisition between groups trained by method of presentation $A_1$ (video tape) and those trained by method of presentation $A_2$ (live).

3. There is a significant interaction between level of retardation and method of presentation.

Delimitations

The present study examined only two methods of instruction designed to train small groups of employees to perform an assembly task in a sheltered workshop setting. Specifically excluded from the domain of this study were the factors of length of retention, variability of reinforcement, variability of group size, production rates over time, degree of task complexity, sex, and age.

Limitations

In addition to the previously identified delimitations, this study was limited in the generalizations allowable by the extent to which:

1. the sample participating in the research was representative of the population of mentally
retarded sheltered workshop employees; and
2. the extent to which the selected task was representative of assembly tasks.

Definition of Terms

In order to insure clarity in understanding the chapters which follow, the following terms are defined:

Training: "controlled, systematic manipulations of the environment administered in such a way that its effect can be measured and recorded" (Gold, 1973b, p. 100).

Sheltered workshop: A non-profit organization which uses work as the focus for client development (Burton, 1976).

Acquisition: "The process of learning a task to some criterion of errorless performance" (Gold, 1973b, p. 41).

Production: "Performance following acquisition, for which rate is the primary measure" (Gold, 1973b, p. 41).

Stimulus: "Any factor inside or outside of the organism . . . which initiates activity of some kind" (Munn, 1961, p. 737).

Cue: A stimulus which provides guidance concerning an appropriate response (Munn, 1961). Also, a stimulus which causes one to attend to the relevant dimension of a task (Gold & Scott, 1971).

Dimension: "Properties of classes of stimuli" (Gold, 1969, p. 3). "A meaningfully related group of items" (Gold & Scott, 1971, p. 425). For example, red, green, blue, etc., comprise the color dimension.

Discrimination: "An influence which restricts the range of generalization and restrains the organism from making the same response to all physically similar stimuli" (Hilgard & Marquis, 1968, p. 361).
Discrimination learning: Learning to attend to those aspects of a situation which are relevant to the task and to ignore those stimuli which are irrelevant (Gold & Scott, 1971).

Overlearning: "Trials beyond criterion" (Gold & Scott, 1971, p. 430).
CHAPTER II

REVIEW OF RELATED LITERATURE

The purpose of this chapter is to review the literature which is pertinent to this study. This review will be presented according to the following format:

1. Section One will review studies which have substantiated portions of Attention Theory in applied settings with retarded persons. Related concepts will also be discussed.

2. Section Two will pertain to studies of task acquisition conducted in applied settings with retarded persons.

3. Section Three will review studies utilizing alternative media in the instruction of the retarded.

Section One

Introduction

Discrimination tasks have been the focus of much of the learning research conducted with normal and retarded subjects (Ross, 1966; Robinson & Robinson, 1976). This focus can be viewed as largely due to the supposition that at least to some degree all learning involves discriminations (Hilgard & Marquis, 1968). One of the most fruitful and systematic approaches to discrimination learning of
retarded subjects has been developed by Zeaman and House (1963). This approach has resulted in an Attention Theory of discrimination learning (Zeaman & House, 1963).

Attention Theory postulates that individuals who are retarded demonstrate deficiencies in solving discrimination tasks because of "their initial inattention" to the relevant stimulus dimensions of the task (Zeaman & House, 1963, p. 187). Zeaman and House state that "retardates [sic: as compared to normals] suffer from low initial probability of observing certain relevant dimensions rather than from poor ability to learn which of two observed cues is correct" (1963, p. 188).

Furthermore, they hypothesize that "the difference between fast and slow learning is not so much the rate at which improvement takes place, once it starts, but rather the number of trials for learning to start" (1963, p. 162). Therefore, the length of time or number of trials required for an individual to begin learning (the attention phase) "varies with intelligence" (1963, p. 162). Therefore, one could contend that if discriminations are in fact involved in all learning and if the point at which persons begin to learn a task varies with intelligence, the rate at which persons at three levels of retardation acquire a task should initially vary. This initial difference should diminish once learning begins.
Several studies have been conducted which attempt to examine aspects of Attention Theory in applied settings. The components of Attention Theory examined experimentally include: effect of overlearning on extra-dimensional shifts, effect of cue redundancy on task acquisition, and effect of cue redundancy during training on transfer to a single relevant dimension task (Gold, 1969). In addition, the effect of cue redundancy and overlearning on retention (Gold, 1972), the effect of easy-to-hard learning sequences on task acquisition (Gold & Barclay, 1973a), and the effect of fading cue redundancy on transfer (Gold, 1974) have been analyzed. Table 1 displays the following facets of each of these studies: independent variables, dependent variables, number of subjects, IQ range of subjects, experimental settings, and tasks performed.

Gold (1969) found that cue redundancy, when two or more relevant stimulus dimensions are always present together, facilitates task acquisition. Subjects trained using the color-form condition learned to assemble a fifteen part bicycle brake significantly faster than those using the form-only condition. Color-form redundancy was created by painting red the surface of each part which faced the subject when it was correctly positioned for assembly. The form-only condition required the assembly of the parts of the brake as they came from the factory.
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<td>(a) Number of relevant dimensions (form only or color form)</td>
<td>(a) Trials to criterion (b) Manipulation errors to criterion (c) Discrimination errors to criterion</td>
<td>53 of the subjects used in Gold 1969</td>
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<td>Procedure for fading color cue (complete reversal or incremental removal or formed choice)</td>
<td>(a) Manipulation errors to criterion (b) Discrimination errors to criterion</td>
<td>36</td>
<td>Sheltered workshop</td>
<td>Bondix, AD-2, quarter brake (13 parts)</td>
</tr>
</tbody>
</table>
In addition, the training task brake was assembled to a criterion of six correct of eight consecutive trials by half of the subjects, while the other half performed the assembly for 20 trials beyond criterion (overlearning). Effect of overlearning was not found to be significant. Since a forward chaining procedure, which requires each step of the assembly to be mastered before the next step is attempted, was used the effect of overlearning was potentially confounded. The effect of cue redundancy during training on transfer to a task where only one dimension (form) is relevant was not significant. Two factors may have contributed to this finding. First, the shift from color-form to form-only may not have been an intradimensional shift, as hypothesized. Second, the training and transfer task brakes may not have represented the hypothesized easy-to-hard sequence.

As a follow-up of the study described above, Gold (1972) conducted a retention study to determine the long-term effects of cue redundancy and overlearning. Subjects had no experience with the assembly during the one year interim between the acquisition and retention studies. In the retention study the color-form overlearning group demonstrated significantly superior performance over the form overlearning group on the coaster brake (training task). In all cases trials to criterion, manipulation errors, and discrimination errors were significantly fewer
for the retention study than for the acquisition study, despite the year interval between the studies. In addition, the superiority of the color-form condition over the form-only condition was demonstrated through the significantly fewer discrimination errors.

Gold and Barclay (1973a) have demonstrated the effectiveness of utilizing an easy-to-hard sequence as a potential means for facilitating task acquisition. In an initial study, none of the moderately and severely retarded subjects reached criterion in 750 trials on the hard-only task (sorting bolts with a one-eighth inch difference in length). All subjects in the easy-to-hard group reached criterion on three tasks, graduated by difficulty, within 750 trials. The hard-only group was subsequently re-run using the easy-to-hard procedure with all but two of these subjects achieving criterion on the three tasks within 750 trials. In a replication study, using mildly and moderately retarded subjects, no significant difference for training procedure was found. The authors interpreted this lack of significant difference to be due to "considerable heterogeneity on variables such as attention span, motivation or coordination, which were not assessed, but which could affect performance on the task" (p. 10). However, there is no indication that the subjects in the initial study were more homogeneous than those in the replication study. Blocking for intelligence or other variables was not used
in the experimental design; therefore, no direct conclusions concerning these differences can be drawn.

The effect of using a color-form cue redundancy for training purposes, then diminishing reliance on the color dimension (fading) prior to production, has been investigated by Gold (1974). The cue redundancy was created following procedures previously established by Gold (1969). Color coding was faded using three procedures. In the first procedure, complete removal of color coding followed attainment of criterion (six correct assemblies in eight trials). In the second procedure, incremental removal, color-coded parts were replaced by non-color coded parts following three consecutive correct assemblies. If a subject being trained by the second procedure made three incorrect discriminations the color-coded condition for the specific part was reinstated. The third procedure first required subjects to achieve criterion on the cue redundant brake. When subjects in this forced-choice group made a discrimination error on the transfer (form-only) task, they were presented with a match-to-sample task which involved matching color-coded and form-only components and completing the assembly. None of the procedures used had a significant effect on trials, manipulation errors, or discrimination errors to criterion. However, significant within-group variance was found which may indicate wide individual differences relative to each procedure.
Section Two

Studies of Acquisition

Numerous studies have been conducted which have demonstrated the ability of persons who are retarded to acquire behavior necessary to perform a variety of tasks. For example, Loos and Tizard (1955) and Clarke and Hermelin (1955) demonstrated the ability of adults who are severely retarded to perform such tasks as nailing wooden frames, constructing boxes, and soldering colored wires to a television plug. Williams (1967) described tasks performed by a profoundly retarded adult such as sorting plastics by shape, color, and size and stripping plastic from components. O'Connor and Tizard (1956) described performance of such tasks as filing rough edges from plastic objects and folding cardboard boxes. Meadow and Greenspan (1965) taught moderately retarded individuals to bag screws, to perform simple two and three piece assemblies, and follow packaging and mailing procedures. Institutionalized adults learned to produce wooden pencil holders, sand wooden blocks, and assemble wooden flower baskets in a study conducted by Crosson and DeJung (1967). Huddle (1969) taught his subjects to assemble a television rectifier unit. Telephone relay panels were assembled in a study conducted by Tate and Baroff (1967).

Gold (1969, 1972, 1974) demonstrated the ability of severely and profoundly retarded persons to acquire the
skills needed to assemble a 15-piece bicycle brake. Bellamy, Peterson, and Close (1976) taught severely retarded workshop employees to assemble 26-piece print heads and 52-piece cam switch actuators at "production often exceeding normal time standards established by contracting agencies" (p. 175). Mithaug and Haring (1977) taught retarded adults to assemble, start, and repair a ten-piece 0.049 gasoline engine. Levy, Pomerantz, and Gold (1977), in a pilot study, trained retarded workshop employees to assemble 45-component electric circuit boards.

Training procedures designed to facilitate the acquisition by retarded subjects of some of the tasks identified above, have been delineated to various degrees. Frequently such training procedures have been utilized following the specification of task behaviors through a form of task analysis. Examples of training techniques include: physical priming (Williams, 1967); color coding (Gold, 1969, 1972, 1974); backward chaining (Screven et al., 1971; and use of verbal cues (Gold & Barclay, 1973b). Forward chaining training procedures have been used by Gold (1969, 1971, 1972, 1974, 1976), Tate and Baroff (1967), Crosson and DeJung (1967), Huddle (1969), Bellamy, Peterson, and Close (1976), and Levy, Pomerantz, and Gold (1977). These training procedures have been the focus of both descriptive and experimental studies.
Descriptive studies have primarily attempted to demonstrate the ability of individuals who are retarded to acquire specified tasks, while experimental studies have examined the facilitative effects of various training procedures upon task acquisition. These studies are discussed separately.

Descriptive Studies

Table 2 displays the following facets of the succeeding descriptive studies: procedure emphasized, number of subjects, IQ range of subjects, training environment, and tasks performed.

Meadow and Greenspan (1965) conducted a pilot study designed to examine "the feasibility for vocational rehabilitation of a group of low level retardates" (p. 623). The training procedures utilized involved describing the tasks and working conditions to be encountered to each subject. This description was followed by exposure to a work task which was "commensurate with his abilities" (p. 625). The outcomes for this training procedure were:

In most cases, the retardates were able to increase their productivity somewhat and perform more difficult work as they went through the program, although their productivity was less than the average of other workers in the program. . . . As a group, the retardates took longer to learn specific tasks and had more difficulty in exhibiting judgment on tasks than did the average worker in the workshop (p. 626).
<table>
<thead>
<tr>
<th>Study</th>
<th>Procedure Emphasized</th>
<th>Subjects</th>
<th>Training Environment</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nimmer and Green (1965)</td>
<td>Verbal explanation and mock exposure.</td>
<td>10</td>
<td>17-80</td>
<td>Community workshop</td>
</tr>
<tr>
<td>Tate and Barlow (1967)</td>
<td>Forward chaining, color naming, modeling, and verbal instruction.</td>
<td>10</td>
<td>40-80</td>
<td>Institution sheltered workshop</td>
</tr>
<tr>
<td>Williams (1967)</td>
<td>Physical printing.</td>
<td>3</td>
<td>Non-visual 60-80</td>
<td>English Industrial Training Unit</td>
</tr>
<tr>
<td>Hellinger, Hellinger, and Cline (1974)</td>
<td>Forward chaining.</td>
<td>1</td>
<td>Severe MH</td>
<td>Institution sheltered workshop</td>
</tr>
<tr>
<td>Levy, Pincus, and Meara (1973)</td>
<td>1. Forward chaining, physical puzzle, verbal puzzle. 2. Match to sample.</td>
<td>16, C1M, C12 8, CA Hames S-12 8</td>
<td>Severe 35-48</td>
<td>Institution sheltered workshop</td>
</tr>
<tr>
<td>Bellamy, Peterson, and Cline, 1972</td>
<td>Trials to (rate of) acquisition.</td>
<td>2 severely 1 severely</td>
<td>3 severely</td>
<td>3. Non given</td>
</tr>
</tbody>
</table>
Poor performance by the subjects in this study may have resulted from inadequate training. No use of predetermined training criteria or consistent methodology was indicated.

The purpose of a training program described by Tate and Baroff (1967) was to demonstrate "the work potential of the retarded when job analysis and appropriate training techniques were used" (p. 403). In this program, assembly line production of relay panels was task analyzed into 20 operations. Subjects were trained using a forward chaining procedure in which each discrete step was mastered prior to attempting the next step. Training techniques and/or the tasks were modified for individual subjects as needed. Training modifications included use of color coding, modeling desired behaviors by the trainers, and provision of verbal instructions or prompts. Task modifications included building jigs to secure certain portions of the assembly and to assist where fine discriminations were required. Outcomes of the program included abolishing the assembly line as a means of production and delegating it to three individual workers, training a worker to perform electrical tests of completed panels, expansion of services to new workers, and acquiring additional contracts to produce "snap leads, light panels, back path eliminators, and switch panels" (pp. 407-408).
Depiction of the vocational potential of profoundly retarded individuals was provided in a case study by Williams (1967). The IQ of the individual described by Williams was immeasurable on the Stanford-Binet. The subject was trained by the use of a physical priming procedure in which the subject's hands were held by the trainer and forced to perform the movements required to strip plastic components. The training period was less than three weeks. This subject was also taught to make color, shape, and size discriminations, although the precise training procedures were not specified. However, position did not appear to be the cue used to make any of these discriminations. Social and tangible reinforcement appeared to have no effect on the subject's performance. Outcomes of the training program include a gain in measured mental age and increased social interactions by the subject.

Documentation of the vocational potential of individuals who are severely and profoundly retarded was the purpose of two studies conducted by Bellamy, Peterson, and Close (1976). The 19-piece assembly task used in the first study was divided into four major segments. Each of these segments were taught to a criterion of two consecutive correct assemblies before introduction of the next segment. As assembly of each segment was mastered it was added to the previously learned segments.
in the response chain. This procedure is referred to as forward chaining of responses (Gold, 1976) and results in an easy-to-hard sequence.

Tangible and social reinforcement were given as each step of the assembly was mastered. Correction procedures such as verbal prompts, modeling, and physical primes were used to guide the subjects to correct responses. Verbal prompts included definitive statements such as "holes go up" and non-specific statements such as "try again." Using these procedures one subject reached criterion in six hours and 19 minutes, while the other required eight hours and 38 minutes.

Two pilot studies concerning acquisition were reported by Levy, Pomerantz, and Gold (1977). The initial exploratory study described by the authors involved training school-aged TMR children to perform an assembly task. Training procedures were essentially non-verbal with major reliance upon physical priming and trainer modeling.

Three major difficulties in training elementary school-aged subjects to perform the assembly task were cited. First, the size and weight of the assembly made the task difficult for the subjects. Second, classroom tables and chairs were an inappropriate size for the task. Third, the smallness of the subjects' hands made some of the manipulations difficult. All subjects,
however, were able to learn the discriminations required. The manipulation errors were related to the weight of the assembly and occurred in the latter stages of the assembly.

Following a detailed task analysis, a match to sample procedure was used in the second pilot study reported by Levy, Pomerantz, and Gold (1977). The circuit board assembly task required color, form, and position discriminations. In addition, some of the components had letters, numbers, or both which were required to face a specific direction. Criterion consisted of five consecutive correctly assembled circuit boards. Two subjects had reached criterion when the report was written. One subject reached criterion in 90 minutes 16 seconds, the second in 141 minutes.

Retarded blind and deaf blind individuals were taught a bicycle brake assembly in a study conducted by Gold (1976). Due to the sensory limitations of the subjects, training procedures were primarily limited to physical priming and verbal prompts. During training discrimination errors . . . were corrected by using the expression 'Try another way.' Subjects who did not respond appropriately to this feedback were then given simultaneous manual assistance, which was faded until verbal feedback alone facilitated the correct response (p. 80).

Additional modifications were made for individuals depending upon degree of sensory limitation. Criterion was six correct of eight consecutive trials.
**Experimental Studies**

Independent and dependent variables, number of subjects, subject IQ ranges, experimental setting, and tasks employed in the succeeding studies are reported in Table 3.

Crosson and DeJung (1967) trained severely retarded adults in groups of three to perform three workshop tasks. The research project was conducted in three phases. Phase I consisted of pilot work designed to validate task analysis procedures. Phase II concerned evaluation of training procedures, while Phase III examined the effect of reinforcement schedules upon maintenance of previously acquired behavior. In Phases I and II, tasks 1 and 3 were used. In Phase III, tasks 1, 2, and 3 were used.

Three subjects whose IQs and ages approximated the mean of the population were selected to participate in Phase I. Subject responses were used to modify the task analysis and training procedures to be used in Phases II and III.

During Phase II, the following training procedures were followed:

1. Experimenter (E) demonstrated a component of the desired behavior.

2. Subjects (Ss) immediately modeled (E) behavior. Modeling was solicited through gesture, verbal or physical shaping.
<table>
<thead>
<tr>
<th>Study</th>
<th>Variables</th>
<th>Methods</th>
<th>Setting</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gordon and Dedmon (1972)</td>
<td>Phase I</td>
<td>Rate of acquisition is of discrimination</td>
<td>10 male aged 18-30</td>
<td>Institution pre-vocational workshop</td>
</tr>
<tr>
<td></td>
<td>Phase II</td>
<td>Rate of production</td>
<td>10 male aged 18-30</td>
<td>Institution pre-vocational workshop</td>
</tr>
<tr>
<td>Gold and Holley (1972)</td>
<td>1. One situation (evental label) or no verbal label?</td>
<td>Trials to criterion</td>
<td>Institution pre-vocational workshop</td>
<td>12 plus 1000 counter break</td>
</tr>
<tr>
<td></td>
<td>2. Learning retention</td>
<td>Trials to criterion</td>
<td>Institution pre-vocational workshop</td>
<td>12 plus 1000 counter break</td>
</tr>
<tr>
<td>Marvin, reported in Levy, Francena, and Gold (1975)</td>
<td>Type of discrimination pre-training</td>
<td>Trials to criterion</td>
<td>State Institution</td>
<td>State institution</td>
</tr>
<tr>
<td>Marvin, reported in Levy, Francena, and Gold (1975)</td>
<td>Type of discrimination pre-training</td>
<td>Trials to criterion</td>
<td>State Institution</td>
<td>State institution</td>
</tr>
<tr>
<td>Padino, 1949</td>
<td>1. Amount (money reward) no reward</td>
<td>Rate of production</td>
<td>20-40 points per group</td>
<td>Similar workshop (institution) 2 sites</td>
</tr>
</tbody>
</table>
3. Shaping continued with candy reinforcement for successive approximations.

4. (E) reduced the use of demonstration (fading) by shifting from demonstration cues, to gestural cues, to withholding of verbal reinforcement.

5. Tangible reinforcement for each operant was gradually reduced, requiring chains of operants to be established.

6. Upon achievement of criterion (two perfect trials within one 20-minute session) production continued for two days. Minimal supervision and delayed reinforcement procedures were used.

7. A sixty-day follow-up was conducted.

During Phase III subjects were trained using the same procedures as in Phase II except that no tangible reinforcement was given. Both experimental and control groups continued to perform the tasks for ten days after reaching criterion. Control group subjects continued to receive verbal reinforcement only. Experimental subjects were shifted to a prescribed token reinforcement schedule. Following acquisition and prior to production experimental subjects were shifted to a discrimination task. The shift to a discrimination task was made to insure equal amounts of exposure to tokens and to limit the effects of additional practice on experimental tasks.
In Phase II, 75 percent of the subjects had reached criterion by trial six on task 3 and by trial twenty-one on task 1, indicating that simple assembly tasks may be acquired more rapidly than machine operation tasks. The learning curves for all subjects resembled the classical positively accelerated experiential learning curve. Also in relation to Phase II, Crosson and DeJung (1967) conclude that the stimulus components served as discriminative stimuli or conditioned reinforcers for each immediately preceding response. These stimulus components also served as the frames of reference in the instructional program for experimenter induced cues. Such stimuli are thus critically important for acquisition and maintenance of specified behaviors.

In addition, "task difficulty or complexity with respect to behavioral demands did not appear to function as critical factors influencing either acquisition rates or retention." The two factors which in Phase II appeared to be critical were (1) discriminative value of the stimulus components associated with the respective responses" and (2) the "spacing of extrinsic reinforcers in the response chain." These "appeared to be the primary determinants of program efficiency" (p. 108).

In Phase III, both verbal and token reinforcement were found to be effective in maintenance of previously
acquired behaviors. Extrinsic or token reinforcement, when prescribed and scheduled, however, was found to maintain these behaviors at a somewhat higher rate. Crosson and DeJung hypothesize that social (verbal) reinforcement may be more effective with severely than less severely retarded individuals because they may be more deprived of such reinforcement.

In addition, in Phase III, IQ was not found to be correlated with task behavior. It was concluded that task complexity was dependent upon the experimenter's ability to perform a discrete analysis of the environment and to prescribe their consequential events rather than subject IQ.

Gold and Barclay (1973b) conducted a study to determine the effects of verbal cues upon the acquisition and retention of an assembly task. Gold's training procedures for demonstrating the task, recording data, providing reinforcement, and correcting errors are similar to those described previously. In this study, verbal cues were given to subjects in the experimental group when an error was made. For example, if an error was made in the placement of the bearing the subject was told, "The flat part goes up. Try another way" (Gold & Barclay, 1973b, p. 50). The only reinforcement given was "good" at the end of each trial and after corrections were made. Criterion was "six correct assemblies
out of eight consecutive trials" (Gold & Barclay, 1973b, p. 40). Subjects who did not achieve criterion by 55 trials were given a score of 55. After six months, subjects were retrained to criterion. No verbal cues were given to either the original control or experimental groups.

Outcomes of this study indicate that significantly fewer trials to criterion, manipulation errors, and discrimination errors occurred in the retention study than during original learning. In addition, the verbal cue group made significantly fewer discrimination errors than the no-verbal-cue group during retention and original learning studies. No other statistically significant differences between the two groups were found for the retention study. No interaction effects were found.

Two studies conducted by M. R. Merwin have been reported by Levy, Pomerantz, and Gold (1977). In Merwin's first study, subjects were pretrained using one of three discrimination tasks. Discrimination pretraining was selected because of the color, size, and form discrimination required for circuit board assembly. An "automated multiple choice visual discrimination apparatus" was used for each discrimination pretraining task (Levy, Pomerantz, & Gold, 1977, p. 249). The three pretraining tasks included match to sample problems involving multidimensional junk stimuli (Group I), switching from junk
stimuli to electronic component stimuli to printed circuit board component stimuli (Group II), and shifting from geometric form stimuli to component stimuli to printed circuit board component stimuli (Group III).

The effects of pretraining on training and transfer were examined. The training and transfer tasks were mastered by 39 of the subjects. The mean acquisition rate for the training and transfer task was 16.5 trials. Pretraining, training, and transfer required a total mean time of 170 minutes. No statistically significant differences were found between the groups. However, Group III did appear to perform better than Groups I or II, with Group II outperforming Group I. All groups demonstrated significant transfer effects.

In her second study, Merwin examined further the effects of pretraining. The types of pretraining included individual direct assembly training (Group I), slide problems using match to sample procedures with components and circuit boards (Group II), and slide problems, placement pretraining, and training and transfer (Group III). No significant pretraining effect was found for the 48 subjects who achieved criterion. Again, significant transfer effects for all groups were found.

In a study conducted by Huddle (1969), it was concluded that "training procedures to teach TMR subjects
simple industrial tasks can be standardized for groups with considerable individual differences" (p. 209). Training procedures included performing task analysis and providing group instruction for 12 to 15 subjects per training session. Instructional methods involved use of repetition of terms ("plate, washer, key") in sequence and encouraging peer tutoring and assistance (p. 206).

Bellamy et al. (1976) described training procedures used with two severely retarded, vocationally naive, institutionalized adults. With his procedure, tangible reinforcement was given as each of the 51 task steps were correctly performed. Correction procedures included verbal modeling and physical priming. Verbal modeling included use of definitive statements ("holes go up") or non-specific statements ("try again") (p. 339). One subject reached criterion in 8 hours, 38 minutes. The second subject reached criterion in 6 hours, 19 minutes.

Section Three
Autoinstructional Techniques

The use of autoinstructional devices in training research with individuals who are mentally handicapped has been sparse (Gold, 1973a). However, the potential usefulness of such devices with this population has been strongly recommended (Gold, 1973a; Lance, 1977; Ashcroft, 1977; Aserlind, 1966).
Autoinstructional devices which have been utilized in training research include: 8mm film loops (Bitter & Bolanovich, 1966); color slides (Neuhaus, cited in Aserlind, 1966); film (Goldstein, cited in Aserlind, 1966); tape recordings and overhead transparencies (Hull et al., 1976); slides and tapes (Blackman & Siperstein, cited in Gold, 1973a); and programmed remotely controlled "stimulus boxes" (Screven et al., 1971, p. 324). Through the use of these devices subjects have been trained to perform a variety of tasks. These tasks include: dish machine operation (Bitter & Bolanovich, 1966); assembly of a television antenna (Neuhaus, cited in Aserlind, 1966); food serving (Goldstein, cited in Aserlind, 1966); discrimination among metal threaded fasteners (Hull et al., 1976); plug solder (Blackman & Siperstein, cited in Gold, 1973a); and assembly of "coin-tubes" (Screven et al., 1971, p. 329).

Studies using autoinstructional devices have been conducted with subjects who were divergent in terms of age and intellectual functioning. Table 4 depicts the subject ages and IQ's used in these studies as well as the devices and tasks employed.

Several factors appear to be common to the majority of studies in which autoinstructional devices have been used in training. First, a form of task analysis was conducted as the first step in instructional program
### Table 4
Studies Utilizing Audiovisual Devices

<table>
<thead>
<tr>
<th>Study</th>
<th>Device</th>
<th>Subject Age</th>
<th>Subject IQ</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitter and Bolanovich, 1966</td>
<td>8mm film loop</td>
<td>Adolescents</td>
<td>40-65</td>
<td>Dish machine operation</td>
</tr>
<tr>
<td>Neuhaus (in Aserlind, 1966)</td>
<td>Slides</td>
<td>Adults</td>
<td>60-80</td>
<td>Television antenna assembly</td>
</tr>
<tr>
<td>Goldstein (in Aserlind, 1966)</td>
<td>Film</td>
<td>Adults</td>
<td>Not specified</td>
<td>Food serving</td>
</tr>
<tr>
<td>Hull et al., 1976</td>
<td>Overhead projection and tape recordings</td>
<td>Adolescents</td>
<td>60-90+</td>
<td>Discriminations</td>
</tr>
<tr>
<td>Blackman and Siperstein (in Gold, 1973a)</td>
<td>Slides and tapes</td>
<td>Adults</td>
<td>&quot;Educable&quot; range</td>
<td>Plug solder</td>
</tr>
<tr>
<td>Screven et al., 1971</td>
<td>Stimulus box</td>
<td>Adults</td>
<td>Unmeasurable to 70</td>
<td>Coin-tube assembly</td>
</tr>
</tbody>
</table>
development. Second, program content was carefully sequenced. Third, autoinstructional programs utilized brief and specific verbal instructions (Bitter & Bolanovich, 1966; Neuhaus, cited in Aserlind, 1966; Hull et al., 1976; Blackman & Siperstein, cited in Gold, 1973a; Screven et al., 1971).

Bitter and Bolanovich (1966) found that use of 8mm film loops appeared to diminish four obstacles to vocational training of retarded persons participating in the work experience center. These obstacles were that:

1. Many retardates lack the common experiences associated with maintaining a job; e.g., community and work exposure.

2. They learn basically from concrete experiences and on a nonverbal level.

3. They require continuous repetition and reinforcement in the learning process.

4. They have limited ability to transfer learning from one situation to another (p. 731).

In addition, Bitter and Bolanovich (1966) found that 8mm film loops were "relatively easy and inexpensive for staff production of materials tailored to fit learner population, subject, and the locality" (p. 732).

The film loops developed by Bitter and Bolanovich (1966) were used with a continuous loop projector. This type of projector allowed for "single framing and automatically cued stops" (p. 731). Using cueing allowed the instructor to stop the film at relevant points and further
reduce the task to more finite steps.

Clients within the work experience center were also taught to operate the projector. "More capable" clients were able to learn and practice each task independently (p. 732). Instructors were thus freed to work more directly with "slower learners" (p. 732). This may indicate that lower functioning clients require more individual assistance and that audiovisual materials alone may not be sufficient for task acquisition.

In addition to the 8 mm film loops, Bitter and Bolanovich (1966) have utilized overhead transparency projection, "2" x "2" slides, and tape recordings in training the retarded. "A multiple-choice response, visual teaching machine has also been developed for nonverbal programmed instruction" (p. 732).

In a study conducted by Neuhaus and cited by Aserlind (1966), 25 young retarded adults were trained to assemble a television antenna. An automatic projector and 35 mm colored slides were used in the training program. Individual acquisition rate determined the speed at which slides were presented. Auditory instructions accompanied each slide.

Subjects were highly receptive to Neuhaus' audiovisual methods. Aserlind states:

... The trainees were unanimous in preferring the audiovisual method over the conventional lecture method. They praised the clarity and
consistency of the instruction and repeatedly commented that the program allowed them to see exactly what was required at each step (1966, p. 738).

The slide program was developed by breaking down each task into as many "independent steps as possible," utilizing repetition of steps, and providing simple verbal instructions (Aserlind, 1966, p. 729). Positive reinforcement was provided to subjects by the programming supervisor.

The literature revealed no direct attempt to compare rates of task acquisition by persons functioning at different levels of retardation. However, several training procedures were consistently found to be effective in facilitating task acquisition by mentally retarded subjects. These training procedures include use of task analysis, forward chaining, verbal cues and physical priming, minimal verbal interaction, and group instruction. A less frequently employed but effective training procedure was found to be the use of auto-instructional devices. The purpose of this study was to examine the effects of a method of autoinstructional presentation versus live trainer presentation, using the effective training procedures discussed above, upon acquisition of an assembly task by persons functioning at three levels of retardation.
CHAPTER III
PROCEDURES
Population and Sample

Population
The population studied consisted of 118 mentally retarded workers employed in a sheltered workshop. The sheltered workshop was located in a metropolitan midwestern city in central Ohio. The employees were persons within the 18-40 age range. Sixty of these mentally retarded sheltered workshop employees were randomly selected to participate in the study.

Sample Selection
In previous studies concerning factors which facilitate acquisition by mentally handicapped persons, subjects were selected according to a variety of criteria. The most frequently used selection criteria required subjects to have no physical or severe sensory or behavioral handicaps (Crosson & DeJung, 1967; Meadow & Greenspan, 1965; Gold & Barclay, 1973b; Gold, 1974). IQ range was also used as a criterion by Huddle (1969) and Meadow and Greenspan, while Gold (1969, 1973a) asked workshop directors to select their lowest functioning clients for inclusion in his studies. Crosson and DeJung (1967), Huddle (1969), and Meadow and Greenspan (1965) also required
that their subjects be adults with little or no previous vocational experience. The present study required subjects to: (1) have no severe psychomotor, sensory, or behavioral handicaps; and (2) agree to participate in the study themselves or be given permission to do so by their parents or guardians.

Prior to subject selection, consent to participate was obtained either from the client, through personal conversation with the experimenter and workshop staff, or through a written consent form from the client's parent or guardian. The determination as to whether or not a parental consent form was required for a particular client was made by workshop staff based upon each client's legal status. Concurrently, permission was obtained for the experimenter to have access to the most recent intelligence test score contained in the client's files. (Refer to Appendix A for copy of the letter and consent form used.)

A random sample of 60 mentally retarded subjects (Ss) was drawn from the total workshop population. The following sampling plan was utilized to obtain the sample:

1. Employees judged by workshop staff to have severe behavioral, psychomotor, hearing, or visual impairment(s) were removed from the population from which the sample was drawn.
2. Consent to participate in the study was obtained from the remaining employees.

3. Consenting employees were rank ordered (high to low) on the basis of most recent IQ scores.

4. The rank ordered list of consenting employees was divided into equal thirds (upper, middle, lower) based upon IQ score. The upper group's IQs ranged from 79 to 54; the middle group IQ range was 53 to 42; and the lower group IQ range was 41 to 15.

5. Twenty subjects (Ss) from the total within each level or range of IQ score (upper, middle, lower) were randomly selected using a table of random numbers (Rand Corporation, 1955) to participate in the study.

6. Each S within each level was randomly assigned to group A or B using the toss of a coin.

7. Treatments were randomly assigned to group A and to group B using the toss of a coin.

This sampling procedure resulted in thirty Ss per treatment, with ten Ss at each of the three levels or ranges of retardation.

Three Ss were subsequently dropped from the study. Two Ss were dropped because they were not present on the second day of the study. These subjects unexpectedly went on vacation and were away from the workshop for the
duration of the study. The third S became ill after the third day of the study and was unable to continue. This S was absent from the workshop during the remainder of the study.

Additional Ss could not be used to replace the missing Ss because the first day of the treatment differed markedly from the remaining sessions. Original selection of more than 60 subjects was not possible due to practical scheduling considerations. Eighteen additional Ss would have had to be drawn in order to maintain group size (three persons per level per treatment per session). This was not possible because the length of time Ss were present in the sheltered workshop (9:00 a.m. to 2:30 p.m.) was not sufficient to allow more than ten sessions per day with three subjects per treatment per session.

**Design**

The basic design used in this study was an extended posttest-only design (Campbell & Stanley, 1963). The form for the basic posttest-only design is as follows:

\[ R \times O_1 \]
\[ R \times O_2 \]

- **R** = Randomization
- **X** = Experimental treatment
- **0_1** = Observation following experimental treatment
- **0_2** = Observation following control treatment

(Campbell & Stanley, 1963).
In this study, the basic posttest-only design was extended to a 2 x 3 factorial design (Kerlinger, 1973). Such a design required the use of at least two independent variables with two levels of one of the variables and three levels of the other variable (Kerlinger, 1973). The two independent variables in this study were: (1) method of presentation (with two levels); and (2) level of retardation (with three levels). The dependent variable was rate of acquisition (trials to criterion) on an assembly task.

The 2 x 3 design may be illustrated as follows:

<table>
<thead>
<tr>
<th>Method of Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_1 ) (Video tape)</td>
</tr>
<tr>
<td>( A_2 ) (Live)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of Retardation</th>
<th>( B_1 ) (High)</th>
<th>( B_2 ) (Middle)</th>
<th>( B_3 ) (Low)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIALS</td>
<td>TO</td>
<td>CRITERION</td>
<td></td>
</tr>
</tbody>
</table>

\( A = \) Method of presentation  
\( A_1 = \) Video tape method of presentation  
\( A_2 = \) Live method of presentation  
\( B = \) Level of retardation  
\( B_1 = \) High level of retardation  
\( B_2 = \) Middle level of retardation  
\( B_3 = \) Low level of retardation  
(Kerlinger, 1973)
Potential contaminating factors such as initial competence level, motivation, general intellectual functioning level, and experience with assembly tasks were controlled in two ways. First, blocking by intelligence test scores was used to control for differences in general intellectual functioning. Secondly, use of random selection, random assignment to groups, and random assignment of treatments to groups were used to control for individual differences in motivation, previous experience with assembly tasks, and initial competence levels.

**Apparatus and Task**

**Apparatus**

The apparatus used in this study was similar to that employed by Gold (1969). It was a 22-inch by 10-inch wooden tray containing five compartments. Compartmental dividers were 3 inches in height. Three of the compartments contained parts used in the assembly task. Compartments varied in size and were sufficiently large to contain five identical parts of the assembly. The fourth compartment contained a small plastic dish of soapy water. The fifth compartment contained the pliers used during the assembly. The two remaining parts of the assembly were, because of their length, placed on either side of the apparatus.
Task

The task was a five-part General Electric washing machine hose assembly. All subjects worked with the parts as they came from the factory. Thus, a form-only discrimination condition was present (Zeaman & House, 1963).

The assembly process duplicated that used in the factory with one exception. The lubrication liquid and the glue solvent used by General Electric was replaced by soapy water.

The use of a lubricant was necessary for completion of the task. Soapy water was selected because of its non-toxicity and ready availability. Use of the solvent would have prohibited disassembly. Therefore, the soapy water was also substituted for this substance in order to maintain industrial procedures while allowing product disassembly. The disassembly condition was necessary so that parts could be reused.

Training Method

Trainers

Two paid female trainers (Ts) were used in the study. Each T was randomly assigned to a method of presentation treatment group by the toss of a coin. Neither T had previous specific training for working with retarded persons. Both Ts were naive as to the level of retardation of the subjects. In addition, since each T was assigned to type of treatment, she trained subjects at each level
of retardation. Random assignment to type of treatment, naivete, and training persons at each level of retardation held effects of Ts constant across groups. Both Ts were trained individually by the experimenter (E).

Training of the Ts included assembly of the washing machine hoses, demonstration procedures, recording and correction procedures. T training proceeded according to the format outlined below:

1. E demonstrated the task twice to the T.
2. The T performed the task with the E intervening when errors were made, using the same intervention strategies which were to be used with the Ss. These interventions included use of standard verbal prompts and physical priming (Bellamy, Peterson, & Close, 1976; Gold, 1976).
3. The T practiced the task during 5 minute assembly sessions.
4. The T and E then simulated two training sessions with the E roleplaying the part of an S. Predetermined inappropriate responses and assembly errors were made by the E, with the T intervening appropriately.
5. Performance recording procedures were explained and demonstrated to the T.
6. Two additional simulation sessions were conducted, with the T recording performance and applying
correction procedures while the E portrayed an S.

7. T and E discussed potential incidental problems which might arise, such as excessive talking by Ss and other off-task behaviors.

Pilot Test

A pilot test was conducted for two purposes. The first purpose was to enable the Ts to have an opportunity to practice training and recording procedures under real conditions with Ss similar to those who would participate in the study with close supervision by the E. The second purpose was to refine the training procedures.

Following procedures similar to those used by Huddle (1969), Ss selected to participate in the pilot test had IQ's which approximated the median IQ scores within each range of retardation from which the sample was drawn. None of the pilot test Ss had been previously selected to participate in the study.

As a result of the pilot test the criterion to acquisition was altered. The original criterion had been five consecutive correctly assembled hoses within a five-minute period. This criterion was changed to five consecutive correctly assembled hoses for two reasons. First, the use of a time period within the criteria altered the nature of the study from an acquisition study to a production study. The focus of the study would have been altered from the rate at which subjects learned to perform the
task to the rate at which they performed the task once it was learned. Previous studies (e.g., Gold, 1969, 1976; Bellamy, Peterson, & Close, 1976) have separated the two types of studies—acquisition and production.

The second reason for altering the original criterion was related to the first. During the pilot test it was evident that if the criterion remained five consecutive correct assemblies within five minutes, Ss who could learn to make the discriminations required to perform the task successfully would be penalized if they could not manipulate the parts with sufficient speed to assemble one hose per minute in each timed assembly session.

During the pilot test it was also determined that pretraining Ss on the use of the pliers involved in one step of the assembly was not necessary. Pilot test subjects were able to learn to use the pliers without pretraining.

Additionally, scheduling decisions were made as a result of the pilot test. If Ss were to learn to perform the assembly task in small groups, the fact that subjects could reach criterion at different times had to be taken into account. Therefore, it was determined that Ss would have to be reassigned to session times on a daily basis. This reassignment was done randomly at the end of each day, eliminating those Ss who had reached criterion that day.
Task Analysis

Prior to conduction of the study the assembly task was task analyzed. Various forms of task analysis have been used in previous studies of factors which facilitate task acquisition by retarded subjects (Bellamy, Peterson, & Close, 1976; Crosson & DeJung, 1967; Gold, 1969, 1972, 1974, 1976; Gold & Barclay, 1973b; Huddle, 1969; Levy, Pomerantz, & Gold, 1977; Tate & Baroff, 1967). Task analysis has been used primarily to precisely define the behaviors required for task performance. The methods employed to perform such analyses, however, have differed in emphasis and sophistication. Tate and Baroff (1967) analyzed a relay panel assembly task into "twenty operations which were placed in what appeared to be a reasonable sequence" (p. 406). Crosson and DeJung (1967) identified discriminated operands and response topographies following three analyze/re-analyze/modify/evaluate pilot test sequences for each of the three tasks used. The steps and sequential movements required to assemble a television rectifier unit were analyzed by Huddle (1969) prior to training. Bellamy, Peterson, and Close (1976) divided the assembly of a 19-piece cam switch into four major segments, each of which was subdivided into steps. Both discriminations and manipulations were specified for each step.
Gold's studies (1969, 1972, 1973b, 1974, 1976) used a more comprehensive form of task analysis than the studies cited above. He defined task analysis as "all the activity which results in there being sufficient power for the learner to acquire the task" (1976, p. 9). This form of task analysis involves three development phases (method, content, and process) and four recycling phases. During the method phase the task analyst selects which task performance method will be employed. During the content phase, this method of assembly or task performance is divided into steps or "teachable components" (Gold, 1976, p. 79). The instructional strategies and procedures required to teach the content are specified during the process phase. The process phase includes delineating the method of presentation; feedback to the learner in terms of instructions and consequences; training plan including specification of trainer behaviors; criterion to be achieved; and method of data collection. The four recycling phases are used to re-analyze the task in terms of method, content, and/or process depending upon the needs of the individual learner. Recycling is used to insure mastery by every learner through increasing power or the type and level of the analysis.

The task analysis performed in this study corresponded to the developmental phases advocated by Gold. (Refer to Appendix B for a copy of this analysis.)
Experimental Method of Presentation

The experimental method of presentation was a videotaped presentation of the assembly task. The videotaped demonstration was made by the E. Subjects participated in each training session in groups of three. Each session was 20 minutes in duration.

The videotaped presentation of the task was developed in accordance with the task analysis of the assembly procedure. The videotaped presentation included a full sequence presentation and a stop-action presentation similar to forward chaining procedures used by Gold (1969; 1971; 1972; 1974; 1976); Tate and Baroff (1967); Crosson and DeJung (1967); Bellamy, Peterson, and Close (1976); Huddle (1969); and Levy, Pomerantz, and Gold (1977).

During the first training session the full sequence demonstration of steps was presented, followed by a second demonstration in which key steps in the assembly were highlighted by a two-second stop-action picture at the end of each step. Following the videotaped demonstrations, Ss were given a five-minute assembly period. The videotaped demonstration and five-minute assembly period were repeated three times during the first session.

In subsequent sessions, the videotaped demonstrations were presented once at the beginning of each session. Following the videotaped presentation Ss were given three five-minute assembly periods with one-minute rest periods
between them. A kitchen timer was used to signal the end of each assembly period.

A T was present during the videotaped demonstration. The T stood in front of the subjects and observed and recorded task performance. Verbal interaction with the subjects was minimal. If a subject had difficulty with an aspect of the assembly process, the T intervened. A predetermined set of T comments was followed. Predetermined reinforcement statements were used when errors were corrected and upon completion of each assembly. (See Appendix C for predetermined comments and reinforcement statements.)

Control Method of Presentation

The control method of presentation procedures were similar to those demonstrated by Gold (1969, 1972, 1973a, 1974, 1976) except that subjects were trained in groups of three. Use of small groups during training was recommended by Gold (1972) and Gold and Barclay (1973a) based upon outcomes of their previous research. Additionally, small groups were trained successfully by Huddle (1969), Crosson and DeJung (1967), and Hull et al. (1976).

Each training session was 20 minutes in duration. The task analysis developed for the experimental method of presentation was also used in the control method of presentation.
During training, the T stood in front of the three Ss. At the beginning of each session, the T demonstrated the entire assembly procedure twice. In the first presentation the T performed the task using minimal verbalizations ("watch" in the beginning and "good" at the end of the demonstration). During the second demonstration, errors were made following a predetermined demonstration format. Errors were corrected using a predetermined set of comments (Gold, 1976). Three five-minute assembly periods followed the demonstrations by the T.

Training trials began immediately following the demonstration. Operant techniques of modeling, physical manipulation, and fading were used as necessary for each subject. As in the experimental method, verbal comments were used as needed (Gold & Barclay, 1973b). Similarly, predetermined reinforcement statements were used only when errors were corrected and upon completion of each assembly (Gold, 1973b). (Refer to Appendix C for predetermined comments and reinforcement statements.)

Disassembly Procedure

Due to the limited number of assemblies available (40), an intra-session disassembly procedure was necessary. At the beginning of each training session each subject was allocated enough parts to complete five assemblies. Beginning with the first day of training, the E entered each training room at variable times. Completed assemblies
were removed and new disassembled parts were placed in the apparatus.

Disassembly took place outside of the subjects' sight. This procedure was used to control for the potential negative reinforcing effect of subjects seeing their work disassembled (Gold, 1976). The potential disruptive effect of the E entering the training room and removing and replacing components was controlled by having this event take place from the onset of training and remaining constant throughout training. The same procedure was followed for each training condition.

Data and Instrumentation

Measure of Rate of Acquisition

The measure of rate of acquisition was trials to criterion. Criterion was five consecutive correctly assembled products. Criterion level was less than the average level of production by nonhandicapped, highly experienced workers employed by General Electric in their Louisville, Kentucky assembly plant. In this industrial setting, experienced assemblers average 170 assemblies per hour when a jig is not used. These workers perform the assembly eight hours per day, five days a week, and are paid approximately $5.00 per hour of production.
Data Collection

Data collection procedures for both the experimental and control conditions were similar to those used by Gold (1969). Accordingly, data was recorded via a matrix. The columns of the matrix corresponded to the steps of the task and the rows represented trials. The T placed a plus (+), a minus (-), or a circle (o) in the appropriate cells of the matrix as each step of the task was completed. A plus (+) indicated that the step was completed correctly; a minus (-) represented an error corrected by the T. If a subject self-corrected an error without T assistance, a circle (o) was placed in the appropriate cell. (Refer to Appendix D for Data Collection Matrix.)

In addition to the matrix previously described, the data collection instrument had three blocks placed on the side of each sheet. Each block corresponded to a five-minute assembly period. The T registered for each subject the number of assembled products per five-minute assembly in these blocks.

Data collection forms were maintained for each subject. Data collection forms were coded to correspond to work station number (1, 2, or 3) and session time (8:30, 9:00, 9:30, etc.). Each subject occupied the same work station each day of training. Work session times were varied daily to maintain a consistency of three subjects per session.
CHAPTER IV
FINDINGS

Sixty adult sheltered workshop employees functioning within three ranges or levels of retardation were randomly selected to learn to perform a washing machine hose assembly task. The independent variables were method of presentation (live versus video tape) and level of retardation (upper, middle, and lower). The dependent variable was rate of acquisition as measured by trials to criterion. Criterion was five consecutively correctly assembled hoses. Groups of three subjects per training session learned to perform the assembly task under both the control (live) and experimental (video tape) conditions.

Data were analyzed using two-way analysis of variance procedures (two-way ANOVA) on the dependent variable trials to criterion. The method of unweighted means approach to two-way analysis of variance was used in accordance with procedures recommended by Kennedy (1978). This method of analysis was chosen because of the disproportionality in cell frequencies due to the loss of three subjects early in the study. In addition, the criteria for use of this approach, a completely randomized design and subject loss due to mortality for reasons unrelated to the treatment, were met (Kennedy, 1978).
The independent variables (method of presentation and level of retardation) were fixed. The research or "substantive" hypotheses were converted to the null form in accordance with the statistical procedure recommended by Kerlinger (1973, pp. 202-203). The following null hypotheses were tested at the .05 level of significance:

1. There will be no significant difference in rate of acquisition of an assembly task between groups in the upper, middle, and lower ranges (levels) of retardation.

2. There will be a significant difference in rate of acquisition between groups trained by method of presentation $A_1$ (video tape) and those trained by method of presentation $A_2$ (live).

3. There will be no significant interaction between level of retardation and method of presentation.

Complete ANOVA tables follow. Significant main effects for level of retardation were found ($F = 12.803$, $p > .0001$). No significant differences were found for method of presentation ($F = 0.783$, n.s.). No significant interaction effects were found ($F = 1.437$, n.s.). Therefore, hypotheses 1 and 2 were rejected, while hypothesis 3 was not rejected.
An eta correlation coefficient was computed to determine the amount of variance attributed to each independent variable. Method of presentation had an eta correlation coefficient of .10 while level of retardation received an eta correlation coefficient of .55.

Table 6 presents trials to criterion, sums, means, standard deviations, variances, and number of subjects for method of presentation by level of retardation.
Table 5
Analysis of Variance on Trials to Criterion

<table>
<thead>
<tr>
<th>Source</th>
<th>Degrees of Freedom</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of Presentation</td>
<td>1</td>
<td>22.817</td>
<td>22.817</td>
<td>0.783</td>
</tr>
<tr>
<td>Level of Retardation</td>
<td>2</td>
<td>746.133</td>
<td>373.067</td>
<td>12.803**</td>
</tr>
<tr>
<td>Interaction</td>
<td>2</td>
<td>83.733</td>
<td>41.867</td>
<td>1.437</td>
</tr>
<tr>
<td>Within</td>
<td>52</td>
<td>1573.493</td>
<td>29.139</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
<td>2426.176</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Significant 0.01
Table 6

Table of Means for Trials to Criterion
for Method of Presentation by Level of Retardation

<table>
<thead>
<tr>
<th>Method of Presentation by Level of Retardation</th>
<th>Number of Subjects</th>
<th>Sum of Trials to Criterion</th>
<th>Mean Trials to Criterion</th>
<th>Standard Deviations</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live</td>
<td>28</td>
<td>462.00</td>
<td>15.40</td>
<td>6.20</td>
<td>38.45</td>
</tr>
<tr>
<td>Upper</td>
<td>10</td>
<td>118.00</td>
<td>11.80</td>
<td>5.80</td>
<td>33.73</td>
</tr>
<tr>
<td>Middle</td>
<td>9</td>
<td>142.00</td>
<td>14.20</td>
<td>5.84</td>
<td>34.17</td>
</tr>
<tr>
<td>Lower</td>
<td>9</td>
<td>202.00</td>
<td>20.20</td>
<td>3.79</td>
<td>14.40</td>
</tr>
<tr>
<td>Video</td>
<td>29</td>
<td>425.00</td>
<td>14.16</td>
<td>6.66</td>
<td>44.41</td>
</tr>
<tr>
<td>Upper</td>
<td>10</td>
<td>87.00</td>
<td>8.70</td>
<td>4.76</td>
<td>22.67</td>
</tr>
<tr>
<td>Middle</td>
<td>10</td>
<td>163.00</td>
<td>16.00</td>
<td>6.73</td>
<td>45.34</td>
</tr>
<tr>
<td>Lower</td>
<td>9</td>
<td>175.00</td>
<td>17.50</td>
<td>4.94</td>
<td>24.50</td>
</tr>
</tbody>
</table>
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Purpose of the Study

The purpose of this study was to determine the extent to which acquisition of an assembly task was facilitated by the use of autoinstructional methods as compared to live presentations with small groups of persons functioning at three levels of retardation and employed in a sheltered workshop. Furthermore, the objectives of this study were to examine the degree to which the two methods of presentation affected the rate of acquisition of the task and to examine the differential or interaction effects of the two methods for persons functioning at three levels of retardation.

Summary of Procedures

A random sample of sixty mentally retarded sheltered workshop employees participated in this study. Prior to selection, subjects were rank ordered on the basis of IQ score and assigned to equally divided groups (upper, middle, and lower). Twenty subjects from each of the upper, middle, and lower IQ ranges were randomly selected to participate. Each participant was then randomly assigned to treatment group A or B, with treatment then randomly assigned to the two groups.
The apparatus consisted of a compartmentalized wooden tray. The tray contained all but two of the components required to complete the assembly. The remaining two components were placed to the right and left of the apparatus. One apparatus was placed at each of the six training stations (three per treatment).

The task was a five-part washing machine hose assembly. Assembly procedures duplicated those used in an industrial setting in all respects except that a non-toxic substance was substituted for the lubricant and solvent typically used.

Two female trainers were randomly assigned to treatment groups and were trained by the E. Each trainer worked with three Ss per 20-minute training session. In addition, each trainer worked with Ss functioning at each level of retardation.

A task analysis of the assembly process was conducted prior to initiating the study. The assembly was divided into 9 components and 18 steps.

The experimental method of presentation was a videotaped presentation of the assembly process made by the E. The video tape was made in accordance with the task analysis. During the first training session, the three Ss in each 20-minute session viewed the video tape three times with 5-minute training trials following each presentation. During subsequent sessions Ss viewed the
video tape once and were given three 5-minute training trials with 1-minute rest periods between each 5-minute training period. A T was present during the entire training session. The T used verbal prompts, modeling, and physical primes to correct S errors.

The control method of presentation was live presentation by a T. The T demonstrated the assembly process twice during each training session. Following the demonstrations Ss were given three 5-minute training trials with 1-minute rest periods between each 5-minute training period. The T used verbal prompts, modeling, and physical primes to correct S errors.

Both the experimental and control treatments occurred at the same time in different rooms in the same location. Both Ts used the same data collection matrix in which the columns corresponded to components of the task and the rows corresponded to the number of trials. Each T recorded correct, self-correct, and error responses for each component of the task for each S on each trial.

Summary of Findings

The independent variables for this study were level of retardation (upper, middle, and lower) and method of presentation (video tape vs live). The dependent variable was trials to criterion. Criterion was five consecutively correctly assembled washing machine hoses.
The following null hypotheses were tested at the .05 level of significance:

1. There will be no significant difference in rate of acquisition of an assembly task between groups in the upper, middle, and lower ranges (levels) of retardation.

2. There will be a significant difference in rate of acquisition between groups trained by method of presentation \( A_1 \) (video tape) and those trained by method of presentation \( A_2 \) (live).

3. There will be no significant interaction between level of retardation and method of presentation.

Data were analyzed using two-way analysis of variance procedures. Hypotheses 1 and 2 were rejected, while hypothesis 3 was not rejected.

Conclusions

Rejection of hypothesis 1 indicates that persons employed in the sheltered workshop from which the sample was drawn vary in the rate at which they learn to perform a washing machine assembly task in accordance with range of IQ. Those in the upper IQ range (79-54) acquired the task most rapidly (\( \bar{x} \) trials to criterion = 10.25). Those in the middle IQ range (53-42) acquired the task at the next most rapid rate (\( \bar{x} \) trials to criterion = 15.25).
Those in the lower IQ range (41-15) acquired the task at the least rapid rate ($\bar{x}$ trials to criterion = 18.85).

All Ss within each range of IQ score learned to perform the assembly task to a criterion of five consecutive correctly assembled hoses. It was concluded from the results obtained that persons employed in this sheltered workshop can learn to perform tasks similar to that used in this study provided they are given sufficient time to learn the required behaviors. This finding is consistent with the Attention Theory research conducted by Zeaman and House (1973) and is related to previous research conducted by Gold (1969, 1972, 1976) and Gold and Barclay (1973b).

Rejection of hypothesis 2 indicates that there was no significant difference in rate of acquisition between subjects trained by the video tape and live methods of presentation. Thus, subjects learned to perform the task at highly similar rates regardless of method of presentation. Examination of mean rates of acquisition indicates that those trained using the video tape method of presentation acquired the task only slightly more rapidly ($\bar{x} = 14.1667$) than those trained by the live method ($\bar{x} = 15.4000$). This finding suggests that for the population from which the sample was drawn, either method of presentation may be advantageous in similar assembly task training.
A significant interaction effect had been expected but was not found. Thus, hypothesis 3 was not rejected. Although significant interaction effects were not found, graphic illustration of mean scores indicates that ordinal interaction was present. Figure 1 depicts this ordinal interaction.

![Graph of Mean Trials to Criterion by Method of Presentation by Level of Retardation]

METHOD OF PRESENTATION

Video tape Live

Examination of the mean scores for rate of acquisition by the upper ($\bar{x} = 8.7$) and lower ($\bar{x} = 17.5$) level of retardation groups indicates that they reached criterion more rapidly under the video tape method of presentation. The mean score for rate of acquisition for the middle group ($\bar{x} = 14.2$), however, indicates that they acquired the task slightly more rapidly under the live method of presentation. Due to the lack of significant interaction effects, however, it cannot be conclusively stated that a
given method of presentation is superior to another for persons functioning within the three specified levels of retardation.

A possible confounding effect relating to all conclusions which can be drawn from this study concerns the sampling plan employed. According to that plan the population from which the sample could be drawn was first limited to those sheltered workshop employees who had no severe behavioral, psychomotor, or visual impairments; then, consent to participate in the study was obtained from those who remained. Next, potential subjects were rank ordered (high to low) on the basis of most recent IQ score. The resultant IQ range was 79-15. This rank ordered list was then divided into thirds, with the upper group having IQ scores between 79-54, the middle group having IQ scores of 53-42, and the lower group having IQ scores between 41 and 15. Subjects were then randomly selected from the upper, middle, and lower groups, randomly assigned to group A or B, with treatments and trainers then randomly assigned to groups A and B.

When random selection of Ss occurred, one S with an IQ score of 54 (the bottom of the upper group) was selected from the upper range. Two Ss with IQ scores of 53, the top of the middle group, and one with an IQ of 51, near the top of the middle group, were selected. Four of the Ss in the middle range were selected who had IQ
scores of 43 or 42, near the bottom of that group. Similarly, three Ss in the lower range were selected who had IQ scores of 41, the top of the lower group.

Thus, three of the Ss in the middle group were selected who had IQ scores within 1 to 3 points of a subject in the upper group. Similarly, four Ss in the middle group had IQ scores within 1 or 2 points of three of the Ss in the lower group. Therefore, seven of the twenty Ss in the middle group had IQ scores which were between 1 and 3 points of their counterparts in the upper and lower groups. The differences in terms of IQ score, then, between the seven Ss from the middle group and Ss in the upper and lower groups may not have been sufficiently large enough to produce a significant interaction effect.

Another potential explanation for the findings related to the interaction hypothesis concerns the stimulus properties associated with the two treatments and is related to the work of Zeaman and House (1973). In this regard, the upper group may have found the color video tape presentation similar to television viewing and thus were receptive to attending to the relevant dimensions of the task. The lower group may have received sufficient stimulation from the video tape presentation to cause them to attend to the relevant dimensions of the task. The middle group, however, may
have found the video tape method of presentation over-stimulating and thus were unable to attend to the relevant dimensions of the task. Thus it could be concluded that the video tape method of presentation may provide sufficient stimulation for the upper and lower groups, but is overstimulating to the middle group.

Recommendations

The findings of this investigation have several implications for training the population studied and for future research. The following recommendations are made in that regard.

Training Recommendations

1. To the extent to which the Ss in this study resemble the remaining sheltered workshop employees from which the sample was drawn, it is clear that persons functioning in the 79-15 IQ range can learn to perform the type of assembly task used in this study. It is recommended that such tasks be incorporated in the training program for this population.

2. This study also demonstrated that persons functioning at three levels of retardation learn to perform an assembly task at variable rates. Thus, when similar tasks are incorporated into the existing training program, employees should be given sufficient time to learn to perform the task before they begin production.
3. Current results also indicate that to the extent the sample drawn is representative of the population, acquisition of the assembly task is facilitated equally by video tape and live methods of presentation. This suggests that the video tape method of presentation is a viable training option. If the equipment required for video tape production and viewing is available, several advantages for its use in training can be envisioned.

First, use of video tape allows storage and retrieval. Thus, as new trainees or staff enter the workshop, they can be trained to perform the assembly task without disruption of current production.

Second, use of the video tape method of presentation would allow trainees who acquire the task at variable rates to begin production in accordance with their rate of acquisition. Thus, those who acquire the task at a slow rate would have the opportunity to fully learn the task without affecting the rate of production upon which contract payment is based.

Third, if portable video tape production equipment is available, video tapes could be made of the assembly process in the industrial setting in which it occurs. Such a procedure would enable trainers and trainees to learn to perform the task to industrial standards and specifications.
Finally, the video tapes from which trainees learned or will learn to perform assembly tasks would be available for review during development and review of the trainee's Individualized Written Rehabilitation Plan (IWRP) required for all vocational rehabilitation services clients. Such a procedure would facilitate the development of annual goals and short-term objectives by those involved in the IWRP process.

Implications for Future Research

1. This study should be replicated with the following changes:
   a. A larger sample should be used in a replication study to allow for greater variance within cells.
   b. A larger sample should be used which is representative of sheltered workshop employees within a larger geographic region, state, and/or the nation in order to increase generalizability.
   c. A replication study should employ more stringent controls for trainer effect by having each trainer use both methods of presentation with persons at each level of retardation.
d. A study similar to this one should be conducted which involves a more complex task in order to determine if there is a relationship between task complexity, method of presentation, and level of retardation. Such a study should attempt to determine if a more complex task is acquired more readily by persons functioning at different levels of retardation using live or video tape methods of presentation.

2. Retention of task behaviors should also be examined in future replication studies. Such a retention study should attempt to ascertain whether the live or video tape methods of presentation facilitated retention of the task for persons functioning at different levels of retardation.

3. A replication study should also examine the effect of method of presentation upon production rates for persons functioning at three levels of retardation.

4. Research involving the two methods of presentation employed in this study with persons functioning at different levels of retardation which
focuses on non-assembly task behaviors should also be conducted. Such a study could examine the utility of these methods of presentation for acquisition of such daily living skills as self-care, personal hygiene, and table setting.

5. The effect of group size on rate of acquisition using the methods of presentation employed in this study with persons functioning at different levels of retardation should also be examined. Such a study should attempt to determine which method of presentation has the most facilitative effect upon acquisition for persons functioning at each level of retardation in relation to various group sizes.
APPENDIX A

Dear Parent:

A training study will be conducted by The Ohio State University and Arcraft West. This study will determine which of two training methods is more effective with sheltered workshop clients. Clients at Arcraft West will be asked to participate in this study.

The study involves two methods of teaching clients to do an assembly task. The task is similar to the work currently done by many clients at Arcraft West.

Clients who participate in the study will be away from their normal work stations 20 minutes a day for two weeks. No client will lose any income as a result of participating in this study.

Your permission for your child to participate in this study is needed. By allowing your child to participate in this study you will help workshop trainers improve training programs for the clients they serve.

Please read and sign the attached permission form. If you have any questions about this study, please feel free to contact:

Carole Johnson
The National Center for Research in Vocational Education
486-3655, extension 316

Thank you for your assistance.

Sincerely,

Carole M. Johnson
APPENDIX A

Protocol No. __________________

CONSENT FORM

The Ohio State University

Consent to Allow Child to Serve as Subject in Research

I consent to allow my child to participate in the research study in vocational education which will be conducted by Carole M. Johnson. I also consent to allow Ms. Johnson access to my child's confidential file for purposes of this study.

I have read the attached letter and understand that any questions I have will be answered. I understand that the identity of my child will not be revealed in any publication or record of any type. Finally, I understand that my child is free to drop out of this study at any time he or she notifies Ms. Johnson or the workshop trainer.

Signed ______________________________________
(Parent)

__________________________________________
(Child)

__________________________________________
(Researcher)

__________________________________________
(Date)
CONSENT FORM

Consent to Serve as a Subject in Research

I consent to participate in the research study in vocational education which will be conducted by Carole M. Johnson. I also consent to allow Ms. Johnson access to test scores contained in my confidential file for purposes of this study.

Ms. Johnson has explained to me the nature of the study and I understand any questions I have will be answered. I understand that my identity will not be revealed in any publication or record of any type. I further understand that I may drop out of this study at any time after notifying Ms. Johnson or the workshop trainer. Furthermore, I understand I will be paid my regular hourly wage for participation in this study.

Signed ____________________________
(Trainee)

(Researcher)

(LICCO Director)

(Date)
## APPENDIX B

### TASK ANALYSIS

<table>
<thead>
<tr>
<th>Task Component</th>
<th>Task Step(s)</th>
<th>Hand</th>
<th>Discrimination</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Hose</td>
<td>Pick up white hose</td>
<td>Left</td>
<td>smooth end up</td>
</tr>
<tr>
<td></td>
<td>Place white hose on table</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short Black Hose</td>
<td>Pick up short black hose</td>
<td>Right</td>
<td>lip up</td>
</tr>
<tr>
<td>Dip Black Hose</td>
<td>Dip black hose</td>
<td>Right</td>
<td>lip up</td>
</tr>
<tr>
<td></td>
<td>Insert black hose in white hose</td>
<td>Right</td>
<td>lip up</td>
</tr>
<tr>
<td>Connector</td>
<td>Pick up connector</td>
<td>Right</td>
<td>indentation</td>
</tr>
<tr>
<td></td>
<td>Dip connector</td>
<td>Right</td>
<td>to right</td>
</tr>
<tr>
<td></td>
<td>Insert connector</td>
<td>Right</td>
<td>indentation</td>
</tr>
<tr>
<td></td>
<td>Right indentation</td>
<td>Right</td>
<td>toward subject</td>
</tr>
<tr>
<td>Corbin Clamp</td>
<td>Pick up corbin clamp</td>
<td>Right</td>
<td>prongs toward</td>
</tr>
<tr>
<td></td>
<td>Slip clamp over connector</td>
<td>Right</td>
<td>subject</td>
</tr>
<tr>
<td>Long Black</td>
<td>Pick up long black hose</td>
<td>Right</td>
<td>short end</td>
</tr>
<tr>
<td></td>
<td>Dip short end long black hose</td>
<td>Right</td>
<td>toward</td>
</tr>
<tr>
<td></td>
<td>Insert connector section into long black hose</td>
<td>Right</td>
<td>subject</td>
</tr>
<tr>
<td>Pliers</td>
<td>Lay down assembly</td>
<td>Right</td>
<td>points in holes</td>
</tr>
<tr>
<td></td>
<td>Pick up pliers</td>
<td>Right</td>
<td></td>
</tr>
<tr>
<td>Position Clamp</td>
<td>Place holes in points of pliers on clamp prongs</td>
<td>Right</td>
<td>distance to</td>
</tr>
<tr>
<td></td>
<td>Apply pressure</td>
<td></td>
<td>lift clamp</td>
</tr>
<tr>
<td></td>
<td>Slip clamp up $\frac{1}{4}$&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Put assembly on floor</td>
<td></td>
<td></td>
<td>82</td>
</tr>
</tbody>
</table>
## APPENDIX C

### VERBALIZATIONS

<table>
<thead>
<tr>
<th>Task Component</th>
<th>Task Step(s)</th>
<th>Verbalizations for Corrections</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Hose</td>
<td>Pick up white hose</td>
<td>other end-good</td>
</tr>
<tr>
<td></td>
<td>Place white hose on table</td>
<td>put it down-good</td>
</tr>
<tr>
<td>Short Black Hose</td>
<td>Pick up short black hose</td>
<td>stop-try again</td>
</tr>
<tr>
<td>Dip Black Hose</td>
<td>Dip black hose</td>
<td>stop-dip-good</td>
</tr>
<tr>
<td></td>
<td>Insert black hose in white hose</td>
<td>stop-try again</td>
</tr>
<tr>
<td>Connector</td>
<td>Pick up connector</td>
<td>other end-good</td>
</tr>
<tr>
<td></td>
<td>Dip connector</td>
<td>stop-try again</td>
</tr>
<tr>
<td></td>
<td>Insert connector</td>
<td>other end-good</td>
</tr>
<tr>
<td>Corbin Clamp</td>
<td>Pick up corbin clamp</td>
<td>dip-good</td>
</tr>
<tr>
<td></td>
<td>Slip clamp over connector</td>
<td>push-good</td>
</tr>
<tr>
<td>Long Black</td>
<td>Pick up long black hose</td>
<td>put it on-good</td>
</tr>
<tr>
<td></td>
<td>Dip short end long black hose</td>
<td>stop-try again</td>
</tr>
<tr>
<td></td>
<td>Insert connector section into long black hose</td>
<td>other end-dip-good</td>
</tr>
<tr>
<td>Pliers</td>
<td>Lay down assembly</td>
<td>stop-try again</td>
</tr>
<tr>
<td></td>
<td>Pick up pliers</td>
<td>push-good</td>
</tr>
<tr>
<td>Position Clamp</td>
<td>Place holes in points of pliers on clamp prongs</td>
<td>put it down-good</td>
</tr>
<tr>
<td></td>
<td>Apply pressure</td>
<td>pliers-good</td>
</tr>
<tr>
<td></td>
<td>Slip clamp up ¼&quot;</td>
<td>stop-try again</td>
</tr>
<tr>
<td></td>
<td></td>
<td>points in holes-good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stop-try again</td>
</tr>
<tr>
<td></td>
<td></td>
<td>squeeze-good</td>
</tr>
<tr>
<td></td>
<td></td>
<td>stop-try again</td>
</tr>
<tr>
<td></td>
<td></td>
<td>up more or down more good</td>
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<tr>
<td>Put assembly on floor</td>
<td></td>
<td>put it down-good</td>
</tr>
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</table>

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## APPENDIX D

### DATA COLLECTION MATRIX

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK SESSION TIME</td>
<td></td>
</tr>
<tr>
<td>FIRST NAME</td>
<td></td>
</tr>
<tr>
<td>WORK STATION</td>
<td></td>
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#### TASK COMPONENT TRIALS

<table>
<thead>
<tr>
<th>Task Component</th>
<th>Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18</td>
<td></td>
</tr>
<tr>
<td>WHITE HOSE</td>
<td></td>
</tr>
<tr>
<td>SHORT BLACK</td>
<td></td>
</tr>
<tr>
<td>DIP BLACK</td>
<td>1st</td>
</tr>
<tr>
<td>CONNECTOR</td>
<td>2nd</td>
</tr>
<tr>
<td>CORBIN CLAMP</td>
<td>3rd</td>
</tr>
<tr>
<td>LONG BLACK</td>
<td></td>
</tr>
<tr>
<td>PLIERS</td>
<td></td>
</tr>
<tr>
<td>POSITION CLAMP</td>
<td></td>
</tr>
<tr>
<td>PUT IN BOX</td>
<td></td>
</tr>
</tbody>
</table>

5 Minute Trials
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