Analysis of Therapeutic Techniques Through Use of the Standard Behavior Chart

Implications for Physical Therapy

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A behavioral measurement tool is described that provides a sensitive, objective, and comprehensive method of data analysis. The implications of this tool for documentation of patient progress and response to treatment in physical therapy are considered.

Key Words: Behavioral measurement, Physical therapy.

A survey of the literature examining data collection and analytical tools in physical therapy suggests that inadequate measurement of patient response to therapeutic intervention is prevalent.1,2 Many physical therapists rely on semiojective, anecdotal reports, or simple outcome studies for their judgment of therapeutic programs. A potentially effective treatment might be judged ineffective because of inappropriate behavior selection and definition, poor measurement techniques, or failure to evaluate environmental variables. As Whitney states:

The child is bombarded with visual and auditory stimuli, reflex inhibitory and facilitory techniques, and developmental activities. If any improvement is noticed, it is assumed that something in the treatment repertoire must have worked. If no improvement is noticed, it is often assumed that if the treatment is continued a little longer something might become effective. Usually no objective data are kept, and decisions on treatment effectiveness are entirely subjective.1

Treatment failures are often attributed to the patient's lack of motivation or intangible brain damage. Instead of looking at patient-therapist-therapy variables in the selection and implementation of treatment techniques, therapists often resort to face-saving measures by blaming the lack of progress on the patient's attitudes or organic condition. Although poor patient attitudes or organic conditions may contribute to retarding progress, these are used all too often as excuses at the expense of the patient. On the other hand, a therapist might erroneously conclude that a treatment technique is effective when actually an external factor may be the primary cause of change in the behavior. This paper describes a behavioral measurement tool that makes possible an objective and comprehensive method of data analysis that is sensitive to small changes in behavior. Use of such a method permits the therapist to evaluate behavior change as a measure of therapy effectiveness easily and quickly and to test and adjust techniques to maximize patient progress.

DEVELOPMENT OF THE EVALUATION METHOD

Martin and Epstein support use of behavior analysis for describing, defining, and measuring behavioral problems.3 Techniques of behavior analysis have been shown to produce reliable data from which conclusions can be made about the relationship between treatment and behavior change. These techniques specify the use of the single-subject design as a means of isolating effective therapeutic techniques where there is great individual variance in deficits across patients. Of particular interest is their statement: "The lack of suitable methods and instruments for behavioral quantification is possibly one of the most important limitations in research with the cerebral palsied."4

Quantification must begin by establishing basic units of measurement. Ideally, these units should be...
Lid can be the general time measure.

By counting the number of occurrences of a certain specified behavior, and by measuring the time over which the behavior occurs, we have an accurate and universal measure of behavior. This standard unit is usually expressed as frequency and defined as count divided by time.

Physical therapy deals directly with human behavior and, more importantly, with changes in human behavior. The ability to measure change, then, is important in any behavioral measurement system. Köenig has pointed out that a derivative of frequency can be used to measure change in frequency over time. The measure, acceleration, has units that are of the general form: number of movements/unit of time/unit of time. Thus, in acceleration, we have a universal measure of behavior change.

To make use of frequency and acceleration in a functional manner, they must be incorporated into an instrument or measurement tool that is applicable to the broadest possible range of behaviors. The tool should have a standard scale to permit both comparison of behaviors and evaluation of the effects of environmental events upon changes in these behaviors. The effectiveness of therapeutic interventions can be monitored and evaluated objectively by comparing environmental events with changes in behavior. The Standard Behavior Chart (Fig. 1) makes such comparisons possible and has the additional advantage of being relatively easy to use.

On the Standard Behavior Chart, the ordinate represents the standard unit of behavioral measurement, frequency. The frequencies on the ordinate are scaled in ratios or in a logarithmic manner permitting sensitive measurement and recording of behaviors whose frequencies vary from 1,000 per minute to 1 per 1,000 minutes. This extensive scale allows easy display and comparison of almost the entire range of human

Fig. 1. Standard behavior chart.
behavior on this single chart without the need for conversions or special scales.

The logarithmic nature of the chart provides a second advantage. Koenig has shown that changes in celeration appear as a linear function on a logarithmic chart. The slope of the line representing the best fit through the frequency dots over time can be easily determined and a celeration value obtained. Visual displays of celerations, as straight lines, make monitoring and comparing rates of change relatively easy. In addition, one can predict future behavior frequencies by projecting the line along the trend established by current and past frequencies.

USE OF THE EVALUATION INSTRUMENT

Use of the Standard Behavior Chart is quite simple despite its formidable appearance. First, the therapist must identify and precisely define the patient's behavior to be changed. For example, when working with a patient who has poor balance, the goal might be to improve sitting balance. The behavior to be changed could be defined as falling from an upright sitting posture. An indication of progress might be a decrease in the frequency with which the patient falls taken over sessions. Another example might involve defining walking steps a patient takes as the behavior to be changed. If the goal were to increase strength and coordination of the patient's legs, treatment effectiveness would be demonstrated by an increased frequency of steps taken over sessions.

Once the patient's behavior is selected and carefully defined, frequency is obtained by dividing the number of instances of the behavior observed into the number of minutes over which the behavior was observed. Thus, a client who took 15 steps in three minutes would be taking steps at a frequency of 5 steps per minute. This value is recorded on the chart as a dot placed at the intersection of the vertical day line and the horizontal line corresponding to the frequency value (Fig. 2). A second logarithmic scale...
(called a frequency finder) provides a slide rule with which one can compute and plot frequencies, and eliminates the need for long calculations. Accurate records of from 4 to 15 frequency dots per minute, given counts and times, can be taken after a few hours of training. The directions for use of this frequency finder are found in Figure 2.

Once a series of daily frequencies has been recorded, the best fitting line through those frequency dots describes the rate of change, or celeration. The standard unit of celeration measurement is movements per minute per week. Because distances along a logarithmic scale represent ratios, a change in frequency is described as a multiplier or divisor of the initial frequency (Fig. 3).

In addition to the ease with which data can be computed and recorded, the versatility and flexibility of the chart add to its usefulness. As already noted, the versatility is demonstrated by the ability of the chart to display the entire range of human behavior. The flexibility is apparent in that the chart can be used to display frequency or any derivation of frequency. Derivations especially functional for physical therapy include 1) duration—the amount of time during which one instance of behavior occurs, 2) interresponse time—the amount of time between occurrences of a behavior, and 3) latency—the amount of time between cue and response.

**CASE REPORT**

Figure 4 represents charted data collected from a 6-year-old, profoundly retarded, cerebral palsied girl who was receiving physical therapy. The child was a nonverbal, pleasant, alert, healthy-looking child with a short attention span. She vocalized by laughing, crying, and grunting. A developmental age of 10 months had been established based on gross motor milestones. She could independently crawl and sit and would self-initiate kneeling, but could not independently stand, pull to stand, cruise, or walk. Mild increased tone was noted in the lower extremi-
ties. A positive support reflex was present bilaterally. The functional goal was for the patient to pull to stand independently with her feet flat, and eventually to walk independently.

This client's behavior was charted routinely without prior planning for collecting researchable data. Her chart is used as an excellent example of data that provided meaningful daily feedback for evaluating the treatment plan on a continual basis. A more careful and specific study might extract individual treatment intervention variables, such as inhibitive casting, and chart them separately without other treatment changes for specified intervals to allow a more thorough evaluation of their effect on client response. However, without the use of the pictorial display of data on the chart, valuable information at even the current level of analytical precision would have been lost.

Base-line data show no independent stands (denoted by dots on the chart) during the two sessions. Treatment began with the patient sitting on a bolster with the lower extremities in a flexed, abducted position to decrease muscle tone and inhibit the positive support reaction. The therapist approached the patient from the side to encourage trunk rotation as another means of decreasing muscle tone. Data from this phase indicated that the patient's frequency of independent stands ranged from almost 2 per minute to 0.6 per minute. When the bolster was removed in the next phase, requiring the patient to pull herself up from the floor, frequency of independent stand-ups dropped to below the record floor (recorded observation time denoted by a horizontal dash) indicating no successful independent stands during the session.

The next phase of treatment included a number of techniques, such as inhibitive casting, pulling up to stand from floor while holding onto desk, and using bread and candy (M&Ms) as reinforcers. Independent stand-ups accelerated rapidly while assists from the therapist (denoted by Xs on the chart) stayed at zero during the sessions.

![Graph](image-url)

*Fig. 4. Case study of independent stand-up program.*
Beginning about the 7th week, the data began to vary considerably with the rate of assists sometimes higher than the rate of independent stands. In addition, beginning about the 10th week, sessions were run infrequently. The technique of holding on wall, instituted at the 13th week, had little effect on this variability. However, changing the reinforcer to water at the 15th week was very effective in increasing and then stabilizing the patient's frequency of independent stands while eliminating the necessity of assists.

The patient's improved behavior was maintained after the casts were removed and ankle-foot orthoses with posterior stops were substituted. After one year of treatment the patient is now walking with one-hand assistance and without braces.

**SUMMARY**

The utility of such a measurement tool is apparent. The pictorial display allows daily assessment of progress, so procedural decisions can be made immediately and can be based on current, precise data rather than subjective evaluation. The chart enables detection of slow, subtle changes that would not normally be noticed. The excellent display properties allow analysis at levels from the very crude to the very rigorous. The chart also enables testing of different procedures and environmental variables with prompt, precise feedback for evaluation purposes and comparisons of different procedures and behaviors can be made easily. Finally, through the use of celeration and the celeration envelope noted in Figure 5, the Standard Behavior Chart makes accurate behavioral prediction and goal setting possible and practical.

Once therapy is based on data analysis, the utility of the Standard Behavior Chart for administrative and research purposes becomes apparent. Through the measurement and graphic display of response frequency and its derivatives, patient response (discounting uncontrollable variables) can become the
objective measure of therapy effectiveness, and can conceivably become a basis for employee performance evaluations. The behavior chart can be used to back up requests for materials that have been demonstrated effective, or to justify use of controversial procedures. Because the chart can be used to predict, cost projections of treatment time, procedures, and materials for management and budget purposes can be determined.

Through the use of the daily Standard Behavior Chart, and a basic knowledge of behavioral modification and analysis, physical therapists can improve the effectiveness and efficiency of individual therapy programs. The chart makes it increasingly possible to manage and administer physical therapy departments on the basis of objective, quantitative indicators of therapy effectiveness.

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REFERENCES