EFFICIENCY OF TWO OPERANT PROCEDURES IN BUILDING FLUENCY IN DRESSING SKILLS OF PROFOUNDLY HANDICAPPED CHILDREN

BY

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There has been an increasing interest in the acquisition of self-care skills by persons identified as profoundly retarded. The development and maintenance of self-care skills has been an important step in dispelling the notion that these individuals could not learn.

In the previous decade, researchers have investigated the acquisition and performance of self-care skills by profoundly retarded individuals. It seems apparent that the next step to be initiated was to examine which procedure for teaching self-care skills was most efficient and effective for this population.

In review of literature, investigators have suggested that backward and forward chaining procedures have been superior to total task procedures. Of the two most frequently discussed and most frequently successful training procedures, neither has been empirically proven superior to the other in the teaching of undressing/dressing skills. In this study, the efficiency and effectiveness of backward and forward chaining procedures were compared.

Six profoundly retarded subjects (IQ range 11 to 18) were selected from a public school setting for the severely and profoundly retarded. The subjects ranged in age from seven through 15 years. Subjects selected for inclusion in the sample (1) required physical direction and/or physical assistance in undressing/dressing skills, (2) exhibited no undressing/dressing skills, and, (3) had undressing and dressing skills listed as goals on their individualized education programs. The subjects were randomly assigned to two treatment groups corresponding to the operant chaining procedures employed. Operant procedural effect on subjects' task performance was evaluated by (a) learning performance, (b) error rate, and, (c) trials to criterion.

A basic group design was used, with the introduction of skill acquisition for subjects varying as a function of the individual. Data were evaluated by tabulating the item of measure and matching it to like items of measure. Comparisons were made upon conversion of the matched items to percentages of difference between them.

From analysis of the results, it may be concluded that for error rate and trials to criterion the forward chaining procedure was superior to the backward chaining procedure. No differences were revealed when the two procedures were compared for effect on learning performances.

CHAPTER I

INTRODUCTION

For efficient and effective learning to take place, individuals must be able to observe various sounds, shapes, odors, textures, and colors. When observations are made, stimuli have been selected for concentrated focus, while at the same time other stimuli have been ignored or given less consideration. This process of active selectivity has been called attention (Stott, 1970). Attention, essentially an unobservable, unmeasurable phenomenon, when used to describe behavior, infers that the individual or observer has been under the control of some stimulus (Bijou & Baer, 1961). "Attending" labels the behavior of "looking at" and noticing certain features which come to be discriminative for the attended conditions (Haring, 1968). Since substantiation of supposed episodes of attending are conducted through observable responses alone, the term attending and responding are regarded as synonymous (Haring, 1968).

Attending and responding are essential to learning, since learning usually takes place when the individual can focus his attention on a specified task for a given period of time (Haring, 1968). Learners are expected to sort out and attend/respond to only those stimuli that are important or relevant. Individuals who have difficulty in or cannot focus their attention on a particular stimulus are often characterized as inattentive, having a short attention span, not paying attention, easily distractable, or daydreaming. Within the classroom, individuals

with these behaviors may be labeled inappropriately as retarded. As illustrated in Table 1, the stimuli that learners are required to respond to have numerous features. The presence of these various stimulus topographies has required that the learner make constant, consistent, and accurate discriminative choices. The failure to identify and screen out meaningless stimuli while at the same time to concentrate on the significant cues of the stimuli has been one major cognitive defect most often associated with individuals identified as severely or profoundly retarded (Brown, 1974; Ellis, 1970; House & Zeaman, 1958; Osler & Kofsky, 1965). It has been this cognitive defect which has impeded and slowed the rate of learning for retarded citizens and consequently posed serious problems in their training and education (Stevenson, 1963).

Bellamy, Inman, and Schwarz (1978) have suggested that shaping, physical priming, modeling, and verbal directions have been practical techniques in the teaching of stimulus response topographies to persons identified as severely and profoundly handicapped. These techniques may be employed to increase the rate of learning. In addition to these methods, stimulus control has been a critical area to be emphasized in studies of attention to and acquisition of response topographies. According to Bellamy et al. (1978) there have been three techniques found to be effective in improving acquisition of stimulus control. The first technique has been the use of differential reinforcement (i.e., reinforcing appropriate responses and not reinforcing inappropriate responses). A second technique involved the manipulation of

Table 1. Features of stimuli to which learners are required to respond

Features	Stimuli
Sound	Teacher's voice
Form	Geometric objects
Odor	Paper's scent
Number	Counting objects
Texture	Finger-painting activity
Color	Classifying objects
Taste	Recognizing foods
Size	Learning concepts
Weight	Judging objects
Proximity	Teacher's presence
Position	Locating page placement
Direction	Identifying letters
Depth	Perceiving distances
Pattern	Piecing puzzles
Time	Knowing schedules

the stimulus features of the task to accentuate the relevant dimension (i.e., adding and then gradually reducing large cue differences on the relevant dimension, or adding and fading a redundant dimension that is highly salient for the learner) to which the learner must attend and respond differentially. In the third technique, external assistance provided to the learner has been gradually removed or faded.

When used in conjunction with teaching a sequence of responses (i.e., chaining procedures), stimulus control techniques have been found to be effective for the acquisition, transfer, and retention of complex educational, recreational, and vocational tasks by learners labeled severely and profoundly retarded (Adams & Shepp, 1975; Bellamy, 1976; Evans & Bilsky, 1972; Gold, 1972; House, 1973; Irvin & Bellamy, 1976; Roos, 1965). Whether these individuals could be taught complex tasks by using these methods (i.e., stimulus control techniques, chaining procedures) not only has been answered, but also has been demonstrated numerous times by various researchers.

The salient questions facing habilitation specialists have included how to effectively achieve skill acquisition, and how to efficiently improve skill performance once it has been acquired. Increased efficiency has been called fluency (Haring, Liberty, & White, 1979). An investigation of methods of acquisition and fluent performance of self-help skills by profoundly retarded learners would be useful to professionals. Such an investigation would also be of value to researchers in that it would help identify possible procedures that may be effective in training a specific learner.

Statement of the Problem

Although investigators (Bellamy et al., 1978; Friedenberg & Martin, 1977; Gold, 1974; Minge & Ball, 1967; Zeaman & House, 1963) have suggested that varied distinct methods of skill training (i.e., physical assistance, shaping, stimulus dimension manipulation, task analysis, etc.) are effective, the question of how to best teach self-help skills to learners who are profoundly retarded has not fully been addressed. One approach to answering this question is through an experimental examination of procedures for establishing and maintaining attention through stimulus control (i.e., the learning of a specified series of responses). Initially, in a specified series of responses such as an operant chain, the individual must learn to attend to the relevant dimensions of difference between the stimuli and then choose the particular stimulus that is correct (Gold & Scott, 1971; Restle, 1955; Ullman & Routh, 1971). Later, the responses become associated with a unique stimulus condition. With a chain, each relevant stimulus condition should set the stage for the ensuing response and act as a conditioned reinforcer for the previous response (Bellamy et al., 1978).

The issue then becomes how to best teach a sequence of responses most efficiently and effectively. In teaching a sequence of responses, three procedures have been used in the acquisition of various tasks by individuals who were profoundly retarded. The three procedures used were (a) backward chaining, (b) forward chaining, and (c) a variation of forward chaining, total task presentation. At the time of this

investigation, researchers have not answered the question as to which of these three procedures has been the most efficient and effective in teaching self-help skills to learners who were retarded.

Question Under Investigation

The proposed question under investigation is: Which of two procedures (backward chaining or forward chaining) is more efficient and effective when an individual who is profoundly retarded is learning to undress and dress with socks and shorts.

Rationale

When programming for persons identified as profoundly retarded, appropriate curriculum design and operative instructional techniques have been deemed essential (Perske & Smith, 1977; Sailor & Haring, 1978). One of the major curricular goals in the education/training of persons who were severely and profoundly retarded has been to assist them to develop the ability to provide for a number of their own needs without supervision (Burton, 1971). The purpose of this goal would be to make the individual who was retarded as independent as possible. Within this goal, there are numerous skill areas which should be organized according to priorities of need and the developmental level of the individual.

One such skill area in which a high priority for training has been established is self-care (Wehman, 1979). Included within this area of self-care behaviors have been such skills as dressing and undressing,

bathing, toileting, personal hygiene, safety, eating habits, and care of clothing (Burton, 1971). The development of self-care behaviors in persons classed as profoundly retarded has been considered to be the basic training goals for this population (Westling & Murden, 1978). Westling and Murden (1978) suggested that self-care skills may be defined as those behaviors which allow an individual to satisfy personal bodily needs and thereby be less dependent on others to care for those needs. Self-care skills have been of primary importance in the initial stages of progress along the continuum from dependence to independence (Wehman, 1979). It has been the teaching of these skills that has contributed to the independence, emotional maturity, and social adjustment of those persons with severely handicapping conditions.

Components of operative instructional techniques for persons in programs for the severely and profoundly retarded have been identified as task and skill analysis, applied behavioral analysis, increasing appropriate behavior, decreasing inappropriate behavior, and maintaining and generalizing gains (Haring, 1977; Kauffman & Snell, 1977). Each of these techniques has been employed in teaching various skills, such as self-care (Westling & Murden, 1978), to persons identified as severely and profoundly retarded. To date, most of the research with such individuals has emphasized pre-vocational training, vocational training, and increased performance rates in regard to performance on vocationally oriented tasks (Bellamy et al., 1978; Spooner, 1981).

It has been demonstrated that individuals who were severely and profoundly retarded could learn complex tasks and self-care skills;

therefore, the question of interest is which procedure is more efficient and effective during the various learning stages (i.e., acquisition, fluency, mastery). Implicit in this point is: Can a procedure be identified that maximizes skill acquisition and decreases error rate in teaching a self-care skill to an individual who is profoundly retarded?

Three procedures (i.e., backward chaining, forward chaining, and total task presentation) have all been found to be effective in the teaching of complex tasks and self-help skills to persons identified as severely and profoundly retarded. When these procedures have been compared using mildly retarded subjects, chaining procedures have appeared to be more effective than total task procedures. Chaining procedures (i.e., backward and forward) were also found to be more effective than total task procedures in the acquisition of self-help skills by severely and profoundly retarded subjects (Westling & Murden, 1978). According to Azrin, Schaeffer, and Wesolowski (1976), of those studies employing a total task procedure for teaching self-help skills to individuals who were severely and profoundly retarded (e.g., Abramson & Wunderlich, 1972; Horner & Keilitz, 1975), limited success was reported. For the purposes of this investigation, only the two most frequently used and successful (i.e., backward chaining and forward chaining) procedures were compared for their effectiveness and efficiency for teaching self-help skills to individuals in a program for the profoundly retarded.

Definition of Terms

The following definitions are intended to facilitate and clarify communication for the purpose of the proposed study.

1. Profoundly retarded: One whose measured intelligence (I.Q.) generally falls below 25 is profoundly retarded (Kirk & Gallagher, 1979). For the purpose of this study, these criteria along with an individual's placement and receipt of service within a public school program for pupils who are profoundly mentally handicapped shall serve to define that individual as being profoundly retarded.

2. Discriminative stimulus: A stimulus in whose presence operant behavior is highly probable since the behavior has previously been reinforced in the presence of that stimulus (Sulzer & Mayer, 1972).

3. Backward chaining: A chaining procedure in which the last step of the task is taught first. The individual is guided through all the steps of the task in reverse (backward) progression (Mori & Masters, 1980). Each step of the task is learned to an a priori criterion before being coupled with the next step(s).

4. Forward chaining: A chaining procedure in which the first step of the task is taught first. The individual is guided through all the steps of the task in a traditional (forward) progression (Mori & Masters, 1980). Each step of the task is learned to an a priori criterion before being coupled with the next step(s).

5. Total task presentation: A teaching technique that requires the teacher to model the entire task sequence from the first step to the last step (Mori & Masters, 1980). Once completed, the learner imitates the entire sequence of task performance.

6. Fluency (proficiency/performance): A stage in learning that follows acquisition and helps to ensure mastery (Haring et al., 1979). The general purpose of fluency is to increase the efficiency of acquired behavior. For the purpose of this study, one becomes fluent in task performance once that individual has reached a predetermined criterion.

7. Criterion: A predetermined point at which the task components are said to have been learned (Sulzer & Mayer, 1972). For the purposes of this study, a subject reaches criterion when the task or task component is performed with an 80% rate of accuracy (8 out of 10 trials) over a period of 3 consecutive sessions, and where the maximum of prompting given by the trainer is contact with the article of clothing.

Delimitations

The delimiting factors for this study were four. These factors were (a) six students selected from a class of sixteen students who were identified as profoundly retarded; (b) a public school setting that serves as an exceptional education center; (c) a city located in the north-cantral section of the state of Florida; (d) the setting for skill teaching which was a large bathroom containing a sink, a large tub for bathing, and windows considerably above eye level.

Limitations

The limitations of this study were four. These limitations were (a) the six students selected for inclusion in this study might not be

representative of other students who were similarly identified as being profoundly retarded; (b) the ability to generalize findings from the study due to the large variation among individuals similarly identified as being profoundly retarded; (c) the possibility of guardians influencing the results of the study by administering chaining procedures of the self-care skill at home; (d) the time constraints placed on the study which may have reduced the opportunity of some individuals to reach the predetermined criterion.

Summary

Teaching self-care skills to individuals identified as profoundly retarded has been an important step in dispelling the notion that these individuals could not learn. Furthermore, the development and maintenance of self-care skills promoted deinstitutionalization and lent credibility to the recent right-to-education mandate provided ofr all handicapped children (Gilhool, 1976).

In the previous decade, a series of clinical reports and a number of controlled research studies have investigated the acquisition and performance of toileting, eating, dressing, and grooming skills in persons labeled as profoundly mentally handicapped (Wehman, 1979). It seems apparent that the next step to be initiated was to examine which procedure for teaching a self-care skill was most efficient and effective for this population.

One solution to the proposed question was an empirical evaluation of the two most commonly used chaining procedures: (1) backward chaining, and (2) forward chaining. The purpose of this investigation was to answer that question.

CHAPTER II

REVIEW OF RELATED LITERATURE

The following review is divided into three sections. In the first section is a review of the literature concerned with a self-care skill, undressing/dressing; its relevancy and hierarchy. In the next section is a review of studies in which certain learning paradigms have been used to teach a sequence of responses to learners who were identified as handicapped. Located in the last section are studies in which fluency-building strategies are reviewed.

The literature included in this review was located by several methods. The comprehensive review of the literature included two computer literature searches, the ERIC search and the ECER search, both using self-care, training procedures, and severe/profound as key words. Further, the Current Index of Journals in Education and Psychological Abstracts were examined for the years 1964 to January 1981 using the same descriptors.

After securing the articles identified through the above described means, the bibliography of each of the articles located was examined to identify additional relevant papers. Finally, a list of all of the articles was prepared.

Several guidelines were established to assist in selection of the articles for review. First, training procedures must have been defined to train at least one subject described as severely or profoundly retarded.

Second, data collected to describe the subject's performance must have been reported in the article. And finally, reports concerned with the acquisition of self-care skills by severely or profoundly retarded subjects were included.

Undressing/Dressing-Relevancy

Most children have already mastered basic self-care skills when they enter school. By and large, children who are profoundly retarded have not (Perske & Smith, 1977). Because these individuals do not possess many self-care skills, one of the major curricular goals in the education/training of this population has been to assist them to develop the ability to provide for a number of their own needs without supervision (Burton, 1971). Westling and Murden (1978) considered the development of self-care behaviors in persons who were profoundly retarded to be the basic training goals for this population. The intent of this goal would be to make the individual as independent as possible. Self-care skills have been of primary importance in the initial stages of progress along the continuum from dependence to independence (Wehman, 1979). Researchers (Goldstein, 1975; Lent, 1975; Wehman, 1979) have suggested that the teaching of self-care behaviors has contributed to the individual's independence, emotional maturity, and social adjustment. According to Hayden (1974), the teacher who failed to help an individual learn to be as independent as possible compounded the individual's difficulties by having promoted unnecessary dependence on others. By having been taught self-care skills, individuals who are profoundly retarded have been provided with an opportunity not only to survive in society,

but possibly to contribute to it (Bigge, 1976; Cuvo, 1973). Consequently, efforts have been made to teach these individuals self-care skills in order to facilitate their possible return to the community.

Self-care skills have been defined as those behaviors which allow an individual to satisfy personal bodily needs and thereby be less dependent on others to care for those needs (Westling & Murden, 1978). Included within this area of self-care behaviors have been such skills as dressing and undressing, bathing, toileting, personal hygiene, safety, eating habits, and care of clothing (Burton, 1971).

Teaching self-care skills to persons identified as profoundly retarded has been an important step in dispelling the notion that these individuals cannot learn. Furthermore, the development and maintenance of self-care skills has allowed the individual to approach normalcy (Westling & Murden, 1978), promoted deinstitutionalization (Gilhool, 1976), and lent credibility to the recent right-to-education mandate provided for all handicapped children (Gilhool, 1976).

Of the self-care skills, acquisition of the ability to undress and dress has become the most relevant skill in the educational training of learners who are profoundly retarded (Voeltz, Note 2). According to Azrin et al. (1976), children who are normal and non-retarded have learned to undress and dress with no special training, while persons who are profoundly retarded often have not mastered the minimal dressing skills even as adults.

In light of certain factors, competence in the skill of undressing/dressing has become paramount. Among these factors are that undressing/

dressing (1) is a required activity of daily occurence, (2) becomes more difficult for the care-giver as the individual grows larger, (3) aids in the ability to teach toileting skills, (4) is a prerequisite to independent toileting, (5) aids in the ability to teach bathing skills, and (6) is a prerequisite to independent bathing. Brolin (1976) added that dressing skills appear to affect an individual's adjustment to and maintenance of vocationally oriented placements.

From a review of the literature concerned with undressing/dressing, it has become evident that the acquisition of this self-care skill has both relevancy and import to a number of persons. First, the target behavior change (undressing/dressing) has been associated with multiple, positive effects upon the learner's overall repertoire of skills and general functioning. Second, the behavior change has been associated with positive effects upon society's attitudes toward the learner. Third, the behavior change has been perceived of as positive by significant others in the learner's enviornment and thus increased the range and quality of options in the learner's daily and future life.

Undressing/Dressing-Hierarchy

There have been a number of resources that included the methods and sequences necessary for the development of various self-care behaviors in individuals classed as severely and profoundly retarded (e.g., Anderson, Hodson, & Jones, 1975; Gardner, 1971; Myers et al., 1973). Each of these resources has provided instructional guidelines for the implementation of undressing/dressing programs. One problem with these resources and most dressing studies (e.g., Minge & Ball, 1967) has been

that the issue of the efficiency of forward versus backward chaining with an array of different dressing skills had not been addressed. Another problem that has existed among advocates of dressing programs for learners who were severely and profoundly retarded has been the confusion concerning the order of hierarchy of the sequence presentation of dressing behaviors that were taught (Wehman, 1979). First, there has been confusion as to whether undressing should have been taught before dressing (see Table 2). Second, there has been confusion as to the order of clothing articles used within undressing and dressing (see Table 3).

Although a substantial body of knowledge exists that has been relevant to the sequencing of undressing and dressing behavior (Copeland, Ford, & Solon, 1976), not all researchers have chosen to model their dressing hierarchy in the same manner (Wehman, 1979). According to some investigators (e.g., Gesell, Halverson, Thompson, Ilg, Castner, Ames, & Amatruda, 1940; Knoblock & Pasamanick, 1974), the ability to take off clothing (undress) appears in normal child development before the ability to put on clothing (dress) (see Table 4). The same principle holds true for children who are developmentally disabled, too (Gesell et al., 1940). Despite this knowledge of developmental progression in dressing, two sets of researchers (Anderson et al., 1975; Johnson & Werner, 1975) chose to teach dressing before undressing. Other researchers (e.g., Azrin et al., 1976; Baldwin, Fredericks & Brodsky, 1973; Copeland et al., 1976; De Vore, 1977; Myers et al., 1973) chose to teach undressing before dressing. Three explanations have been given for teaching undressing first. The three explanations have been that (a) undressing comes before dressing in the development of the normal child (Copeland et al., 1976);

Table 2. Undressing/dressing hierarchy preference used in teaching dressing skills to individuals who were severely/profoundly retarded

Preference	Investigator
Undressing	Abramo, Feder, Geismar, Gelbwasser, Laidre, Lambert, Leibowitz, Sacks, & Strasburger (1975)
	Azrin, Schaeffer, & Wesolowski (1976)
	Baldwin, Fredericks, & Brodsky (1973)
	Bigge (1976)
	Copeland, Ford, & Solon (1976)
	De Vore (1977)
	Myers, Sinco, & Stalma (1973)
	Wehman (1979)
Dressing	Anderson, Hodson, & Jones (1975)
	Johnson & Werner (1975)

Table 3. Clothing article hierarchy preference used in teaching dressing skills to individuals who were severely/profoundly retarded

Preference	Investigator
Socks, Pants, T-shirt	Azrin, Schaeffer, & Wesolowski (1976)
	Copeland, Ford, & Solon (1976)
	Myers, Sinco, & Stalma (1973)
	Shortridge (Note 1)
Pants, T-shirt, Socks	Baldwin, Fredericks, & Brodsky (1973)
	Johnson & Werner (1975)
T-shirt, Pants, Socks	Abramo, Feder, Geismar, Gelbwasser, Laidre, Lambert, Leibowitz, Sachs, & Strasburger (1975)
	Minge & Ball (1967)

Table 4. Developmental progression in undressing/dressing skill

Undressing/Dressing Skill
Removes socks, mittens, hat
Unzips and zips
Removes shoes (unlaced)
Hooks and unhooks
Removes panties or shorts
Removes shirt (unbuttoned)
Puts on socks
Puts on panties or shorts
Unbuttons
Puts on coat or dress
Removes T-shirt
Puts on shoes
Puts on slip or T-shirt
Buttons
Laces shoes
Ties shoes (bowknot)

(b) undressing was easier than dressing (Azrin et al., 1976; Bigge, 1976; Wehman, 1979); and (c) undressing increased initial learner success (Azrin et al., 1976).

Confusion as to whether undressing or dressing should be taught first to individuals identified as severely and profoundly retarded has not been limited to researchers and trainers. The order of preference for teaching either undressing or dressing has differed even among some assessment tools and training guides. For instance, in a review of the Wabash Guide to Early Developmental Training (1972) and the Vulpé Assessment Battery (Vulpé, 1977) it has been found that undressing skills are evaluated first, while in a review of the Behavioral Characteristics Progression (1973) and the Pennsylvania Training Model-Individual Assessment Guide (1975) it has been found that dressing skills are evaluated first.

The sequence of clothing articles used within the areas of undressing and dressing skill acquisition has been another source of controversy (see Table 3). Three sets of investigators (Copeland et al., 1976; Myers et al., 1973; Shortridge, Note 1) have suggested that the clothing article acquisition hierarchy adhere to the sequence (i.e., socks, pants, T-shirt) depicted in normal child development by Gesell et al. (1940). A fourth set of investigators (Azrin et al., 1976) used the same clothing article sequence set forth by Gesell et al., but added that the T-shirt was taught last becuase it was a more difficult task to teach as well as to learn.

Other researchers (i.e., Baldwin et al., 1973; Johnson & Werner, 1975) have suggested that in both undressing and dressing the sequence

of teaching garment use be pants, T-shirt, and socks. While no apparent reason was given for the garment sequence used by Baldwin et al. (1973), an examination of Johnson and Werner's (1975) work led to the conclusion that pants was taught first because of its influence on the self-care skill of toileting.

Employing still another clothing article sequence in the acquisition of undressing and dressing skills, two sets of researchers (i.e., Abramo, Feder, Geismar, Gelbwasser, Laidre, Lambert, Leibowitz, Sachs, & Strasburger, 1975; Minge & Ball, 1967) suggested that individuals who were severely and profoundly retarded should be taught the appropriate use of first, a T-shirt; next, pants; and then, socks. No apparent rationale was reported for the sequence of garments.

Several conclusions can be drawn from this review of studies in which varying dressing hierarchies have been employed in teaching dressing to learners classified as severely and profoundly retarded. First of all, there has been some disagreement as to whether undressing should be taught before dressing. Secondly, there has been disagreement as to the presentation order of the various articles of clothing. Finally, the merit of training using forward chaining or backward chaining with an array of different dressing skills has not yet been addressed.

Learning Paradigms

Legal decisions and parental pressure have led to an emerging national commitment to appropriate education and training for all individuals who were handicapped (Bellamy et al., 1978). When carried

to its logical conclusion, this philosophy has resulted in a marked increase in the services available to learners who were severely and profoundly handicapped. With a marked increase in the availability of services, the potential has existed for narrowing the gap between popular expectations regarding what individuals labeled as severely and profoundly retarded have been capable of learning and what they actually have learned. This gap has been narrowed when these learners have received appropriate task training.

When task training involved repeated progression through a set sequence of behaviors, conceptualization of a single task cycle as an operant chain has been useful (Bellamy et al., 1978). A chain has been defined as a specified series of responses, each of which has been associated with a unique stimulus condition. In a chain, each relevant stimulus condition should function in two ways. First, each discriminative stimulus (except for the very last) should set the occasion for the subsequent response in the chain. Second, each stimulus should serve as a conditioned (or secondary) reinforcer for the previous response (Bellamy et al., 1978; Kelleher, 1966).

The training issue has become how to best teach a sequence of responses most efficiently and effectively so as to maximize the establishment of the associated stimuli and minimize the errors and pauses in subsequent responding. In teaching a sequence of responses, three procedures have been used in the acquisition of various tasks with individuals identified as severely or profoundly retarded (see Table 5). The three procedures of operant chaining that have been used

Table 5. Procedures used in teaching individuals who were severely/profoundly retarded to perform various tasks

Procedure	Investigator	Task
Backward Chaining	Ball, Seric, & Payne (1971)	Dressing & Undressing
	Bensberg, Colwell, & Cassell (1965)	Dressing
	Bensberg & Slominski (1965)	Dressing
	Breland (1965)	Dressing & Undressing
	Horner (1970)	Dressing
	Minge & Ball (1967)	Undressing
	Prill (1977)	Tool use
	Screven, Straka, & LaFond (1971)	2-piece coin-tube assembly
	Watson (1972)	Dressing
Forward Chaining	Azrin, Schaeffer, & Wesolowski (1976)	Undressing & Dressing
	Hunter & Bellamy (1976)	11-wire cable harness assembly
	Martin, Kehoe, Bird, Jensen, & Darbyshire (1971)	Dressing
	Minge & Ball (1967)	Dressing
	O'Neill & Bellamy (1978)	11-piece saw chain assembly
Total Task Presentation	Abramson & Wunderlich (1972)	Tooth brushing
	Horner & Keilitz (1975)	Tooth brushing
	Gold (1972)	15-piece & 24-piece bicycle brake assembly
	Gold & Barclay (1973)	12-piece bicycle brake assembly

are: (a) backward chaining; (b) forward chaining; and (c) a variation of forward chaining, total task presentation.

Backward Chaining

Backward chaining has been an effective operant procedure. In this procedure, the last step of the task has been taught first and has been followed immediately by reinforcement for correct performance. Once the last step has been taught to an a priori criterion, the next to last step in the sequence of responses of the task is added to the last step. The individual now has to perform the last two steps of the task before being reinforced immediately for correct performance. The steps of the task are added in this reverse (backward) fashion until the individual can perform the entire sequence of behaviors successfully. According to Gardner (1971), backward chaining has been frequently desirable in the development of a chain of behavior. The desirability of backward chaining has been three-fold in that (a) the steps of the task which occur nearest to the primary reinforcer have been strengthened first, (b) the last task response has always been reinforced, and (c) conditioned reinforcers have been established which then function as discriminative stimuli for the next task response.

Backward chaining procedures have been used to teach the acquisition of various self-care and vocational tasks to individuals who are severely and profoundly retarded (see Table 5). According to Azrin et al. (1976), the majority of investigators teaching dressing skills to learners labeled as severely and profoundly retarded have employed backward chaining procedures. Of the studies in which backward chaining

was employed, success has been reported as being limited (Azrin et al., 1976). Either little improvement (Horner, 1970; Minge & Ball, 1976) or excessive amounts of training time (Ball, Seric, & Payne, 1971; Watson, 1972) have been noted.

Breland (1965) suggested that dressing has been accomplished through a backward chaining procedure that began with teaching attending behavior. Once the individual had been taught to attend and follow simple commands (e.g., come here, sit down); other responses could be added to the chain of already established behavior. Two sets of investigators (Ball et al., 1971; Minge & Ball, 1967) modeled their procedures for teaching dressing after the Breland-Colwell program (Bensberg, 1965).

Minge and Ball (1967) initially attempted to teach attending, coming to the attendant, sitting down, remaining seated, and standing up. Later, they targeted the various responses necessary for undressing (dressing was taught using a forward chaining procedure). Upon completion of 30 hours of training, the subjects (six profoundly retarded girls) demonstrated some improvement in undressing. Ball et al. (1971), in a four-year follow-up of subjects trained by Minge and Ball (1967), found that there was a general decrease in undressing performance. This general decrease had been attributed to the influence of the verbal cues used by ward attendants that had not been used during original training.

From a review of the literature, with regard to backward chaining procedures, it seems evident that backward chaining has been found to be effective in the teaching of self-care skills to learners who were

severely and profoundly retarded. The strength of the backward chaining procedure has been in the establishment of conditioned reinforcers which in turn function as discriminative stimuli for the next sequence in the chain of responses.

Forward Chaining

Forward chaining has been an effective operant procedure. In this procedure, the first step of the task has been taught and has been followed immediately by reinforcement for correct performance. Once the first step has been taught to an a priori criterion, the second step in the sequence of responses of the task is added to the first step. The individual now has to perform the first two steps of the task before being reinforced immediately for correct performance. The steps of the task are added in this manner until the individual can perform the entire sequence of behaviors successfully. A forward chaining procedure follows the "traditional" task progression beginning with the first step of the task and moving to each successive step until the whole sequence has been completed. Mori and Masters (1980) have suggested that the individual will benefit from performing the steps in the "traditional" order as this progression most parallels the order in which the steps will be performed in "real life." Reynolds (1975), on the other hand, has suggested that the farther a stimulus is from the completion of the sequence, the less effective it is both as a discriminative stimulus and as a conditioned reinforcer. Despite the underlying problem of reduced effectiveness of the stimulus both as a

discriminative stimulus and a conditioned reinforcer when lengthy tasks have been taught using a forward chaining procedure, it has been used to teach the acquisition of various self-care and vocational tasks to individuals who were severely and profoundly retarded (see Table 5).

Azrin et al. (1976) used a forward chaining procedure to effectively teach dressing skills to profoundly retarded individuals. Based on the limited success of earlier dressing programs that used backward chaining procedures (Ball et al., 1971; Bensberg, Colwell, & Cassell, 1965; Bensberg & Slominski, 1965; Breland, 1965; Horner, 1970; Minge & Ball, 1967; Watson, 1972), Azrin et al. initiated a new program for teaching undressing and dressing. In their use of forward chaining, the author stated:

> Instead of backward chaining, the method used a forward sequence in which the student participated fully in the initial, as well as in the final, components of the dressing actions. (p. 29)

While Azrin et al. taught undressing before dressing to increase initial learner success, another set of investigators (Martin, Kehoe, Bird, Jensen, & Darbyshire, 1971) taught attending and clothing identification before dressing to increase initial learner success.

Positive results have been stated in both studies. Azrin et al. (1976) reported that the number of independent dressing skills on a standard test (not specified) increased from a pre-training level of 10% to a post-training level of 90%. The per subject training time

ranged from 4 to 20 hours (mean of 12). Meanwhile, Martin et al. (1971) reported that the amount of assistance needed to perform each step of the dressing task was greatly reduced, as was the amount of time needed to complete the entire dressing procedure.

Numerous investigators (e.g., Azrin et al., 1976; Hunter & Bellamy, 1976; Martin et al., 1971; O'Neill & Bellamy, 1978) have found forward chaining to be a powerful tool in helping to teach varied tasks of many steps to learners who were severely and profoundly retarded. Similar to backward chaining, forward chaining has been effective when employed as training procedure during skill acquisition.

Total Task Presentation

Bellamy, Horner, and Inman (1979) have suggested that total task presentation is a variation of a forward chaining procedure. In a total task presentation, every step of the task has been practiced during each training trial (Gold, 1976). Practice consisted of performing every step in a forward progression. With time, learner errors and trainer assistance have been reduced. The major difference between total task presentation and forward chaining has been that in total task, progression to the next step has not been contingent upon meeting an a priori criterion of the preceding step. Bellamy et al. (1979) suggested that the total task procedure appeared to have the advantage of maximizing the learner's independence early in the training program especially if some of the task's steps have already been familiar to the individual.

Two sets of investigators (Abramson & Wunderlich, 1972; Horner & Keilitz, 1975) have successfully employed a total task procedure in the

acquisition of self-care skills by retarded individuals. The two studies were similar in both training procedures and in task specificity, toothbrushing.

In both studies, modeling and physical guidance were employed on an "as needed" basis. According to Westling and Murden (1978), Horner and Keilitz were very precise in determining the use of assistance. For each step (15 steps) of the task, if the subject did not complete the step without help, the subject was verbally directed to execute the behavior. If this approach failed, the trainer modeled the behavior while giving verbal direction. Then, if necessary, the trainer repeated the verbal direction while physically guiding the subject.

Horner and Keilitz (1975) reported that six of the eight subjects reached criterion in 18 to 30 training sessions. Abramson and Wunderlich (1972) reported that, based on a pre-post checklist, there were significant increases of correct responses ($p < .005$) for all subjects after 15 training sessions.

Total task presentation has not been limited to the acquisition of self-care skills. Other investigators (Gold, 1972; Gold & Barclay, 1973) have demonstrated the effectiveness of a total task procedure in the training of individuals who were severely and profoundly handicapped to perform vocationally oriented tasks.

Fluency-Building

The chief purpose of fluency-building has been to increase the efficiency of learned or acquired behavior. Fluency-building has

involved increasing the rate of the behavior, increasing or decreasing the duration of the behavior, or decreasing the latency of responding (Haring et al., 1979). Described as the rate of performance in relation to a preset criterion (White & Haring, 1980), fluency has been a critical element of learning in that skill competence, retention, application, and future skill acquisition may be dependent on it. Other researchers have described fluency in terms of mastery (Alper, Nowlin, Lemoine, Perine, & Bettencourt, 1974), performance (Haring & Gentry, 1976), and proficiency (Koenig & Kunzelman, 1977). In relation to hierarchies of learning, some researchers (Haring & Eaton, 1978; White & Haring, 1980) viewed fluency as a stage following skill acquisition which ensured mastery. Stephens (1977) believed fluency was developed at the last level of learning, mastery.

Fluency is an important aspect of training and has been examined in relation to increasing rate of performance on vocational tasks (Bellamy et al., 1978), increasing the duration of walking (O'Brien, Bugle, & Azrin, 1972), and decreasing the time requirements to complete various self-help skills (Westling & Murden, 1978). Haring et al. (1979) identified four fluency-building strategies: (a) drill and practice, (b) instructions versus consequences, (c) schedules of consequences, and (d) other strategies.

Opportunity for and exercise of rehearsal, have been reported as the major components of drill and practice. One approach to drill and practice has been examined by Mayhall and Jenkins (1977). The authors compared the effects of daily and less-than-daily study on the

performance of academic tasks by children who were learning-disabled. A review of the findings indicated that, in this instance, daily instruction yielded better performance.

In a second study, O'Brien et al. (1972) used practice in walking to help diminish crawling behavior in individuals who were profoundly retarded. By limiting crawling, the authors were able to increase the amount of practice for walking. Likewise, Haring et al. (1979) believed that increases in the amount of practice have produced increases in the rates of performance. An instructional scheme which provided opportunities for practice and consequences for accurate and inaccurate responses, therefore, was likely to produce fluency. At present, however, researchers have not examined the effects of varying kinds or amounts of practice on performance by individuals identified as severely or profoundly retarded (Smith, 1968).

Another more direct method of increasing fluency has been to inform the learner, in some fashion, as to the desired performance criterion. Loos and Tizard (1955), while teaching cardboard cake box folding and gluing, told their trainees to "go fast." Instructions have not been effective with individuals who were more severely retarded because of extreme deficiencies in their receptive language (Levy, Pomerantz, & Gold, 1977). A strategy designed to reduce the influence of deficient language upon fluency has been the use of highly motivating consequences for correct performance. With more severely involved individuals, though, the ability to identify appropriate consequences has often been difficult. Since the rate of consequences increases as the rate of

performance increases during the building of fluency, satiation has been a factor in limiting the effectiveness of reinforcement.

To avoid the satiation during the building of fluency, changing the schedules of reinforcement has often been required. Some methods of schedule change examined have been (a) making the consequences contigent upon a certain response rate (Haring, White, & Liberty, 1978); (b) using intermittent fixed ratio schedules (Stephens, Pear, Wray, & Jackson, 1975); and (c) providing contingent punishing consequences for low work rates (Haring et al., 1978).

Other strategies for building fluency that have been examined have been based on rearranging the instructional environment to allow for greater opportunity of task performance which may, in turn, affect fluency. Carnine (1976) found that a fast-rate teacher presentation of task items resulted in reduced latency of student responding. Van Houten, Hill, and Parsons (1975) found that public posting of performance rates increased fluency, while teacher praise for performance had unpredictable effects. Using typing as a skill, Muhich (1976) found that speed increases were more predictable than accuracy increases in an arranged instructional environment. To date, most of the research using such strategies has been conducted with learners who were mildly handicapped or normal. In the only study involving severely handicapped subjects, Haring et al. (1978) altered the instructional environment with a "beat the clock" technique. This technique blended verbal directions, stated contigencies, a set amount of time for task completion, and a consequence.

In summary, research on strategies for increasing fluency in a behavior have emphasized the provision of practice and appropriate consequences for desired behavior. Additional research in the area of self-care skills, especially with individuals who are profoundly retarded, is necessary to determine (1) appropriate schedules for increasing performance rates, and (2) strategies which demonstrate a long-term effectiveness for increasing fluency.

Summary of Related Literature

In summary, it has become evident that an appropriate educational program for individuals who are profoundly mentally handicapped must include training in certain basic life skills. Of these skills, dressing has become one of the most important. The importance or relevance of the ability to undress and dress has come from its influence on other self-care skills, and its influence on other persons in the learner's environment.

Without possessing competence in dressing skills, the learner (a) has difficulty in developing appropriate toileting skills, (b) cannot master independent toileting, (c) has difficulty in developing appropriate bathing skills, and (d) cannot master independent bathing. The acquisition of dressing skills has become extremely pertinent in the education of persons who are profoundly mentally handicapped not just because it is a prerequisite to other areas of independent functioning.

The ability of individuals who are profoundly mentally handicapped to undress and dress has both relevancy and import to a number of

persons. Undressing/dressing has been associated with multiple, positive effects upon (a) the learner's overall repertoire of skills and general functioning, (b) society's attitude toward the learner, and (c) significant others' perception of the learner's ability which then has the potential of increasing the learner's range and quality of daily and future life option.

Though the acquisition of dressing skills has been perceived as an essential component in the education of this population, much confusion still exists as to how best to teach those skills. Numerous training programs, investigations, and assessment guides have been developed concerning dressing, but there has been some discord in their presentations. In review, it has been revealed that all dressing presentations have not been in agreement on (a) the hierarchy preference of undressing/dressing, (b) the hierarchy perference of clothing article usage, and (c) the preference of operant procedure usage (i.e., backward chaining versus forward chaining).

A review of the work conducted in the area of dressing has disclosed that there is some consensus of opinion as to certain hierarchial preferences. It now seems apparent that the majority of research in the acquisition of dressing skills has led to the conclusion that undressing should be taught before dressing, and that clothing article usage should be taught in the order it has appeared in normal child development schemes.

The third area of disagreement, preference of operant procedure, has not yet been resolved. Ample evidence exists that suggests

that it would be appropriate to examine the effectiveness and efficiency of backward chaining and forward chaining in the training of individuals who are profoundly retarded to undress/dress. Additional evidence exists that suggests that it would be appropriate to examine the effects of drill and practice in building fluency in dressing skills by these same individuals. An attempt to respond to these areas of concern has been made in the present study.

CHAPTER III

METHODS AND PROCEDURES

Backward chaining, forward chaining, and total task presentations have all been found to be effective training procedures in the teaching of self-help skills to persons who were severely and profoundly retarded. According to Westling and Murden (1978), chaining procedures (i.e., backward and forward) were found to be more effective than total task procedures in the acquisition of self-help skills by severely and profoundly retarded subjects. Of those studies employing a total task procedure for teaching self-help skills to individuals identified as severely and profoundly retarded (e.g., Abramson & Wunderlich, 1972; Horner & Keilitz, 1975), limited success was reported.

For the purposes of this study, only two of the procedures (i.e., backward chaining and forward chaining) were tested for their efficiency and effectiveness. From a review of the literature, it seems apparent that the procedures of backward chaining and forward chaining have been the most frequently discussed and most frequently successful procedures for teaching self-help skills to individuals who were described as severely or profoundly retarded. What is evident is that these two procedures have not been compared in the teaching of dressing skills to learners who were profoundly retarded.

Statement of Hypotheses

To fulfill the purposes of the study, the following hypotheses were tested:

1. There are no differences in learning performance when backward chaining procedures or forward chaining procedures are used to teach undressing and dressing skills to a person who is profoundly retarded.

2. There are no differences in error rate when backward chaining procedures or forward chaining procedures are used to teach undressing and dressing skills to a person who is profoundly retarded.

3. There are no differences in trials to criterion when backward chaining procedures or forward chaining procedures are used to teach undressing and dressing skills to a person who is profoundly retarded.

In essence, two general questions have been posed in the hypotheses of this study. The questions were: (1) Under which operant procedure (i.e., backward chaining or forward chaining) do subjects achieve the highest level of task learning performance (hypothesis 1); and, (2) How do specific features that help to profile the subject's learning performance (i.e., error rate and trials to criterion) appear when compared across procedures (hypotheses 2 and 3, respectively).

Interpretation of operant procedural effect on performance was made from a review of the results of the first question in four distinct areas. These areas were: (1) backward chaining versus forward chaining in undressing using socks; (2) backward chaining versus forward chaining in undressing using shorts; (3) backward chaining versus forward chaining in dressing using socks; and, (4) backward chaining versus forward chaining in dressing using shorts.

Interpretation, influenced by operant procedural effects, of two of the features that help to profile the subject's learning performance was made from a review of the results of the second question. The features used to help profile the subject's learning performance were: (1) error rate; and, (2) trials to criterion. For each subject, each of these features was examined across procedures.

Subjects

The subjects were six profoundly mentally handicapped students (IQ range 11 to 18) in a public school setting for the severely and profoundly retarded. The subjects ranged in age from 7 through 15 years. All subjects selected for inclusion in the sample had: (1) required either physical direction and/or physical assistance in undressing skills (see Table 6); (2) exhibited no undressing skills; (3) required either physical direction and/or physical assistance in dressing skills; (4) exhibited no dressing skills; and, (5) had these same two skill areas (i.e., undressing and dressing) listed as goals on their individualized education programs (IEP's). The students were further chosen for inclusion in this sample through use of a table of random numbers.

Setting

Experimental sessions took place on the grounds of the public school in which the pupils were enrolled. A training room, located adjacent to the classroom for the profoundly mentally handicapped, was provided by the staff of the school. During the scheduled times of the

training sessions, the training room was free from outside disturbances. In the room used for training, there was a large chair to hold clothing articles and for learner balance for some undressing and dressing skills, and two small chairs, one for the learner and one for the experimenter. Other training materials included were clothing articles (i.e., socks and shorts), and sufficient and appropriate data collection forms for the skill being taught.

The room used for training was a large bathroom containing a sink, a large tub for bathing, and windows considerably above eye level. There were no other distracting stimuli in the room.

Method

Undressing-Dressing

Each subject was trained to undress and dress using two articles of clothing. Undressing, which has been identified as easier than dressing, was taught first in order to increase the potential of initial learner success. Once undressing with one article of clothing (i.e., socks) was mastered, undressing with a second article of clothing (i.e., shorts) followed. After undressing with both articles of clothing was mastered, dressing was taught using the same procedure and order of clothing articles as was used in teaching undressing.

Reinforcing Stimuli

Since it is often difficult to identify potential reinforcers for specific student functioning in the severely or profoundly retarded range, the reinforcing stimuli used for each subject was not determined until the subjects were selected for inclusion in this study.

Selection of the reinforcing stimuli was based on: (1) the preference of the individual; and, (2) by empirically testing the effectiveness of the reinforcer with the individual.

Procedure

Instruction

Instruction proceeded from general (i.e., "Get undressed", "Get dressed") to specific (i.e., "Pull down your sock", "Pull up your sock") depending on the ability of the student to follow the instructions. If the student appeared inattentive, the instruction was prefaced by calling the learner's name and by directing the learner's head toward the task. The directing of the learner's head was done gently and only if requisite. The training procedure was not begun until initial learner control (i.e., "Look at me") was established.

Prompts and Guidance

A system of prompts and guidance was developed to ensure trainer/procedure conformity and to measure student progress along a continuum from complete dependence to independence in the performance of the various dressing skills (see Table 6). The prompts and guidance were assigned numbers signifying the various levels required to assist the learner through the task sequence. Instruction was first presented verbally. If after a period of five seconds, movement toward performance had not been initiated, the experimenter pointed at or touched the article of clothing. In the event that movement toward performance had still not been initiated, the instruction was repeated and

Table 6. A system of levels and prompts required to assist learner through task sequence

Levels	Prompts
5	Verbal instruction (general)
4	Verbal instruction (specific)
3	Physical contact with article of clothing
2	Physical contact with learner (direction)
1	Physical contact with learner (guidance)

accompanied by physical guidance through the task. Once the student demonstrated an ability to attend to instruction and task, prompting and guidance were gradually faded. Initial control was established before any trials of the task were attempted.

Sessions and Trails

Sessions were conducted daily on a rotating schedule to reduce the effects of possible set time preferences by certain individuals (see Table 7). Daily sessions of ten trials each were scheduled each school day to provide for some task drill and practice.

Apparatus

Clothing Articles

Socks and shorts were used by each subject in both undressing and dressing skills. Clothing provided each subject was identical in color and style. The socks were white and of the crew variety. The shorts were khaki and of the boxer or slip-on variety.

Timing Device

To measure the durations of each step of the skills, the experimenter used a digital stop-watch with a "split timing" capability. The watch was able to accurately measure time to the 1/100 of a second level.

Experimental Design

The experimental design was a group design in nature (see Figure 1). With two tasks (i.e., undressing and dressing) and two treatments (i.e., backward chaining and forward chaining), six subjects were used to conduct the study. Although fewer subjects were actually needed, six

Table 7. A rotating schedule of sessions by day for six subjects

Time period	1	2	3	4	5	6	7
1	S1	S2	S3	S4	S5	S6	REPEAT DAY 1
2	S2	S3	S4	S5	S6	S1	
3	S3	S4	S5	S6	S1	S2	
4	S4	S5	S6	S1	S2	S3	
5	S5	S6	S1	S2	S3	S4	
6	S6	S1	S2	S3	S4	S5	

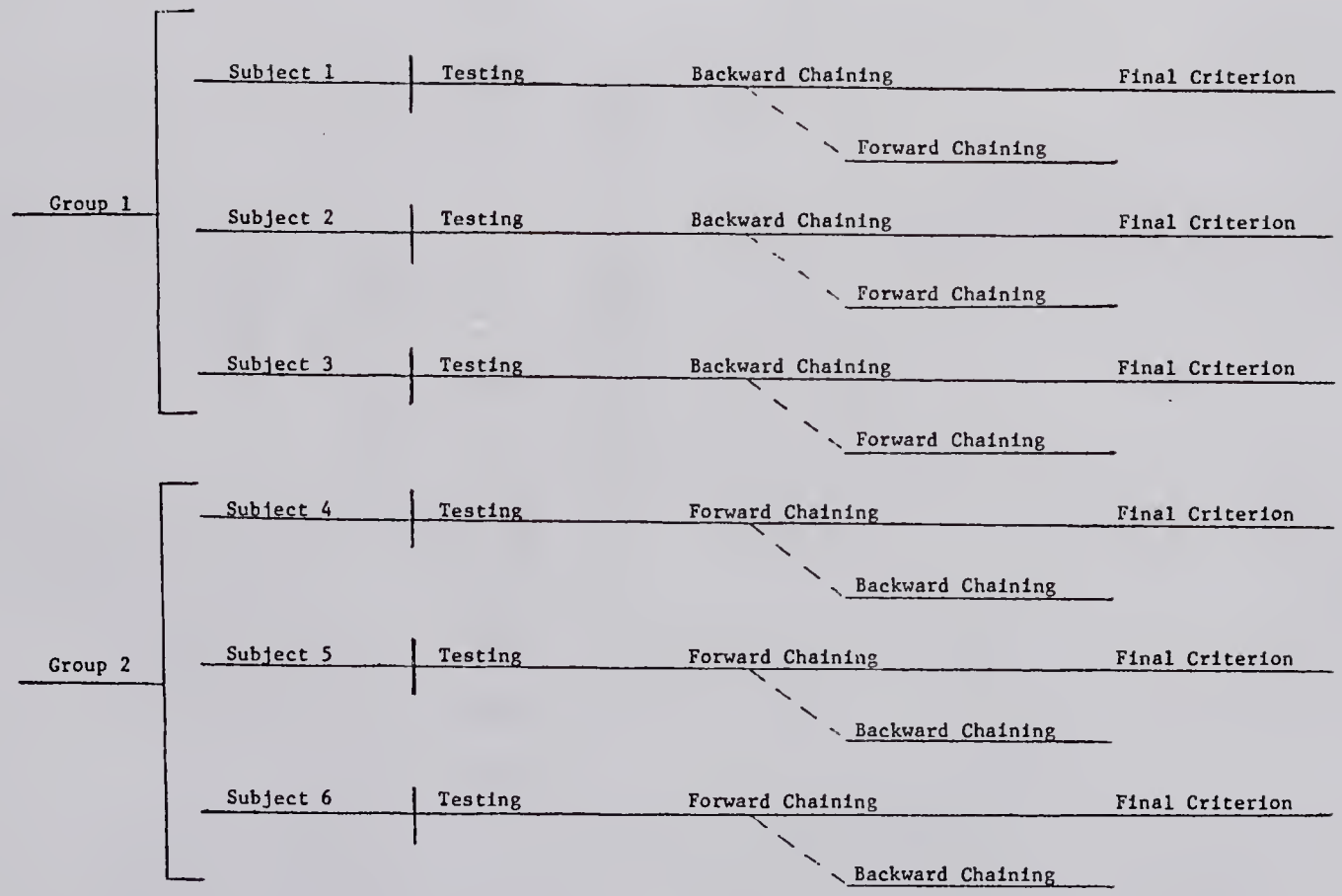

Figure 1. Experimental design for six subjects.

were chosen to see if the experimental effect had the potential to generalize across subjects. The subjects were then randomly assigned to two groups. Pupils in group one, containing three subjects (i.e., Subject 1, Subject 2, and Subject 3), used a backward chaining procedure, while the pupils in group two, containing another three subjects (i.e., Subject 4, Subject 5, and Subject 6), used a forward chaining procedure (see Figure 1). The introduction of skill acquisition for subjects varied as a function of the individual.

When a subject reached criterion on a segment of one of the skills, that subject proceeded to the next segment. When a subject reached criterion on a particular skill with one article of clothing, that subject proceeded to the next article of clothing. When a subject reached criterion with both articles of clothing in undressing, that subject proceeded to dressing. If a subject reached final criterion on both skills with both articles of clothing, that subject continued the use of the same chaining procedure to measure the effects of long-term practice on the fluency of the self-care skill.

If a subject could not reach criterion on a particular segment of a skill over a period of 15 consecutive sessions, chaining procedures were altered for that particular subject. For instance, if Subject 2 after a period of 15 consecutive sessions had not reached criterion on the first segment of undressing with socks using a backward chaining procedure, that subject was then switched to using a forward chaining procedure (see Figure 1). This altering of procedures was used to demonstrate possible procedure specific problems and/or possible learner specific characteristics.

Dependent Variables

The dependent variables in the study were three. First was the learning performance by a subject on undressing/dressing using either a backward or forward chaining procedure. Second was the error rate by a subject on undressing/dressing using either a backward or forward chaining procedure. Third was the trials to criterion by a subject on undressing/dressing using a backward or forward chaining procedure.

Independent Variables

There were four independent variables. The first independent variable was undressing using socks. Second was undressing using shorts. Third was dressing using socks. Fourth was dressing using shorts.

Instrumentation

A data collection form for each task was designed in order to facilitate measurement of the rate of acquisition and fluency on the respective tasks. In each of the chaining procedures, one trial was the demonstration of a specified component of the undressing or dressing hierarchy. The data collection forms for undressing with socks, undressing with shorts, dressing with socks, and dressing with shorts are presented in Tables 8, 9, 10, and 11, respectively.

Data Collection

There were three segments in the data collection plan for this investigation. In the first portion, the investigator recorded a duration measure (i.e., time spent per step(s)) for each step(s) of

Table 8. Data collection form: Undressing with socks

Subject # Date Time

STEP / TRIAL	1	2	3	4	5	6	7	8	9	10
FIRST FOOT										
1. Pull sock off when over toes										
2. Pull sock off when at mid-ft.										
3. Pull sock off when at heel										
4. Pull sock off when around ankle										
5. Pull sock off when at dress										
ERRORS										
ASSISTS										
SECOND FOOT										
1. Pull sock off when over toes										
2. Pull sock off when at mid-ft.										
3. Pull sock off when at heel										
4. Pull sock off when around ankle										
5. Pull sock off when at dress										
ERRORS										
ASSISTS										
TOTAL										
ERRORS										
ASSISTS										

Table 9. Data collection form: Undressing with shorts

Subject # Date Time

STEP / TRIAL	1	2	3	4	5	6	7	8	9	10
1. Pull shorts off when at ankle & 1 ft.										
2. Pull shorts off when at ankle & 2 ft.										
3. Pull shorts off when at knees										
4. Pull shorts off when at hips										
5. Pull shorts off when at dress										
ERRORS										
ASSISTS										

Table 10. Data collection form: Dressing with socks

Subject # Date Time

STEP / TRIAL	1	2	3	4	5	6	7	8	9	10
FIRST FOOT										
1. Pull sock on from ankle										
2. Pull sock on from heel										
3. Pull sock on from mid-ft.										
4. Pull sock on from toes										
5. Pull sock on to dress										
ERRORS										
ASSISTS										
SECOND FOOT										
1. Pull sock on from ankle										
2. Pull sock on from heel										
3. Pull sock on from mid-ft.										
4. Pull sock on from toes										
5. Pull sock on to dress										
ERRORS										
ASSISTS										
TOTAL										
ERRORS										
ASSISTS										

Table 11. Data collection form: Dressing with shorts

Subject # Date Time

STEP / TRIAL	1	2	3	4	5	6	7	8	9	10
1. Pull shorts on from hips										
2. Pull shorts on from knees										
3. Pull shorts on from ankle & 2 ft. in										
4. Pull shorts on from ankle & 1 ft. in										
5. Pull shorts on to dress										
ERRORS										
ASSISTS										

each task. This time was placed in the cells corresponding to the step(s) of the task. In the second portion, the investigator recorded marks of a plus (+) or a minus (-) for each step(s) or each task and placed the marks in the cells corresponding to the step(s) of the task. A minus (-) was recorded when the learner made an error and the experimenter had to intervene. In the third portion, the investigator recorded the level of prompt required for each step(s) of the task. The data collection forms were organized in such a manner where the rows represented the various steps of the task, while the columns represented the individual trials (Tables 8, 9, 10, 11, respectively). Each of the data collection forms were ordered using a backward chaining procedure. When the forward chaining procedure was used, the same forms were employed but a different order of task steps was followed and the directionality instructions (i.e., on and off) were switched.

Data Analysis

For the first hypothesis, a criterion of 80% successful attempts at handling each garment for a minimum of three consecutive sessions was set to help gauge under which of the two training procedures (i.e., backward chaining and forward chaining) was the highest level of task learning performance achieved.

For each of the remaining hypotheses, the item of measure (i.e., error rate and trials to criterion) was first tabulated. Once the item of measure had been tabulated, it was matched to like items of measure. Comparisons were made upon conversion of the matched items to percentages of difference of 20% (x 1.2 difference).

For two reasons, this percentage of difference of 20% (x 1.2 difference) was established. First, the previous methods of analysis in the teaching of dressing skills to individuals described as severely and profoundly retarded involved a count of days and/or hours required for training. Second, a 20% difference in procedural effects on error rate and/or trials to criterion could be viewed as a functional criteria in terms of the economics in training time and energy required by the trainer and trainee. An example of deriving this level of functional criteria follows.

Given that the error rate using the first procedure equals 5 and the error rate using the second procedure equals 7, error rate using the first procedure would be functionally less adequate than the second procedure. This is true because the error rate (5) x 1.2 equals 6 in the first procedure, which is more than 20% less than the error rate (7) in the second procedure.

Percentages of difference were examined for each of the undressing/dressing tasks. First, percentages of difference were examined across procedures and then across subjects.

In practical application, there may be an important difference between backward and forward chaining procedures. If one of these procedures requires less training time and energy, the trainer has more time to teach additional tasks and/or work with other learners. Further, the learner has more time to learn additional tasks and/or more complex tasks.

CHAPTER IV

RESULTS

Backward chaining, forward chaining, and total task presentations have all been found to be effective training procedures in the teaching of self-help skills to persons identified as severely and profoundly retarded. According to Westling and Murden (1978), chaining procedures (i.e., backward and forward) were found to be more effective than total task procedures in the acquisition of self-help skills by severely and profoundly retarded subjects. Of those studies employing a total task procedure for teaching self-help skills to individuals identified as severely and profoundly retarded (e.g., Abramson & Wunderlich, 1972; Horner & Keilitz, 1975), limited success was reported.

For the purposes of this study, only two of the procedures (i.e., backward chaining and forward chaining) were tested for their efficiency and effectiveness. From a review of the literature, it seems apparent that the procedures of backward chaining and forward chaining have been the most frequently discussed and most frequently successful procedures for teaching self-help skills to individuals described as severely or profoundly retarded (e.g., Azrin et al., 1976; Ball et al., 1971; Minge & Ball, 1967).

In order to determine the relative efficiency and effectiveness of these two chaining procedures in the acquisition of undressing/dressing skills by profoundly mentally handicapped learners, two general

questions were posed. The questions were: (1) Under which operant procedure (i.e., backward chaining or forward chaining) do subjects achieve the highest level of task learning performance (hypothesis 1); and, (2) How do specific features that help to profile the subject's learning performance (i.e., error rate and trials to criterion) appear when compared across procedures (hypotheses 2 and 3, respectively). Interpretation of operant procedural effect on efficiency and effectiveness for learner task acquisition was obtained from a review of the results of the study in four distinct areas. These areas were: (1) backward chaining versus forward chaining in undressing using socks; (2) backward chaining versus forward chaining in undressing using shorts; (3) backward chaining versus forward chaining in dressing using socks; and, (4) backward chaining versus forward chaining in dressing using shorts.

Selected for participation in this study were six profoundly mentally handicapped students (IQ range 11 to 18) enrolled in a public school program for the severely and profoundly retarded. The subjects ranged in age from seven through 15 years. All subjects selected for inclusion in the sample had: (1) required either physical direction and/or physical assistance in undressing skills (see Table 6); (2) exhibited no undressing skills; (3) required either physical direction and/or assistance in dressing skills; (4) exhibited no dressing skills; and, (5) had both skill areas of undressing and dressing listed as goals on their individualized education programs (IEP's).

Each subject was trained to undress and dress using socks and shorts. Each subject's clothing was alike in color and style. The

socks were white and of the crew variety. The shorts were khaki and of the boxer or slip-on variety. Undressing, which had been identified as easier than dressing (Azrin et al., 1976; Bigge, 1976; Wehman, 1979), was taught first in order to increase the potential of initial learner success. Once undressing with one article of clothing (i.e., socks) was mastered, undressing with a second article of clothing (i.e., shorts) followed. After undressing with both articles of clothing was mastered, dressing was taught using the same procedure and order of clothing articles as was used in teaching undressing.

Instruction proceeded from general (i.e., "Get undressed", "Get dressed") to specific (i.e., "Pull down your sock", "Pull up your sock") depending on the ability of the student to follow the instructions. If the student appeared inattentive or slow in responding, the instruction was prefaced by calling the learner's name and by physically directing the learner's head toward the task. The guiding of the learner's head was done gently and only if requisite. The training procedure was not begun until learner attention (i.e., "Look at me") was established.

A system of prompts and guidance was developed to ensure trainer/procedure conformity and to measure student progress along a continuum for complete dependence to independence in the performance of the various dressing skills. The prompts and guidance were assigned numbers signifying the various levels required to assist the learner through the task sequence (see Table 6). Instruction was first presented verbally. If after a period of five seconds, movement toward

performance had not been initiated, the experimenter pointed at or touched the article of clothing. In the event that movement toward performance had still not been initiated, the instruction was repeated and accompanied by physical direction to the task. If movement toward performance had still not been initiated, the instruction was repeated and accompanied by physical guidance through the task. Once the student demonstrated an ability to attend to instruction and task, prompting and guidance were gradually faded. Initial control was established before any trials of the task were attempted.

Sessions were conducted daily on a rotating schedule to reduce the effects of possible set time preferences by certain individuals (see Table 7). Daily sessions of ten trials each were scheduled each school day to provide for some task drill and practice.

Using a table of random numbers, the subjects were assigned to one of two treatment groups. Group one, containing three subjects (i.e., Subject 1, Subject 2, and Subject 3), used a backward chaining procedure, while group two, containing another three subjects (i.e., Subject 4, Subject 5, and Subject 6), used a forward chaining procedure (see Figure 1). The introduction of skill acquisition for subjects varied as a function of the individual.

When a subject reached criterion on a segment of one of the skills, that subject proceeded to the next segment. When a subject reached criterion on a particular skill with one article of clothing, that subject proceeded to the next article of clothing. When a subject reached criterion with both articles of clothing in undressing, that

subject proceeded to dressing. If a subject reached final criterion on both skills with both articles of clothing, that subject continued the use of the same chaining procedure to measure the effects of long-term practice on the fluency of the self-care skill. For the purposes of this study, a subject reached criterion or mastery when the task or task component was performed with an 80% rate of accuracy (eight out of 10 trials) over a period of three consecutive sessions, and where the maximum of prompting given by the trainer was contact with the article of clothing (see Table 6).

If a subject could not reach criterion on a particular segment of a skill over a period of 15 consecutive sessions, chaining procedures were altered for that particular subject. For instance, if Subject 2 after a period of 15 consecutive sessions had not reached criterion on the first segment of undressing with socks using a backward chaining procedure, that subject was then switched to using a forward chaining procedure (see Figure 1). This altering of procedures was used to demonstrate possible procedure specific problems and/or possible learner specific characteristics.

A data collection form for each task was designed in order to facilitate measurement of the rate of acquisition and fluency on the respective tasks (see Tables 8, 9, 10, and 11). In each of the chaining procedures, one trial was the demonstration of a specified component of the undressing or dressing hierarchy.

There were three portions to the data collection plan for this investigation. In the first portion, the investigator recorded a

duration measure (i.e., time spent per step(s)) for each step(s) of each task. This time was placed in the cells corresponding to the step(s) of the task. In the second portion, the investigator recorded marks of a plus (+) or a minus (-) for each step(s) of each task and placed the marks in the cells corresponding to the step(s) of the task. A minus (-) was recorded when the learner made an error and the experimenter had to intervene. In the third portion, the investigator recorded the level of prompt required for each step(s) of the task. The data collection forms were organized in such a manner where the rows represented the various steps of the task, while the columns represented the individual trials (Tables 8, 9, 10, 11, respectively). Each of the data collection forms were ordered using a backward chaining procedure. When the forward chaining procedure was used, the same forms were employed, but a different order of task steps was followed and the directionality instructions (i.e., on and off) were switched.

Data were also recorded on Standard Behavior Charts (see Appendices). Phase change lines were used to denote both phase changes and undressing/dressing task introductions.

For the first hypothesis, a criterion of 80% successful attempts at undressing/dressing with each garment for a minimum of three consecutive sessions was set to help gauge under which of the two training procedures (i.e., backward chaining and forward chaining) was the highest level of task learning performance achieved. Successful attempts at undressing/dressing with each garment was examined across tasks (i.e., undressing and dressing).

For each of the remaining hypotheses, the item of measure was first tabulated and then matched to like items of measure. Comparisons were made upon conversion of the matched items to percentages of difference between them. A level of functional criteria was set at a difference of 20% (x 1.2).

In order to present the results of the analysis of the data, the remainder of the chapter is divided into three major sections which correspond to the hypotheses of the study. The differences in learning performance, error rate, and trials to criterion were examined for subject performance in undressing and dressing using backward chaining procedures or using forward chaining procedures.

Hypothesis One

In the first hypothesis, the differences in learning performance were examined for subject task performance when backward chaining procedures or forward chaining procedures were used to teach undressing and dressing skills to a person identified as profoundly retarded. The hypothesis was that there were no differences between learning performance.

The data for hypothesis one were analyzed to detect operant procedural effect on learning performance in four distinct areas. These areas were backward chaining versus forward chaining in: (1) undressing using socks; (2) undressing using shorts; (3) dressing using socks; and, (4) dressing using shorts.

In undressing using socks, no difference in operant procedural effect on subject task performance was detected since each subject reached final criterion on the task. Subjects 1, 2, and 3 reached

final criterion on the task using a backward chaining procedure. Subjects 4, 5, and 6 reached final criterion on the task using a forward chaining procedure. Mastery of each and all of ten steps (i.e., five steps per sock) was required for a subject to reach final criterion on undressing using socks (see Table 12).

In undressing using shorts, no difference in operant procedural effect on subject task performance was detectable. This was true despite the fact that only those subjects using a forward chaining procedure (i.e., Subjects 4, 5, and 6) reached final criterion on this task. Mastery of each and all of five steps was required for a subject to reach final criterion in undressing using shorts (see Table 12). Those subjects using a backward chaining procedure (i.e., Subjects 1, 2, and 3) were in the process of task acquisition (see Table 12) when the investigation ended and thereby precluded the possibility of making true comparisons of procedural effectiveness. At the time the investigation ended, only Subjects 2 and 3 reached criterion on the first steps of the task.

In dressing using socks, no difference in operant procedural effect on subject task performance was detected. This was true despite the fact that two of the three subjects using a forward chaining procedure (i.e., Subjects 4 and 6) reached final criterion on the task, and none of the three subjects using a backward chaining procedure (i.e., Subjects 1, 2, and 3) reached final criterion on the task. Mastery of each and all of ten steps (i.e., five steps per sock) was required for a subject to reach final criterion in dressing using socks

Table 12. Learning performance (steps mastered) across undressing/dressing tasks by subjects using backward or forward chaining procedures

Subjects	Learning Performance			
	Undressing		Dressing	
	socks	shorts	socks	shorts
Backward chaining				
Subject 1	10	(0)[a]	--[b]	--
Subject 2	10	(1)	--	--
Subject 3	10	(1)	--	--
Total	30	(2)	--	--
Forward chaining				
Subject 4	10	5	10	5
Subject 5	10	5	--	--
Subject 6	10	5	10	5
Total	30	15	(20)	(10)

Note. Numbers not in parentheses indicate total possible steps to be mastered by subject(s).

[a]Numbers in parentheses indicate totals attained by subject(s) when investigation ended.

[b]Dotted line indicates task had not been introduced to subject(s).

(see Table 12). Subject 5, using a forward chaining procedure, and Subjects 1, 2, and 3, using a backward chaining procedure, had not been introduced to the dressing task when the investigation ended (see Table 12). Since dressing using socks had not been introduced to any of the subjects using a backward chaining procedure in addition to one of the subjects using a forward chaining procedure, the possibility of making true comparisons of procedural effectiveness on this task was precluded.

In dressing using shorts, no difference in operant procedural effect on subject task performance was detectable. This was true despite the fact that two of the three subjects using a forward chaining procedure (i.e., Subjects 4 and 6) reached final criterion on the task, and none of the three subjects using a backward chaining procedure (i.e., Subjects 1, 2, and 3) reached final criterion on the task. Mastery of each and all of five steps was required for a subject to reach final criterion in dressing using shorts (see Table 12). Subject 5, using a forward chaining procedure, and Subjects 1, 2, and 3, using a backward chaining procedure, had not been introduced to the dressing task when the investigation ended (see Table 12). Since dressing using shorts had not been introduced to any of the subjects using a backward chaining procedure in addition to one of the subjects using a forward chaining procedure, the possibility of making true comparisons of procedural effectiveness on this task was precluded.

From a review of the undressing/dressing skill requirements, it appeared evident that the ability to make true comparisons of procedural effectiveness was limited. Of the four undressing/dressing tasks,

undressing using socks was the only task in which all six subjects had the opportunity to complete skill acquisition and training. When comparison of procedural effectiveness was made, no differences were revealed between learning performances when backward chaining or forward chaining procedures were used to teach undressing using socks to a person identified as profoundly retarded.

Hypothesis Two

In the second hypothesis, the differences in error rate were examined for subject task performance when backward chaining or forward chaining procedures were used to teach undressing and dressing skills to a person identified as profoundly retarded. The hypothesis was that there was no difference in error rate.

Error rate was determined by tabulating the number of errors recorded for each step(s) of the task. An error was recorded when the learner made an unsuccessful attempt at performing the requirements of the step(s) of the task and the experimenter had to intervene. The errors were totaled across the task by chaining procedure and then matched to like items of measure. Comparisons of operant procedural effect on errror rate were made upon conversion of the matched items to percentages of difference between them. A level of functional criteria was set at a difference of 20% (x 1.2 difference).

The data for hypothesis two were analyzed to detect operant procedural effect on error rate in four distinct areas. These areas were backward chaining versus forward chaining in : (1) undressing

using socks; (2) undressing using shorts; (3) dressing using socks; and, (4) dressing using shorts.

In undressing using socks, a difference in procedural effects on error rate was detectable. Subjects 1, 2, and 3, using a backward chaining procedure, committed a total of 82 errors in reaching final criterion on the task (see Table 13). Subjects 4, 5, and 6, using a forward chaining procedure, committed a total of 66 errors in reaching final criterion on the task (see Table 13). Those subjects using forward chaining were found to have committed functionally fewer (66 x 1.2) errors than those subjects using backward chaining (82).

Subject 1, using a backward chaining procedure, committed 43 errors in reaching final criterion in undressing using socks (see Table 13). Approximately 60%, or 26 out of 43, of Subject 1's errors occurred during skill acquisition on the first step of the task (see Appendix G, Table 15). In examination of Appendix A, Figure 2, it is evident that the addition of the second sock in the undressing task was not detrimental to Subject 1's error rate. In fact, no errors were committed after steps six through 10 were introduced.

Subject 2, using a backward chaining procedure, committed 19 errors in reaching final criterion in undressing using socks (see Table 13). Approximately 58%, or 11 out of 19, of Subject 2's errors occurred during skill acquisition of the first step of the task (see Appendix G, Table 15). In examination of Appendix B, Figure 2, it is evident that the addition of the second sock in the undressing task was not detrimental to Subject 2's error rate. In fact, only one error was committed after steps six through 10 were introduced.

Table 13. Error rate across undressing/dressing tasks by subjects using backward or forward chaining procedures

Subjects	Error Rate			
	Undressing		Dressing	
	socks	shorts	socks	shorts
Backward chaining				
Subject 1	43	(19)[a]	--[b]	--
Subject 2	19	(4)	--	--
Subject 3	20	(5)	--	--
Total	82	(28)	--	--
Forward chaining				
Subject 4	3	3	12	0
Subject 5	58	0	--	--
Subject 6	5	2	4	0
Total	66	5	16	(0)

[a]Numbers in parentheses indicate totals attained by subject(s) when investigation ended.

[b]Dotted line indicates task had not been introduced to subject(s).

Subject 3, using a backward chaining procedure, committed 20 errors in reaching final criterion in undressing using socks (see Table 13). Sixty-five percent, or 13 out of 20, of Subject 3's errors occurred during skill acquisition on the fourth step of the task (see Appendix G, Table 15). In examination of Appendix C, Figure 2, it is evident that the addition of the second sock in the undressing task added to Subject 3's error rate. The only errors (four) committed during steps six through 10 (i.e., use of the sock on the other foot) occurred on step nine. Step four, which was the source of 13 errors in usage of the first sock, corresponds to step nine in skill requirements in which the subject was required to "pull sock off when around ankle."

Subject 4, using a forward chaining procedure, committed three errors in reaching final criterion in undressing using socks (see Table 13). All of Subject 4's errors occurred during skill acquisition on the first step of the task (see Appendix G, Table 15).

Subject 5, using a forward chaining procedure, committed 58 errors in reaching final criterion in undressing using socks (see Table 13). Approximately 72%, or 42 out of 58, of Subject 5's errors occurred during skill acquisition on the first step of the task (see Appendix G, Table 15).

After Subject 5 in 10 sessions had committed 56 errors and had mastered the first step of the task of undressing using socks, the subject's physical position during task training was changed. From the original position of sitting in a chair, the subject was switched to a position of sitting on a mat. Once Subject 5's positioning had been

changed, the subject required just seven additional sessions to complete the next four steps of the task sequence. During these final seven sessions, the subject committed one additional error.

In examination of Appendix E, Figure 2, it is evident that the addition of the second sock in the undressing task was not detrimental to Subject 5's error rate. In fact, only two errors were committed after steps six through 10 were introduced.

Subject 6, using a forward chaining procedure, committed five errors in reaching final criterion in undressing using socks (see Table 13). All of Subject 6's errors occurred during skill acquisition on the first step of the task (see Appendix G, Table 15).

From a review of the comparison of procedural effect on error rate in undressing using socks, it was evident that functionally fewer (x 1.2) errors were committed when forward chaining was employed. In addition, functionally lower (x 1.2) error rates were achieved by each subject using forward chaining, except Subject 5, than each subject using backward chaining. This difference in functional criteria was determined by taking the highest error rate by subject, excluding Subject 5, in forward chaining (i.e., Subject 6's five errors) and comparing it to the lowest error rate by subject in backward chaining (i.e., Subject 2's 19 errors). The relatively high number of errors attained by Subject 5 may be attributed to the subject's initial physical positioning during skill acquisition (see Appendix E, Figure 2).

In undressing using shorts, a difference in procedural effects on error rate was detectable. Subjects 1, 2, and 3, using a backward

chaining procedure, committed a total of 28 errors without reaching final criterion on the task (see Table 13). Subjects 4, 5, and 6, using a forward chaining procedure, committed a total of five errors in reaching final criterion on the task (see Table 13). Those subjects using forward chaining were found to have committed functionally fewer (5 x 1.2) errors than those subjects using backward chaining (28).

Subject 1, using a backward chaining procedure, committed 19 errors without reaching criterion on the first step of undressing using shorts (see Appendix G, Table 16). The investigation ended before the subject had the opportunity to demonstrate possible skill acquisition (see Appendix A, Figure 4).

Subject 2, using a backward chaining procedure, committed four errors without reaching criterion on the second step of undressing using shorts (see Table 13). Two errors were com-itted in reaching criterion on the first step of the task. Two more errors had been committed during skill acquisition on the second step of the task when the investigation ended (see Appendix G, Table 16). This precluded the opportunity for the subject to demonstrate additional skill acquisition.

Subject 3, using a backward chaining procedure, committed five errors in reaching criterion on the first step of undressing using shorts (see Table 13). All of Subject 3's errors were committed during skill acquisition on the first step (see Appendix G, Table 16). The investigation ended before the subject had the opportunity to demonstrate additional skill acquisition.

Subject's 4, 5, and 6, using a forward chaining procedure, committed all of their errors during step four of undressing using shorts in

which the subjects were required to "pull shorts off when at ankle and around both feet" (see Appendix G, Table 16). Subject 4 committed a total of three errors, and Subject 6 committed a total of two errors, in mastering the task (see Table 13).

From a review of the comparison of procedural effect on error rate in undressing using shorts, it was evident that functionally fewer (6 x 1.2) errors were committed when forward chaining procedures were employed versus backward chaining procedures (28). This was true despite the fact that only those subjects using forward chaining completed task training. In addition, functionally lower (x 1.2) error rates were achieved by each subject using forward chaining, than each subject using backward chaining. This difference in functional criteria was determined by taking the highest error rate by subject in forward chaining (i.e., Subject 4's three errors) and comparing it to the lowest error rate by subject in backward chaining (i.e., Subject 2's four errors).

In dressing using socks, no true comparison of procedural effect on error rate could be determined. This was so since the dressing task had not been introduced to Subjects 1, 2, and 3, using backward chaining procedures (see Table 13). Dressing using socks had not been introduced to those subjects since each had failed to reach final criterion on the prerequisite task of undressing using shorts (see Table 13).

Subject 5, using a forward chaining procedure, did not have the opportunity to demonstrate possible skill acquisition in dressing using socks (see Table 13). Although Subject 5 had mastered the

prerequisite task of undressing using shorts, the investigation ended on the day the subject reached final criterion on the task (see Appendix E, Figure 4).

Subject 4, using a forward chaining procedure, committed 12 errors in reaching final criterion in dressing using socks (see Table 13). All of Subject 4's errors (see Appendix G, Table 17) occurred during skill acquisition on the first step of the task with the other (second) foot (i.e., step six).

Subject 6, using a forward chaining procedure, committed four errors in reaching final criterion in dressing using socks (see Table 13). All of Subject 6's errors occurred during skill acquisition on the first step of the task (see Appendix G, Table 17).

Interestingly, the errors committed by Subjects 4 and 6 occurred on the step requiring the same skill (i.e., pulling sock on to toes). The differences between their error rate were in (1) the amount of errors and (2) the foot in usage during task training. While Subject 6 had difficulty (four errors) in pulling the sock over the toes of the first (right) foot, Subject 4 had difficulty (12 errors) in pulling the sock over the toes of the second (left) foot.

From a review of the subjects' results in dressing using socks, no true comparison of procedural effect on error rate could be determined. The failure of Subjects 1, 2, and 3 to master the prerequisite undressing skill precluded any comparison on this dressing skill.

In dressing using shorts, no true comparison of procedural effect on error rate could be determined. This was so since the dressing

task had not been introduced to Subjects 1, 2, and 3 using backward chaining procedures (see Table 13). Dressing using shorts had not been introduced to those subjects since each had failed to reach criterion on the prerequisite tasks of undressing using shorts and dressing using socks (see Table 13).

The task of dressing using shorts was not introduced to Subject 5 using a forward chaining procedure (see Table 13). Subject 5 failed to reach criterion on the prerequisite task of dressing using socks (see Table 13), which precluded the introduction of dressing using shorts.

Subject 4, using forward chaining procedures, committed zero errors in reaching final criterion in dressing using shorts (see Table 13). Subject 6, using a forward chaining procedure, committed zero errors in mastering the task (see Table 13).

From a review of the subjects' results in dressing using shorts, no true comparison of procedural effect on error rate could be determined. The failure of Subjects 1, 2, 3, and 5 to master the prerequisite dressing skill precluded any comparison on this task.

In summary, it appeared evident that in making comparisons of procedural effect on the undressing/dressing skill requirements, there were differences in error rate. Under forward chaining procedures, functionally fewer subject task errors were produced in undressing skill requirements than under backward chaining procedures. The ability to make true comparisons of procedural effect on error rate in dressing skill requirements was precluded by the failure of subjects

using backward chaining procedures to master the prerequisite undressing tasks.

Hypothesis Three

In the third hypothesis, the differences in trials to criterion were examined for subject task performance when backward chaining or forward chaining procedures were used to teach undressing and dressing skills to a person identified as profoundly retarded. The hypothesis was that there were no differences in trials to criterion.

Trials to criterion was determined by tabulating the number of trials (1o per session) required to reach criterion on each step(s) of the task. For the purpose of this study, a subject reached criterion or mastery when the task or task component was performed with 80% rate of accuracy (eight out of 10 trials) over a period of three consecutive sessions, and where the maximum of prompting given by the trainer was contact with the article of clothing (see Table 6). The trials were totaled across the task by training procedure and then matched to like items of measure. Comparisons of operant procedural effect on trials to criterion were made upon conversion of the matched items to percentages of difference between them. A level of functional criteria was set at a difference of 20% (x 1.2 difference).

The data for hypothesis three were analyzed to detect operant procedural effect on trials to criterion in four distinct areas. These areas were backward chaining versus forward chaining in: (1) undressing using socks; (2) undressing using shorts; (3) dressing using socks; and, (4) dressing using shorts.

In undressing using socks, a difference in procedural effects on trials to criterion was detectable. Subjects 1, 2, and 3, using a backward chaining procedure, required a total of 670 trials in reaching final criterion on the task (see Table 14). Subjects 4, 5, and 6, using a forward chaining procedure, required a total of 340 trials in reaching final criterion on the task (see Table 14). Those subjects using forward chaining were found to have required functionally fewer (340 x 1.2) trials then those subjects using backward chaining (670).

Once a subject reached final criterion in undressing using socks on the first (right) foot, the steps six through 10 were combined. A subject then had the opportunity of demonstrating skill acquisition on the second (left) foot in a minimum number of required trials (30).

Subject 1, using a backward chaining procedure, required 230 trials in reaching final criterion in undressing using socks (see Table 14). The subject required 200 trials to master undressing with socks on the first (right) foot. On the second (left) foot, steps six through 10, a minimum of 30 trials was required to reach final criterion (see Appendix G, Table 19).

Subjects 2 and 3, using backward chaining procedures, required 220 trials each in reaching final criterion in undressing using socks (see Table 14). The subjects required 190 trials each to master undressing using socks on the first (right) foot, steps one through five. On the second (left) foot (i.e., steps six through 10), a minimum of 30 trials per subject was required to reach final criterion (see Appendix G, Table 19).

Subjects 4 and 6, using forward chaining procedures, required 70 trials each in reaching final criterion in undressing using socks (see

Table 14. Trials to criterion across undressing/dressing tasks by subjects using backward or forward chaining procedures

Subjects	Trials to Criterion			
	Undressing		Dressing	
	socks	shorts	socks	shorts
Backward chaining				
Subject 1	230	(20)[a]	--[b]	--
Subject 2	220	(30)	--	--
Subject 3	220	(40)	--	--
Total	670	(90)	--	--
Forward chaining				
Subject 4	70	30	40	30
Subject 5	200	40	--	--
Subject 6	70	30	30	30
Total	340	100	(70)	(60)

[a]Numbers in parentheses indicate totals attained by subject(s) when investigation ended.

[b]Dotted line indicates task had not been introduced to subject(s).

Table 14). The subjects required 40 trials each to master undressing using socks on the first (right) foot, steps one through five. In the removal of the sock from the first foot, Subjects 4 and 6 combined steps one through five of the undressing task (see Appendix G, Table 19). With the sock completely on, each subject removed the sock in one step. The procedure was performed similarly with the second (left) foot by combining steps six through 10. This grouping of steps afforded the subjects the opportunity to perform the task in a minimum of 30 trials versus the standard criterion of 150 trials (i.e., 10 trials per step for three consecutive sessions).

Subject 5, using a forward chaining procedure, required 200 trials in reaching final criterion in undressing using socks (see Table 14). Fifty percent, or 100 out of 200, of those trials were required in reaching criterion on the first step of the task (see Appendix G, Table 19). After Subject 5 had taken 100 trials (10 sessions) and had mastered the first step of the task, the subject's physical position during task training was changed. From the original position of sitting in a chair, the subject was switched to a position of sitting on a mat. Once Subject 5's positioning had been changed, the subject required just 70 additional trials (seven sessions) to complete the next four steps of the task sequence. This was accomplished by the subject combining steps two through five (see Appendix G, Table 19). With the sock completely on, Subject 5 removed the sock in one step. The procedure was performed similarly with the second (left) foot by combining steps six through 10. This grouping of steps afforded the

subject the opportunity to perform the task of undressing using socks in a minimum of 30 trials for each foot. On the second (left) foot, Subject 5 required the minimum number of trials (30) in reaching final criterion.

From a review of the comparison of procedural effect on trials to criterion in undressing using socks, it was evident that functionally fewer (x 1.2) trials were required when forward chaining was employed. In addition, functionally fewer (x 1.2) trials were required by each subject using forward chaining, except Subject 5, than each subject using backward chaining. This difference in functional criteria was determined by taking the highest number of trials by subject, excluding Subject 5, in forward chaining (i.e., Subject 4 and 6's 70 trials) and comparing it to the lowest number of trials by subject in backward chaining (i.e., Subject 2 and 3's 220 trials). The relatively high number of trials required by Subject 5 may be attributed to the subject's initial physical positioning during skill acquisition (see Appendix E, Figure 2).

In undressing using shorts, a difference in procedural effects on trials to criterion was detectable. Subject's 1, 2, and 3, using a backward chaining procedure, required a total of 100 trials without reaching final criterion on the task (see Table 14). Subjects 4, 5, and 6, using a forward chaining procedure, required a total of 100 trials in reaching final criterion on the task (see Table 14). Although the total number of trials required by subjects across each procedure equaled 100 and those subjects using backward chaining failed to reach criterion, it could be determined that the number of trials required

in reaching final criterion using backward chaining was functionally greater (x 1.2) than their counterparts using forward chaining.

If all subjects using backward chaining had had the opportunity to complete task training in undressing using shorts, a minimum of 150 trials would hav been required by Subject 1, a minimum of 110 trials would have been required by Subject 2, and a minimum of 120 trials would have been required by Subject 3. This was so since three consecutive sessions (30 trials) were required to reach criterion on each step of the task, and a number of steps had yet to be mastered by each of the subjects (see Appendix G, Table 20).

Subject 1, had failed to achieve an 80% accuracy (eight out of 10 trials) on either of two sessions (20 trials) attempted on step one of the task before the investigation ended. Based on established performance criteria, a minimum of three sessions (30 trials) were required on each of the five steps of the task, for a minimum total of 150 additional trials.

Subject 2 had mastered step one of the task and had achieved an 80% rate of accuracy (eight out of 10 trials) on the only session attempted on step two before the investigation ended. Based on established criteria, a minimum of two sessions (20 trials) were required to reach criterion on step two of the task and nine sessions (90 trials) were required to reach criterion on the next three steps (i.e., steps three, four, and five) of the task. This added up to a minimum total of 110 additional trials.

Subject 3 had mastered step one of the task and had not attempted step two before the investigation ended. Based on established criteria,

a minimum of 12 sessions (120 trials) were required to reach criterion on the next four steps of the task (i.e., steps two, three, four, and five).

Subjects 4, 5, and 6, in the removal of the shorts, combined steps one through five of the undressing sequence (see Appendix G, Table 20). This grouping of steps afforded the subjects the opportunity to perform the task in the minimum number of 30 trials versus the standard criterion of 150 trials (i.e., 10 trials per step for three consecutive sessions). In reaching criterion in undressing using shorts, Subject 4 required 30 trials, Subject 5 required 40 trials, and Subject 6 required 30 trials.

From a review of the comparison of procedural effect on trials to criterion in undressing using shorts, it was evident that functionally fewer (x 1.2) trials were required when forward chaining was employed. In addition, functionally fewer (x 1.2) trials were required by each subject using forward chaining than each subject using backward chaining once the additional required trials were a-ded to those subjects using a backward chaining procedure. This difference in functional criteria was determined by taking the highest number of trials by subject in forward chaining (i.e., Subject 5's 40 trials) and comparing it to the lowest number of trials by subject in backward chaining (i.e., Subject 2's 150 trials).

In dressing using socks, no true comparison of procedural effect on trials to criterion could be determined. This was so since the dressing task had not been introduced to Subjects 1, 2, and 3 using backward chaining procedures (see Table 14). Dressing using socks had

be determined. The failure of Subjects 1, 2, and 3 to master the prerequisite undressing skill precluded any comparison on this dressing skill.

In dressing using shorts, no true comparison of procedural effect on trials to criterion could be determined. This was so since the dressing task had not been introduced to any of the subjects (i.e., Subjects 1, 2, and 3) using backward chaining procedures (see Table 14). Dressing using shorts had not been introduced to those subjects since each had failed to reach criterion on the prerequisite tasks of undressing using shorts and dressing using socks (see Table 14).

The task of dressing using shorts was not introduced to Subject 5 using a forward chaining procedure (see Table 14). Subject 5 had failed to reach criterion on the prerequisite task of dressing using socks (see Table 14), which precluded the introduction of dressing using shorts.

Subjects 4 and 6, in dressing using shorts, combined steps one through five of the task (see Appendix G, Table 22). This grouping of steps afforded the subjects the opportunity to perform the task in the minimum of 30 trials versus the standard criterion of 150 trials (i.e., 10 trials per step for three consecutive sessions). In reaching criterion in dressing using shorts by forward chaining procedures, Subjects 4 and 6 required the minimum of 30 trials.

From a review of the subjects' results in dressing using socks, no true comparison of procedural effect on trials to criterion could

not been introduced to those subjects since each had failed to reach final criterion on the prerequisite task of undressing using shorts (see Table 14).

Subject 5, using a forward chaining procedure, did not have the opportunity to demonstrate possible skill acquisition in dressing using socks (see Table 14). Although Subject 5 had mastered the prerequisite task of undressing using shorts, the investigation ended on the day the subject reached final criterion on that task (see Appendix E, Figure 4).

Subject 4, using a forward chaining procedure, required 40 trials in reaching final criterion in dressing using socks (see Table 14). In the placement of the socks on the feet, Subject 4 combined steps one through five and steps six through 10 (see Appendix G, Table 21). This grouping of steps afforded the subject the opportunity to perform the task in a minimum of 30 trials versus the standard criterion of 300 trials (i.e., 10 trials per step for three consecutive sessions).

Subject 6, using a forward chaining procedure, required 30 trials in reaching final criterion in dressing using socks (see Table 14). In the placement of the socks on the feet, Subject 6 combined steps one through five and steps six through 10 (see Appendix G, Table 21). This grouping of steps afforded the subject the opportunity to perform the task in a minimum of 30 trials versus the standard criterion of 300 trials (i.e., 10 trials per step for three consecutive sessions).

From a review of the subjects' results in dressing using socks, no true comparison of procedural effect on trials to criterion could

be determined. The failure of Subjects 1, 2, 3, and 5 to master the prerequisite dressing skill precluded any comparison on this task.

In summary, it appeared evident that in making comparisons of procedural effect on the undressing/dressing skill requirements, there were differences in trials to criterion. Under forward chaining procedures, functionally fewer subject task trials were required in undressing skill requirements than under backward chaining. The ability to make true comparisons of procedural effect on trials to criterion in dressing skill requirements was precluded by the failure of subjects using backward chaining procedures to master the prerequisite undressing tasks.

Summary of Results

Through an examination of the data relevant to the hypotheses of the study, it was found that forward chaining procedures were superior to backward chaining procedures in teaching undressing skills to children identified as profoundly mentally handicapped. In examining the error rate and trials to criterion of subject performance, it was found that functionally fewer errors were made and functionally fewer trials were required to reach final criterion by subjects using forward chaining procedures.

In examining the learning performance, it was found that all subjects using forward chaining procedures reached criterion on both of the undressing tasks. Two out of the three same subjects reached criterion on both of the dressing tasks also. Those subjects using

backward chaining procedures reached criterion only on the initial undressing task (i.e., undressing using socks).

CHAPTER V

DISCUSSION

The purpose of this study was to compare the efficiency and effectiveness of backward chaining procedure and a forward chaining procedure when an individual identified as profoundly retarded was acquiring undressing/dressing skills. Researchers have found both procedures to be effective when used in skill acquisition by various populations. An empirical determination of the efficiency and effectiveness of these two procedures will not only aid researchers and practioners, but will also aid trainers in selecting appropriate paradigms when training individuals identified as profoundly retarded in undressing/dressing skills.

Review of the Literature

Researchers have demonstrated that when backward chaining procedures and forward chaining procedures have been used in isolation, both procedures have been effective. Individuals identified as profoundly retarded have not only acquired self-care skills, but also vocational skills when trainers have used either procedure.

At present investigators appear to be directed to use one procedure in favor of the other procedure by nonempirically based decisions. It is unclear as to the selection criterion for using one form of chaining instead of another.

Review of Hypotheses

In this study, three hypotheses were examined. The first hypothesis was the difference in learning performance produced by subjects when backward or forward chaining procedures were used. The second hypothesis was the difference in error rate produced by subjects when either of the two procedures was used. The third hypothesis was the differences in trials to criterion required by subjects when either of the two procedures was used. It was proposed that there would be no differences in subject performance for each of the hypotheses.

Review of Methods

Six subjects identified as profoundly mentally handicapped were selected from a public school program for the severely and profoundly retarded. These six subjects were chosen based on meeting the investigator's selection criteria. The subjects were randomly assigned to treatment groups corresponding to the operant chaining procedure employed.

Each subject was to have been trained to undress and dress using socks and shorts. Each subject's clothing was alike in color and style. The tasks and task components were similar in that the skill requirements were the same for each procedure. Task training sessions were conducted daily on a rotating schedule to reduce the effects of possible set time preferences by certain individuals.

The investigator trained the subjects and collected the data. Based on daily examination of the data, decisions for changes in training techniques were made by the investigator.

The experimenter collected data for a period of eight weeks, five days a week. Data were evaluated by tabulating the item of measure (i.e., learning performance, error rate, and trials to criterion) and matching it to like items of measure. Comparisons of procedural effect were made upon conversion of the score on each of the matched items to percentages of difference between them.

Summary of Findings

Through an examination of the data relevant to the hypotheses of the study, it was found that forward chaining procedures were superior to backward chaining procedures in teaching undressing skills to children identified as profoundly mentally handicapped. In examining the error rate and trials to criterion of subject performance, it was found that functionally fewer errors were made and functionally fewer trials were required to reach final criterion by subjects using forward chaining procedures.

In examining the learning performance, it was found that all subjects using forward chaining procedures reached criterion on both of the undressing tasks. Two out of the three same subjects reached criterion on both of the dressing tasks also. Those subjects using backward chaining procedures reached criterion only on the initial undressing task.

Interpretation of the Findings and Literature Support

In 11 out of 12 comparisons, the subjects' performance of the undressing tasks using forward chaining procedures was superior. This

finding seems to counter Gardner's (1971) and Reynold's (1975) view of the desirability of backward chaining procedures.

Similarly, other researchers (e.g., Ball et al., 1971; Horner, 1970; Minge & Ball, 1967) seemed to advocate backward chaining procedures for both undressing and dressing. These researchers' results had a significant affect on this investigator's responding prior to the undertaking of the research project.

There could be several potential underlying reasons for the efficacy of the forward chaining procedure. The reason that would be most pertinent to this investigation would be related to the progression of the task components.

In forward chaining, the first step of the task is taught first. The individual is guided through all the steps of the task in a traditional (forward) progression (Mori & Masters, 1980). Following a traditional progression, an individual could combine various task components and thereby lessen the actual number of steps to be learned.

In this study, each of the subjects using a forward chaining procedure combined steps in learning the various undressing and/or dressing skills. This grouping of steps for task acquisition afforded the subjects the opportunity to require a minimum of from 120 fewer trials (five step task) to 300 fewer trials (10 step task) than each subject using a backward chaining procedure. Those subjects using backward chaining were prevented from combining steps by the very nature of the procedure.

Although the data in this investigation are convincing, investigators would argue that with other tasks and other subjects the same

convincing result would not be obtained. These issues are considered in suggestions for future research.

Problems and Limitations

There were several problems and limitations that should be considered when interpreting the results of this research study. Although the trainer spent 35 days in training, the greatest limiting factors was time. Due to the time limitation, subjects using backward chaining failed to reach criterion on the second undressing task and on both dressing tasks. The major factor limiting one of the subjects (Subject 5) who failed to reach criterion on the dressing tasks, using forward chaining, was time.

Another problem was the investigator's limited practical experience in teaching dressing skills. Had the investigator realized, a priori, the difficulty of undressing/dressing in certain "traditional" positions, Subject 5's physical positioning during skill acquisition of undressing using socks would have been altered sooner than it was. Subject 5's task performance appeared to be effected by his physical positioning during skill training.

Practical Implications

There are a number of practical implications that can be derived from the findings of this study. The researcher as well as those individuals involved in the training of persons identified as profoundly retarded can benefit from the results of this investigation.

Researchers should begin to systematically identify the potential sources of reinforcement that appear to be inherent in the interaction

between the learner, the trainer, the task, and the training environment. The reasearcher's opportunities for future investigations are also enhanced by the findings of this study.

Trainers should consider the effects of the training environment on the performance of various tasks. Task acquisition may be enhanced by conducting training in environments similar to those in which later task performance will be expected (i.e., undressing/dressing in a bathroom).

Trainers should also consider the economics of time and energy being expended during task training. With the expenditure of less time and less effort, subjects using forward chaining were able to demonstrate skill acquisition that other subjects could not. Findings such as these could lead to more efficient and effective training procedures. The use of these training procedures would produce a savings in both time and energy and thereby allow (1) the trainer freedom to concentrate on other individuals and/or areas of concern; and, (2) the learner the freedom to master additional and/or more complex tasks.

Trainers should be influenced by the direct and continuous measurement technique that was used in this study. The daily decisions made by practitioners should be based on data in order to maximize the quality of training for persons identified as profoundly retarded.

In addition to these practical implications, practitioners should recognize the multiple, positive effects that may be associated with the acquisition of certain skills. Skill acquisition may produce effects upon (a) the learner's overall repertoire of skills and general

functioning, (b) society's attitudes toward the learner, and (c) significant other's perception of the learner's ability which then has the potential of increasing the learner's range and quality of daily and future life options.

Suggestions for Future Research

Through the process of conducting the foregoing research, numerous research questions related to the efficiency and effectiveness of learning paradigms for persons identified as profoundly retarded have been identified. Research is needed to fully comprehend the effects of training procedures on handicapped learners.

Replication of the study should be the first area of concern addressed. Will comparative research provide similar information and results (Wehman, 1979)? Systematic replication could provide reliability for the present study.

Through the use of systematic replication, the generality of the present study could be extended (Reynolds, 1975). First, replications with other individuals identified as profoundly handicapped could extend the generality of the present findings.

Second, replications with older individuals (i.e., 16 years and up) is important for understanding the generality of the present results with older individuals identified as profoundly handicapped. Another replication is the use of different undressing/dressing tasks (i.e., clothing articles other than socks and shorts) with a similar population.

A subsequent related study would be learning of the effects of the training of individuals identified as profoundly retarded to undress/

dress using their own clothes. The results of this study could provide information as to the efficiency and effectiveness of using a standard training set of clothing articles in attempting to transfer learning from a training environment to a more natural community environment.

Summary of Future Research

It is evident that the potential to execute these suggestions for future research is a valid effort to improve self-care skill training for individuals identified as profoundly retarded. The ability to perform self-care skills could enhance the potential of increasing their range and quality of daily and future life options.

APPENDIX A--SUBJECT 1

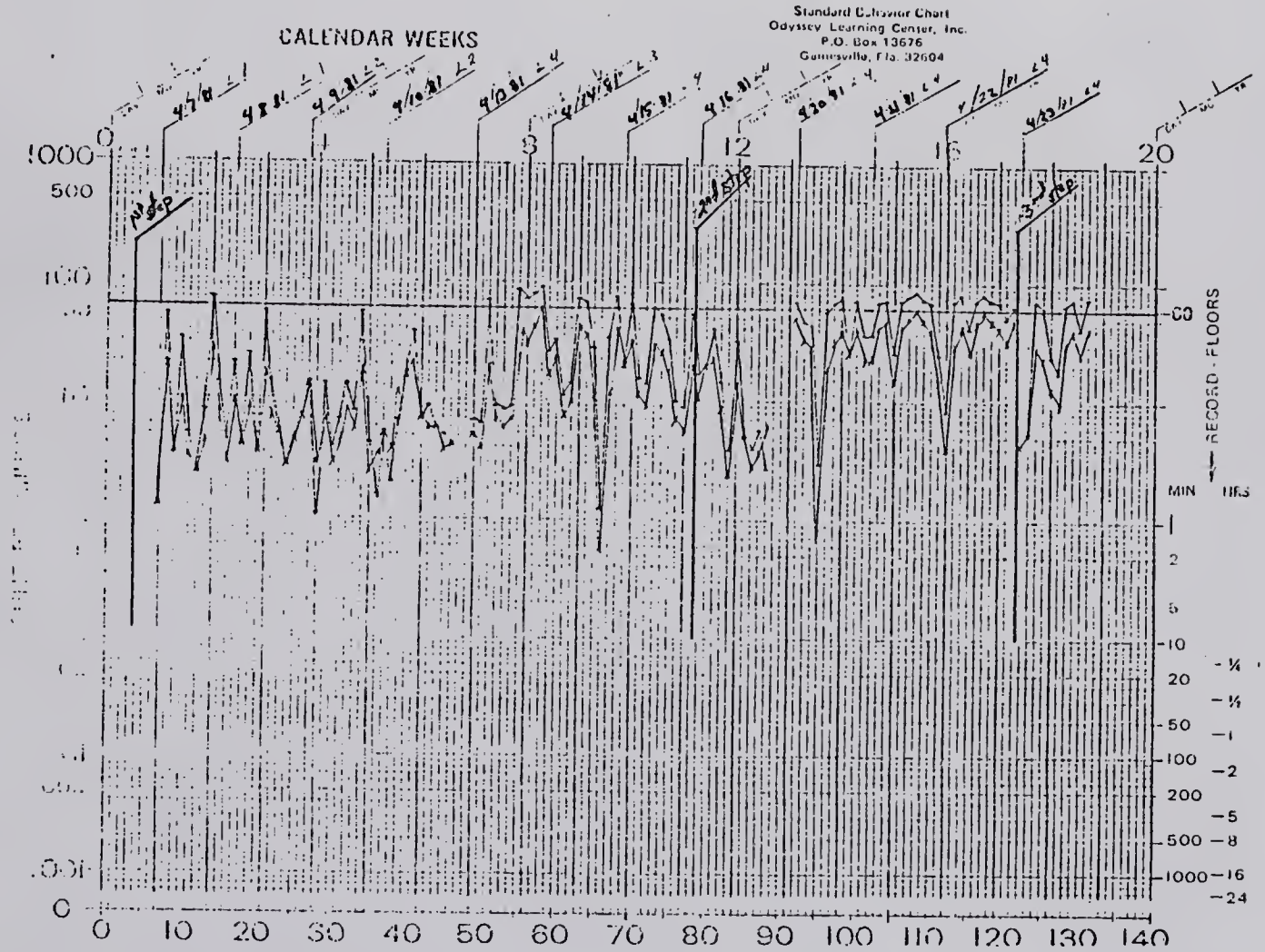

Figure A1. Subject 1, backward chaining in undressing using socks by trials.

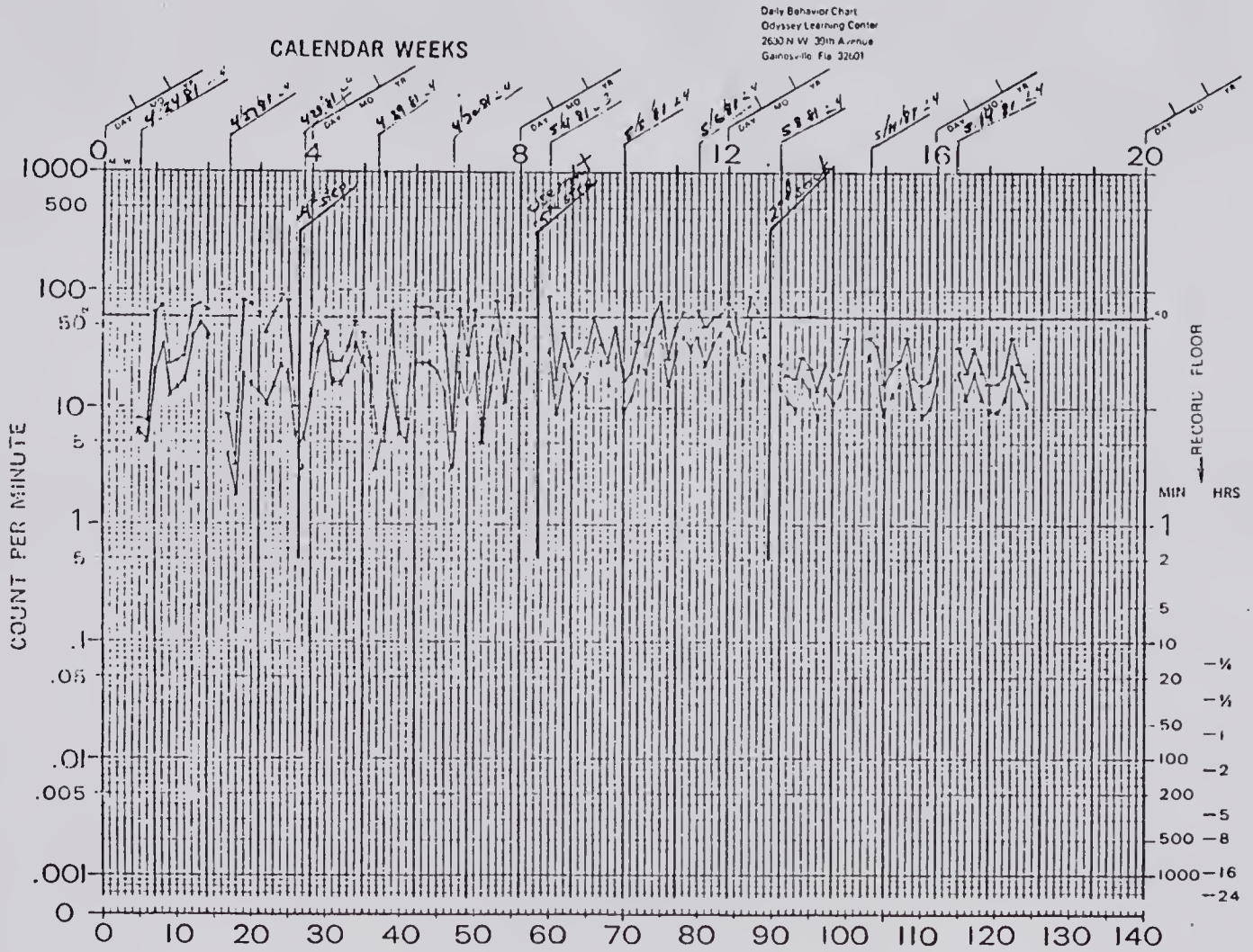

Figure A2. Subject 1, backward chaining in undressing using socks by trials.

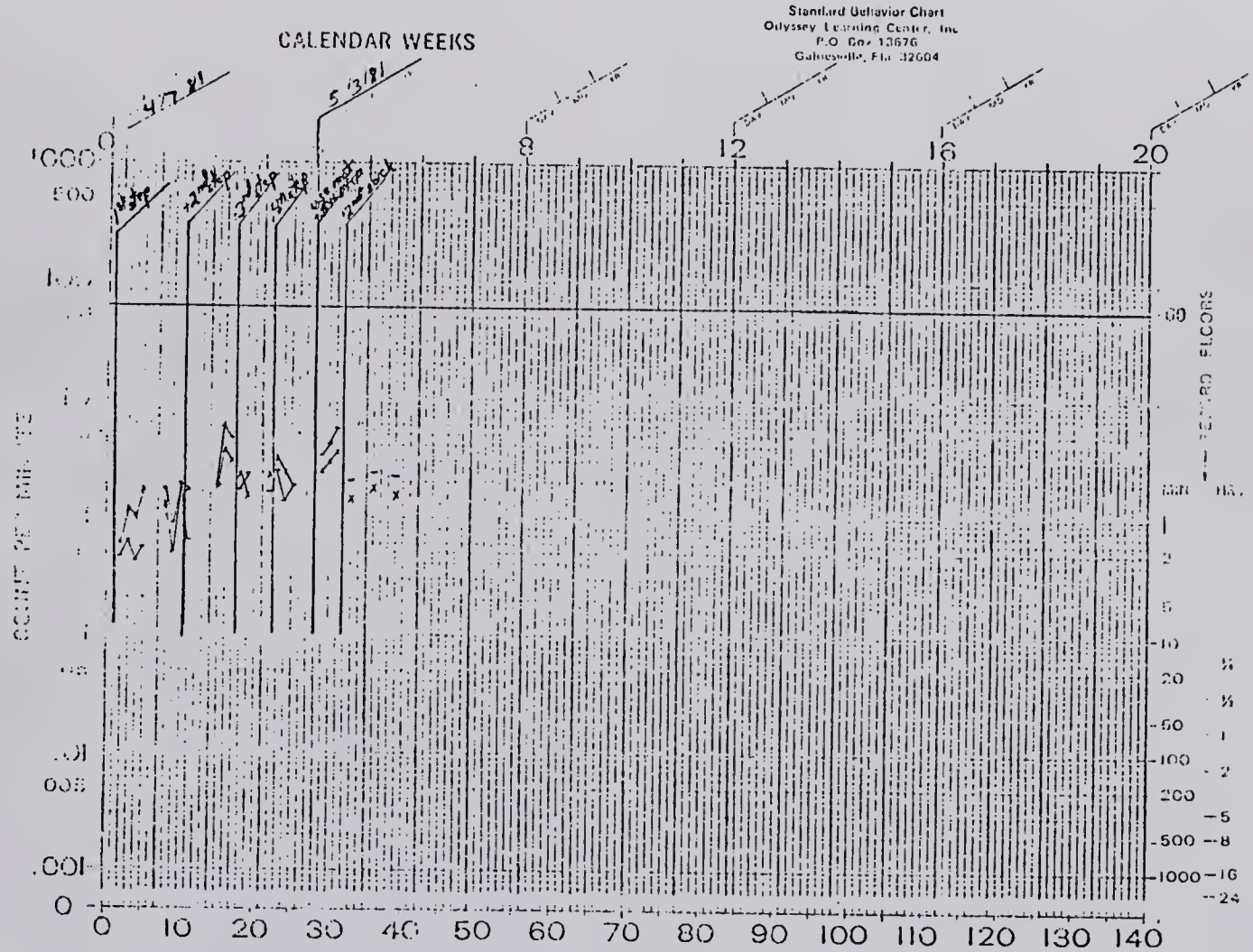

Figure A3. Subject 1, backward chaining in undressing using socks by sessions.

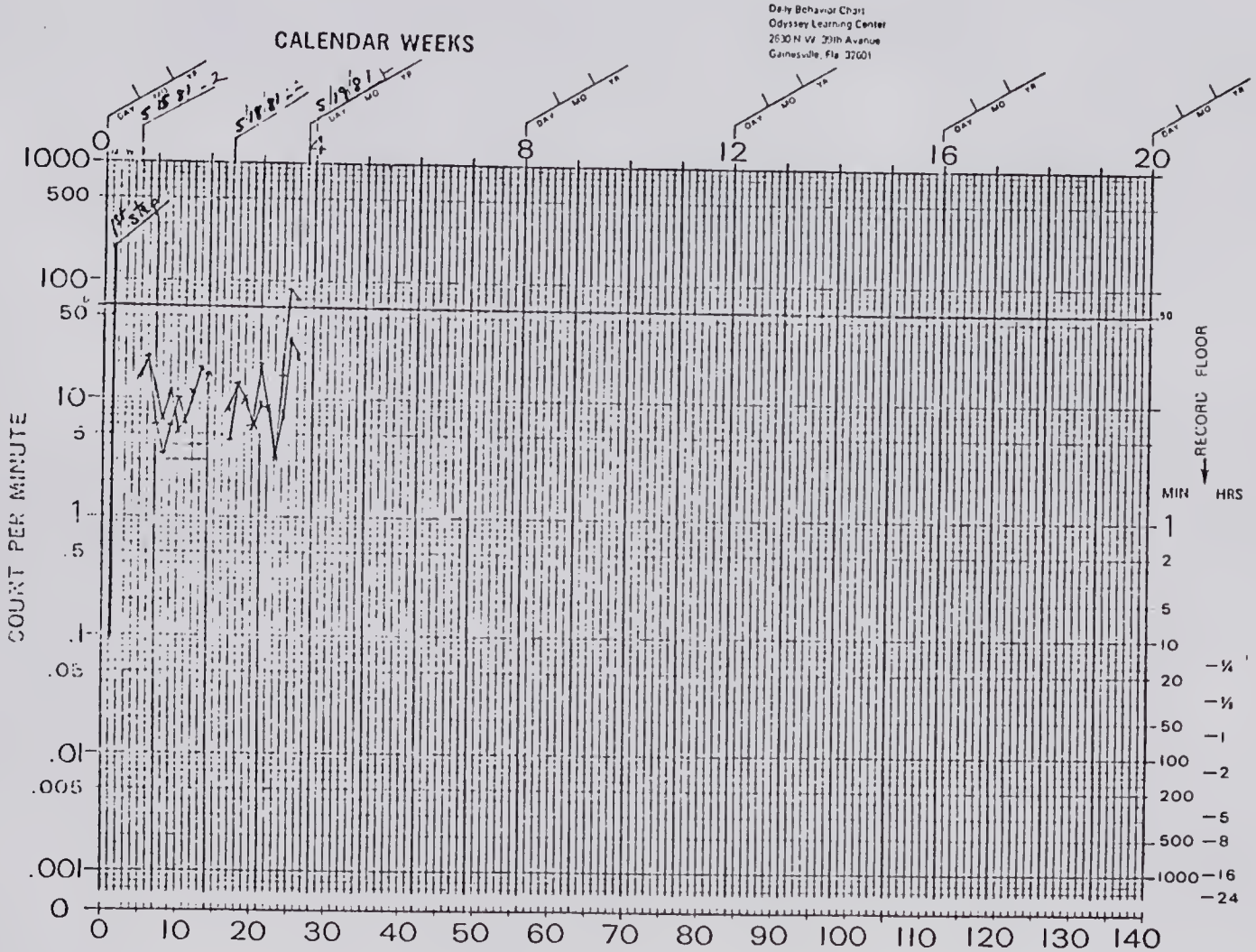

Figure A4. Subject 1, backward chaining in undressing using shorts by trials.

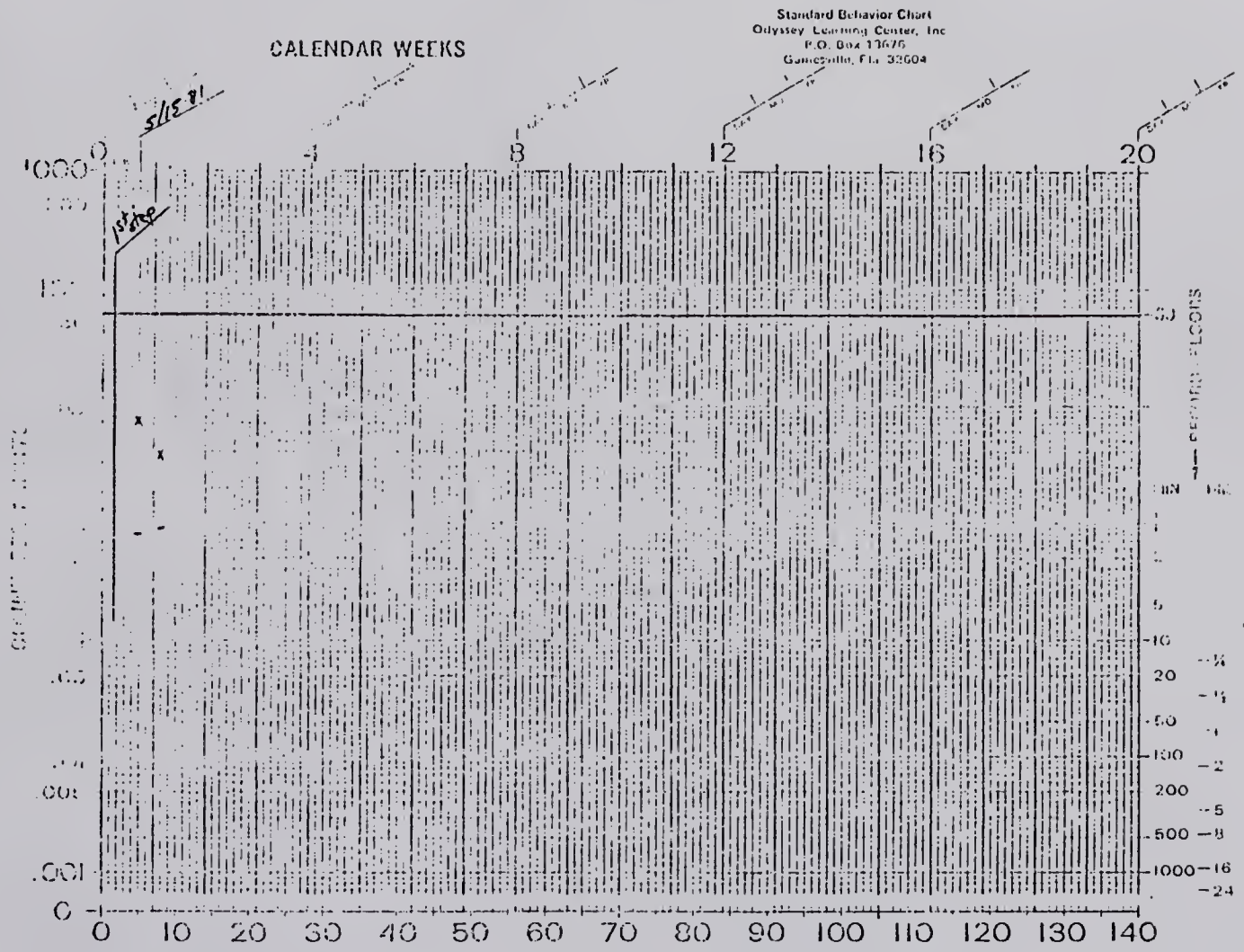

Figure A5. Subject 1, backward chaining in undressing using shorts by sessions.

APPENDIX B--SUBJECT 2

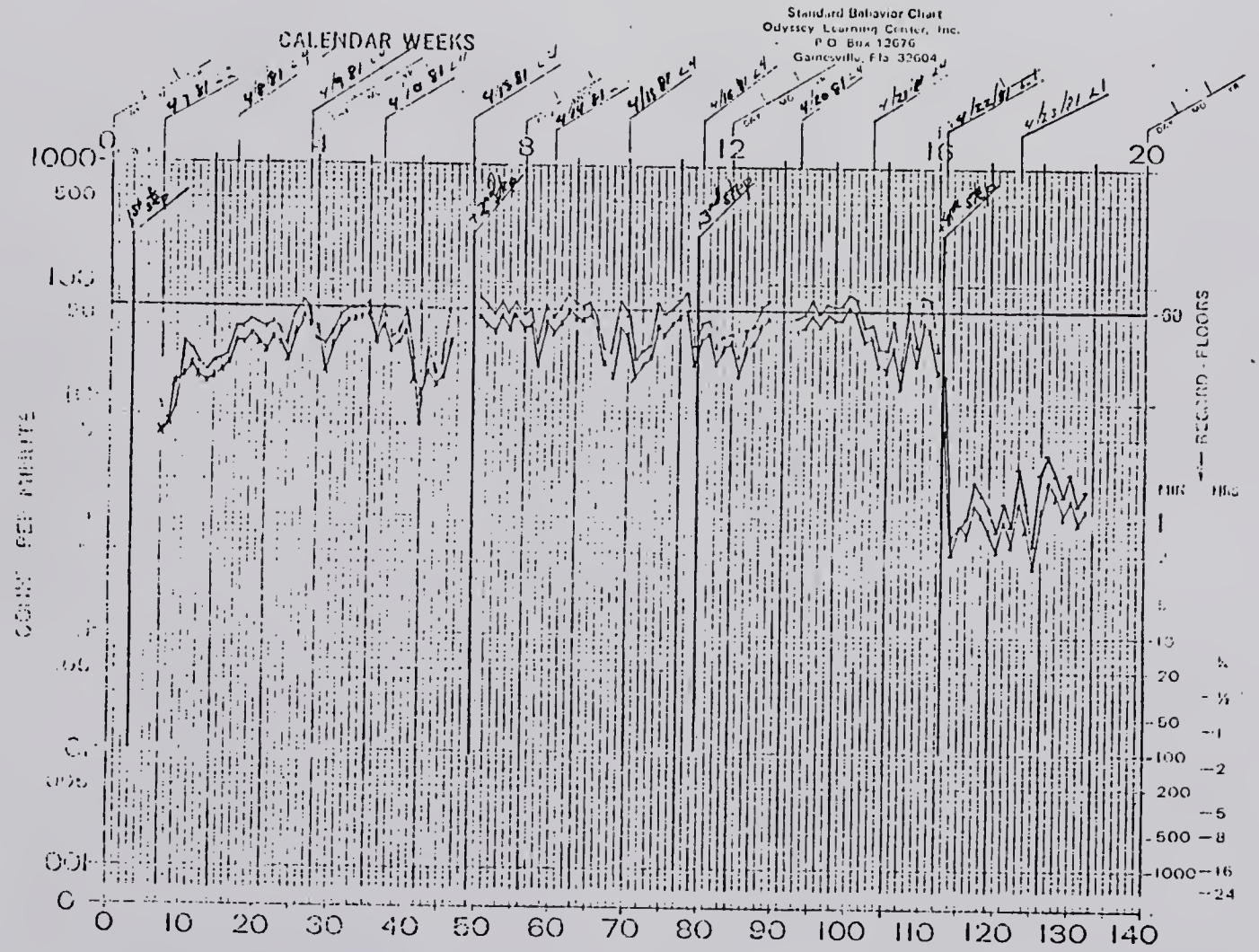

Figure B1. Subject 2, backward chaining in undressing using socks by trials.

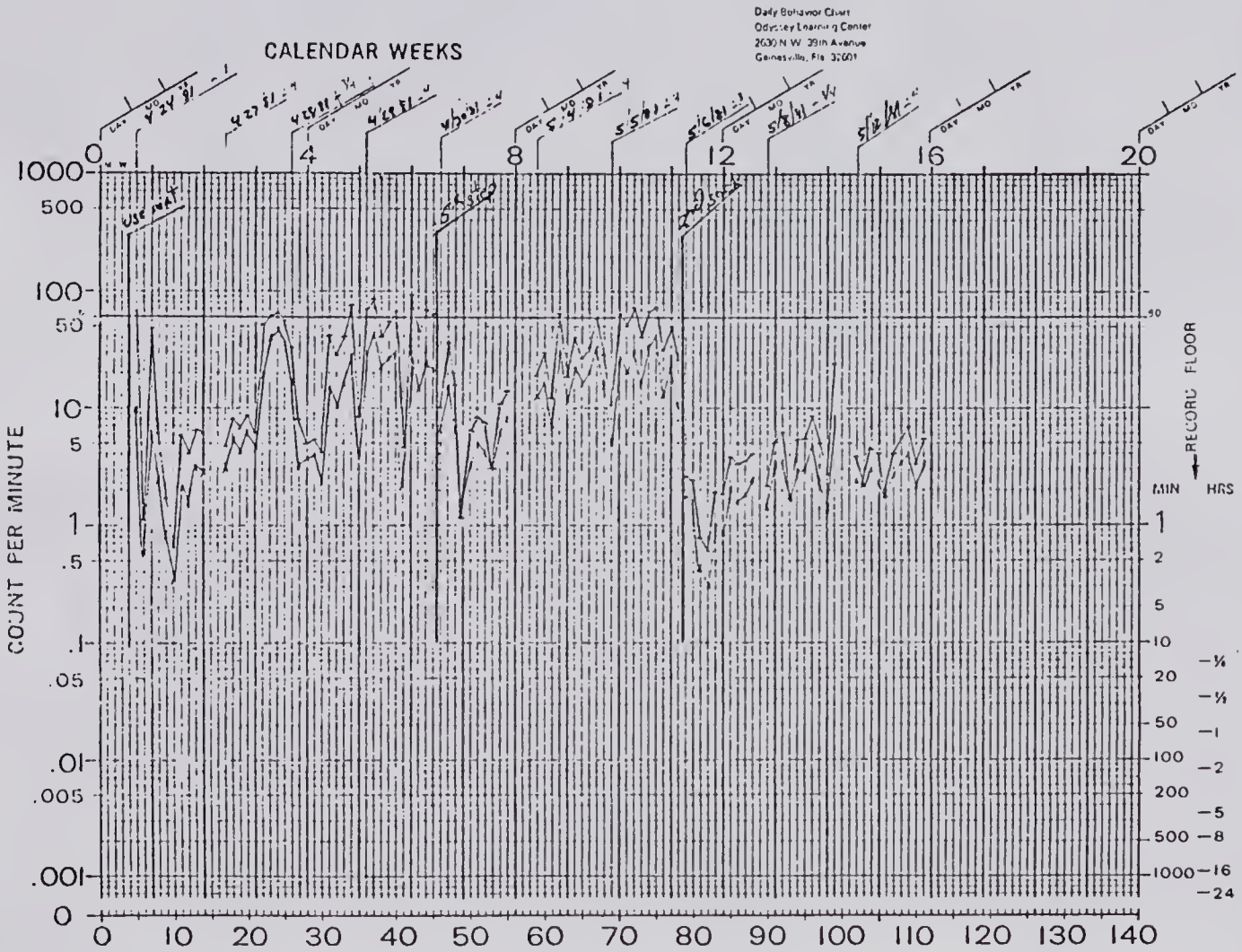

Figure B2. Subject 2, backward chaining in undressing using socks by trials.

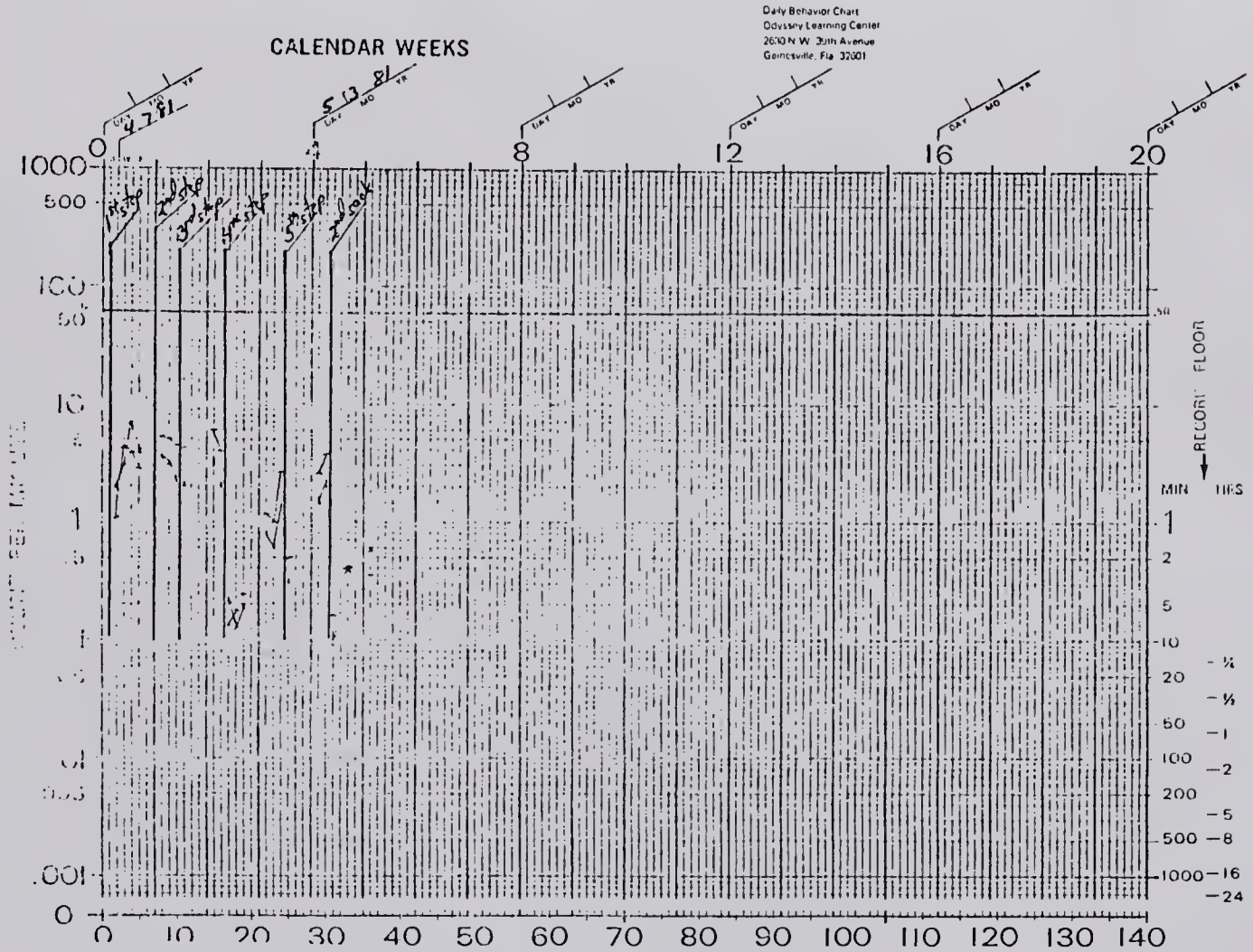

Figure B3. Subject 2, backward chaining in undressing using socks by sessions.

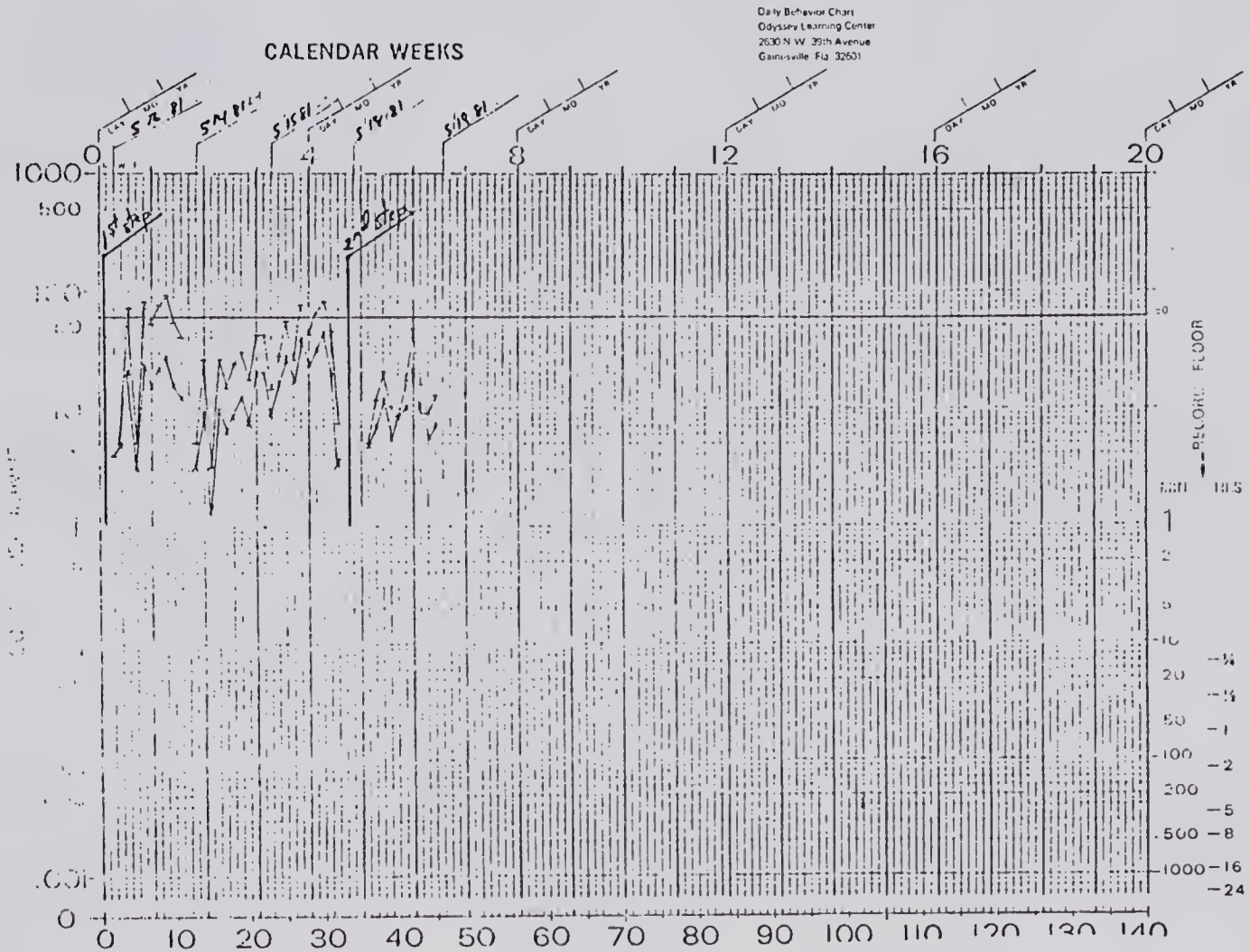

Figure B4. Subject 2, backward chaining in undressing using shorts by trials.

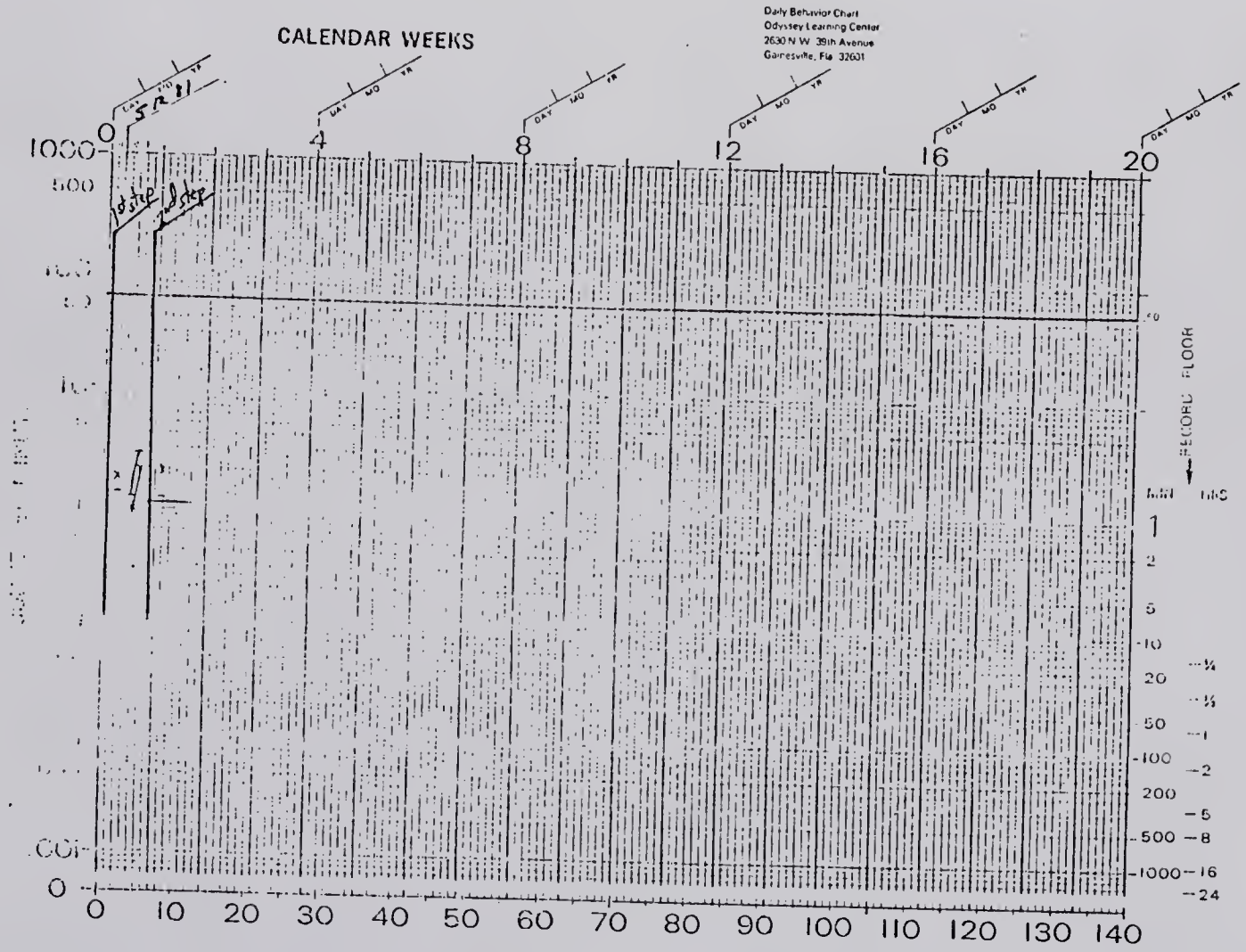

Figure B5. Subject 2, backward chaining in undressing using shorts by sessions.

APPENDIX C--SUBJECT 3

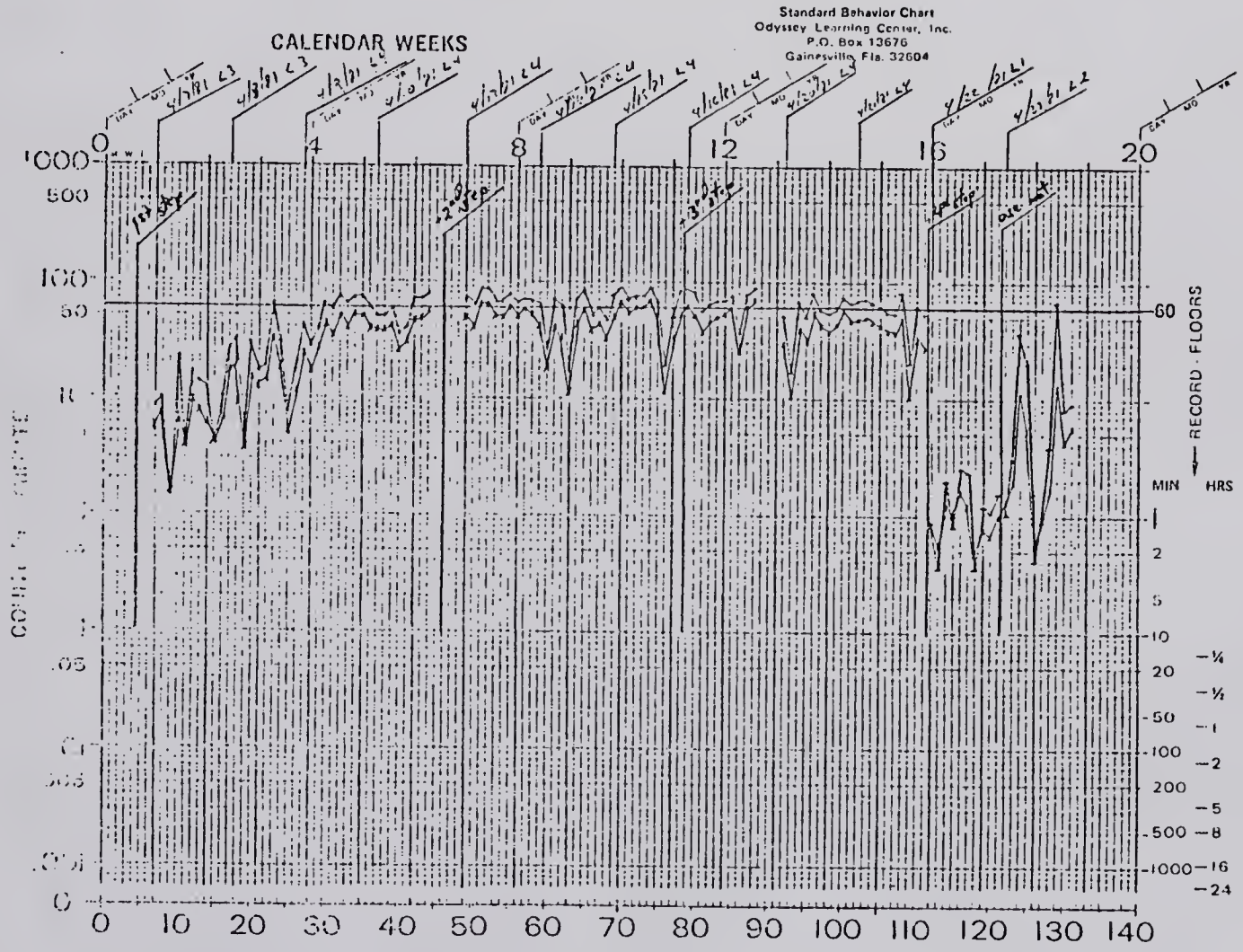

Figure C1. Subject 3, backward chaining in undressing using socks by trials.

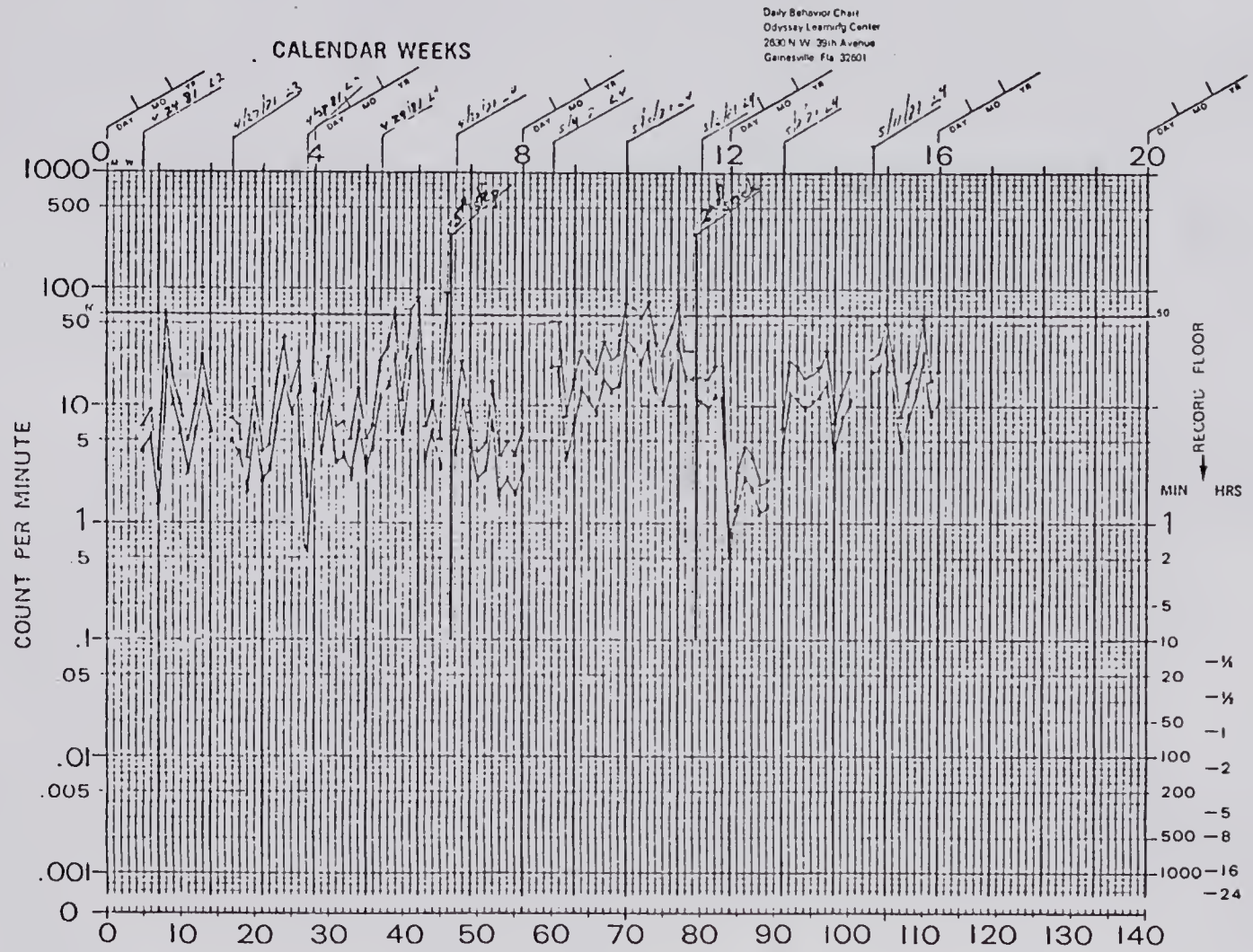

Figure C2. Subject 3, backward chaining in undressing using socks by trials.

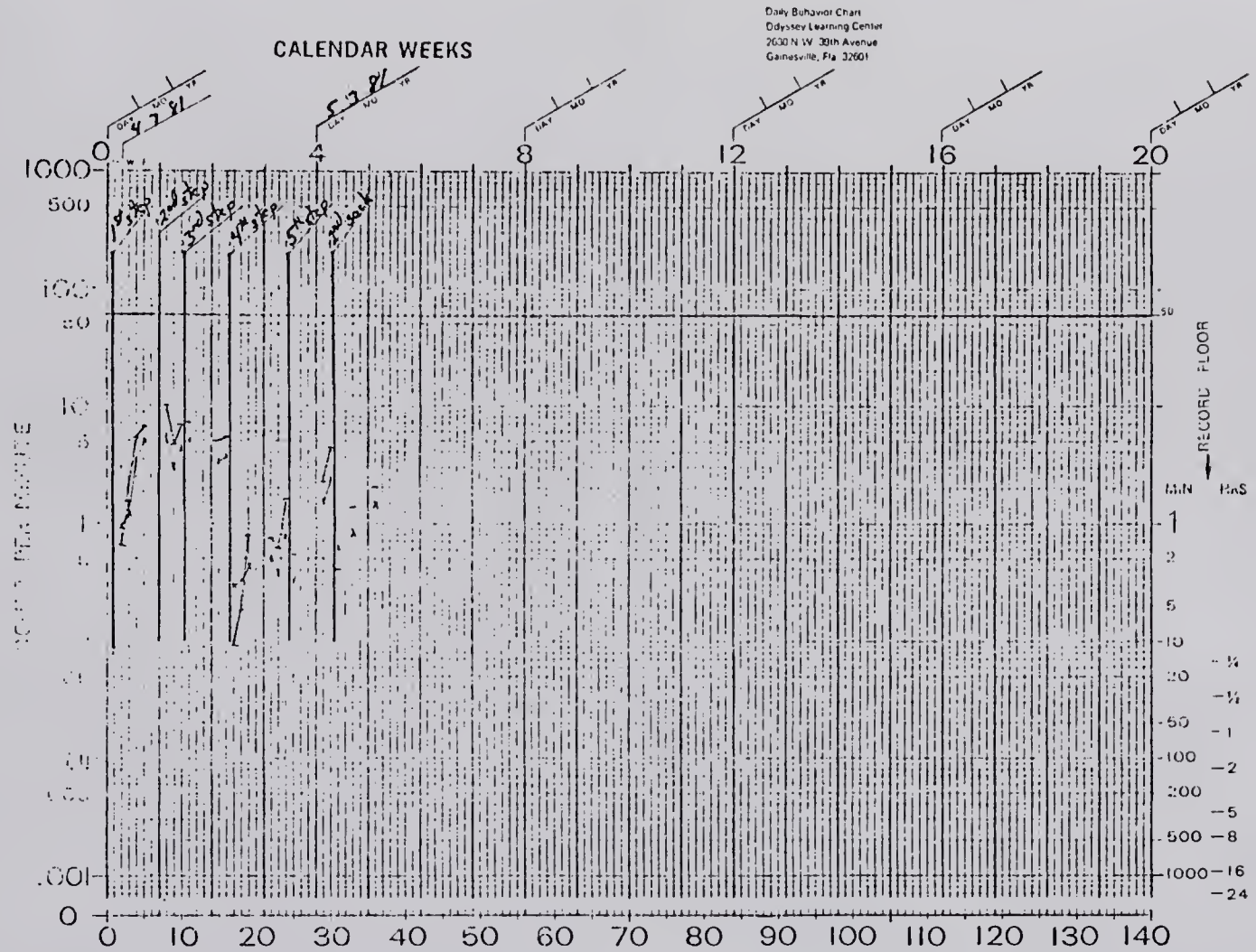

Figure C3. Subject 3, backward chaining in undressing using socks by sessions.

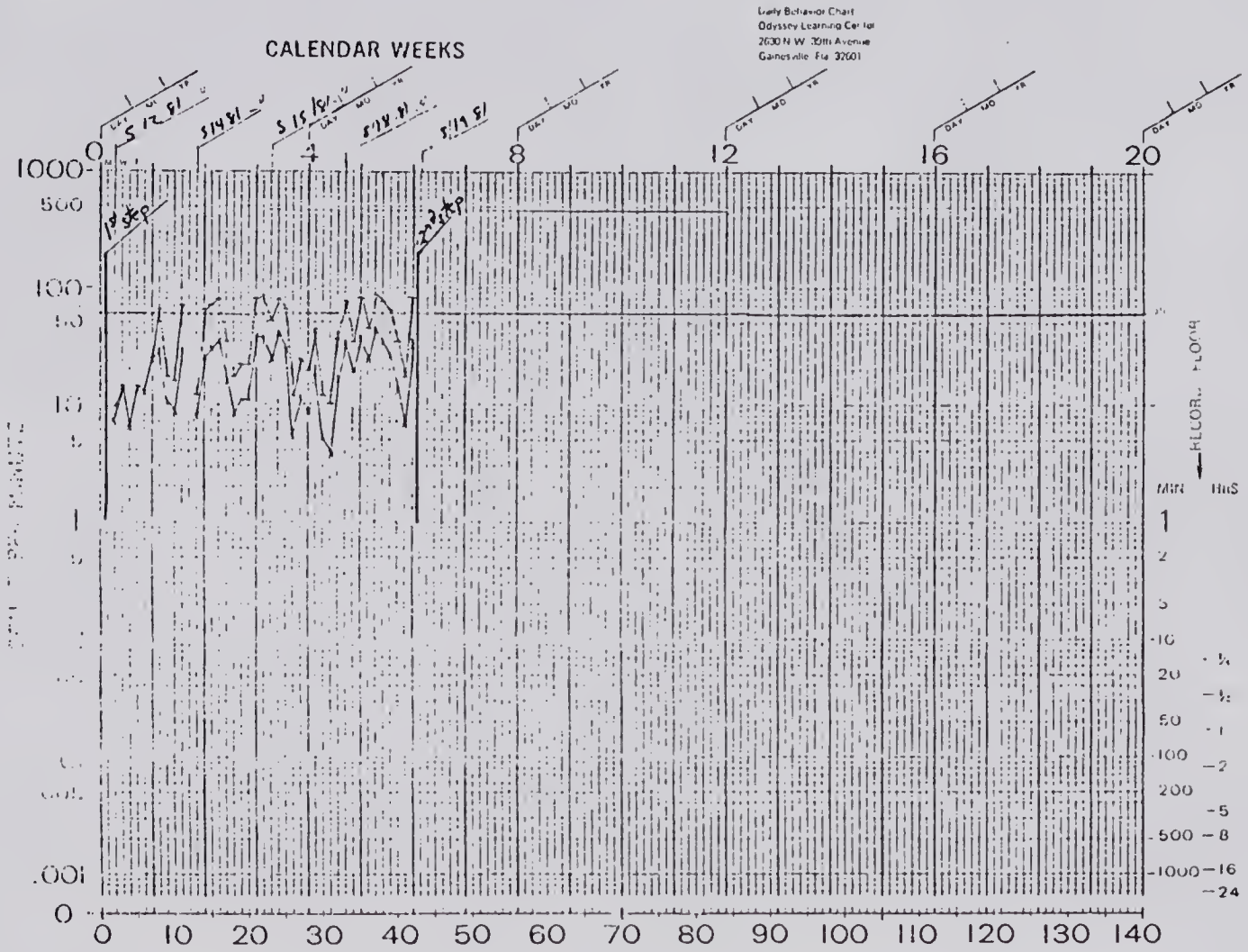

Figure C4. Subject 3, backward chaining in undressing using shorts by trials.

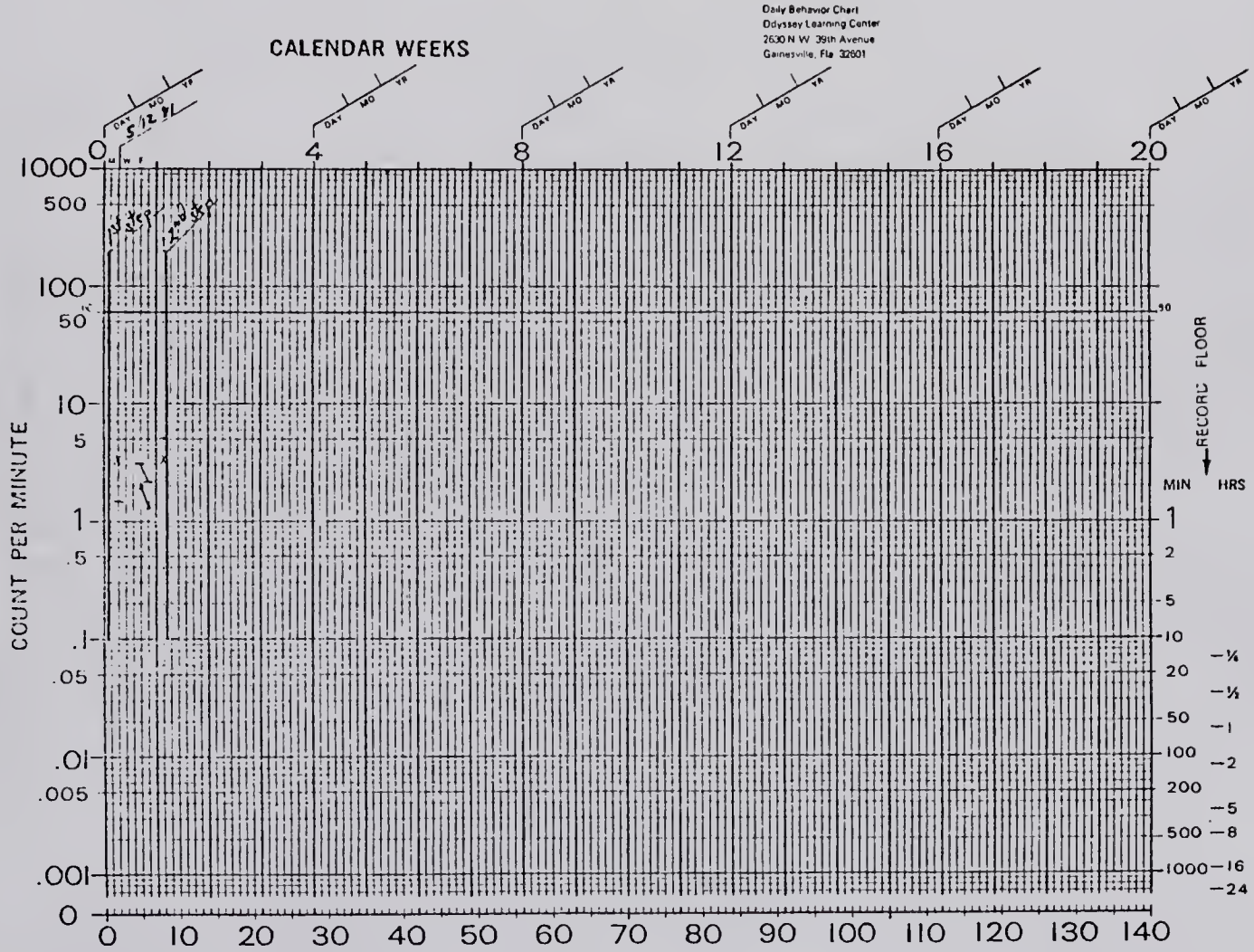

Figure C5. Subject 3, backward chaining in undressing using shorts by sessions.

APPENDIX D--SUBJECT 4

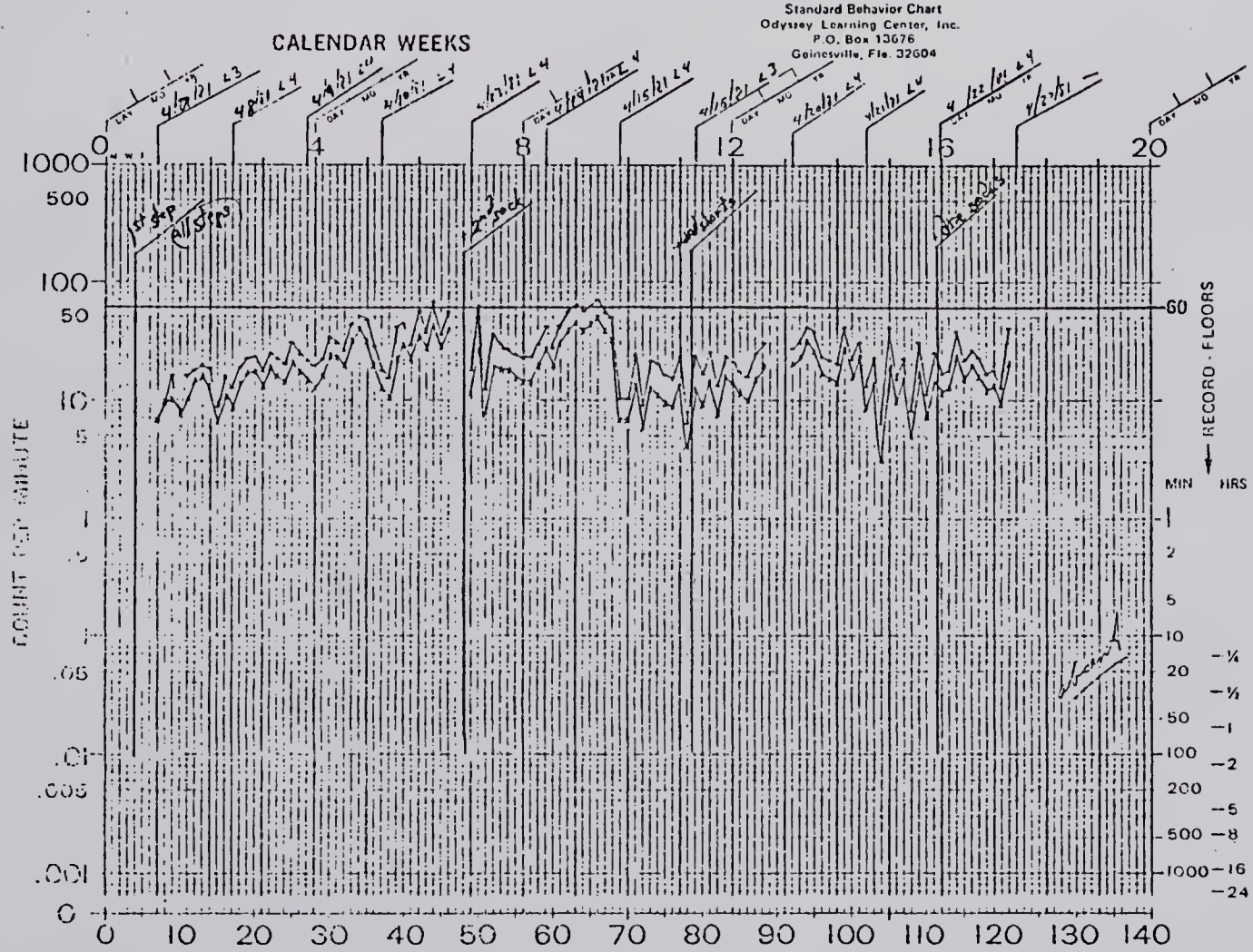

Figure D1. Subject 4, forward chaining in undressing using socks by trials.

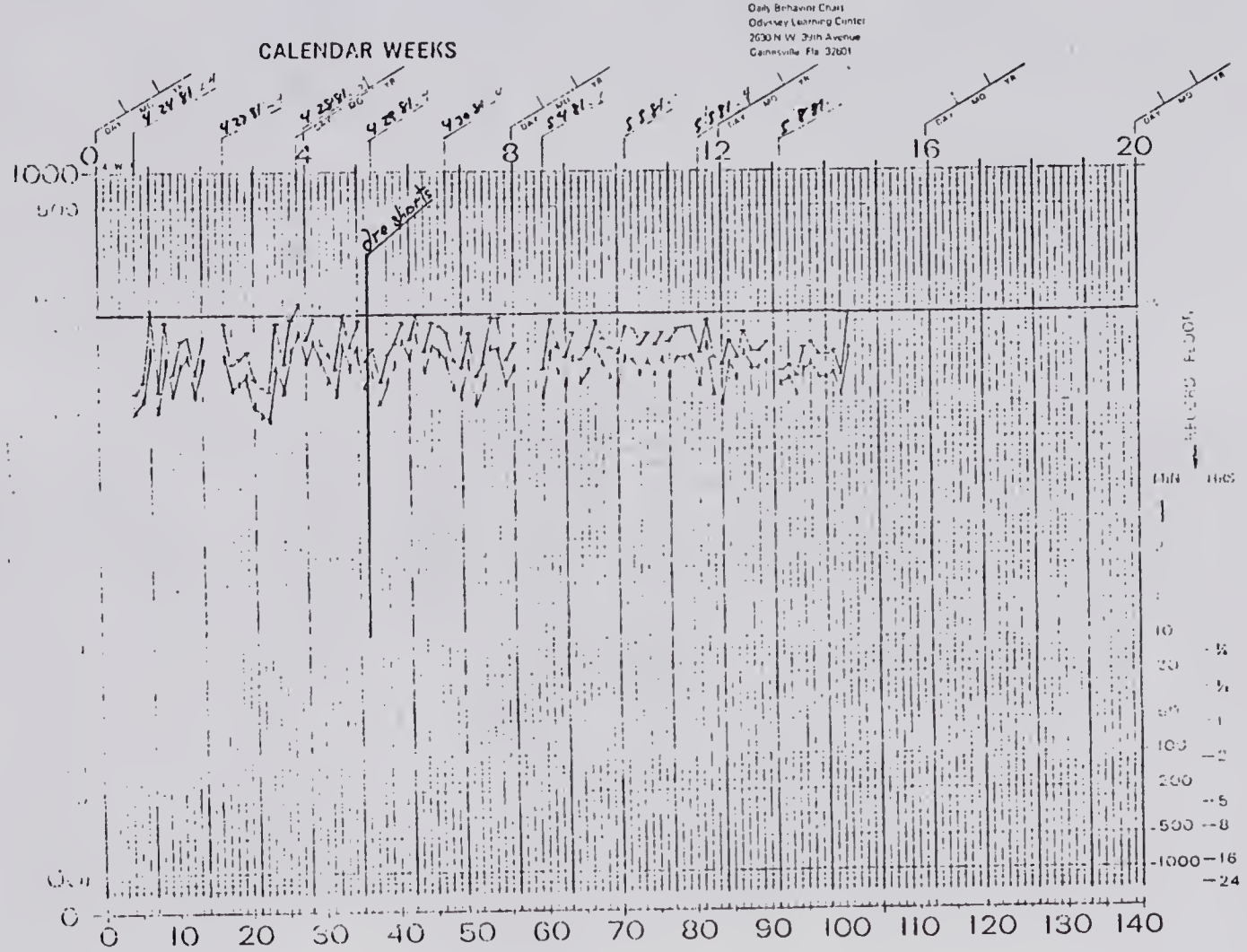

Figure D2. Subject 4, forward chaining in undressing using socks by trials.

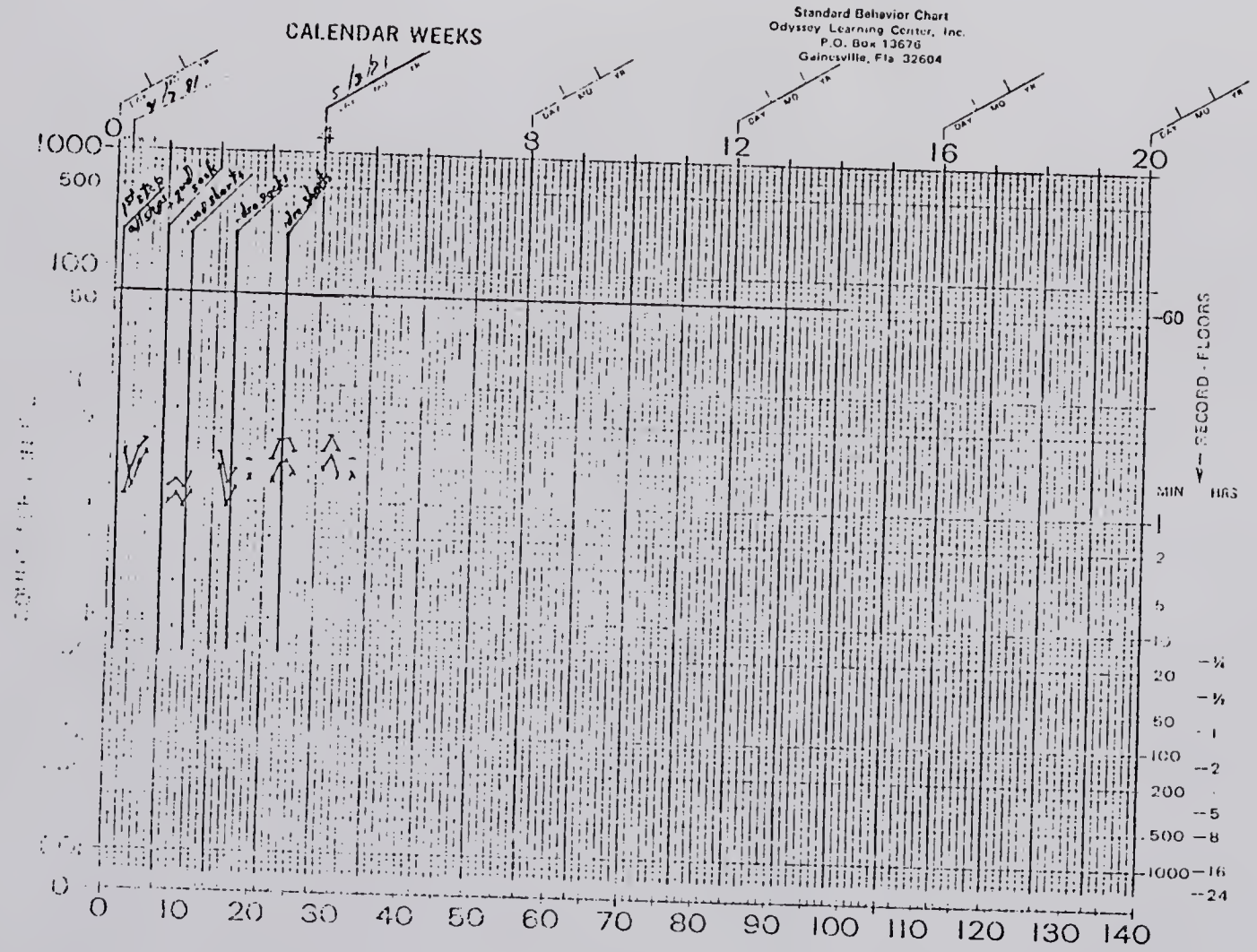

Figure D3. Subject 4, forward chaining in undressing using socks by sessions.

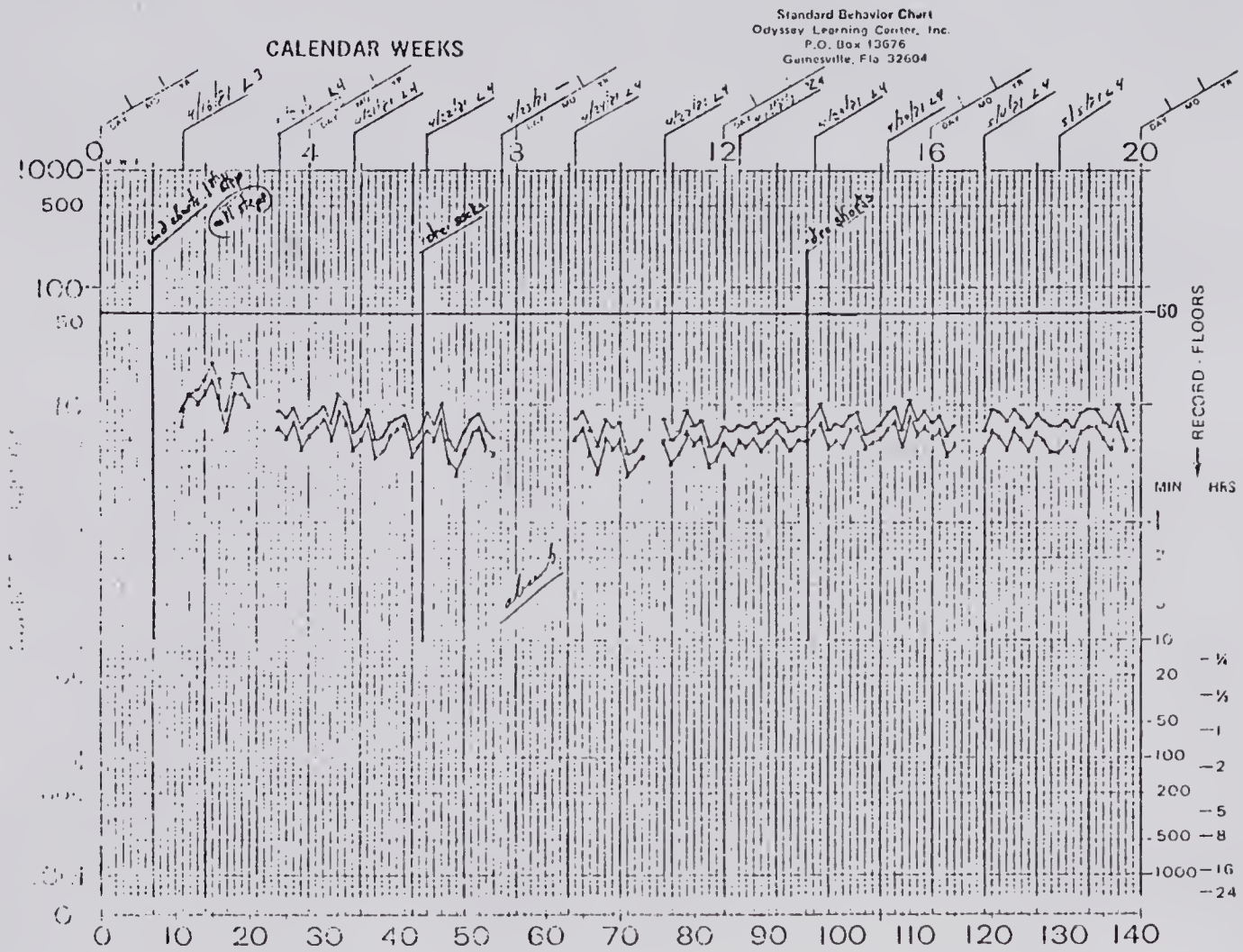

Figure D4. Subject 4, forward chaining in undressing using shorts by sessions.

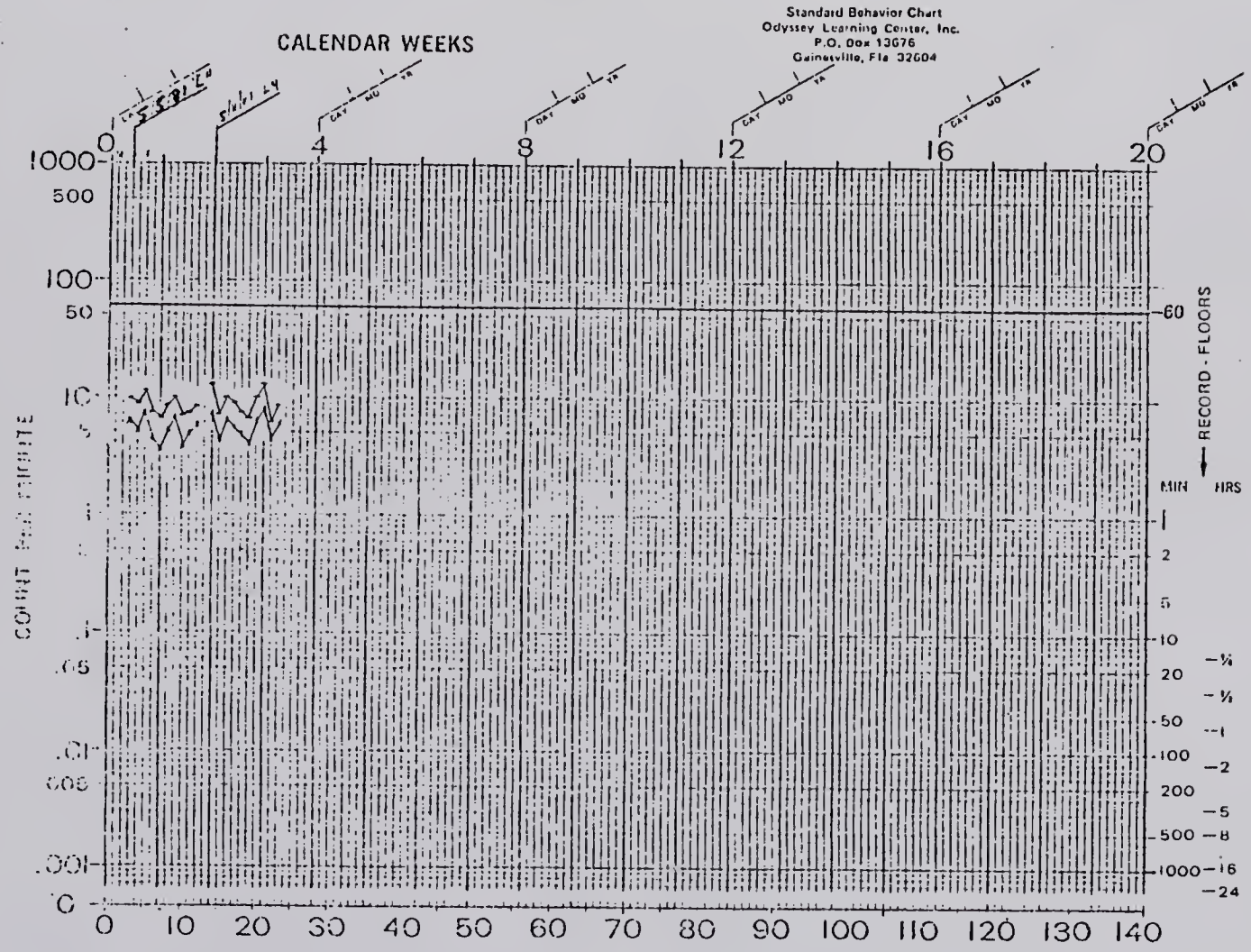

Figure D5. Subject 4, forward chaining in undressing using shorts by trials.

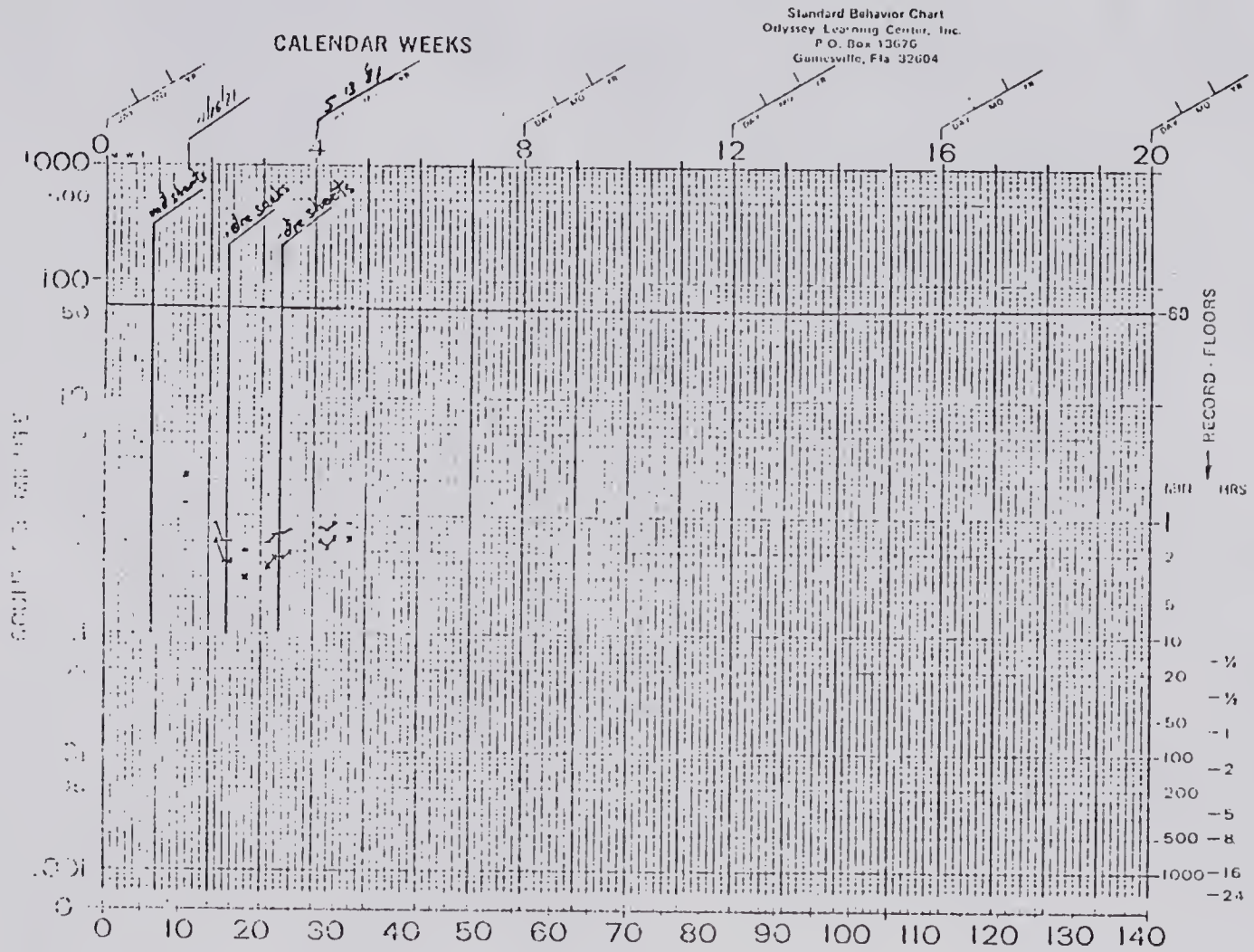

Figure D6. Subject 4, forward chaining in undressing using shorts by sessions.

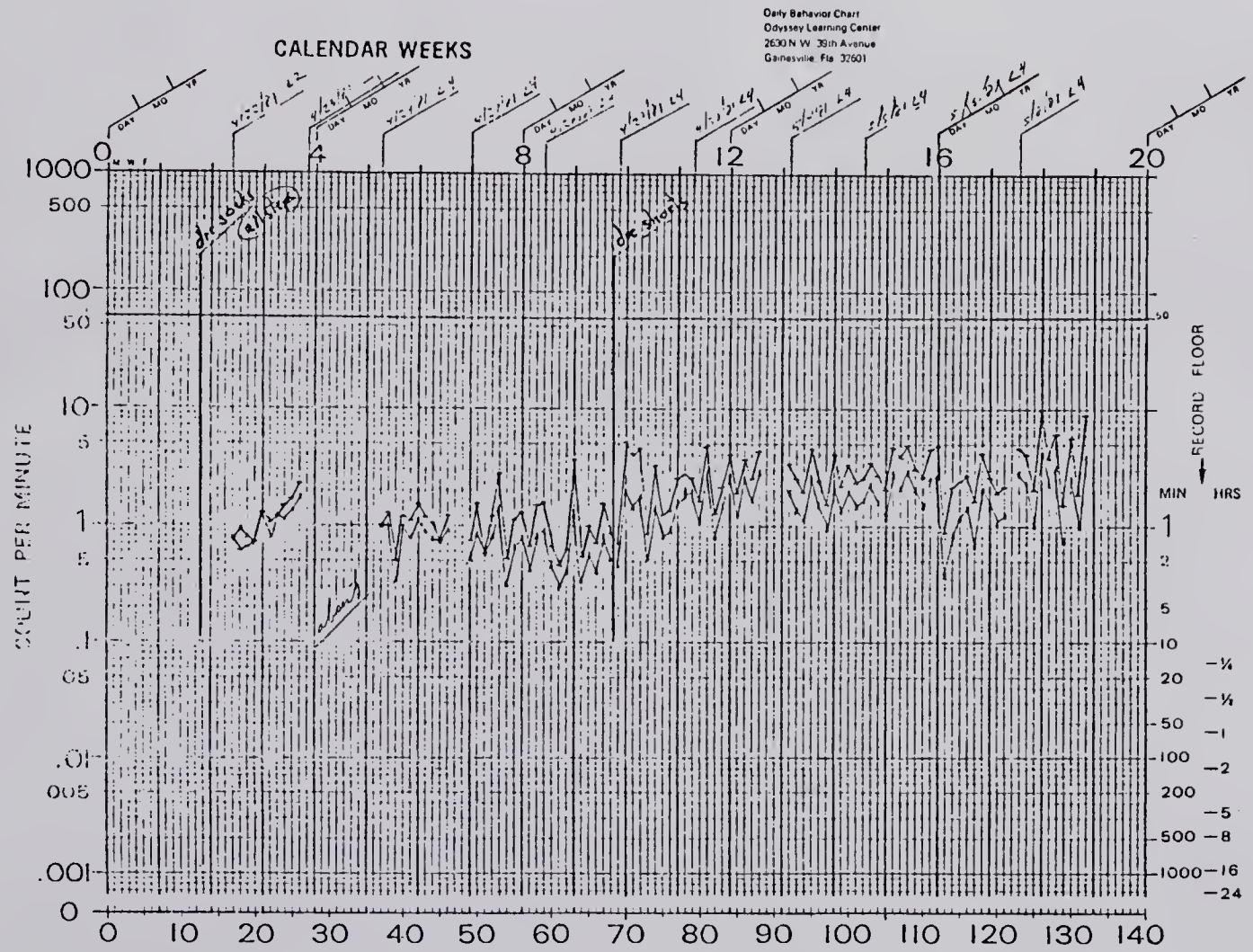

Figure D7. Subject 4, forward chaining in dressing using socks by trials.

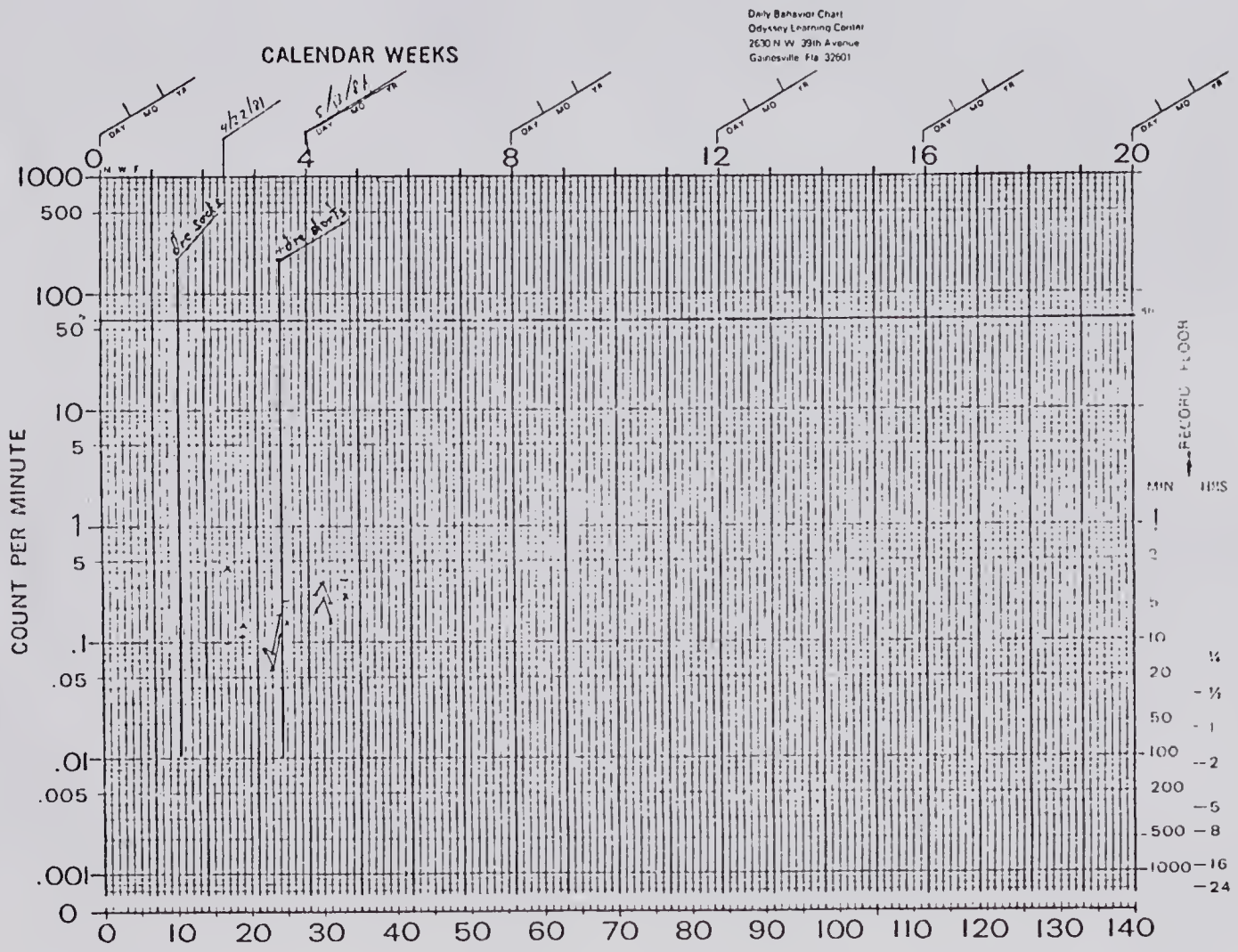

Figure D8. Subject 4, forward chaining in dressing using socks by sessions.

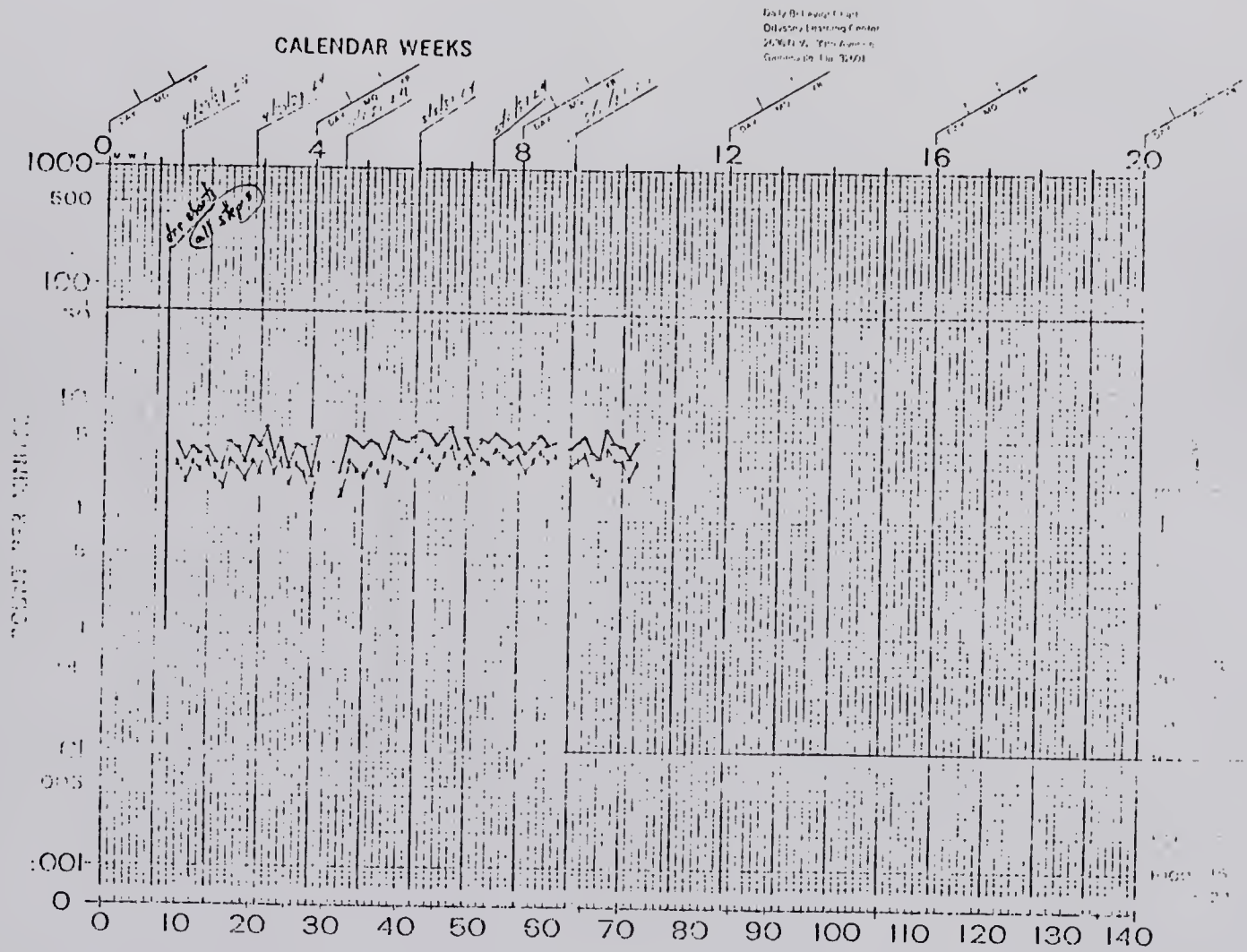

Figure D9. Subject 4, forward chaining in dressing using shorts by trials.

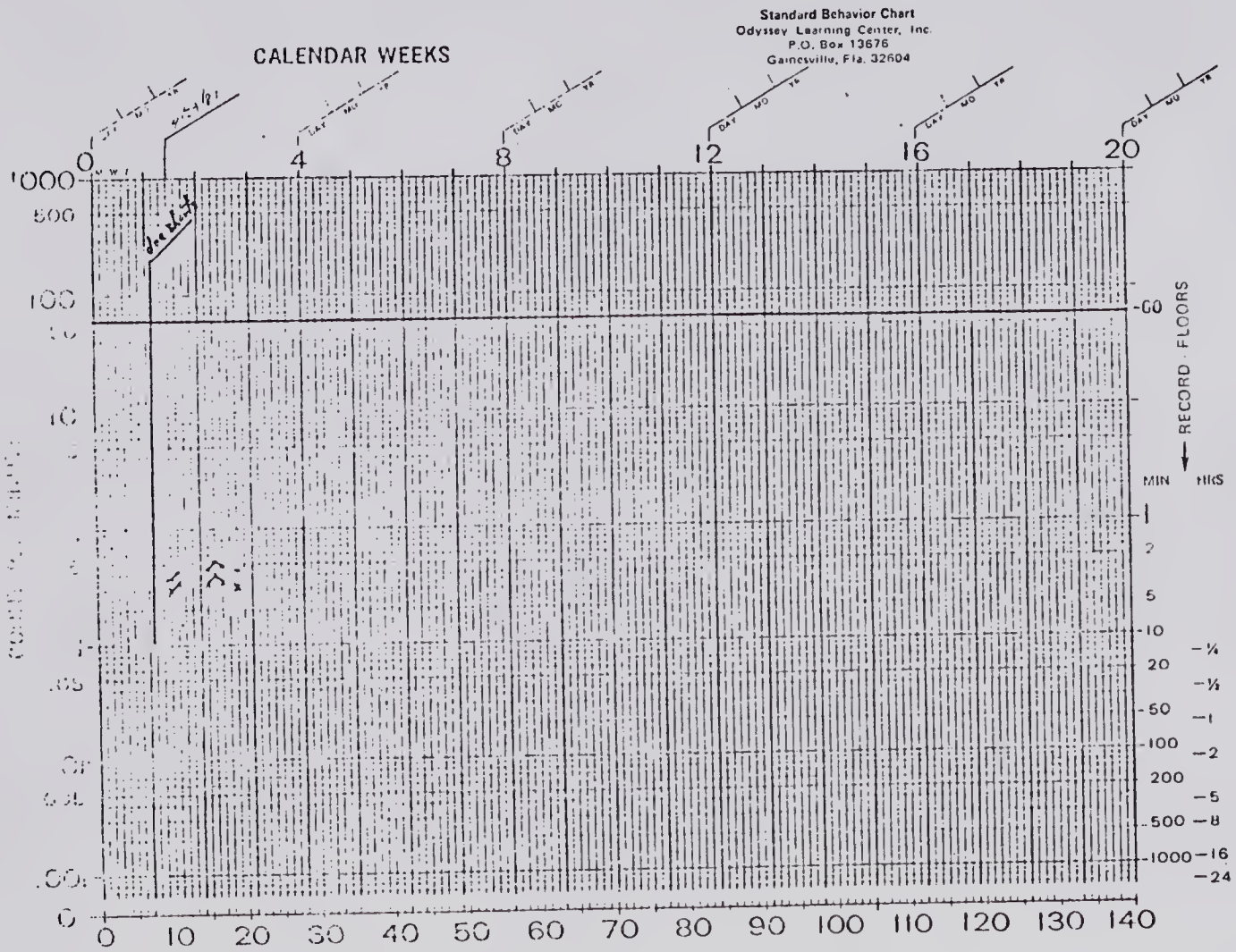

Figure D10. Subject 4, forward chaining in dressing using shorts by sessions.

APPENDIX E--SUBJECT 5

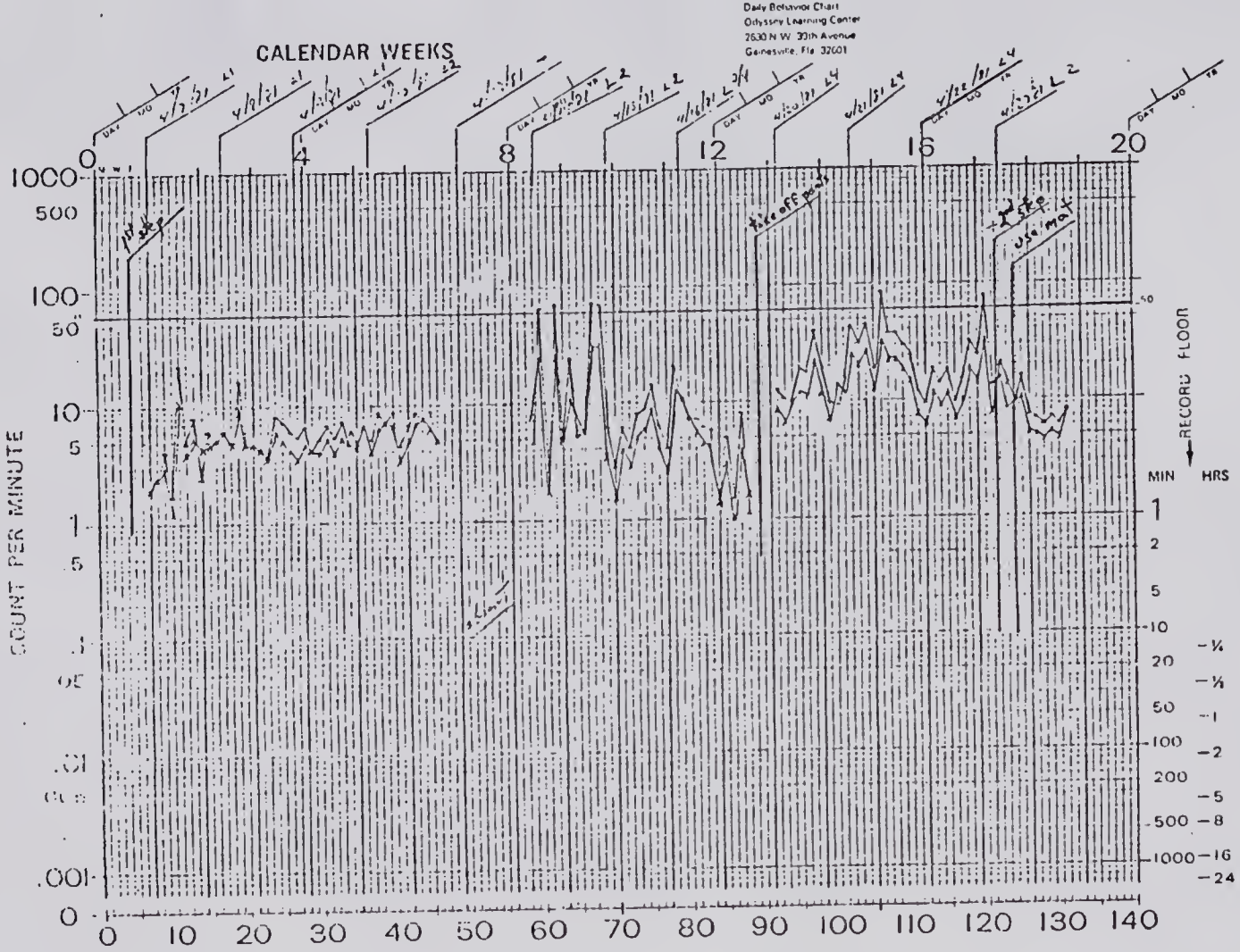

Figure E1. Subject 5, forward chaining in undressing using socks by trials.

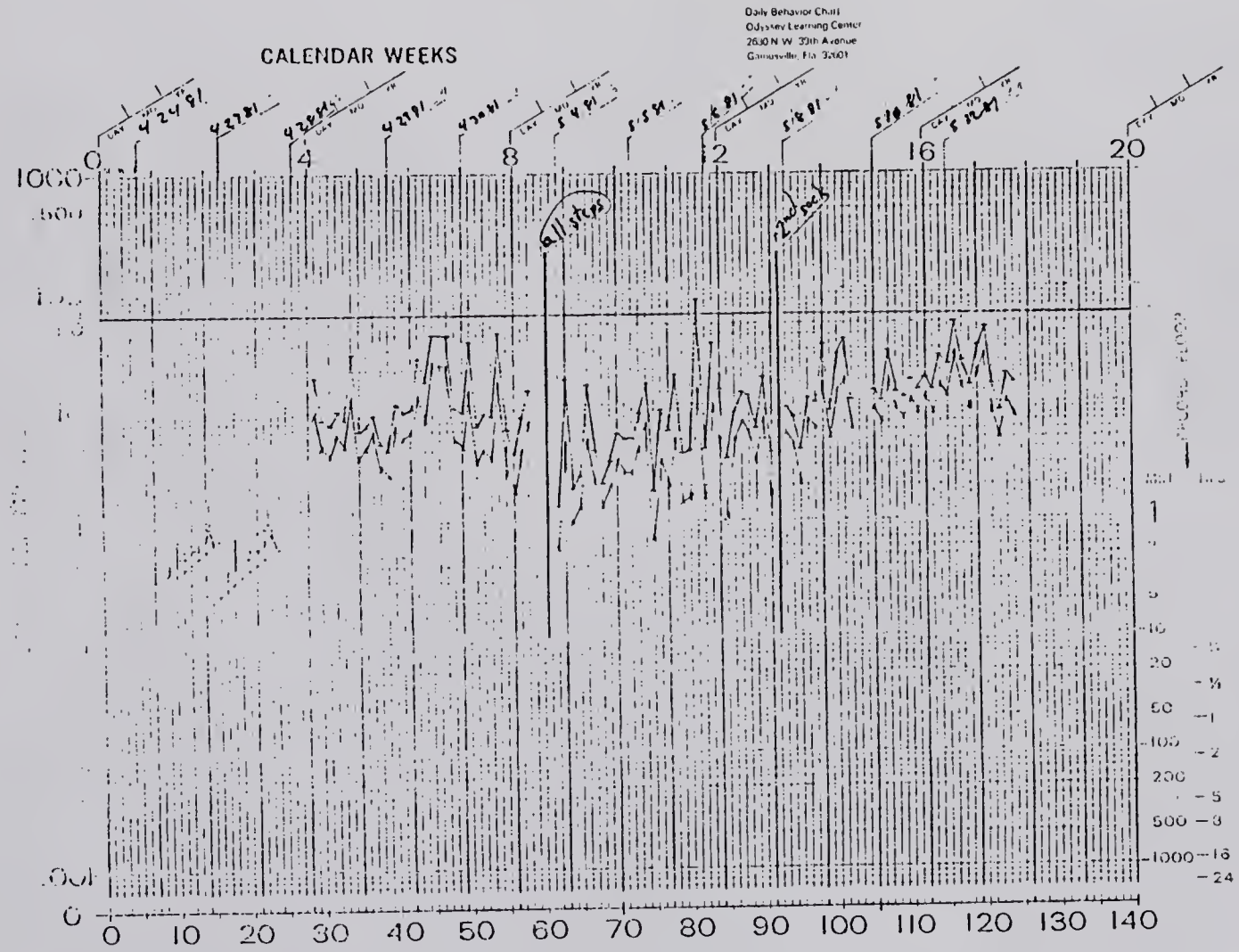

Figure E2. Subject 5, forward chaining in undressing using socks by trials.

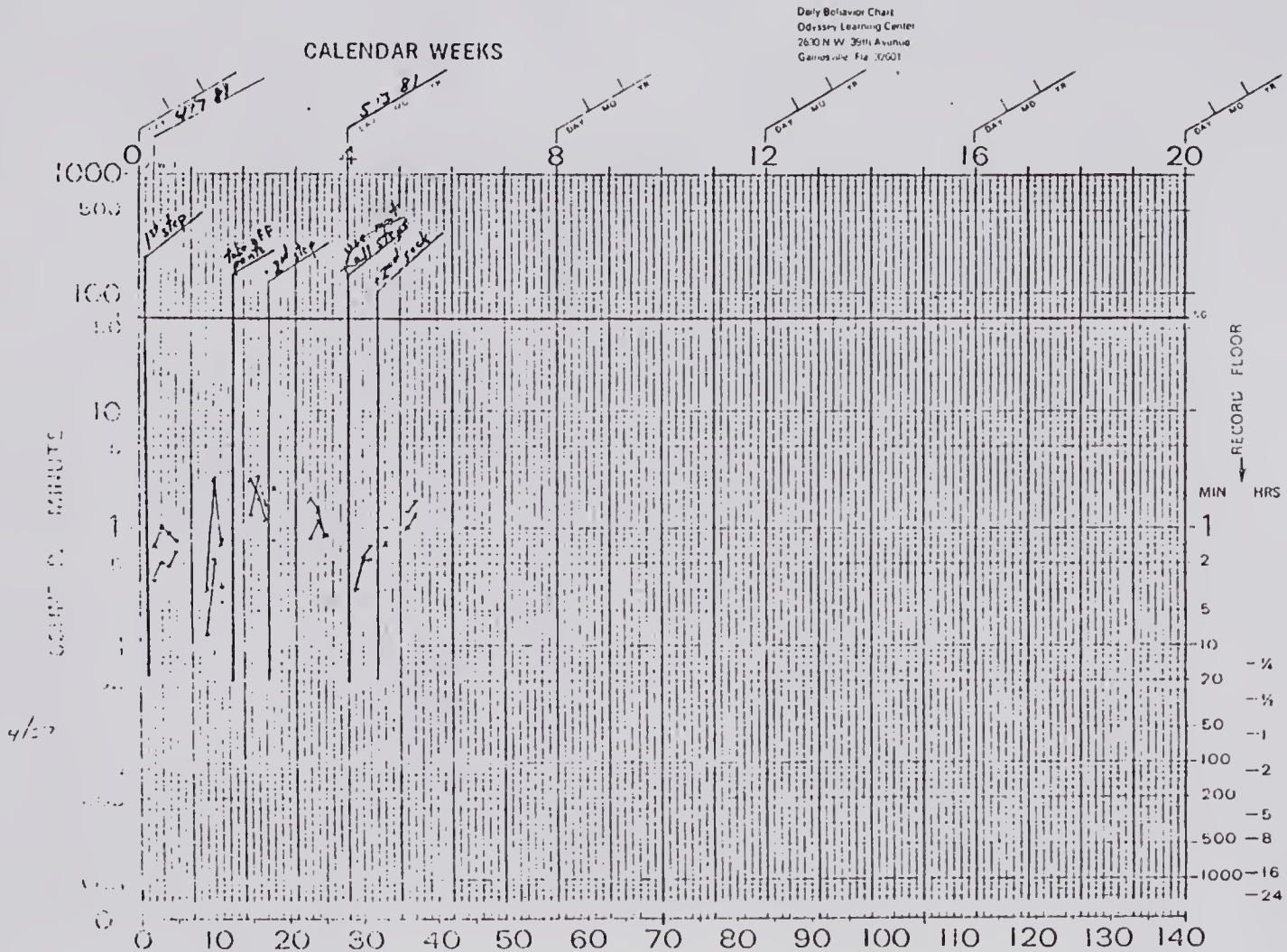

Figure E3. Subject 5, forward chaining in undressing using socks by sessions.

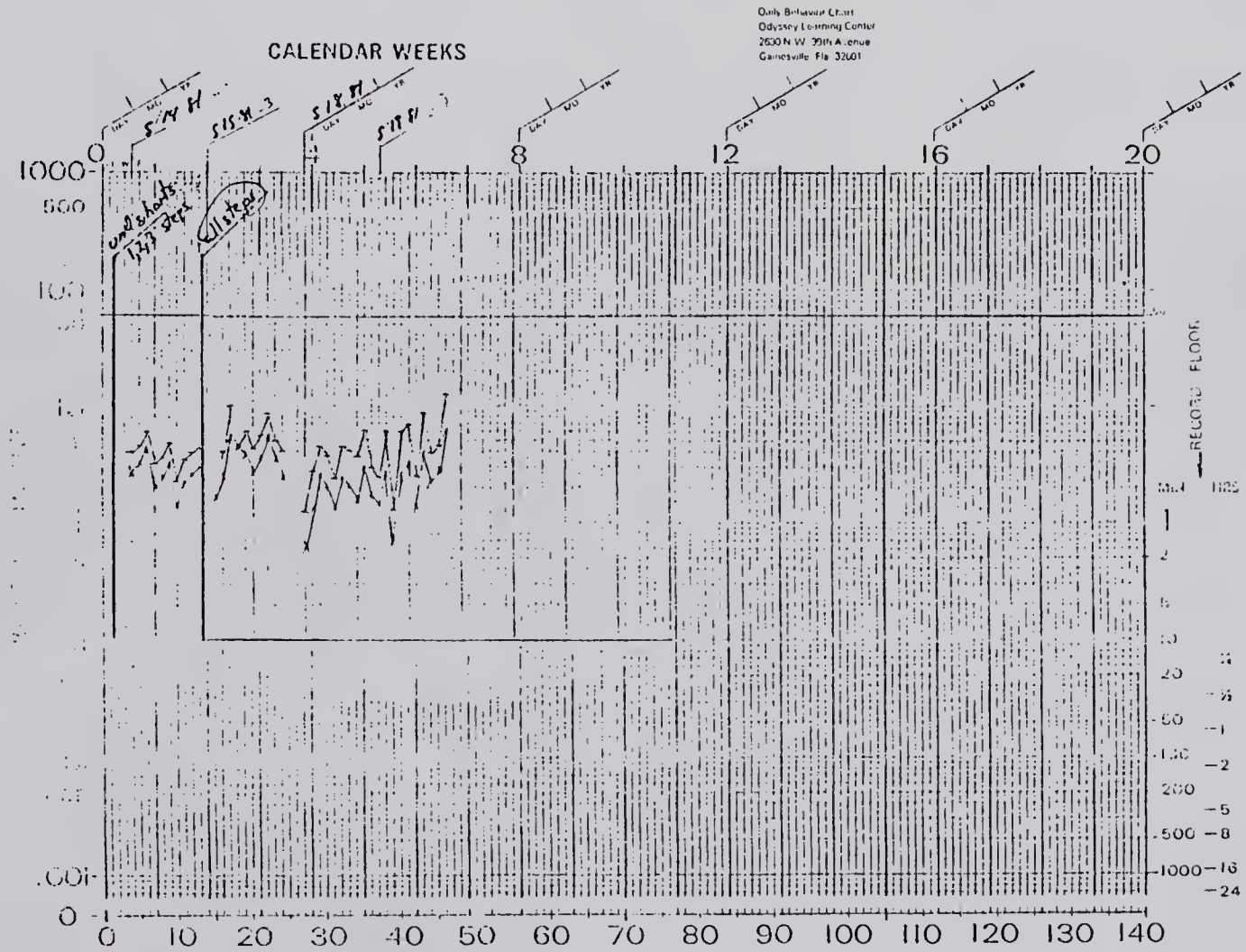

Figure E4. Subject 5, forward chaining in undressing using shorts by trials.

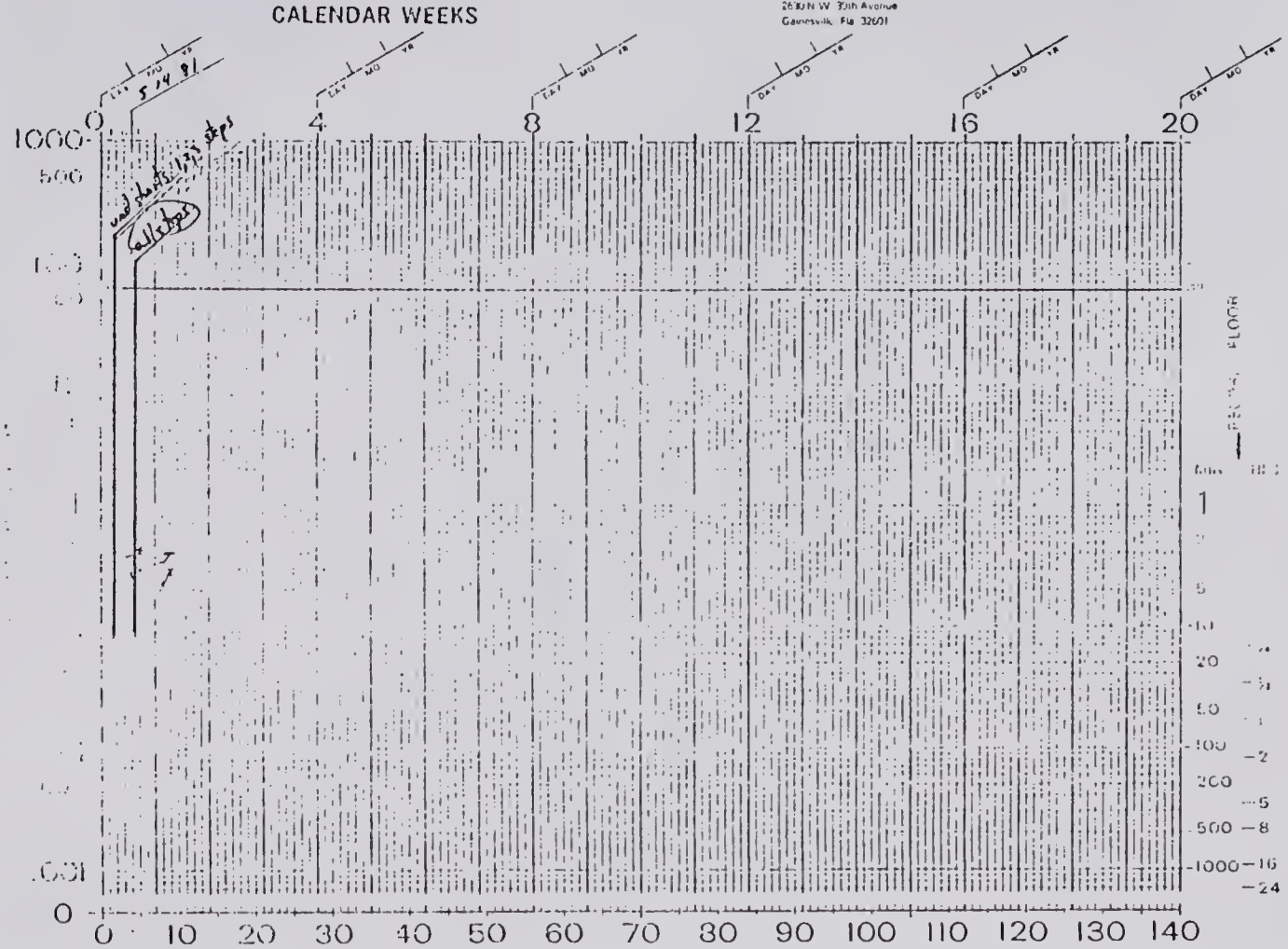

Figure E5. Subject 5, forward chaining in undressing using shorts by sessions.

APPENDIX F--SUBJECT 6

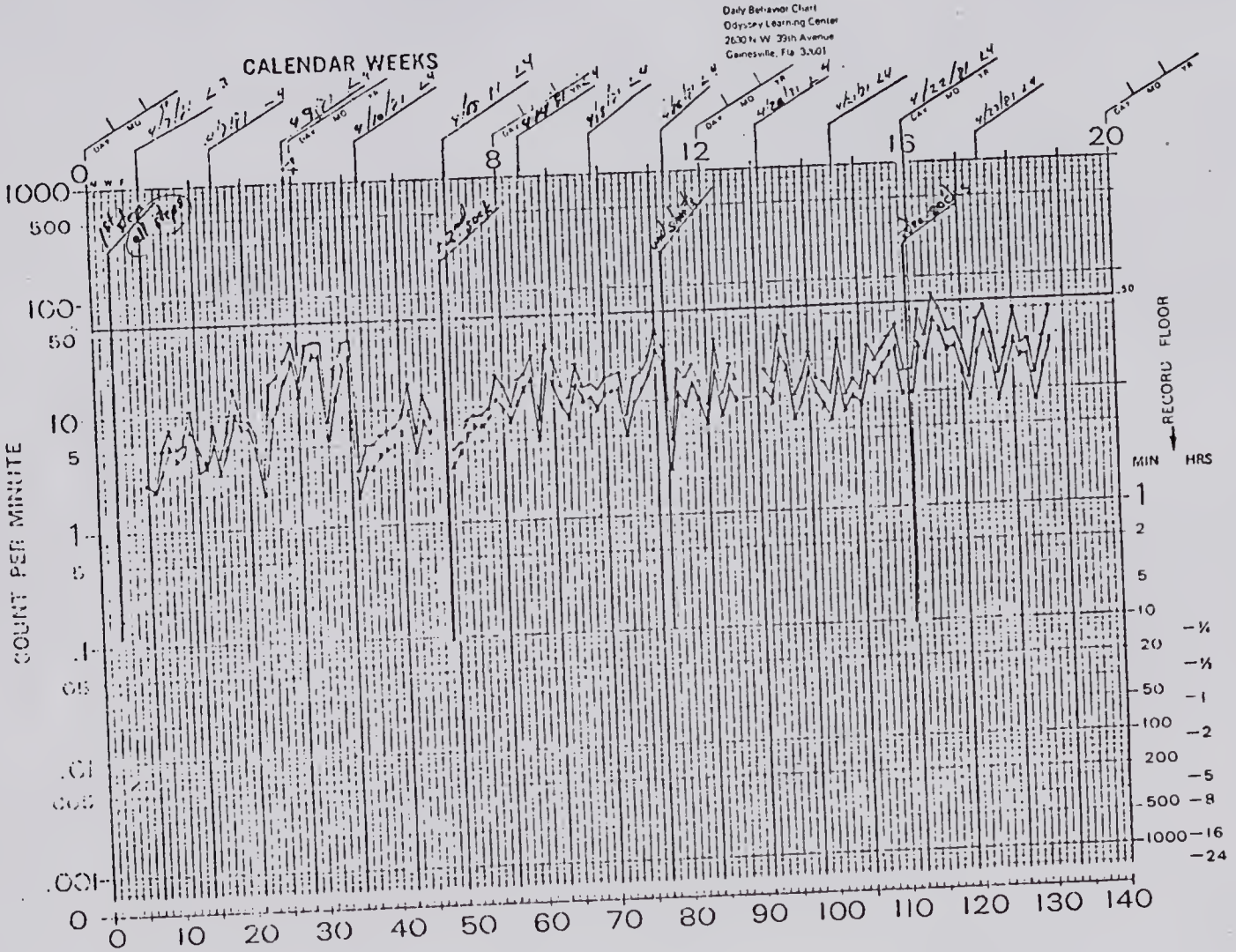

Figure F1. Subject 6, forward chaining in undressing using socks by trials.

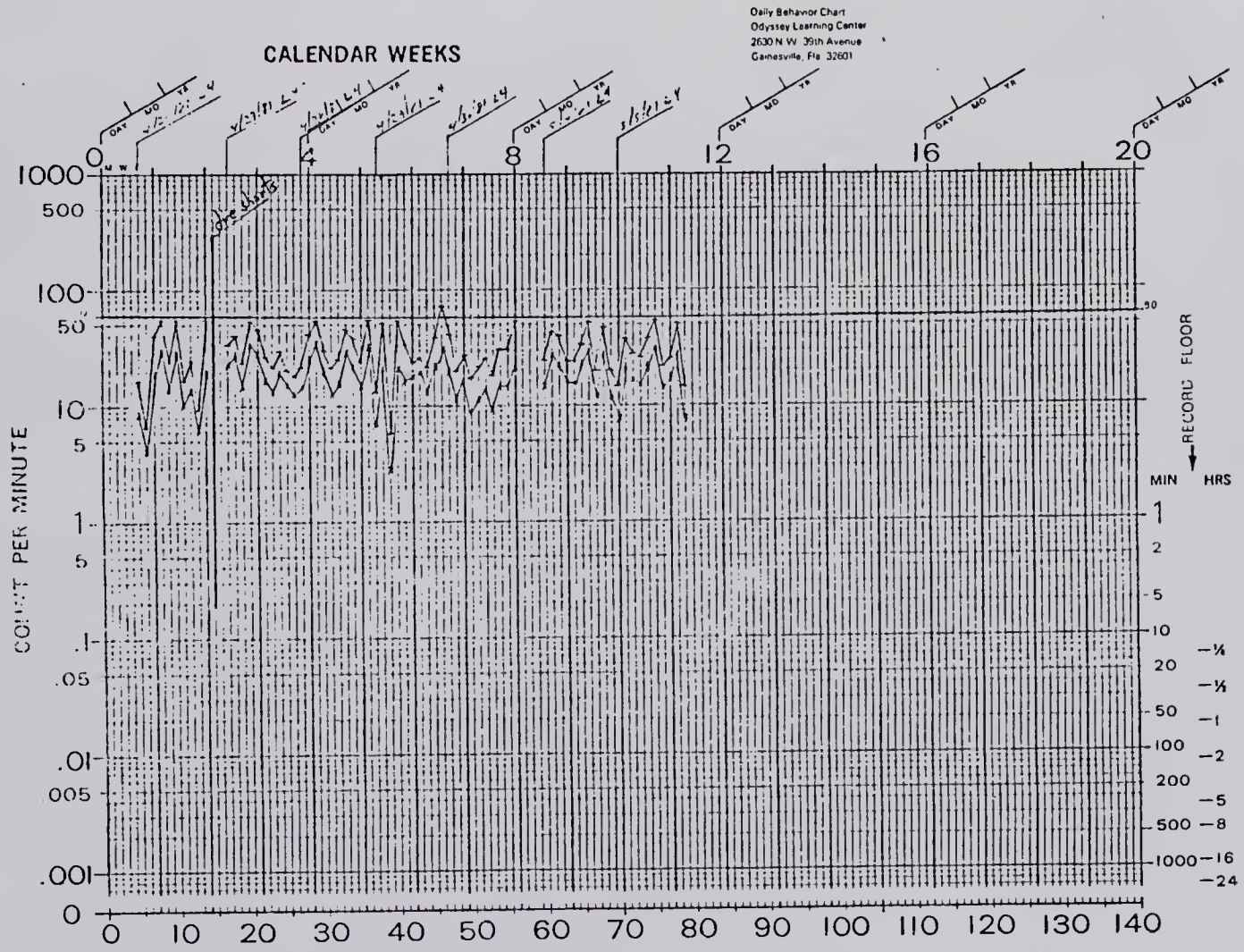

Figure F2. Subject 6, forward chaining in undressing using socks by trials.

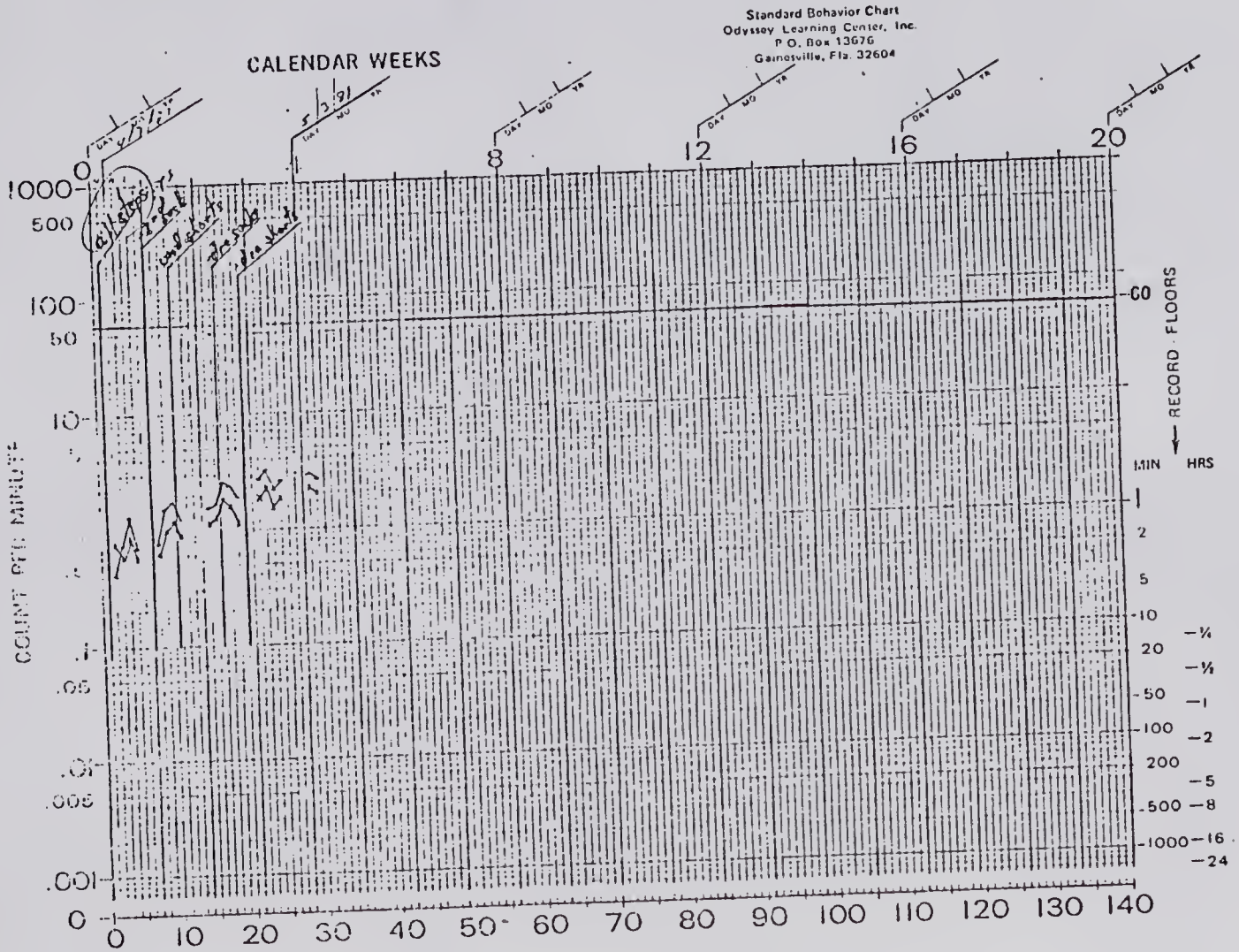

Figure F3. Subject 6, forward chaining in undressing using socks by sessions.

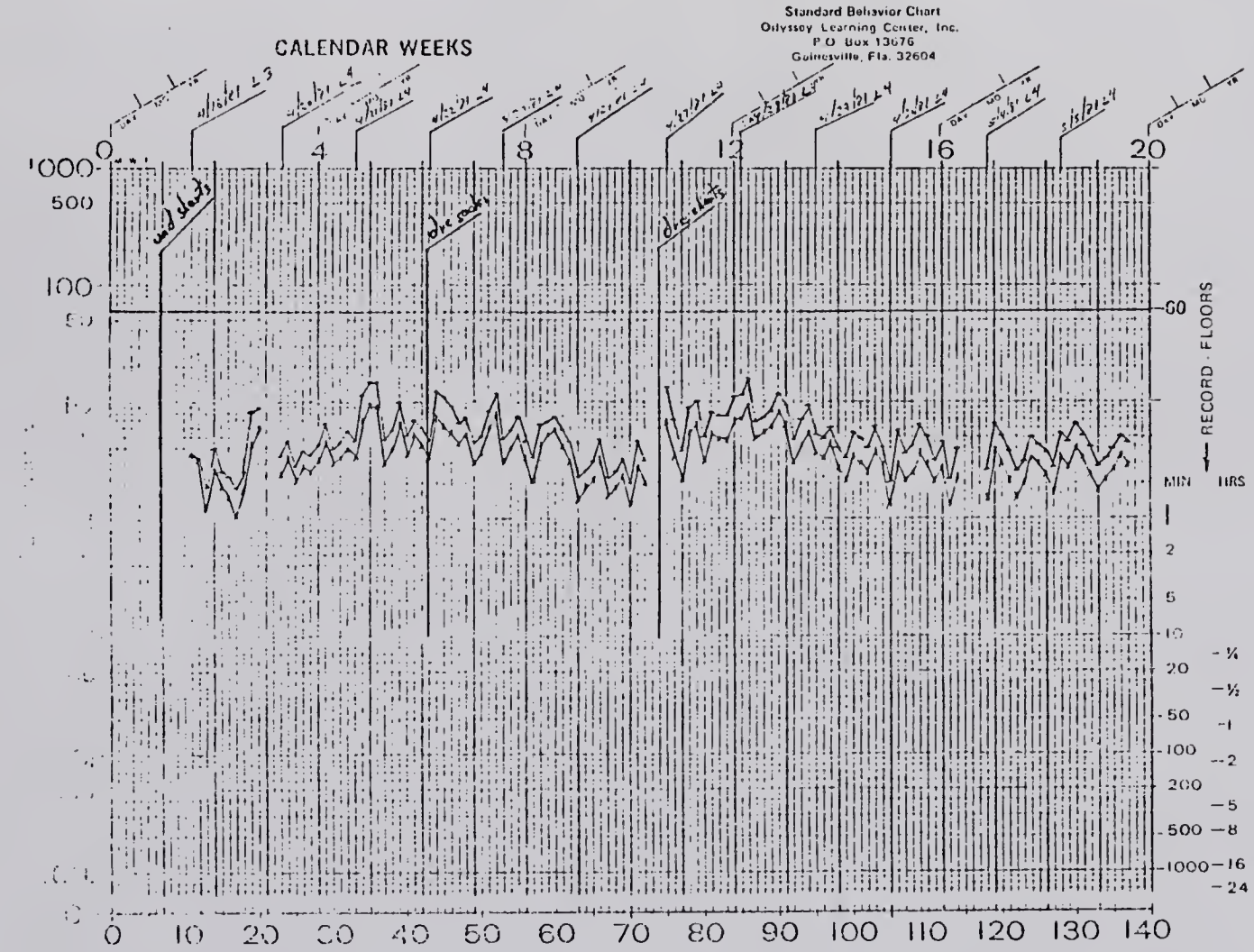

Figure F4. Subject 6, forward chaining in undressing using shorts by trials.

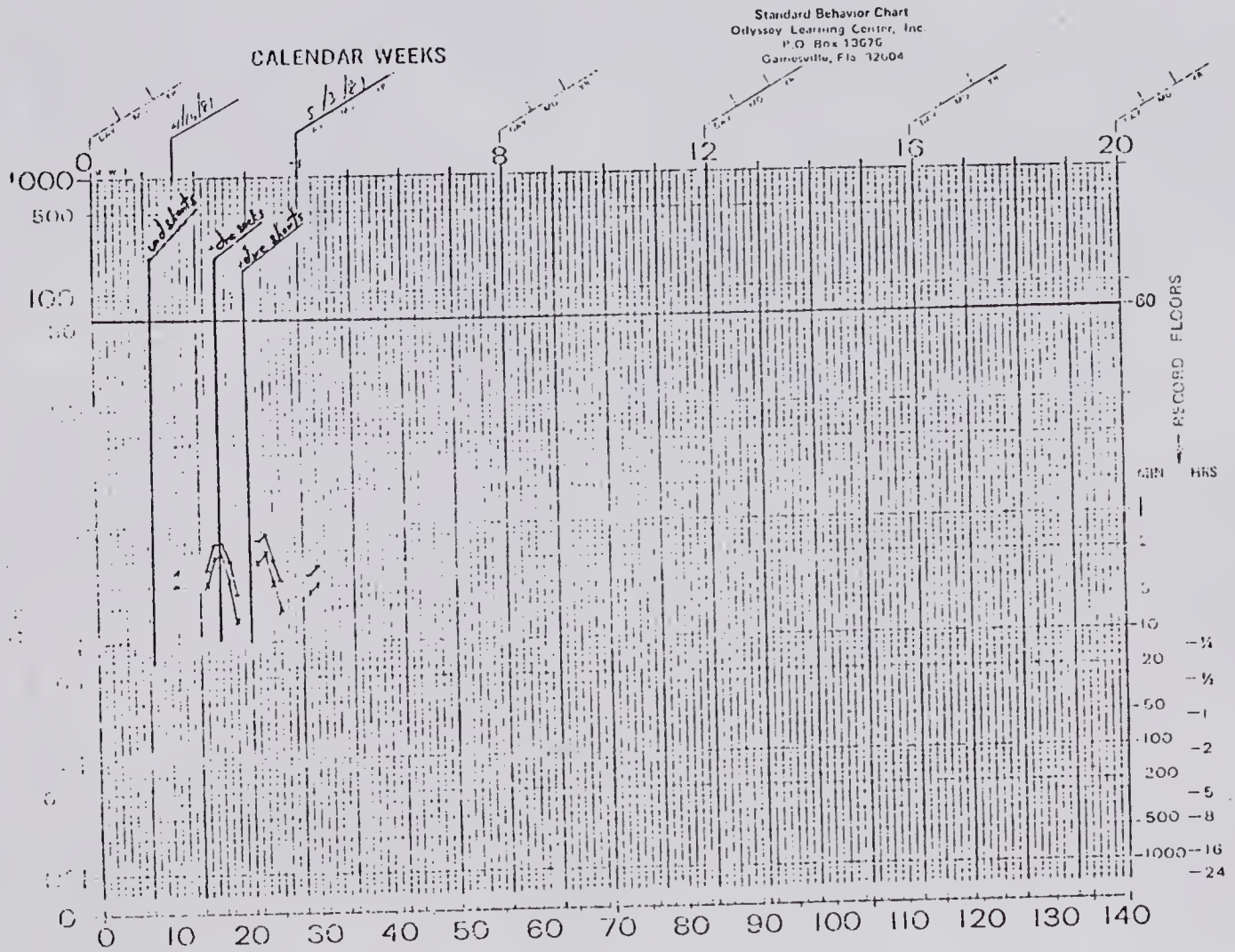

Figure F5. Subject 6, forward chaining in undressing using shorts by sessions.

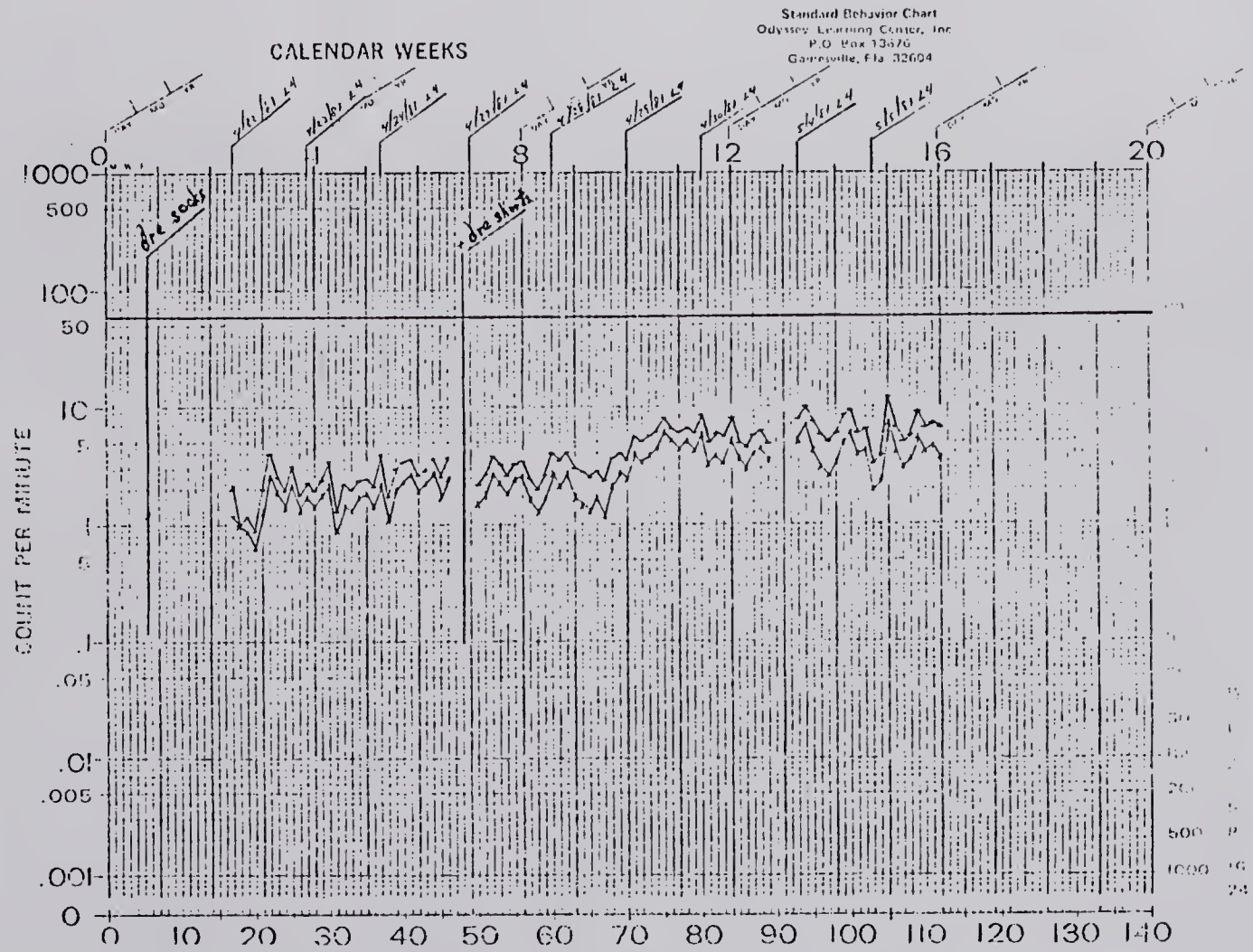

Figure F6. Subject 6, forward chaining in dressing using socks by trials.

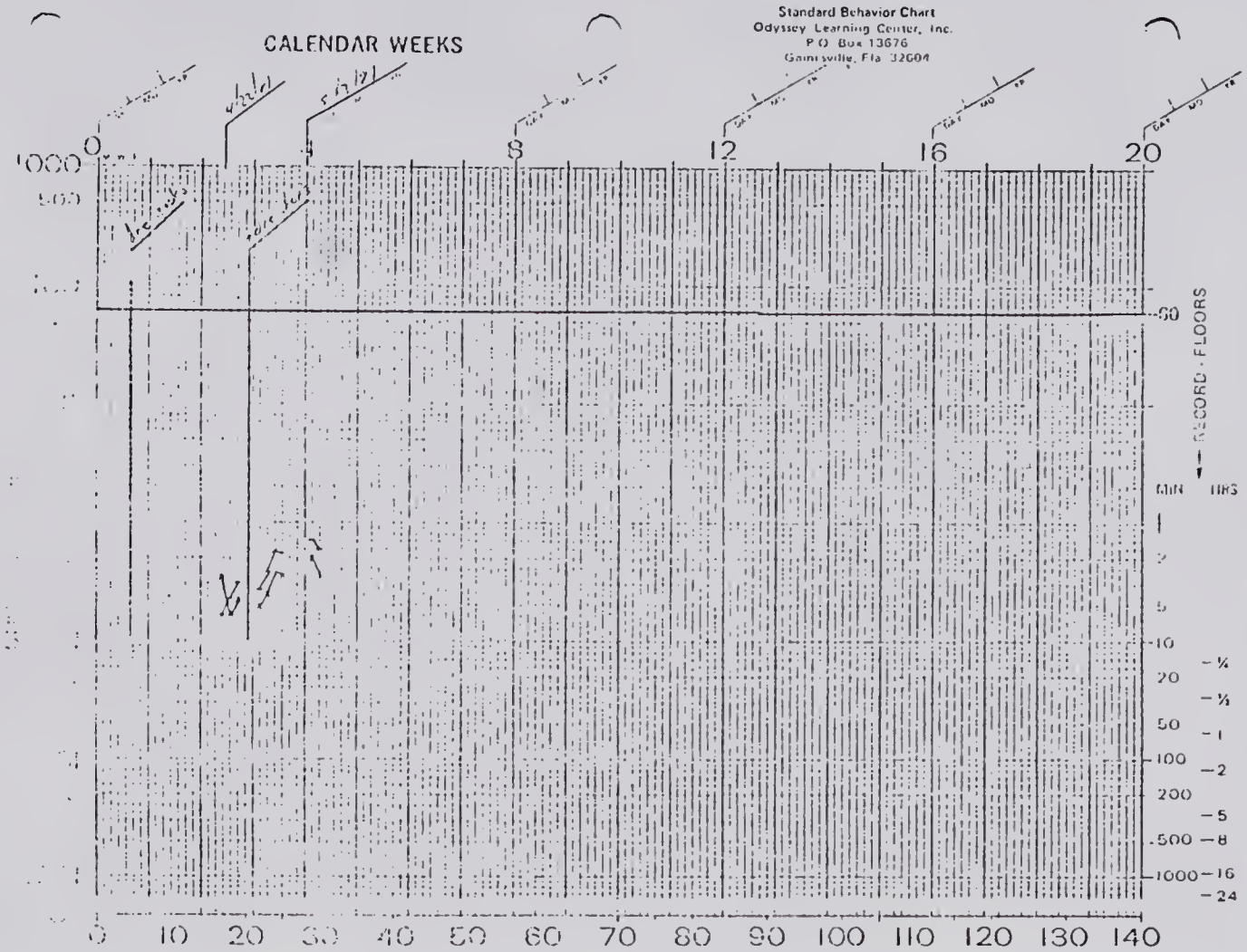

Figure F7. Subject 6, forward chaining in dressing using socks by sessions.

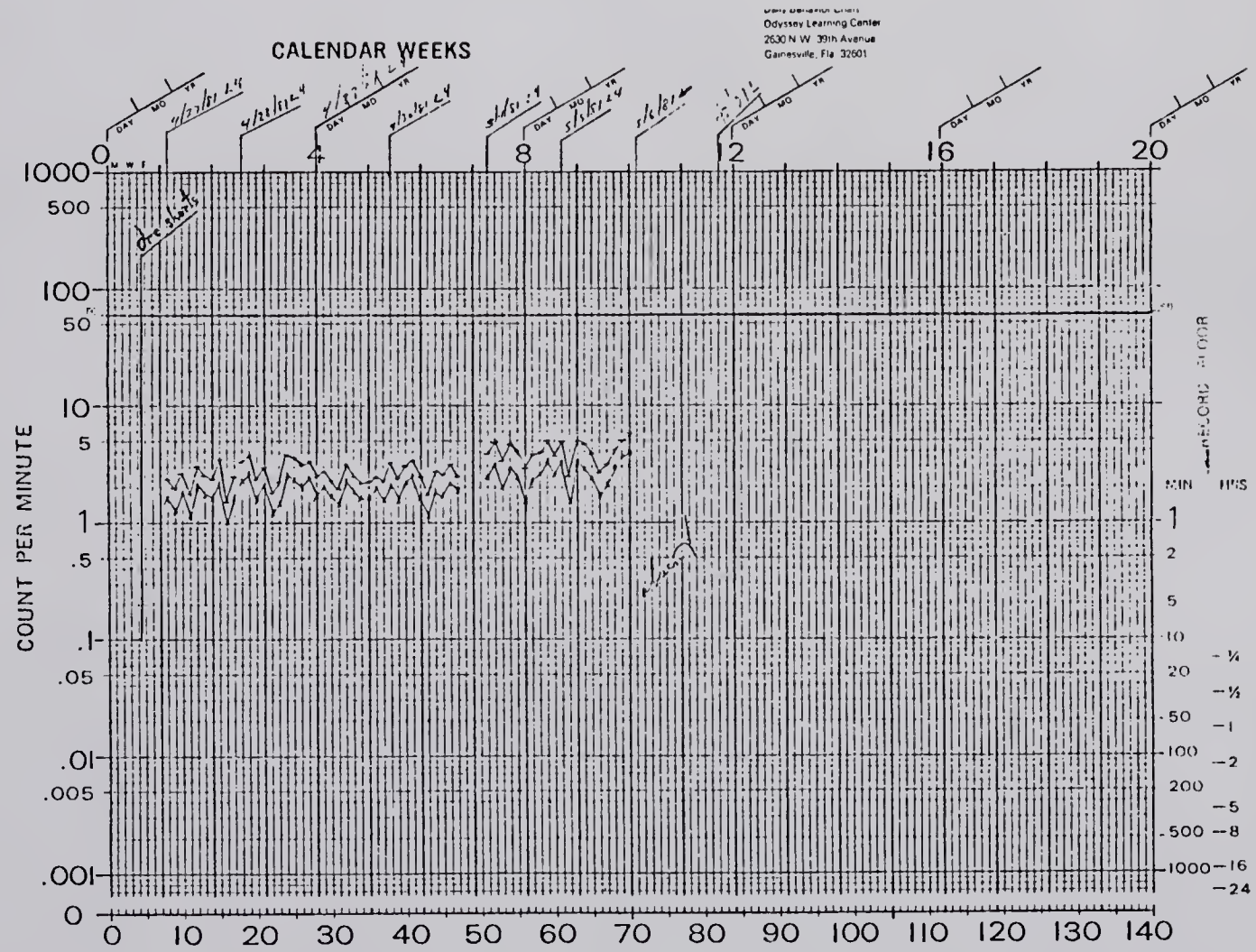

Figure F8. Subject 6, forward chaining in dressing using shorts by trials.

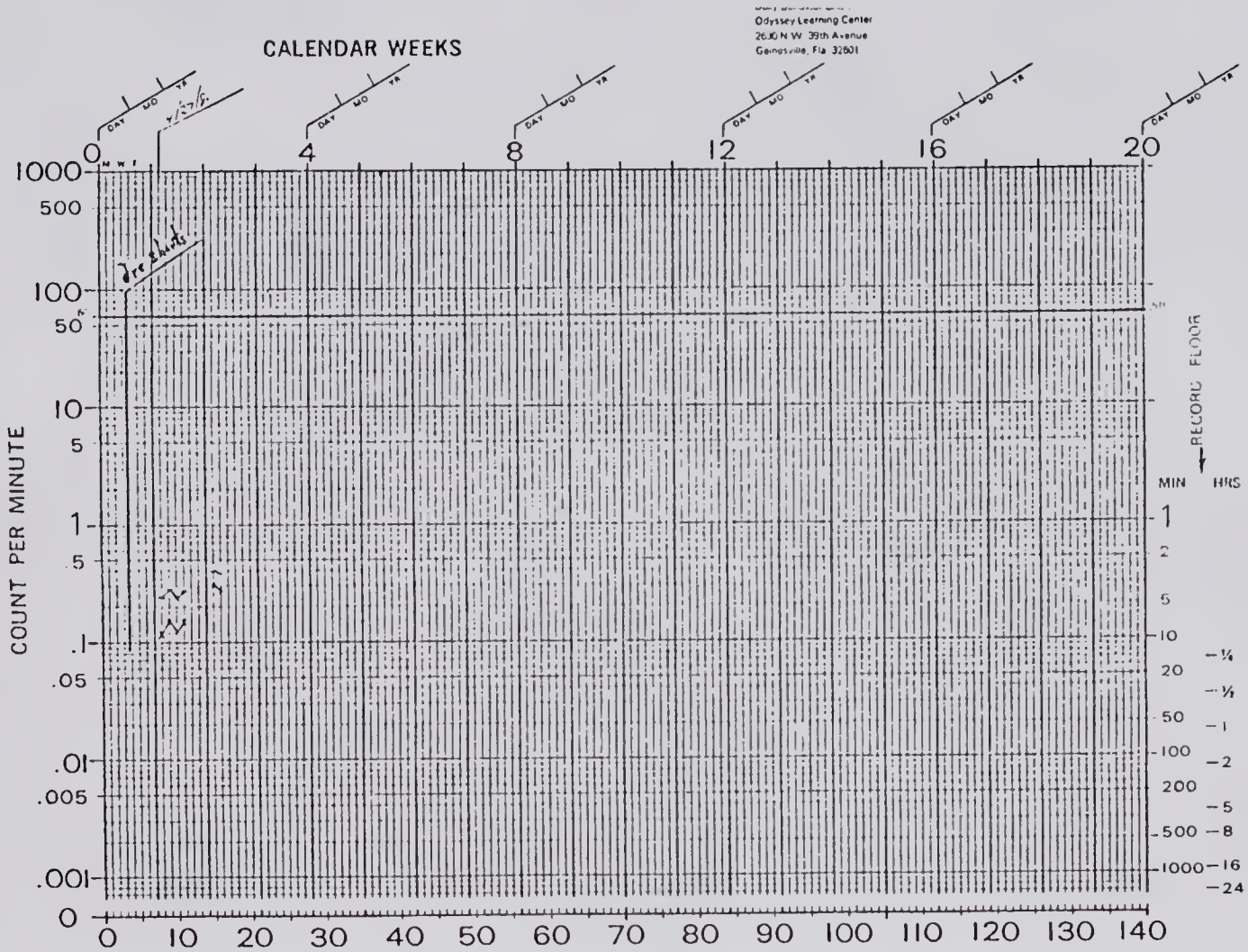

Figure F9. Subject 6, forward chaining in dressing using shorts by sessions.

APPENDIX G--TABLES OF ERROR RATE AND TRIALS TO CRITERION

Table 15. Error rate across step(s) by subjects using backward or forward chaining in undressing using socks

Subjects	Error rate									
	Steps									
	1	2	3	4	5	6	7	8	9	10
Backward chaining										
Subject 1	26	6	4	6	1	0	0	0	0	0
Subject 2	11	0	0	4	3	0	0	0	1	0
Subject 3	3	0	0	13	0	0	0	0	4	0
Forward chaining[a]										
Subject 4	3	0	0	0	0	0	0	0	0	0
Subject 5	42	14	0	0	0	0	0	0	2	0
Subject 6	5	0	0	0	0	0	0	0	0	0

Note. Steps 6-10 are actually a repeat of steps 1-5, but involve removal of the sock from the other (second) foot.

[a]Numbering of steps in forward chaining correspond to the sequence of step presentation and do not correspond to the numbering of steps in backward chaining.

Table 16. Error rate across step(s) by subjects using backward or forward chaining in undressing using shorts

Subjects	Error rate				
	Steps				
	1	2	3	4	5
Backward chaining					
Subject 1	(19)[a]	--[b]	--	--	--
Subject 2	2	(2)	--	--	--
Subject 3	5	--	--	--	--
Forward chaining[c]					
Subject 4	0	0	0	3	0
Subject 5	0	0	0	1	0
Subject 6	0	0	0	2	0

[a]Numbers in parentheses indicate totals attained by subject(s) when investigation ended.

[b]Dotted line indicates task had not been introduced to subject(s).

[c]Numbering of steps in forward chaining correspond to the sequence of step presentation and do not correspond to the numbering of steps in backward chaining.

Table 17. Error rate across step(s) by subjects using backward or forward chaining in dressing using socks

Subjects	Error rate									
	Steps									
	1	2	3	4	5	6	7	8	9	10
Backward chaining										
Subject 1	--[a]	--	--	--	--	--	--	--	--	--
Subject 2	--	--	--	--	--	--	--	--	--	--
Subject 3	--	--	--	--	--	--	--	--	--	--
Forward chaining[b]										
Subject 4	0	0	0	0	0	12	0	0	0	0
Subject 5	--	--	--	--	--	--	--	--	--	--
Subject 6	4	0	0	0	0	0	0	0	0	0

[a]Dotted line indicates task had not been introduced to subject(s).

[b]Numbering of steps in forward chaining correspond to the sequence of step presentation and do not correspond to the numbering of steps in backward chaining.

Table 18. Error rate across step(s) by subjects using backward or forward chaining in dressing using shorts

Subjects	Error rate				
	Steps				
	1	2	3	4	5
Backward chaining					
Subject 1	--[a]	--	--	--	--
Subject 2	--	--	--	--	--
Subject 3	--	--	--	--	--
Forward chaining[b]					
Subject 4	0	0	0	0	0
Subject 5	--	--	--	--	--
Subject 6	0	0	0	0	0

[a]Dotted line indicates task had not been introduced to subject(s).

[b]Numbering of steps in forward chaining correspond to the sequence of step presentation and do not correspond to the numbering of steps in backward chaining.

Table 19. Trials to criterion across step(s) by subjects using backward or forward chaining in undressing using socks

Subjects	Trials to Criterion									
	Steps									
	1	2	3	4	5	6	7	8	9	10
Backward chaining										
Subject 1	70	40	30	30	30					(30)[a]
Subject 2	40	30	30	60	30					(30)
Subject 3	40	30	30	60	30					(30)
Forward chaining[b]										
Subject 4					(40)					(30)
Subject 5	100				(70)					(30)
Subject 6					(40)					(30)

Note. Steps 6-10 are actually a repeat of steps 1-5, but involve removal of the sock from the other (second) foot.

Note. A blank in the column indicates subject learned steps in groups of steps 1-5 and/or 6-10.

[a]Numbers in parentheses indicate totals of trials subject needed in learning groups of steps 1-5 and/or 6-10.

[b]Numbering of steps in forward chaining correspond to the sequence of presentation and do not correspond to the numbering of steps in backward chaining.

Table 20. Trials to criterion across step(s) by subjects using backward or forward chaining in undressing using shorts

Subjects	Trials to Criterion				
	Steps				
	1	2	3	4	5
Backward chaining					
Subject 1	(20)[a]	--[b]	--	--	--
Subject 2	30	(10)	--	--	--
Subject 3	40	--	--	--	--
Forward chaining[c]					
Subject 4					30
Subject 5					40
Subject 6					30

Note. A blank in the column indicates subject learned steps in groups of steps 1-5.

[a]Numbers in parentheses indicate totals attained by subject(s) when investigation ended.

[b]Dotted line indicates task had not been introduced to subject(s).

[c]Numbering of steps in forward chaining correspond to the sequence of presentation and do not correspond to the numbering of steps in backward chaining.

Table 21. Trials to criterion across step(s) by subjects using backward or forward chaining in dressing using socks

Subjects	Trials to Criterion									
	Steps									
	1	2	3	4	5	6	7	8	9	10
Backward chaining										
Subject 1	--[a]	--	--	--	--	--	--	--	--	--
Subject 2	--	--	--	--	--	--	--	--	--	--
Subject 3	--	--	--	--	--	--	--	--	--	--
Forward chaining[b]										
Subject 4										40
Subject 5	--	--	--	--	--	--	--	--	--	--
Subject 6										30

Note. Steps 6-10 are actually a repeat of steps 1-5, but involve placement of the sock on the other (second) foot.

Note. A blank in the column indicates subject learned steps in groups of steps 1-10.

[a]Dotted line indicates task had not been introduced to subject(s).

[b]Numbering of steps in forward chaining correspond to the sequence of presentation and do not correspond to the numbering of steps in backward chaining.

Table 22. Trials to criterion across step(s) by subjects using backward or forward chaining in dressing using shorts

Subjects	Trials to Criterion				
	Steps				
	1	2	3	4	5
Backward chaining					
Subject 1	--[a]	--	--	--	--
Subject 2	--	--	--	--	--
Subject 3	--	--	--	--	--
Forward chaining[b]					
Subject 4					30
Subject 5	--	--	--	--	--
Subject 6					30

Note. A blank in the column indicates subject learned steps in groups of steps 1-5.

[a]Dotted line indicates task had not been introduced to subject(s).

[b]Numbering of steps in forward chaining correspond to the sequence of presentation and do not correspond to the numbering of steps in backward chaining.

REFERENCES

Abramo, B., Feder, H., Geismar, H., Gelbwasser, R., Laidre, T., Lambert, E., Leibowitz, G., Sacks, L., Strasburger, G. Teaching the retarded child. Flushing, New York: Medical Examination, 1975.

Abramson, S. E., & Wunderlich, R. A. Dental hygiene-training for retardates: An application of behavioral techniques. Mental Retardation, 1972, 10 (3), 6-8.

Adams, J., & Shepp, B. Selective attention and breadth of learning: A developmental study. Journal of Experimental Child Psychology, 1975, 20 (1), 168-180.

Alper, T., Nowlin, L., Lemoine, K., Perine, M. & Bettencourt, B. The rated assessment of academic skills. Academic Therapy, 1974, 9, 151-164.

Anderson, D., Hodson, G., & Jones, W. Instructional programming for the handicapped student. Springfield, Illinois: Charles C. Thomas, 1975.

Azrin, N. H., Shaeffer, R. M., & Wesolowski, M. D. A rapid method of teaching profoundly retarded persons to dress. Mental Retardation, 1976, 14 (6), 29-33.

Baldwin, V., Fredericks, H. D., & Brodsky, G. A training program for parents of retarded children. Springfield, Illinois: Charles C. Thomas, 1973.

Ball, T. S., Seric, K., & Payne, L. Longterm retention of self-help skill training in the profoundly retarded. American Journal of Mental Deficiency, 1971, 76, 378-382.

Behavioral characteristics progression--The Santa Cruz special education management system. Palo Alto, California: Vort Corp., 1973.

Bellamy, G. T. Habilitation of the severely and profoundly retarded: A review of research on work productivity. In G. T. Bellamy (Ed.), Habilitation of severely and profoundly retarded adults: Reports from the specialized training program. Eugene, Oregon: University of Oregon Center on Human Development, 1976.

Bellamy, G. T., Horner, R. H., & Inman, D. P. Vocational habilitation of severely retarded adults: A direct service technology. Baltimore: University Park Press, 1979.

Bellamy, G. T., Inman, D. P., & Schwarz, R. H. Vocational training and production supervision. A review of habilitation techniques for the severely and profoundly retarded. In N. G. Haring & D. Bricker (Eds.), Teaching the severely and profoundly handicapped (Vol. 3). Seattle: AAESPH, 1978.

Bensberg, G. J. Teaching the mentally retarded: A handbood for ward personnel. Atlanta, Georgia: Southern Regional Education Board, 1965.

Bensberg, G. J., Colwell, C. N., & Cassell, R. H. Teaching the profoundly retarded self-help activities by behavior shaping techniques. American Journal of Mental Deficiency, 1965, 69 (5), 674-679.

Bensberg, G. J., & Slominski, A. Helping the retarded learn self-care. In G. J. Bensberg (Ed.), Teaching the mentally retarded: A handbook for ward personnel. Atlanta, Georgia: Southern Regional Education Board, 1965.

Bigge, J. Self-care. In J. L. Bigge & P. O'Donnell (Eds.), Teaching individuals with physical and multiple disabilities. Columbus, Ohio; Charles E. Merrill, 1976.

Bijou, S. W., & Baer, D. M. Child development I: A systematic and empirical theory. New York: Appleton-Century-Crofts, 1961.

Breland, M. Application of method. In G. J. Bensberg (Ed.), Teaching the mentally retarded: A handbood for ward personnel. Atlanta, Georgia: Southern Regional Education Board, 1965.

Brolin, D. E. Vocational preparations of retarded citizens. Columbus, Ohio: Charles E. Merrill, 1976.

Brown, A. L. The role of strategic behavior in retardate memory. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 7). New York: Academic Press, 1974.

Burton, T. A. Mental health clinic services to the retarded. Mental Retardation, 1971, 9, 38-41.

Carnine, D. W. Effects of two teacher-presentation rates on off-task behavior, answering correctly, and participation. Journal of Applied Behavior Analysis, 1976, 9, 199-206.

Copeland, M., Ford, L., & Solon, N. Occupational therapy for mentally retarded children. Baltimore, Maryland: University Park Press, 1976.

Cuvo, A. J. Child care workers as trainers of mentally retarded children. Child Care Quarterly, 1973, 2 (1), 25-37.

De Vore, M. Individualized learning program for the profoundly retarded. Springfield, Illinois: Charles C. Thomas, 1977.

Ellis, N. R. Memory processes in retardates and normals. In N. R. Ellis (Ed.), International review of research in mental retardation (Vol. 4). New York: Academic Press, 1970.

Evans, R. A., & Bilsky, L. Discrimination training on the identification of reversible letters by EMR adolescents. American Journal of Mental Deficiency, 1972, 77 (2), 169-174.

Friedenberg, W. P., & Martin, A. S. Prevocational training of the severely retarded using task analysis. Mental Retardation, 1977, 15 (2), 16-20.

Gardner, W. I. Behavior modification in mental retardation. Chicago: Aldine-Atherton, 1971.

Gesell, A., Halverson, H. M., Thompson, H., Ilg, F. L., Castner, B. M., Ames, L. B., & Amatruda, C. S. The first five years of life. New York: Harper & Brothers, 1940.

Gilhool, T. Changing public policies in the individualization of instruction: Roots and Forces. Education and Training of the Mentally Retarded, 1976, 11, 180-188.

Gold, M. W. Stimulus factors in skill training of retarded adolescents on a complex assembly task: Acquisition, transfer, and retention. American Journal of Mental Deficiency, 1972, 76 (5), 517-526.

Gold, M. W. Redundant cue removal in skill training for the retarded. Education and Training of the Mentally Retarded, 1974, 9 (1), 5-8.

Gold, M. W., & Barclay, C. R. The learning of difficult visual discriminations by the moderately and severely retarded. Mental Retardation, 1973, 11 (2), 9-11.

Gold, M. W., & Scott, K. G. Discrimination learning. In W. B. Stephens (Ed.), Training the developmentally young. New York: John Day, 1971.

Goldstein, H. Importance of social learning. In J. M. Kauffman & J. S. Payne (Eds.), Mental retardation: Introduction and personal perspectives. Columbus, Ohio: Charles E. Merrill, 1975.

Haring, N. G. Attending and responding. San Rafael, California: Dimensions, 1968.

Haring, N. G. Measurement and evaluation procedures for programming with the severely and profoundly handicapped. In E. Sontag (Ed.), Educational programming for the severely and profoundly handicapped. Reston, Virginia: CEC, 1977.

Haring, N. G. & Eaton, M. Systematic instructional procedures: An instructional hierarchy. In N. Haring, T. Lovitt, M. Eaton, & C. Hansen (Eds.), The fourth R-research in the classroom. Columbus, Ohio: Charles E. Merrill, 1978.

Haring, N. G. & Gentry, N. D. Direct and individualized instructional procedures. In N. G. Haring & R. L. Schiefelbush (Eds.), Teaching special children. New York: McGraw Hill, 1976.

Haring, N. G., Liberty, K. A., & White, O. R. Acquisition and fluency-building: Current research and instructional implication. Department of Health, Education, and Welfare, United States Office of Education, Bureau of Education for the Handicapped, Division of Research. Grant No. G007593, 1979.

Haring, N. G., White, O. R., & Liberty, K. A. An investigation of phases of learning and facilitating instructional events for the severely handicapped. Annual progress report 1977-1978, Bureau of Education for the Handicapped, Project No. 443CH70564, College of Education, University of Washington, Seattle, Washington, 1978.

Hayden, A. H. Perspectives of early childhood education in special education. In N. G. Haring (Ed.), Behavior of exceptional children: An introduction to special education. Columbus, Ohio: Charles E. Merrill, 1974.

Horner, R. D. Detailed progress report: Behavior modification program to develop self-help skills. Final Report. Wheat Ridge, Colorado: State Home and Training School, June 1968 to June 1970.

Horner, D. & Keilitz, I. Training mentally retarded adolescents to brush their teeth. Journal of Applied Behavior Analysis, 1975, 8, 301-309.

House, B. J., Problem length and multiple discrimination learning in retarded children. American Journal of Mental Deficiency, 1973, 78 (3), 255-261.

House, B. J. & Zeaman, D. A comparison of discrimination learning in normal and mentally defective children. Child Development, 1958, 29 (3), 411-416.

Hunter, J., & Bellamy, G. T. Cable harness construction for severely retarded adults: A demonstration of training technique. AAESPH Review, 1976, 1 (7), 2-13.

Irvin, L. & Bellamy, G. T. Manipulation of stimulus features in vocational skill training of the severely retarded: Relative efficacy. In G. T. Bellamy (Ed.), Habilitation of severely and profoundly retarded adults: Reports from the Specialized Training Program. Eugene, Oregon: University of Oregon Center of Human Development, 1976.

Johnson, V., & Werner, R. A step-by-step learning guide for retarded infants and children. New York: Syracuse University Press, 1975.

Kauffman, J. M. & Snell, M. E. Managing the behavior of severely handicapped persons. In E. Sontag (Ed.), Educational programming for the severely and profoundly handicapped. Reston, Virginia: CEC, 1977.

Kelleher, R. T. Chaining and conditioned reinforcement. In K. Honig (Ed.), Operant behavior: Areas of research and application. New York: Appleton-Century-Crofts, 1966.

Kirk, S. & Gallagher, J. Educating exceptional children (3rd edition). Boston, Mass.: Houghton Mifflin, 1979.

Knobloch, H. & Pasamanick, B. (Eds). Gesell and Amatruda's developmental diagnosis: The evaluation and management of normal and abnormal neuropsychologic development in infancy and early childhood (3rd ed.). New York: Harper & Row, 1974.

Koenig, C. H. & Kunzelmann, H. P. Classroom learning screening manual. Kansas City, Mo.: International Management Systems, 1977.

Lent, J. R. Teaching daily living skills. In J. M. Kauffman & J. S. Payne (Eds.), Mental retardation: Introduction and personal perspectives. Columbus, Ohio: Charles E. Merrill, 1975.

Levy, S. M., Pomerantz, D. J., & Gold, M. W. Work skill development. In N. G. Haring & L. J. Brown (Eds.), Teaching the severely and profoundly handicapped (Vol. 2). New York: Grune & Stratton, 1977.

Loos, F. M. & Tizard, J. The employment of adult imbeciles in a hospital workshop. American Journal of Mental Deficiency, 1955, 59, 395-403.

Martin, G. L., Kehoe, B., Bird, E., Jensen, V., & Darbyshire, M. Operant conditioning in the dressing behavior of severely retarded girls. Mental Retardation, 1971, 9 (3), 27-30.

Mayhall, W. F., & Jenkins, J. R. Scheduling daily or less-than-daily instruction: Implications for resource programs. Journal of Learning Disabilities, 1977, 10 (3), 159-163.

Minge, M. R. & Ball, T. S. Teaching self-help skills to profoundly retarded patients. American Journal of Mental Deficiency, 1967, 71, 864-868.

Mori, A. A., & Masters, L. F. Teaching the severely mentally retarded: Adaptive skills training. Germantown, Maryland: Aspen, 1980.

Muhich, D. Criterion-referenced measurement in the initial acquisition of psychomotor skill with exceptional children. Journal of Special Education, 1976, 10 (1), 15-33.

Myers, D. G., Sinco, M. E., & Stalma, E. S. The right-to-education child: A curriculum for the severely and profoundly mentally retarded. Springfield, Illinois: Charles C. Thomas, 1973.

O'Brien, F., Bugle, C., & Azrin, H. H. Training and maintaining a retarded child's proper eating. Journal of Applied Behavior Analysis, 1972, 5, 67-72.

O'Neill, C. T., & Bellamy, G. T. Evaluation procedure for teaching saw chain assembly to a severely retarded woman. Mental Retardation, 1978, 16 (1), 37-41.

Osler, S. F. & Kofsky, E. Stimulus uncertainty as a variable in the development of conceptual ability. Journal of Experimental Child Psychology, 1965, 2, 264-279.

Pennsylvania training model--Individual assessment guide. Harrisburg, Pennsylvania: Pennsylvania Department of Education, Bureau of Special and Compensatory Education, 1975.

Perske, R. & Smith, J. Beyond the ordinary: The preparation of professionals to educate severely and profoundly handicapped persons toward the development of standards and criteria. Parsons, Kansas: Words & Pictures Corp., 1977.

Prill, N. M. Evaluation of a procedure for teaching generalized tool use skills to a severely retarded person. In G. T. Bellamy, R. H. Horner, & D. P. Inman (Eds.), Habilitation of severely and profoundly retarded adults (Vol. 2). Eugene, Oregon: Specialized Training Program and Rehabilitation Research and Training Center in Mental Retardation, 1977.

Restle, F. A theory of discrimination learning. Psychological Review, 1955, 62, 11-19.

Reynolds, G. S. A primer of operant conditioning. (Rev. ed.). Glenview, Illinois: Scott, Foresman, 1975.

Roos, P. Development of an intensive habit-training unit at Austin State School. Mental Retardation, 1965, 3 (3), 12-15.

Sailor, W. & Haring, N. G. Progress in education. In N. G. Haring & D. Bricker (Eds.), Teaching the severely and profoundly handicapped (Vol. 3). Seattle: AAESPH, 1978.

Screven, C. G., Straka, J. A., & Lafond, R. Applied behavioral technology in a vocational rehabilitation setting. In W. I. Gardner (Ed.), Behavior modification in mental retardation. Chicago: Aldine-Atherton, 1971.

Smith, R. M. Clinical teaching: Methods of instruction for the retarded, New York: McGraw-Hill, 1968.

Spooner, F. An operant analysis of the effects of backward chaining and total task presentation. (Doctoral dissertation, University of Florida, 1980). Dissertation Abstracts International, 1981, 41, 3992A. (University Microfilms No., 8105615)

Stephens, C. E., Pear, J. J., Wray, L. D., & Jackson, G. C. Some effects of reinforcement schedules in teaching picture names to retarded children. Journal of Applied Analysis, 1975, 8, 435-447.

Stephens, T. M. Teaching skills to children with learning and behavior disorders. Columbus, Ohio: Charles E. Merrill, 1977.

Stevenson, H. W. Discrimination learning. In N. R. Ellis (Ed.), Handbook of mental deficiency. New York: McGraw-Hill, 1963.

Stott, T. E. Attention and concentration in trainable mentally retarded. Unpublished doctoral disseration, Eastern New Mexico, 1970.

Sulzer, B., & Mayer, G. R. Behavior modification procedures for school personnel. Hinsdale, Illinois: Dryden Press, 1972.

Ullman, D. G. & Routh, D. K. Discrimination learning in mentally retarded and nonretarded children as a function of the number of relevant dimensions. American Journal of Mental Deficiency, 1971, 76 (2), 176-180.

Van Houten, R., Hill, S., & Parsons, M. An analysis of a performance feedback system: The effects of timing and feedback, public posting, and praise upon academic performance and peer interaction. Journal of Applied Behavior Analysis, 1975, 8, 449-457.

Vulpé, S. G. Vulpé assessment battery. Toronto, Ontario, Canada: National Institute on Mental Retardation, 1977.

Wabash guide to early developmental training. Lafayette, Indiana: Wabash Center for the Mentally Retarded, 1972.

Watson, L. S. How to use behavior modification with mentally retarded and autistic children: Programs for administrators, teachers parents, and nurses. Libertyville, Illinois: Behavior Modification Technology, 1972.

Wehman, P. Curriculum design for the severely and profoundly handicapped. New York: Human Sciences Press, 1979.

Westling, D. L. & Murden, L. Self-help skills training: A review of operant studies. Journal of Special Education, 1978, 12 (3), 253-289.

White, O. R. & Haring, N. G. Exceptional teaching. Columbus, Ohio: Charles E. Merrill, 1980.

Zeaman, D. & House, B. J. The role of attention in retardate discrimination learning. In N. R. Ellis (Ed.), Handbook of mental deficiency, New York: McGraw-Hill, 1963.

REFERENCE NOTES

1. Shortridge, S. D. Personal communication, February 26, 1981.

2. Voeltz, L. M. Evaluating the effects of leisure activities training upon severely handicapped youth: Multiple measures of treatment validity. Paper presented at the 7th annual meeting of The Association for the Severely Handicapped, Los Angeles, October, 1980.

BIOGRAPHICAL SKETCH

Jon Michael Saulson was born in Orlando, Florida, August 9, 1950. Shortly after that date, he and his family moved to Miami Beach, Florida. It was here that he spent the next 17 years of his life.

In 1968, Jon was graduated from Miami Beach High School in Miami Beach, Florida. After high school Jon enrolled in the University of Florida, Gainesville, Florida, where he completed the requirements for a Bachelor of Arts degree in secondary education in December of 1972, and the requirements for a Master of Education in special education in August of 1974.

Jon's first involvement with handicapped individuals was in 1974 when he was employed as a teacher for behavior disordered children at Westwood Middle School in Gainesville, Florida. In August, 1975, Jon continued his involvement in special education while working with severely disturbed and autistic children as Lead Academic Therapist at South Dekalb Children's Center in Decatur, Georgia. He remained at South Dekalb in various professional capacities until August, 1977, when he took the position of lead special education teacher at Brockett Elementary School in Tucker, Georgia.

While employed in Atlanta, Jon met Patricia Ann Steen. They were married June 26, 1976.

In August, 1978, Jon entered the doctoral program in special education at the University of Florida. While at the University of

Florida, he assumed the position of instructor in the Career Associate in Special Education program at Santa Fe Community College in Gainesville, Florida.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Mary K. Dykes

Mary K. Dykes, Chairperson
Associate Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert F. Algozzine

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Charles J. Forgnone

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Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Rex E. Schmid
Associate Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the Department of Special Education in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 1981

Dean for Graduate Studies and Research