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Experimental-Longitudinal Methods in Assessment, Research, and Treatment

Arthur W. Staats

University of Hawaii

The experimental-longitudinal methods to be described here have a long history of development (Staats, 1957, 1963, 1968, 1975, 1977). The present author, to begin, made the first behavior analyses for the modification of problem behaviors, analyses which were formally verified by Ayllon and Michael (1959). Relatively simple behaviors and (primarily) social reinforcers were employed in the author's early demonstrations and in Ayllon and Michael's study. These are not apropos, however, to the complex human behaviors that are acquired over long periods of time. On the one hand, Skinner's (Ferster & Skinner, 1957; Sidman, 1960) single-subject research methodology with animals is not appropriate with long-term learning involving complex, variegated stimuli and behaviors. But on the other hand, neither are the group methods of traditional experimental psychology. Traditional educational research, while dealing with complex learning tasks and behavior, sometimes over long periods of time, does not analyze training procedures and achievements in detail. Further, although longitudinal studies have been made in child development, the conditions that produce such development have not been specifically observed, on the assumption that much of development is due to maturation. These various methods of research thus have provided important knowledge, but they do not answer questions concerning specific training procedures for specific behavioral skills involving complex learning procedures and long duration of training, where repertoires of skills, instead of simple responses, are involved, possibly arranged in hierarchical order with one repertoire basic to the next (see Staats, 1968).

In continuing the work he had introduced, the author extended the principles of classical and instrumental conditioning to more complex functional behaviors by use of the experimental-longitudinal methods first developed in naturalistic situations involving his own infant child. Behavior analyses were first made of a number of behavioral repertoires, and the author then devised training

procedures for producing the repertoires. Examples of this work that began in 1960 included sensory-motor skills, such as walking and swimming; language repertoires including verbal-imitation behaviors, the verbal-motor repertoire (responding to words), the labeling repertoire; number concepts, such as number discrimination and labeling, counting of objects; writing letters and numbers; and so on.

In 1962, when the child was 2 years of age, systematic training in (and study of) reading learning was commenced. Tape and film recordings and behavior samplings, like writing samples, revealed the systematic learning changes and especially the process of producing a skill.

EXPERIMENTAL-LONGITUDINAL METHODS IN THE ORIGINAL ACQUISITION OF LANGUAGE-COGNITIVE REPERTOIRES

The next step in this development was testing the procedures with additional children and with another behavior-technician. This was done with several children of 3 to 4 years of age (see Staats, 1968) and provided confirmation of the analyses and procedures as well as of the type of information necessary to teach an adult how to train young children.

With this fund of information the time had arrived for a more general application of the experimental-longitudinal methods. A classroom-laboratory was established in 1965 for 4-year-old culturally deprived children, consisting of a large classroom with an adjoining room where three children could be worked with individually, using three of the apparatuses pictured in Figure 1, located several feet away from one another.[1]

The child sat in the chair facing the panel with the window (to hold stimulus cards) and the chute below. With this apparatus, letters, pictures, numbers, words, or whatever, may be presented on 5 X 8 cards, exposed in the window. If objects were to be counted, or letters to be copied or written, this was done in the space in front of the child. The experimenter sat in the other chair. There he had the materials he employed in the child's training, including a container for marbles (used as token reinforcers), a container for small edibles such as peanuts, and a container for small trinkets. The child could secure an edible or a trinket by depositing a marble in the hole to the right of the window. To the child's left were tubes of varying capacities. When the child filled any one of the tubes with marbles he received the toy hung above it, which was then replaced with another toy the child selected to work for.

[1] This apparatus is effective for use across children of a wide variety of problems, for a wide variety of therapeutic aims, ranging from treatment of language and speech problems to educational deficits. Problems can be objectively studied while they are being treated.

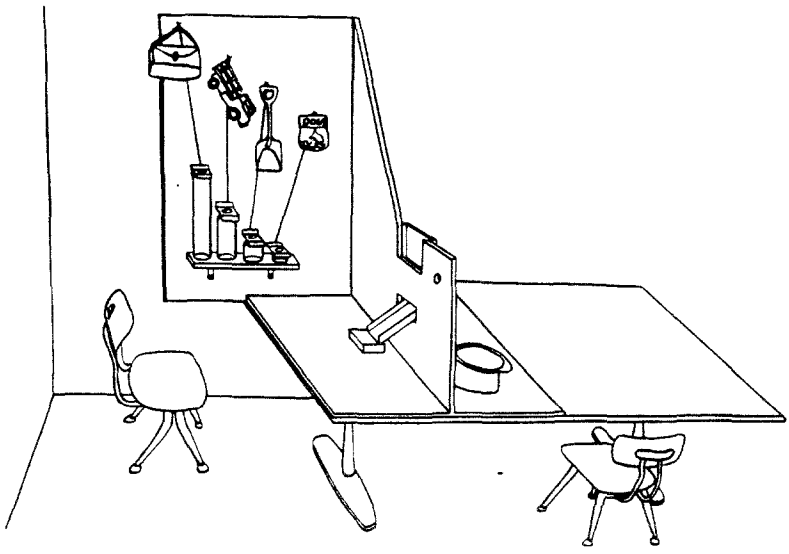

Fig. 1. The Staats child learning and behavior modification apparatus.

The children attended the class (half day), which provided traditional preschool activities, but which was operated using behavior modification principles to enhance desirable behaviors and to control undesirable behaviors. Three times each morning each child would leave the classroom and go to the workroom, where he would receive training in either reading letters, number concept learning (such as discriminating numerosity, counting, reading numbers, writing numbers and so on), or writing letters. The training sessions were brief (5-7 minutes) but each child attended well and made many responses.

Every stimulus presented to the children was recorded, every response made was recorded, and every reinforcer the child received was recorded. On the basis of these data it was possible to see the process as it occurred; if the child was having difficulty in some part of the training, this could have been seen. Moreover, the data revealed the processes of learning involved. For example, the number of learning trials necessary to learn to read the first letter of the alphabet could be compared to trials to learn the second, the third, and so on. It was important, as an example, to find a learning acceleration in these young children in learning intellectual skills in advance of their age, especially since traditional education has recommended against teaching before the child is ready "maturationally." There was evidence that the same acceleration of learning occurred in writing the letters as in learning number concepts (Staats, Brewer, & Gross, 1970). It should be noted that being able to read the letters is the best predictor of early reading success (Chall, 1967; Bond & Dykstra, 1967), so important intellectual skills were involved in this study.

In the writing training there were records of every letter the child wrote. The child's records could be examined to see the course of learning, what each child did throughout the process. It was possible to see if the process is different for different children, or very much the same. It was found that the various children, with IQs differing by as much as 40 points, learned very similarly in these learning conditions, which insured that they participated and attended well. The children went through very similar progressions, which involved reversals and displacements in their writing, crowding, and so on. This finding, as an example, did not support the rather general idea that such things as reversals are only characteristic of children with perceptual problems. Moreover, the process of learning was generally a gradual one. All of the children required many learning trials. There were no circumstances where children without training simply developed the skills involved through maturation (Staats, 1968).

In the area of number concepts it was interesting to find that the process of learning to discriminate numbers, to count objects in a line or randomly arranged, to read the numbers, and so on took place in a regular fashion. The children were capable of learning skills in advance of their age. For example, the preschool children could learn readily to count randomly arranged objects, an ability Piaget (1953) has stated only develops in childre 6 to 7 years old.

It was also possible to discover general features of the learning processes of young children in the procedures used. That is, the children on first beginning the learning made responses at a relatively slow rate. Over the 60 sessions of training in reading letters, however, the children made responses more and more rapidly. The children not only increased their specific learning skills, and increased their ability to learn (requiring fewer and fewer learning trials per unit), they also learned how to work attentively and make responses more rapidly (Staats, Brewer, & Gross, 1970). The importance of the latter skills in academic as well as other endeavors cannot be overestimated.

Finally, it may be added that the children were given intelligence and achievement tests at the beginning and end of the training. In the first study they showed an average increase of 11.6 IQ points and advancement from the 2.3 percentile on a readiness test to the 23.8 percentile (Staats, 1968).

EXPERIMENTAL-LONGITUDINAL METHODS IN TREATING NONREADERS

This was one line of development of the experimental-longitudinal methods for dealing with complex human behaviors that require long-term participation and thousands of learning trials. It was to meet such requirements that the author in 1959 designed and applied the token reinforcer system. The token reinforcer system was also applied in the above-described work, in laboratory studies (Staats, Staats, Schutz, & Wolf, 1962; Staats, Finley, Minke, & Wolf,

1964; Staats, Minke, Finley, Wolf, & Brooks, 1964) as well as in the development of token economy programs (see, for example, Ayllon & Azrin, 1965).

The present author and associates first used the token reinforcer system combined with experimental-longitudinal methods for treating existing problems in a study involving a young juvenile delinquent with severe behavior problems, reading retardation, and academic failure. Exemplifying the experimental-longitudinal research and assessment methodology, the remedial reading methods required recording every stimulus presented, every response made, and every reinforcer given. The reading material was based on stories. Before the presentation of a new story the subject would be individually presented with each new word appearing in the story. He was reinforced for knowing or learning each new word. Then the paragraphs of the story were read aloud by the subject and reinforcement given, depending on the quality of performance to a criterion of perfect performance. Then the subject read the story to himself and answered questions on the story. Each reading response of the subject was tabulated. All the tabulation was accomplished by the instructional technician, as was the case with study of original reading, employing paper-and-pencil materials developed for this purpose.

On the basis of these data it was possible to graph the number of reading responses made each day of the reading training. The child made reading responses progressively more rapidly, although the reading material progressively increased in difficulty and even though the amount of reinforcement per word read was systematically reduced. In addition, the results showed that the child was reading a higher percentage of words on first presentation as he progressed – suggesting that the child was learning methods of sounding out new words. Records of the child's misbehaviors in the regular school situations indicated marked improvement over the course of the study. Achievement tests given before and after the 40 hours of treatment, spread over a 4½-month period, showed an improvement from the second-grade level to the 4.3 grade level – thus more than doubling the achievement of the child's first eight years of schooling. Finally, although the training was not conducted within the school, this juvenile delinquent passed all of his school courses at the end of the period of training. This was impressive in view of the fact that this boy had never passed a course in school. Thus, the assessment of the effects of the treatment of this boy (as well as the assessment of the training materials) was detailed and multifaceted.

The results were clear with respect to this one case. But the question of the generality of the principles, training procedures, and assessment methods was not answered by one case. Since that time other studies have been conducted using the same principles with more than one subject. Staats, Minke, Goodwin, and Landeen (1967) found that subprofessional instructional technicians working with 18 retarded readers and educable-retarded children produced similar results. Staats, Minke, and Butts (1970) extended the methods to 32 black children, including delinquents, employing black instructional technicians. In

this case the results were significantly different for the experimental group over a control group in reading achievement, relevant parts of an intelligence test, and vocabulary. So, too, Ryback and Staats (1970) found the same behavioral results with 4 children with varying psychological problems with mothers administering the SMART (Staats Motivation-Activating Reading Technique). Pre- and posttesting on the Spache Diagnostic Reading Scales showed significant increases in word recognition, instructional level, and independent level, as well as on a 100-word test taken from the reading materials. More recently, Harris (1974) ascertained that dyslexic and nondyslexic retarded readers advanced in Spache reading achievement measures, with those having traditional remedial reading training achieving 1.28 months' advancement and those receiving SMART training achieving 16.45 months' advancement. It is significant to note that the dyslexic subjects improved in the same manner as the nondyslexic children, and that the dyslexic children trained on the SMART improved commensurately on a test of perceptual skill, a traditional diagnostic characteristic of dyslexia. (This finding supports conclusions from previous investigations (see Staats, 1975) that dyslexia is a breakdown of learning, not a genetically based deficiency.)

EXPERIMENTAL-LONGITUDINAL METHODS: BEHAVIOR ANALYSIS AND LOGIC

Thus far the focus has been on describing the content of the studies involved in the development and utilization of the experimental-longitudinal methods. It should be emphasized that the methodology here is one that has general characteristics that make it suitable for use in a large number of assessment, research, and treatment problems. Some of these characteristics have been used widely already in various behavior modification studies. However, the use is many times only partial, and the logic and the characteristics of experimental-longitudinal methodology require a systematic statement so that future usage can be more effective. It will not be possible to treat this topic fully at this time, but some general points can be made.

Behavior Analysis

The methods of research and treatment that have been described herein have been based upon behavior analysis, as has the author's work generally, from the beginning, as the following early statement of this concept indicates:

> To begin the extension of basic learning principles to a complex human behavior, it seems necessary to make a learning analysis of the behavior involved. This analysis can be of several types. One way is to begin with systematic observations of behavior. This might be elaborated to include observations of the reinforcers which are acting upon the behavior, as well as deprivation and satiation operations

> which affect the reinforcers, and also the way the reinforcers become reinforcing, if conditioned reinforcers are involved. The discriminative stimuli which have come to control the behavior may be important. This may include various types of stimuli – environmental, response-produced, interoceptive, and so on. The behavior in which one is interested may actually be a complex chain itself – not a single, momentary response. The observations should include reference to competing behaviors (Staats, 1964, p. 140).

An earlier statement of the author's (Staats, 1963, pp. 459-460) had employed the name "behavior analysis," instead of the synonymous "learning analysis." These accounts constitute the first description of the general methodology and philosophy involved, although a number of other behaviorists, including the author, previously had made specific behavior analyses. It may also be added that the methods of behavior analysis are still relatively undeveloped. Influenced by operant conditioning theory, the learning principles employed are too sparse and analysis is oversimplified (Staats, 1970, 1975).

In any event, it is suggested that behavior analysis is basic in experimental-longitudinal methods. It is on the basis of behavior analysis that one can specify stimulus manipulations (training or behavior modification procedures) and response outcomes. It is this specification that permits recording and behavioral assessment of change and that permits isolation of the learning processes and principles involved.

The Logic of Design: The Experimental-Longitudinal Progression

Psychology has had the characteristic of forming specialized groupings organized around research, theoretical, or methodological interests. A strong characteristic has been a separatism among such groups. In methodology, for example, those who employed group experimental designs in animal learning research eschewed Skinner's single-animal methods. And the same parochialism extended, and still extends, in the opposite direction. It was necessary in the development of behavior modification methods, for example, to break out of the conceptual limitations of both traditional group experimental designs and single organism design orthodoxies.

Group design adherents demand multiple subjects, manipulations occurring by altering treatments to subject groups. Operant methodologists demand multiple responses from one subject – responses of a simple, unitary type – only manipulating reinforcement variables for some groups of responses and not others. Studies of one subject that meet neither of these demands may as a consequence be dismissed as case studies, of unreliable methodology.

It is suggested, however, that such orthodoxy is unwarranted. Study of a single case, without repetitious responding on a simple manipulandum, can produce general data. This can occur even though the stimuli change and the responses change, where the focus is not on reinforcement variables but on the

nature of the training stimuli and on the behaviors produced and on the learning processes involved. Moreover, using the experimental-longitudinal methods, the procedures developed and the data produced can be highly reliable and very general. It was found, for example, that the results with the single juvenile delinquent generalized astonishingly closely with the additional children, who were of various types. The same has been true of the experimental-naturalistic work the author did with his own children in areas ranging from sensory-motor and language development to number concepts and writing. The same findings, along various indices, were made with additional children, with variegated backgrounds.

It has been shown also how experimental hypotheses can be tested with one child in experimental-longitudinal research. For example, one hypothesis was that the child can learn *original* behaviors – that is, if one response was learned to one stimulus and another response to another stimulus when the stimuli were later presented together the responses would occur as an original combination. This hypothesis was corroborated in the context of reading with a single subject (Staats, 1968) and later with learning to count with additional subjects (Staats, Brewer, & Gross, 1970). This suggests that specific hypotheses concerning learning processes can be tested in experimental-longitudinal research, first with a single child.

However, central in the logic of experimental-longitudinal methodology is the notion of progression. Although the research may commence in experimental longitudinal studies with a single subject extended over long periods of times, and although reliable and general findings may result, it is recognized that results that include only one subject require further extension. It is necessary to extend the analysis and the findings with the one subject to additional subjects. While this may be done with individual children, it may also be done with groups, as has been indicated.[2] In either case the explicit procedures and behavioral data lend themselves to grouping, and considering the data of groups. For example, the data with the one juvenile delinquent showed that the number of reading responses made during training sessions underwent an acceleration as the training program continued over the 4½ months. Averaged curves for 18 subjects in the study by Staats et al., (1967) and 32 subjects in the study by Staats, Minke, and Butts (1970) showed the same acceleration.

Another avenue of progression resides in the use of statistical methods. Thus, for example, the author's first work with reading and writing with his own daughter revealed a learning acceleration phenomenon (Staats, 1968). Extensions to another child corroborated the finding (Staats, 1968). Later, however, the data of a group of 10 children were subjected to statistical analysis and the learning acceleration results were shown to be statistically reliable

[2] The manner in which the token-reinforcer system should be extended to a whole school has been outlined (e.g., Staats, 1973).

(Staats, Brewer, & Gross, 1970). Although it was expedient to begin the work with the single child, it was advantageous at a later point to use groups and statistical analysis.

Another progression, when the use of groups of subjects has become feasible, involves experimental and control group comparisons. For example, groups have been compared on some of the behavioral sampling assessment measures, such as the sample of words taken from the material the experimental group has learned to read (Staats, Minke, & Butts, 1970).

This suggests one of the characteristics of the methodology involved. It is not parochial, not bound by orthodoxy. The central theme of the approach is to fit the data collection and the data analysis to the requirements of the problem, realizing there are various methods of data collection for research and behavior assessment. Thus, for example, although radical behaviorism (such as operant conditioning) has eschewed psychological tests (Mischel, 1972; Patterson, 1967; Skinner, 1969), experimental-longitudinal research has from the beginning seen the value of such measures. Important aspects of the study with the juvenile delinquent involved assessing the effects of the training by comparing the child on achievement tests administered before and after the training (Staats & Butterfield, 1965). Other behavior modification studies of that time assessed only the specific response that was reinforced. The method of combining traditional test instruments with behavior assessment measures was further developed in later studies (Staats, 1968; Staats, Brewer, & Gross, 1970). A general theoretical context for integrating behavioral assessment and traditional psychometric methods has been indicated (see Staats, 1975), and this orientation is being elaborated (Cone, in press).

It is further suggested that this use of psychometric tests characterizes the logic of experimental-longitudinal methods – the use of varying observational methods to increase analysis of the subject matter studied. Thus, for example, the behavioral methods of observation employed with the remedial reading methods revealed much about the validity of the basic learning principles, the training materials, and the behavioral gains that resulted, e.g., the words learned, the increase in reading rate, the learning how to learn new words. Using these data it could also be shown how the children who were so trained improved more than control children. But, what about the question concerning whether the treatment had cured the children's reading deficits? This question could only be answered by using instruments that contained normative observations, that told how well the child was doing in comparison to other children, or in comparison to an absolute index of achievement. The social behavioristic philosophy of science, of which the experimental-longitudinal methods are a derivative, aims for an integration of sources of knowledge of human behavior (Staats, 1975), and this is a case in point.

The whole progression from behavior analysis to group studies represents a progression for the study of functional human behaviors in a manner that will

yield understanding of important aspects of human behavior, procedures for dealing with problems of those behaviors, and methods for assessment of the results for both research and clinical purposes. It is suggested that the experimental-longitudinal logic and methods should be recognized as an addition to our methodological knowledge. Moreover, the broader paradigm of social behaviorism (see Staats, 1975), which is the foundation for experimental-longitudinal methodology, should be substituted for the more simplistic approach of behavior modification and behavior assessment that is based solely on our early principles, or on operant behaviorism.

Recognitiion of the experimental-longitudinal method should apply to each of the levels of the method; for example, carefully formulated analyses of behavior should be acceptable for publication, as should single case studies based on such analyses, when they contain specification of training materials and procedures as well as behavioral outcomes. It remains to systematically develop and extend experimental-longitudinal methods and to gain a climate of acceptance for use of the methods, especially those aspects of the methods – like behavior analysis and single case experimental-longitudinal studies – that characterize early points in the progression. The work thus far suggests the methods are relevant for dealing with various aspects of functional and important complex human behavior.

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