

# JOURNAL OF PRECISION TEACHING

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## Contents

<b>A single movement frequency strategy for programs serving severely handicapped learners.....</b>	<b>25</b>
Felix F. Billingsley and Renee L. Beebe	
<b>Frequency and the Standard Celeration Chart: necessary components of Precision Teaching.....</b>	<b>28</b>
Patrick McGreevy	
<b>Obtaining a learning picture in a half-hour .....</b>	<b>36</b>
John W. Eshleman	
<b>Teaching signing to children with severe handicaps .....</b>	<b>40</b>
Michele Mayer-Sherman	
<b>About PT.....</b>	<b>43</b>

## EDITORIAL POLICY

The **Journal of Precision Teaching** is a multidisciplinary journal dedicated to a science of human behavior which includes direct, continuous and standard measurement. This measurement includes a standard unit of behavior, **frequency**, a standard scale on which successive frequencies are displayed, the **Standard Celeration Chart**, a standard measure of behavior change between two frequencies, **frequency multiplier**, and a standard, straight-line measure of behavior change across seven or more frequencies, **celeration**. Frequencies, frequency multipliers, and celerations displayed on the Standard Celeration Chart form the basis for Chart-based decision-making and for evaluating the effects of independent variables.

The purpose of the **Journal of Precision Teaching** is to accelerate the sharing of scientific and practical information among its readers. To this end, both formal manuscripts and informal, Chart-sharing articles are considered for publication.

Materials submitted for publication should meet the following criteria: (1) be written in plain English, (2) contain a narrative that is brief, to the point and easy to read, (3) use the **Journal of Precision Teaching Standard Glossary and Charting Conventions**, (4) contain data displayed on the Standard Celeration Chart that justify conclusions made, (5) be submitted in quadruplicate to the editor, and (6) include one set of original charts or hand-drawn copies. Each formal manuscript will be reviewed by one consulting editor and two reviewers, two of whom must approve it prior to publication.

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**A SINGLE MOVEMENT FREQUENCY  
STRATEGY FOR PROGRAMS SERVING  
SEVERELY HANDICAPPED LEARNERS**

**Felix F. Billingsley  
Renee L. Beebe  
University of Washington**

Although it is not a requirement of the Precision Teaching model, it seems clear that, in practice, the orientation of Precision Teachers is to measure movements at a molecular level. Our training orients us to count multiple, often narrowly defined behaviors within the ubiquitous context of the 1-minute probe (see, for example, suggestions offered by Eaton [1983] regarding classroom organization). Such practices have, and continue to, produce rapid and gratifying growth in essential skills for many pupils. To some of us who attempt to provide severely handicapped learners with functional, generalizable skills, however, it seems that there are times when a broader approach to movement definition may be desirable and appropriate. That approach, which is consistent with recent recommendations for total task instruction within naturally occurring sequences (Neel, Billingsley, & Lambert, 1983; Sailor & Guess, 1983), may be applicable in situations in which a pupil has component movements in his or her repertoire, but needs to combine them within a behavioral chain which achieves some critical function. For example, it may be functional for a pupil to walk directly from the classroom to the gym within five minutes, to clean the dining room table after lunch within 30 seconds, to vacuum the floor within seven minutes, to complete eating lunch with a fork during a 30-minute lunch period, or to put toys in a toy box within two minutes. Such skills seem particularly suitable for assessment as intact behavioral units.

Certainly, the components necessary to the achievement of each skill could be assessed in a relatively molecular fashion. In the case of walking to the gym, we could count and chart steps per minute, while in the case of vacuuming the floor, frequency of successful and unsuccessful "passes" with the vacuum nozzle could be

documented, and so forth. However, such practices may be more difficult to implement than it first appears and may possess a number of disadvantages.

The number of steps per minute necessary to accomplish the objective of getting to the gym within the allotted time is likely to change as the child gets older (younger, smaller pupils must walk faster) and aims in terms of steps per minute may vary depending on the time available to reach different destinations. A steps-per-minute aim appropriate to the pupil at age six may not, therefore, be appropriate to the same pupil at age 10 because the six year old aim may exaggerate differences between the 10 year old handicapped pupil and non-handicapped peers in his or her environment. It is also conceivable that the specification of a steps-per-minute aim could mitigate against the skill generalization and adaptation necessary to regulate locomotion according to distance and time available. The measurement of vacuuming presents slightly different problems. The simple mechanics involved in counting (and defining) successful "passes" with a vacuum nozzle may be difficult to manage, since success would probably require a very rapid judgment by the manager (depending on pupil fluency) regarding response adequacy along at least two dimensions: the length of the pass and the cleanliness of the floor. In addition, a reasonable aim might be difficult to establish since different vacuuming styles (e.g. heavy or light pressure on the nozzle) can require a different number of passes to achieve the same degrees of cleanliness. That is, multiple behavior forms which achieve the same function may be acceptable even though those forms are performed at different frequencies.

Similar skill-specific problems could be outlined for each of the examples cited earlier. In the larger context, however, a common measurement problem exists across many such skills: molecular approaches to measurement almost invariably require close observation by a manager. As it is entirely possible that manager presence may act as a discriminative stimulus for responding by severely handicapped pupils (cf. Bellamy,

Horner, & Inman, 1979), manager proximity should be faded to the greatest extent possible as training progresses. Molecular measurement may increase the difficulty of "fading the manager out" and, at least in some cases, act to reduce the probability of obtaining generalized skill performance in situations where manager presence is less obvious.

Due to the difficulties occasionally encountered in the measurement of narrowly defined, multiple movements in instructional programs for severely handicapped pupils, we have been experimenting with the use of a "single-movement frequency strategy" in some programs for pupils within the severely/multiply handicapped classroom at the University of Washington Experimental Education Unit. The procedure retains the concept of frequency calculated on a per-minute basis, but applies it to the accomplishment of a single movement where the movement is defined in terms of the completion of a relatively broad behavioral sequence (e.g. walking to the gym, vacuuming the floor, eating lunch with a fork, etc.). Completion of the behavioral sequence is, therefore, counted as a correct movement. Timing is begun when the cue which should act to initiate the sequence is delivered (e.g. a teacher direction such as, "Tina, it's time to go to the gym") and is stopped when the sequence is completed (e.g., arrival at the gym). Frequency is then calculated by dividing 1 (the number of movements) by the total time required to begin and perform the movement. This results in what Owen White (personal communication, December 14, 1983) calls "frequency to start and do." It should be noted that the frequency is a single movement frequency with a value which will always be equivalent to the counting period, and which is, therefore, plotted as a dot on top of the counting period floor. Presuming that the objective is to systematically reduce the start and do time, the correct frequency and the counting period floor will march up the Chart toward the aim if the program is successful. The aim, of course, is computed as  $1/\text{desired start and do time}$ .

Because the time base for the calculation of frequency is variable by design in the proposed system, it has been our practice to chart errors (e.g., turning down the wrong hallway on the way to gym, leaving three "globs" of food on the dining room table which was supposed to be cleaned) as "counts", rather than frequencies, plotted from the 1-line on the Chart. This practice seems to reduce the confusion which may accompany the visual display of an increasing error frequency on a chart where the time to perform a skill is decreasing, but where the actual number of errors remains the same or decreases.

Chart 1 provides an example of data collected and charted according to the method we have described. The chart depicts the progress of Martha, a 13 year old, severely retarded pupil. The program was designed to teach Martha to walk independently from the classroom to the school bus within six minutes. It was also desired that she complete the trip without dropping her lunchbox (the deceleration target). It may be observed that Martha made steady progress toward her aims for both acceleration and deceleration targets and achieved those aims by the end of the fourth week of instruction.

We are not suggesting that the proposed counting and charting method will be applicable to all programs designed for severely handicapped pupils. It is likely that it will be most useful in programs (1) where successful completion of a behavioral sequence requires the repetition of a single movement or very few different movements, (2) where the several different movements required within a behavior sequence are performed with a relatively high degree of accuracy, and (3) where errors are observable from "afar" or produce a product for counting following the completion of the behavioral sequence. Its use is not intended to imply that teachers should ignore the component movements which lead to the achievement of critical functions or that it is inappropriate to employ interventions designed to affect those movements. We would enjoy hearing from other Precision Teachers about the utility of this method for assessing the

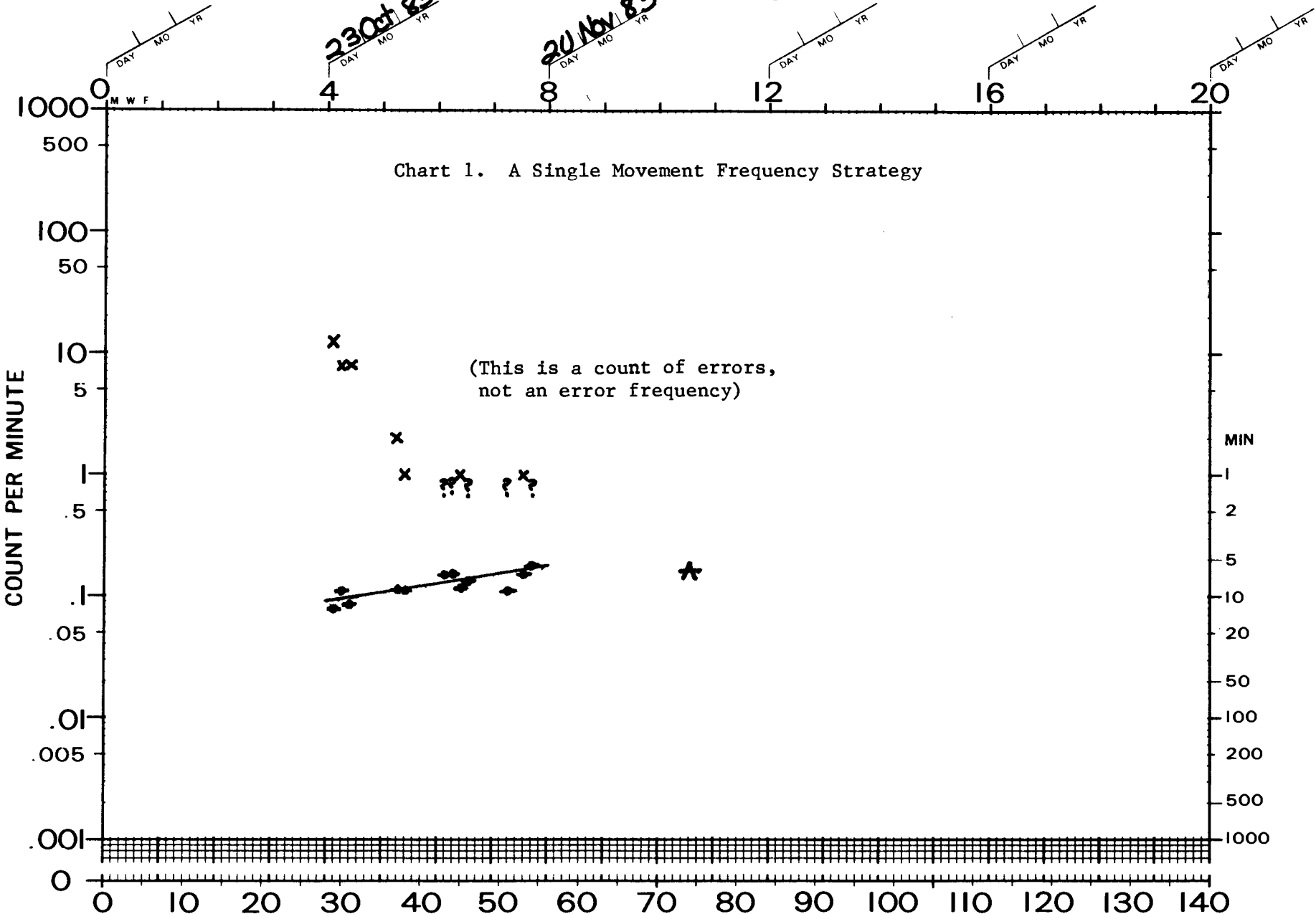


DAILY BEHAVIOR CHART (DCM-9EN)  
 6 CYCLE - 140 DAYS (20 WKS)  
 BEHAVIOR RESEARCH CO.  
 BOX 3351 - KANSAS CITY, KANS. 66103

CALENDAR WEEKS

23 Oct 83

20 Nov 83



SUPERVISOR \_\_\_\_\_ ADVISER BEEBE MANAGER \_\_\_\_\_ BEHAVIOR MARTHA AGE \_\_\_\_\_ LABEL \_\_\_\_\_ COUNTED \_\_\_\_\_

University of Washington Seattle, Washington

DEPOSITOR \_\_\_\_\_ AGENCY \_\_\_\_\_ TIMER \_\_\_\_\_ COUNTER \_\_\_\_\_ CHARTER \_\_\_\_\_

WALKS TO BUS/  
DROPS LUNCHBOX

performance of severely handicapped pupils.

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#### FREQUENCY AND THE STANDARD CELERATION CHART: NECESSARY COMPONENTS OF PRECISION TEACHING

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#### Abstract

Precision Teaching was founded by Ogden Lindsley and his students in 1965, and is essentially a movement advocating a science of human behavior and a practice of behavior change that includes the frequent observation and recording of behavior using a standard measurement unit, frequency, and a standard measurement scale, the Standard Celeration Chart. Lindsley adopted frequency, the standard unit of measurement used by Skinner(1938), and developed the Standard Celeration Chart. The Chart enabled Lindsley to determine the magnitude of human behavior frequencies, the change between two frequencies(frequency multiplier) and the change over seven or more frequencies(acceleration). Some teachers and teacher trainers in the field of Precision Teaching are currently using non-standard measurement units like percent correct and count per opportunity rather than frequency. Since frequency is a standard unit of measurement, it cannot be changed without significantly affecting our understanding of human performance. In addition, some teacher trainers have truncated, that is, cut the Standard Celeration Chart and enlarged the remaining section, making it a non-standard, equal-ratio measurement scale. Since the Chart is a standard measurement scale like a meter stick, it cannot be enlarged(or, for that matter, reduced) without losing the absolute value and hence the understanding and interpretation of frequency, the frequency multiplier and acceleration. The need to retain frequency and the Standard Celeration Chart(in its original size) as necessary components of Precision Teaching is demonstrated and discussed.

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Many teachers, like the author himself, learned to collect children's frequencies and chart them on the

Daily Standard Celeration Chart without fully understanding the importance and implications of these two elements of Precision Teaching. We were like little children first learning multiplication facts. We did not yet understand the importance of those facts and how we could use them to solve complex problems in the future. In our first attempts as teacher trainers, we often encountered the following types of resistance and confusion: (1) a teacher would tell us proudly that a child "only missed three" or "did all ten correctly", having collected a "count" or "count per opportunity" without having conducted a timing; (2) a teacher would refuse to continue conducting timings, because, according to him/her, the timings made the children nervous; (3) a teacher would conduct timings, but still insist on changing the frequencies to "percent correct"; (4) a teacher would say that she couldn't mark the Chart because the lines were "too close together"; and (5) a teacher would either incorrectly mark a counting period floor for a counting period of greater than one minute, or correctly mark the floor and then count up from the one-per-minute line.

These types of resistance and confusion may have influenced some of us, whose teaching and using frequency and/or the Daily Standard Celeration Chart decelerated. Instead of changing our training methods, some of us permitted teachers to use count per opportunity and percent correct. Some teacher trainers, including the author, truncated, that is, cut the Chart so that most of the upper left hand quadrant remained. This new chart was then enlarged so that the frequency lines and day lines would be farther apart and so that the one-per-minute line would always be the counting period floor. These "new" behaviors were accelerated and maintained for several years. This may have been the result of the teachers, at least temporarily, using the charts, and the teachers no longer expressing resistance and confusion. For some teacher trainers, including the author, these behaviors were eventually extinguished, apparently by teachers discontinuing to use the truncated and enlarged charts and by colleagues refusing to "pay attention"

to the charts. This extinction process, along with several explanations from colleagues concerning the importance of frequency and the Standard Celeration Chart, resulted in our return to teaching and using these elements. However, some Precision Teachers and teacher trainers are still using percent correct, count per opportunity or charts that have been truncated and enlarged. The purpose of this article is to demonstrate that frequency and the Standard Celeration Chart (in its original size) should be retained as necessary components of Precision Teaching.

In order to fully understand and appreciate frequency and the Standard Celeration Chart, it is necessary to understand the role of standard measurement in the natural and social sciences. In the natural sciences the direct and frequent observation and recording of phenomena using standard measurement units has been acknowledged for many centuries as a prerequisite for both scientific inquiry and everyday practical applications of science. For example, in chemistry, the volume of a liquid is measured in liters. The number of liters can be directly observed and recorded. Changes in the volume over frequent observations can also be recorded. Without liters, a standard measurement unit, there could be no observation of changes in the volume over time and no systematic investigation of variables that might affect the volume. Sometimes, to assist in the measurement of the magnitude of a phenomenon and the changes in that phenomenon, standard measurement units are displayed along a standard measurement scale. For example, in medicine, human body temperature is measured in degrees Fahrenheit or Centigrade, displayed along the oral thermometer ranging from 94-110 degrees Fahrenheit or 35-43 degrees Centigrade. The magnitude of a temperature and the change in temperature over frequent observations can be recorded. Without degrees, a standard measurement unit and the oral thermometer, a standard measurement scale, there could be no determination of the magnitude of a temperature, no observation of changes in the temperature over time and no systematic investigation of variables

what might affect the temperature. If volume and body temperature were measured using multiple units of measurement and multiple measurement scales, there would be no science or practice of chemistry or medicine. We would learn almost nothing from these disciplines about how to improve the human condition and how to control and predict future events.

In the social sciences, attempts at the standard measurement of human behavior have focused primarily on the administration of infrequent, norm-referenced standardized tests, rather than on the direct and frequent observation and recording of specific behaviors using a standard measurement unit. This lack of a standard measurement unit for daily performance and a standard measurement scale to record weekly and monthly performance change has greatly impeded progress in developing a science of human behavior and in improving the practice of behavior change. According to Johnston and Pennypacker(1980), standard units of measurement and a standard measurement scale are necessary components to such a science and practice. According to Lindsley(personal communication, March 5, 1981), without standard units and a standard scale, the measurement of dependent variables and the change in those variables is a variable itself, and consequently of almost no utility. In other words, if some teachers use count and percent correct to measure the performance and progress of their students, while others use count per opportunity and duration, and all these measurement units are displayed on multiple measurement scales, the resulting information is of almost no use to teachers in determining precisely a student's strengths, weaknesses, and progress. This information is also of almost no use to researchers seeking to discover the major determinants of behavior.

Skinner(1938) was the first to suggest the direct and frequent observation and recording of behavior using a standard measurement unit. He used a unit of measurement in the animal laboratory that he interchangeably called frequency and rate(Skinner, 1938, 1953). Frequency or rate was defined as the number of times a behavior occurred per minute. He

called this unit the universal datum of behavior. In the early 1950s, Lindsley, Skinner and Solomon(1953) adopted this unit of measurement and were the first to collect human behavior frequencies.

In 1965, Lindsley and his students began to use this same measurement unit with children and teachers in public school classrooms. In 1966, Lindsley and his colleagues developed the Daily Standard Behavior Chart(Pennypacker, Koenig and Lindsley, 1972; Koorland and Martin, 1975; McGreevy, 1983), which Lindsley later renamed the Daily Standard Celeration Chart. The Chart was an attempt to provide a standard measurement scale to display and determine the magnitude of a number of successive human frequencies collected over a short period of time. Using a logarithmic, equal-ratio (multiply-divide) scale, Lindsley and his colleagues discovered that they could display the full range of human frequencies(one per 24 hours- 1000 per minute) along six cycles of "x10". They decided to display these six cycles along the short side of an 8 1/2" x 11" sheet of paper. The resulting frequency scale was Count Per Minute. This left the long side of the paper for a measure of time. The 11 inches easily accommodated 140 days or 20 weeks, the approximate length of a public school semester, displayed along an equal-interval scale. The resulting time scale was Successive Calendar Days. The Daily Standard Celeration Chart is thus a standard, semi-logarithmic, equal-ratio (multiply-divide) measurement scale used for the display of daily frequencies.

From the Chart, Lindsley discovered two measures of behavior change-- the frequency multiplier and celeration. The former described the change between two frequencies, while the latter summarized the change in seven or more frequencies per week. These measures were constant across the entire range of human frequencies, that is, anywhere on the Chart, and were thus standard measures of behavior change. In sum, Lindsley became the first social scientist to develop and use a system for the standard measurement of the magnitude of specific human behaviors and the



change in magnitude over frequent observations.

Frequency and the Daily Standard Celeration Chart became the foundation of a movement known as Precision Teaching. This movement includes many measurement and teaching strategies that were developed from this standard measurement foundation. Some of these strategies are: (1) one-minute timings, (2) child knows best, (3) try three-at-once, (4) the dead person's test, (5) learning pictures, (6) Chart-based decision-making, (7) high initial error frequencies, and (8) SAFMEDS. Some Precision Teachers have emphasized these strategies to the exclusion of either frequency, the Standard Celeration Chart, or both.

The Daily Standard Celeration Chart is a measurement scale like a meter stick (see Chart 1). The Chart measures the magnitude of a frequency by its location along the Count Per Minute scale relative to the one per 24 hour line or starting point of the scale in the same way that a meter stick measures the distance between two points by the location of a point along the stick relative to the "zero" or starting point of the stick. Ten per minute is always two-thirds of the way up the Chart, while 50 centimeters is always half way up the meter stick.

The Chart also measures the magnitude of a frequency multiplier as the distance between two frequencies along the same Count Per Minute scale. A frequency multiplier describing an increase in frequency from two per minute to 20 per minute is a specific distance along the Count Per Minute scale that has a value of  $\times 10$ . A frequency multiplier describing a corresponding decrease in frequency from 20 per minute to two per minute is the same distance along the scale in the opposite direction and has a value of  $/10$ . This same distance has the same  $\times 10$  or  $/10$  value everywhere along the scale. For example, the distance from one per 80 minutes to one per eight minutes and vice versa is this same distance and again has a value of  $\times 10$  and  $/10$ , respectively.

Finally, to measure celeration, we must first draw a celeration line. This line is a best-fit straight line drawn through seven or more

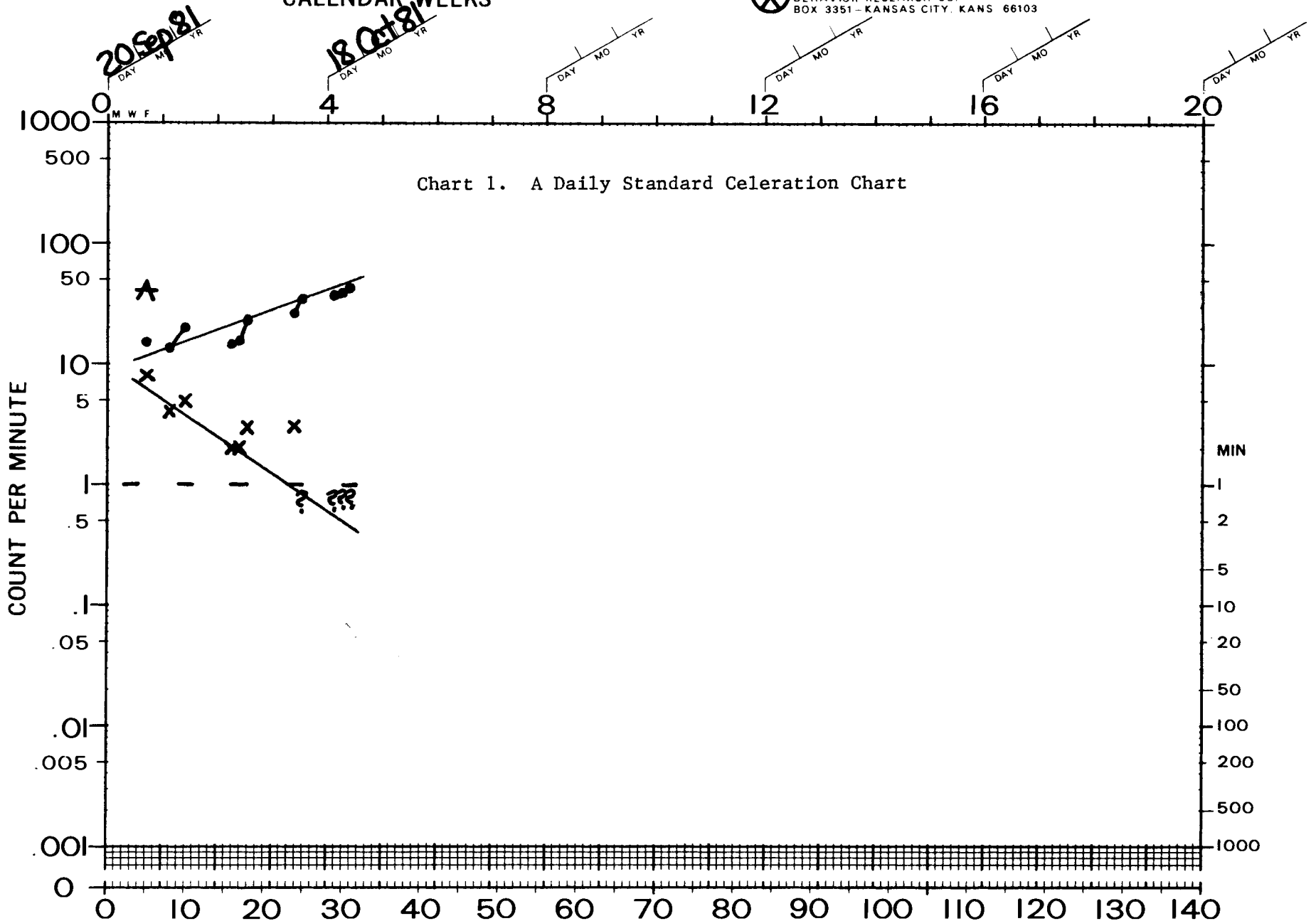
frequencies. The Chart, then, measures celeration as the distance along the Count Per Minute scale that a celeration line covers between successive Sundays along the Successive Calendar Days scale. The slope of this line has a value that corresponds to the value for the distance covered. A celeration line passing through successive Sundays at one per 10 minutes and one per five minutes describes an increase in frequency and covers a specific distance along the Count Per Minute scale that has a value of  $\times 2$ . The slope of this line has a value of  $\times 2$  per week. A celeration line describing a corresponding decrease in frequency from one per five minutes to one per 10 minutes covers the same distance along the scale in the opposite direction. This distance has a value of  $/2$  and the slope of this line has a value of  $/2$  per week. This same distance and slope have the same value of  $\times 2$  or  $/2$  and  $\times 2$  per week or  $/2$  per week, respectively, everywhere along the scale. For example, a celeration line passing through successive Sundays at 12 per minute and 24 per minute and vice versa covers this same distance of  $\times 2$  and  $/2$ , and has a slope of  $\times 2$  per week and  $/2$  per week, respectively.

As mentioned earlier, some Precision Teachers, including the author, have truncated, that is, cut the Standard Celeration Chart, enlarged the remaining section, and created an instrument that provides equal-ratio, but non-standard measurement. When you enlarge (or reduce) a measurement scale, you retain relative measurement, but lose the absolute value of each measurement unit along the scale. If you make an enlarged photocopy of a section of a meter stick, each centimeter in that section retains its relative proportion to all other centimeters in the section, but each centimeter has now lost its former absolute value and is, in fact, no longer a centimeter. In addition, a distance of three centimeters along the enlarged scale is no longer three centimeters. Since the Daily Standard Celeration Chart is a measurement scale like a meter stick, it cannot be enlarged without losing the absolute value of every part of the Chart.

CALENDAR WEEKS



DAILY BEHAVIOR CHART (DCM-9EN)  
 6 CYCLE - 140 DAYS (20 WKS)  
 BEHAVIOR RESEARCH CO.  
 BOX 3351 - KANSAS CITY, KANS. 66103



see and say  
color names

SUPERVISOR	ADVISER	MANAGER	Tony			
			BEHAVER	AGE	LABEL	COUNTED
DEPOSITOR	AGENCY	TIMER	COUNTER	CHARTER		

Chart 1 displays 11 frequencies for Tony describing the magnitude of his performance on "see and say color names". These frequencies range from 16 to 41 per minute for the correct movement and eight to less than one per minute for the incorrect movement. Sixteen per minute is almost exactly 2/3 of the way along the Count Per Minute scale and is in the fifth cycle(10-100 per minute) of human behavior frequencies. Chart 1 also determines the x2 frequency(accuracy) multiplier between the initial frequency for the correct and incorrect movements. The x2 frequency multiplier covers a distance of 1/4 inch along the Count Per Minute scale. Finally, Chart 1 determines the x1.5 and /2 celerations for the correct and incorrect movements, respectively. The x1.5 and /2 celerations are lines with specific slopes that cover 1/8 and 1/4 inch distances per week, respectively, along the same scale.

Charts 2 and 3 display the same eleven frequencies on Standard Celeration Charts that have been truncated and enlarged. Chart 2 was initiated by the author in 1974 and disavowed by the same in 1979. Its use has been limited. Chart 3 was initiated in 1979 and is widely used today. Other truncated and enlarged charts are also in use today. The number of these charts and the extent of their use is unknown. On Charts 2 and 3, 16 per minute is now 55/100 and 45/100 of the way, respectively, along the Count Per Minute scale, giving a false impression of lower initial frequency or greater weakness. In addition, on these charts, there is no difference between a frequency of 16 per minute and 16 per day. On Charts 2 and 3, the x2 frequency(accuracy) multiplier is now a distance of 5/8 and 9/16 inches, respectively. This gives a false impression of greater initial accuracy. Finally, on Charts 2 and 3, the celeration lines have the same slope as Chart 1, but now cover 3/8 and 1/4 inch distances, respectively, for the correct movement and 5/8 and 9/16 inch distances, respectively, for the incorrect movement. This gives a false impression of higher celeration or more progress. With these truncated and enlarged charts, it is no longer possible to understand or interpret 16 per minute, a x2 frequency multiplier or a x1.5

celeration. With these charts, we have effectively "lost" all three standard measures of behavior.

Precision Teaching has the potential to make a significant contribution to a science of human behavior and the practice of behavior change. For the first time in human history, the elements necessary for such a science are available: standard units of measurement and a standard measurement scale. The standard measurement of dependent variables will enable us to precisely determine the effects of independent variables, the potential determinants of behavior. In addition, these elements will significantly improve the practice of behavior change. For the first time, the standard measurement of children's or adults' daily performance and weekly and monthly progress in school or therapy is possible. This means that we as teachers, therapists and researchers can more precisely determine, understand and interpret children's or adults' strengths, weaknesses and continuous progress. In addition, daily and weekly data-based decision-making can become a regular part of educational and therapeutic programming. If non-standard units of measurement and measurement scales persist, especially in the field of Precision Teaching, our chance for this understanding and improvement will be all but lost, and Precision Teaching will have been just another movement that contributed very little to either our knowledge of behavior or the improvement of the human condition.

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20 Sep 81  
Date

Manager	Tony
see and say color names	Behavior
Counted	1 min.
	Counting Period

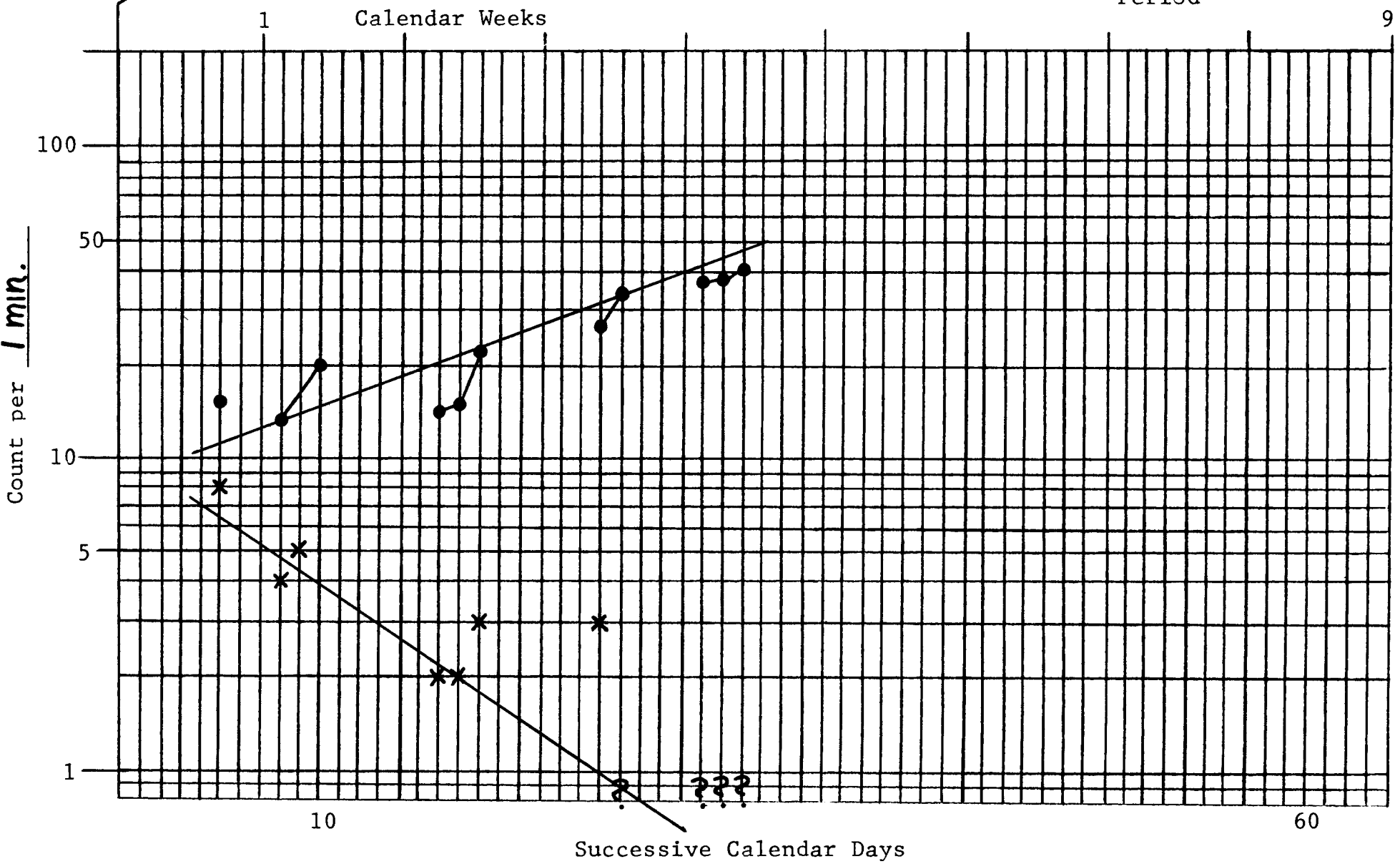
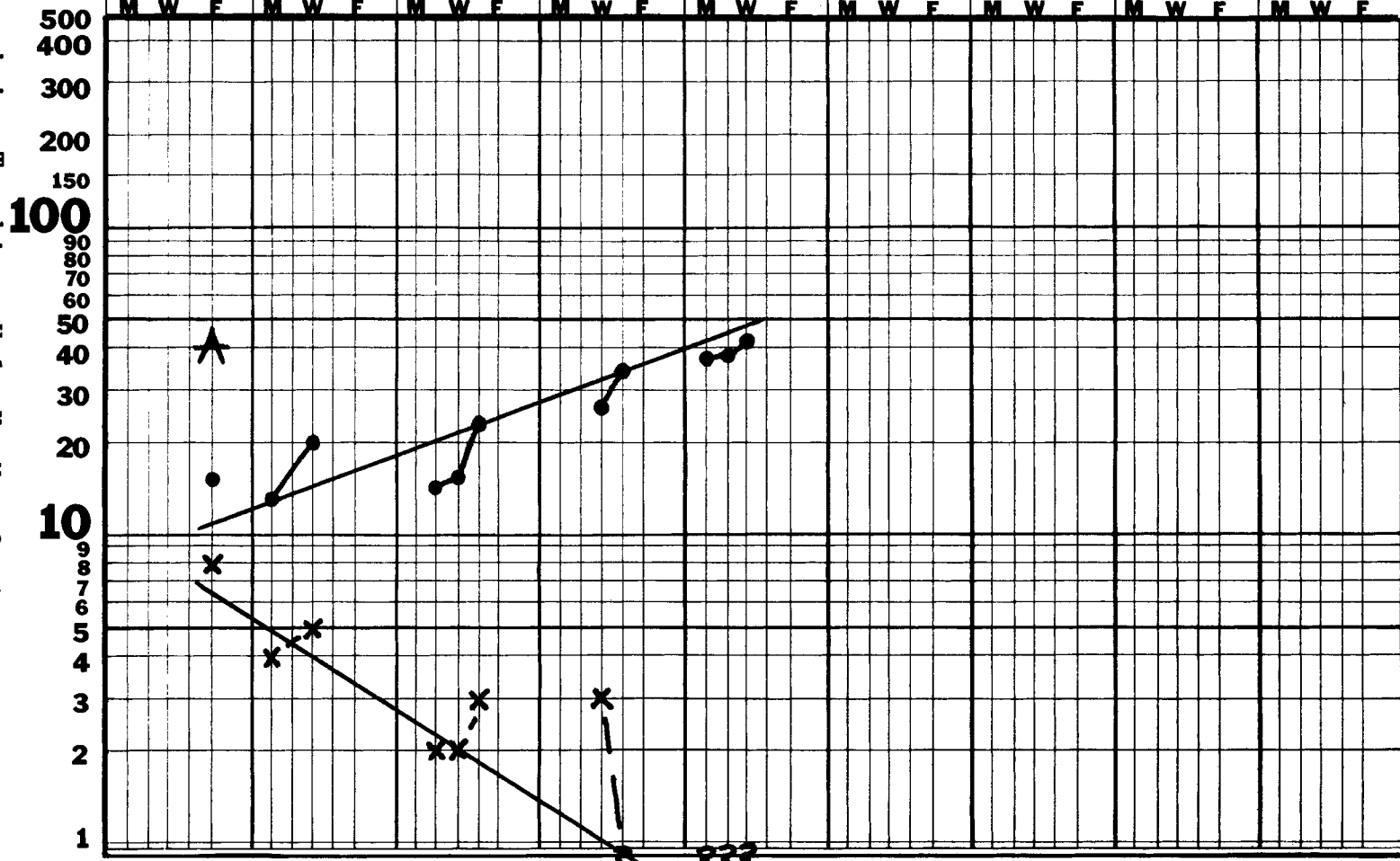


Chart 2. An Equal-ratio, Non-standard Chart

18-09-81  
20-09-81

18-09-81  
20-09-81

AC-4  
BEHAVIOR DEVELOPMENT SYSTEMS  
P.O. BOX 13289  
GAINESVILLE, FLORIDA 32604



	M	T	W	Th	F
1	/	/	/	/	168
2	14/4	/	20/5	/	/
3	/	15/2	16/2	23/3	/
4	/	/	26/3	34/0	/
5	38/0	39/0	41/0	/	/
6	/	/	/	/	/
7	/	/	/	/	/
8	/	/	/	/	/
9	/	/	/	/	/

NAME Tony GRADE K

BEHAVIOR see and say color names GOAL 40/minute

Chart 3. An Equal-ratio, Non-standard Chart

McGreevy, P. (1983). **Teaching and learning in plain english** (2nd ed.). Kansas City, MO: Plain English Publications.

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#### OBTAINING A LEARNING PICTURE IN A HALF-HOUR

John W. Eshleman  
West Virginia University

You can generate a learning picture in a very short period of time, such as a half-hour. I have done so many times, using myself as subject, recorder, and charter. Instead of conducting one-minute timings daily over a period of several weeks, I have compacted these timings into about one hour of one day.

Part of the reason I came to do timings in this manner, over the course of an hour, can be attributed to the "Tender Loving Care Chart" (Haughton, Maloney & Desjardins, 1980), on which "SUCCESSIVE MINUTES" serves as the horizontal axis of the chart. Yet another reason was a statement made by Lindsley(1981) in which he indicated that you can collect in one hour, one thousand behavioral incidents with the continuous, direct measurement of free operant behavior. Lindsley was talking about the origins of Precision Teaching, but his comment served as a prompt for me to try "Precision Teaching in an hour". A final contributing factor was that I had

been doing daily timings for several years with SAFMEDS, using myself as subject, and had become quite sensitive to many variables affecting performance (Eschleman, 1982).

The behavior of interest in all cases thus far has been "see-say with SAFMEDS"--"Say All Fast a Minute Each Day Shuffled" (similar to flashcards). A more appropriate term for the cards in the present case would be SAFMEMS--"Say All Fast a Minute Every other Minute Shuffled." The basic procedure was to do a one-minute timing with the SAFMEMS, going through as many cards as I could. Then, in the next minute, I counted and charted correct and error responses, and shuffled the cards. When this intervening minute timed out, I did another timing, followed again by another minute of counting, charting, and shuffling, and so on. A timing in all cases consisted of: (1) looking at the front of a card, (2) saying some response, (3) checking the answer on the back if necessary, (4) putting the card into a "corrects" or "errors" stack, and (5) doing the same for each succeeding card until the minute timed out. By following this procedure, it is possible to do 15 one-minute timings in a half-hour.

After 15 minutes a recognizable learning picture will begin to develop (see Chart 1). In my case, the pictures have all been "jaws", "crossover jaws", "climb", or "at aim" pictures. Since I plot the data on Daily Standard Celeration Charts with the horizontal axis re-labelled, I calculate celerations in terms of count/min./seven min., a measure analogous to the familiar count/min./wk.

#### Data

Chart 1 displays a recent series of successive one-minute timings. On March 29, 1984, I did 33 timings in 70 minutes. The SAFMEMS contained information about Apple II Machine Language commands (Inman & Inman, 1981). The function of the command was on the front of the card and the name of the command on the back. For example, "Load Accumulator" and "LDA" would be on the front and back, respectively (the terms I selected actually make up the instruction set

CALENDAR WEEKS

DAILY BEHAVIOR CHART (DCM-9EN)  
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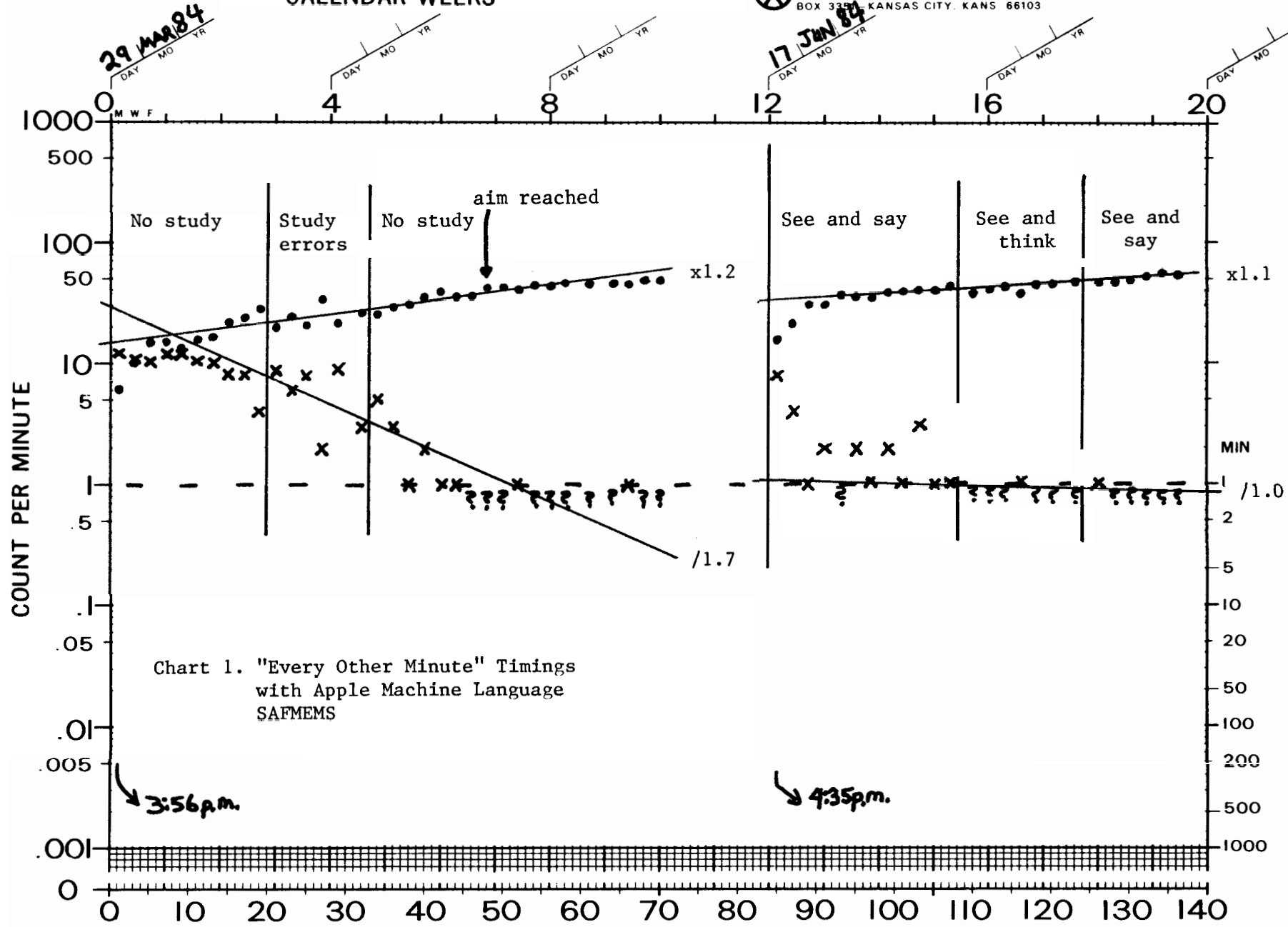


Chart 1. "Every Other Minute" Timings with Apple Machine Language SAFMEMS

**JOHN ESHLEMAN 28**

SUPERVISOR	ADVISER	MANAGER	DEPOSITOR	AGENCY	TIMER	COUNTER	CHARTER	BEHAVIOR	AGE	LABEL	COUNTED
								Apple Machine Language SAFMEMS			

of the 6502 processor in the Apple II+). I set an aim of 40 correct/min. and achieved a modest "crossover jaws". The celeration for corrects was low, only  $x1.2$ . From the 19th to the 30th minute I studied errors during the non-timing minute. This did not bring about any improvement. Indeed, there was a slight frequency jump-down in correct responding. I reached aim at the 48th minute and quit at the 70th from fatigue and a horizontal most-recent celeration.

On June 17, 1984, I replicated the earlier set of timings with the same cards, without having seen the cards during the intervening 2 1/2 months (see Chart 1). With the June 17 timings an initial learning picture, recognizably "jaws", quickly leveled off to more of an "at aim" picture. The overall celerations were nearly flat, being  $x1.1$  and  $/1.0$  for corrects and errors, respectively. There was also no apparent effect on either frequency or celeration of switching to a "see-think" learning channel set for seven timings during the session. Most notable on Chart 1 was a frequency jump-down ( $/3.2$ ) for correct responding, and a frequency jump-up (around  $x8$ ) for error responding, from the last of the March 29 timings to the first of those on June 17th.

A couple of notes regarding the machine language SAFMEMS are in order: (1) since I had created the cards over a year prior to the March 29 timings, learning from card creation was not a factor, and (2) I had not done any machine language programming with my Apple up to that point. Hence, I was unfamiliar with the subject matter.

Chart 2 shows more of an endurance test, where the SAFMEMS were based on the Journal of Precision Teaching Standard Glossary and Charting Conventions. After about the 10th minute, the correct celeration was essentially horizontal, though it took about a half-hour for errors to reach the record floor (and this for a subject matter that I already "knew"! ). I studied errors from the 28th to the 50th minute in an effort to "squeeze out" a little more improvement in the accuracy ratio. Clearly, there was no noticeable effect from doing so, a result that is consistent with the later effort

displayed in Chart 1. The initial part of the picture in Chart 2 is a slight "jaws". The latter half resembles more of an "at aim" learning picture--similar to the June 17 timings shown on Chart 1. On both charts, the bounce is greater for errors than for corrects, which supports Lindley's (1980) statement that correct and error learning are independent of one another.

### Discussion

I have drawn several conclusions from doing such "massed practice" timings with myself as the subject. First, it is a quick way to generate valid learning pictures. Second, the same principles apply in the massed practice as in the distributed practice of daily timings. Third, I do not recommend "every other minute" timings as an instructional technique. With regard to this lattermost conclusion, I found that a great deal of stamina was necessary. I had to find a quiet hour with no interruptions--I was behaving consistently non-stop every minute. I found that, after a half-hour, fatigue begins to reach the point where decrements in performance set in. That was usually when I quit. On the positive side, I have found this procedure to be a quick way to learn a set of facts, a convenient way to generate behavioral data quickly, and a good way to maintain chart skills.

A criticism of this "every other minute" procedure has come from Lindsley (1983, personal communication), who describes learning as "a daily thing," where evolutionary processes have selected learning as a day-by-day type of process. This may be true, but if we equate the terms "learning" and "celeration" then quite clearly there is learning going on over the span of minutes. Where Lindsley's comment may be most appropriate is in the relative permanence of learning from doing it daily versus every other minute. As mentioned, in Chart 1 there is an obvious degradation from the March to the June timings. An empirical question arising from this is whether there is as much degradation when the timings are done daily as when they are massed into one hour. For such a comparison, various conditions would



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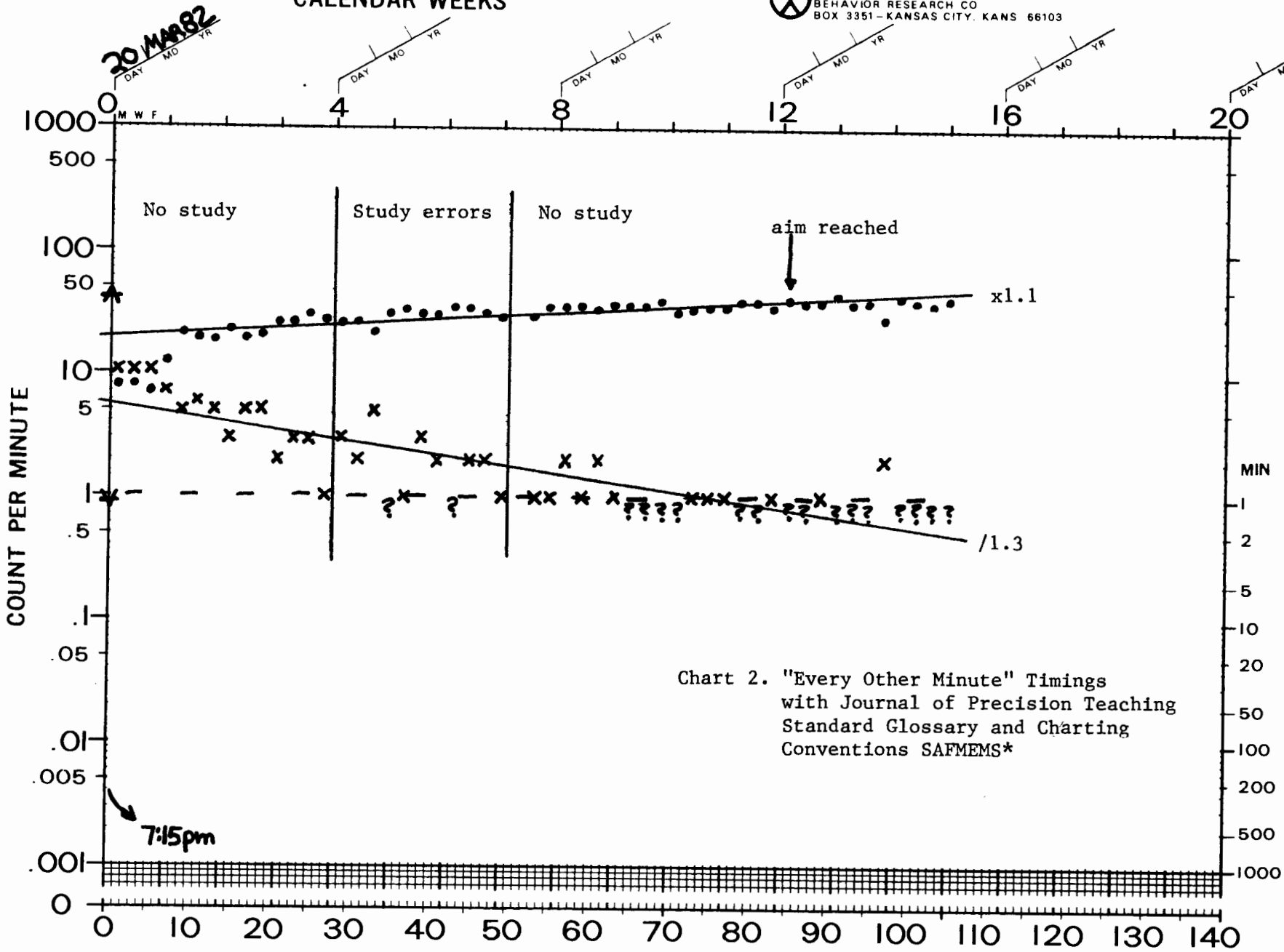


Chart 2. "Every Other Minute" Timings with Journal of Precision Teaching Standard Glossary and Charting Conventions SAFMEMS\*

SUPERVISOR	ADVISER	MANAGER	JOHN ESHLEMAN 26		see and say SAFMEMS*
DEPOSITOR	AGENCY	TIMER	COUNTER	CHARTER	BEHAVIOR AGE LABEL COUNTED

have to be held constant between the daily and the "every other minute" timings. The set of facts would have to be of comparable difficulty, and the number of days between the end of the first set of learning pictures and the beginning of the second set would have to be the same, to mention two.

Finally, to some individuals a study where one uses oneself as the subject seems to be of questionable scientific validity. I hope that the current case here helps to demonstrate the fallacy of such a notion. As Graf(1984, personal communication) has pointed out, the method of using oneself as subject in a behavioral study has a tradition going back to Ebbinghaus, who generated all his data on learning by using himself as the subject.

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#### TEACHING SIGNING TO CHILDREN WITH SEVERE HANDICAPS

Michele Mayer-Sherman  
Kennedy-Donovan Center

In teaching severely handicapped children, a great deal of emphasis is placed on developing alternative communication systems. In addition to assisting with communication, these systems help the children exert control over their environment in a socially acceptable manner. This article describes a strategy for teaching signing, an alternative communication system, to severely handicapped children and displays data for one such child.

Donna is a six year old student with a diagnosis of mental retardation. Initial informal observation and assessment yielded no consistent expressive communication skills. Signs were selected as her means of expression due to her intact motor skills. "Food" and "drink" were selected as the first signs for her to learn.

The overall goal for Donna was to independently express herself in appropriate situations. To this end, the following three-part strategy was used: (1) to teach Donna the signs for food and drink in naturally occurring situations, that is, during lunch and snack times; (2) to also teach Donna the signs during daily 15-second timings; and (3) to monitor daily progress during the 15-second timings until proficiency(30 signs per minute) is reached and then to monitor progress during lunch and snack times until proficiency(2 signs every 10 minutes) is maintained for several months. The first part of this strategy is similar to that suggested by Sailor and Guess(1983). The second part is designed to provide extra practice opportunities that will hopefully lead to proficiency(30 signs per minute). The third part was suggested by our experience with Precision Teaching.

Donna was taught the signs for food during a daily 15-second timing to proficiency using a series of prompts and prompt fading. Chart 1 displays her progress. She was also taught the sign for drink using the same

CALENDAR WEEKS

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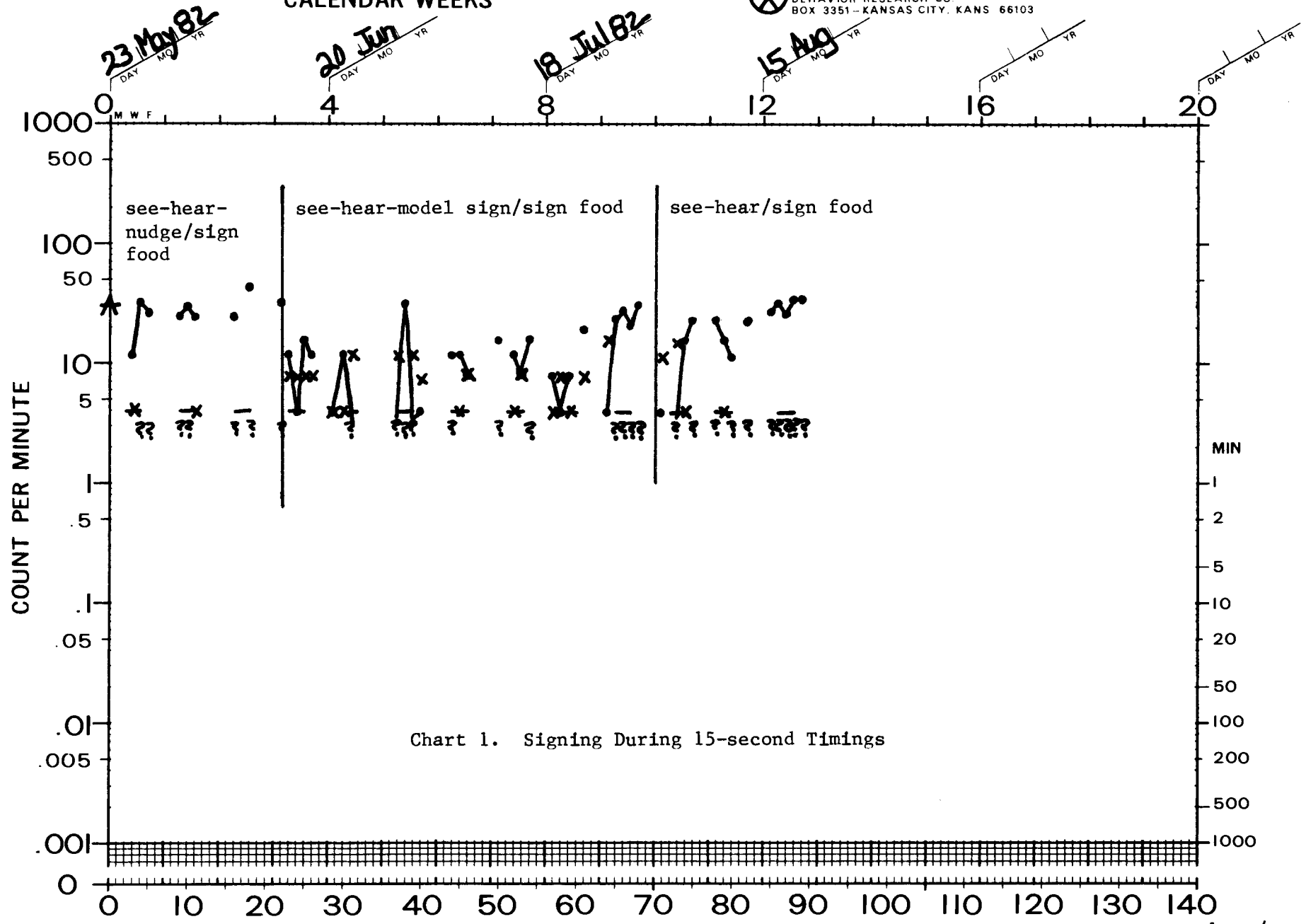


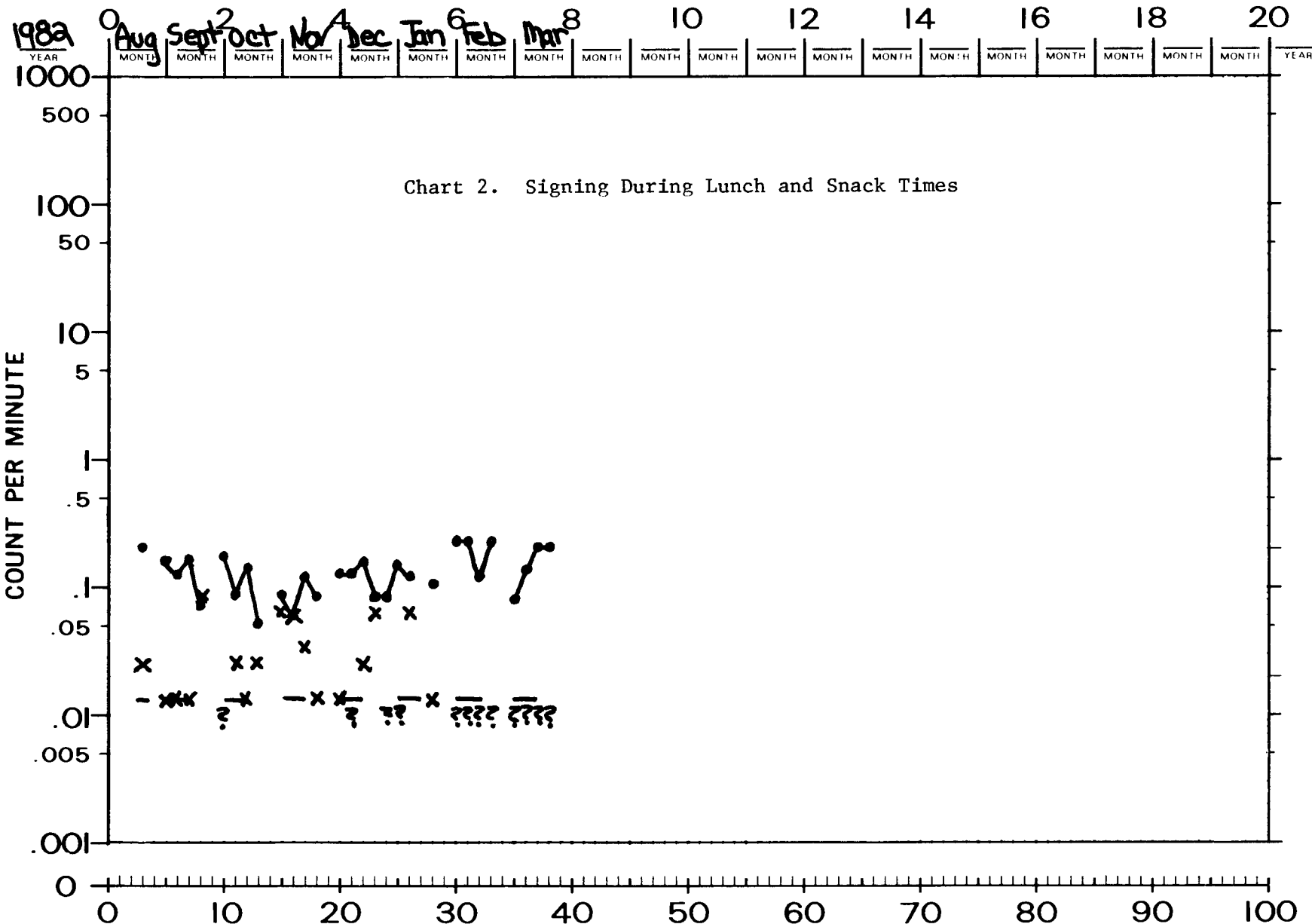
Chart 1. Signing During 15-second Timings

SUPERVISOR		ADVISER		MANAGER		SUCCESSIVE CALENDAR DAYS		Donna		b		see-hear/ sign food	
Kennedy-Donovan Center		Foxboro, MA						BEHAVIOR		AGE		LABEL	
DEPOSITOR		AGENCY		TIMER		COUNTER		M. Cave		CHARTER		COUNTED	

CALENDAR MONTHS



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J. Kelly    M. Mayer-Sherman SUPERVISOR    ADVISER    MANAGER		Donna    6 BEHAVIOR    AGE		see-hear/ sign food	
Kennedy-Donovan Center    Foxboro, MA DEPOSITOR    AGENCY		M. Cave CHARTER		COUNTED	
_____ TIMER		_____ COUNTER		_____	

procedure. During this same period of time, she was being taught both of these signs during lunch and snack times. Once proficiency was reached during the 15-second timings, progress was monitored during lunch and snack times. Chart 2 displays Donna's progress for the sign for food. Some generalization for both signs occurred and proficiency was reached and maintained.

Similar success has been achieved in teaching signing to other students utilizing this strategy. The students enjoy using their new skill and the freedom it brings them.

#### REFERENCE

Sailor, W., and Guess, D. (1983). **Severely handicapped students: an instructional design.** Boston: Houghton-Mifflin.

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Michele Mayer-Sherman is the head teacher at the Kennedy-Donovan Center, Lewis School, Mechanic Street, Foxboro, MA 02035.

## About PT

#### NOTES FROM THE EDITOR

Patrick McGreevy

Welcome to Volume V, Number 2. I would like to thank the following people at Louisiana State University for assisting with the publication of JPT: Ted Devlin, Coordinator of Special Education, Alden Moe, Chairman of Curriculum and Instruction, and Charles Smith, Dean of the College of Education. Their assistance is greatly appreciated.

If you have suggestions for improvements in JPT, let us know. If you would like to react to an article or a column, send us a letter. If you have information on new curricula, technology, or teaching strategies, send it along and we will include it in the next issue.

#### AROUND THE STANDARD CELEBRATION CHART

Patrick McGreevy

The Journal of Precision Teaching was founded in 1980 to serve two major purposes: (1) to publish research conducted using frequency, the Standard Celebration Chart, and the measurement and teaching strategies of Precision Teaching; (2) to promote and preserve standard behavior measurement; and (3) to share technical and practical information among Precision Teachers. In 1980, these three purposes were not being fulfilled by any other publication. Other journals were reluctant to publish Chart-based articles and many Precision Teachers were unwilling to continue submitting manuscripts.

In the last few years, however, several journals have published articles describing Precision Teaching strategies and/or containing multiply-divide charts that resemble the Standard Celebration Chart. This new development has encouraged many Precision Teachers to submit Chart-based manuscripts to these and other journals. The Journal of Precision Teaching and your editor enthusiastically support this initiative.

Since its inception in 1980, the Journal of Precision Teaching has had an 8 1/2" x 11" format and has printed the Standard Celebration Chart in its original size. The reasons for this adherence to a standard format and a standard chart are outlined in the second article in this issue.

Since most other journals have a format that is too small to accommodate the Standard Celebration Chart, the multiply-divide charts contained in articles in these journals have been either reduced, or truncated and enlarged Charts. In the first instance, the Chart has been reduced to less than its normal size. In the second instance, the Chart has been truncated or cut along each scale so that from 1-3 cycles and 1-10 weeks remain. Then, this truncated chart has been enlarged to fill a journal page. In the interest of preserving standard behavior measurement, your editor would like to suggest two alternative options for preparing

charts for these journals. These options were developed as a result of a recent conversation with Chuck Merbitz.

The first option is to truncate or cut the Chart without additional enlargement(see Chart 1). A Daily Standard Celeration Chart that has been simply truncated, rather than reduced, or truncated and enlarged, retains the distance between values along both the Count Per Minute and the Successive Calendar Days scales. In other words, frequency multiplier, the measure of performance change, remains intact.

A truncated Chart, however, may cause a reader to misinterpret the magnitude of a frequency. For example, in Chart 1, one every five minutes is near the bottom rather than near the middle of the Count Per Minute scale. A reader could easily misread this frequency as approximately one every eight hours. To minimize the number of times this confusion occurs, arrows and numbers indicating the parts of the Count Per Minute scale that are missing can then be drawn as shown in Chart 1. The missing part of the Successive Calendar Days scale can also be indicated.

A truncated Chart may also cause a reader to misinterpret the value of a celeration line. As shown in Chart 1, a x2 celeration line has the same slope and covers the same distance along the Count Per Minute scale, but no longer bisects the chart diagonally. A x2 celeration may be misread as something more or less than x2.

To eliminate the possible misinterpretation of the value of a celeration line, a second option is available: truncating the Chart proportionally, that is, by the same fraction along each scale. Chart 2 is a Daily Standard Celeration Chart truncated proportionally by one-half. Both the Count Per Minute and the Successive Calendar Days scales have been truncated by one-half. As a result, Chart 2 has three cycles and 70 days. A x2 celeration line bisects the chart diagonally, and, as a result, the x2 value should not be misread.

As shown in Chart 2, the fraction that the Chart is truncated is determined by the distance from the counting period floor to the aim mark and the number of weeks required to display all the frequencies on the Chart. For ease of reading, the Daily Chart should be truncated so that a /2 distance remains below the floor and a x2 distance above the aim mark, and so that a distance of one week remains after the last week containing one or more frequencies.

When preparing a daily chart to accompany a journal article, take a frequency finder and measure the distance along the Count Per Minute scale from a point /2 below the counting period floor to a point x2 above the aim mark. Then, count the number of weeks you wish to display on the chart. Count from the first week during which there is at least one frequency to the last week in which there is again at least one frequency and add one week. Then use Table 1 to determine where the Chart should be truncated. Truncate the chart proportionally, as necessary, and, as shown in Charts 1 and 2, indicate the missing part(s) of each scale. Make certain that each scale is clearly and correctly labelled.

Table 1

Truncating Proportionally The Daily Standard Celeration Chart				
Weeks Needed	Dist. Meas.	Trunc. Cycles	Where: Day Line	Fract. Line Trunc.
1-6	=x100	2	47	2/3
7-9	=x1000	3	70	1/2
10-12	=x10000	4	93	1/3
13-16	=x100000	5	123	1/6

Chart 3 requires a distance along the Count Per Minute scale of x500, but contains 11 weeks of frequencies. Thus, the Chart must be truncated proportionally by 1/3. As shown in Chart 3, the Count Per Minute scale does not have to be truncated along frequency lines that begin a cycle.

When preparing a weekly, monthly, or yearly chart or summary chart, follow the same procedure for measuring

Chart 1. A Daily Standard Celeration Chart  
Truncated by Four and One-half Cycles  
and Sixteen Weeks

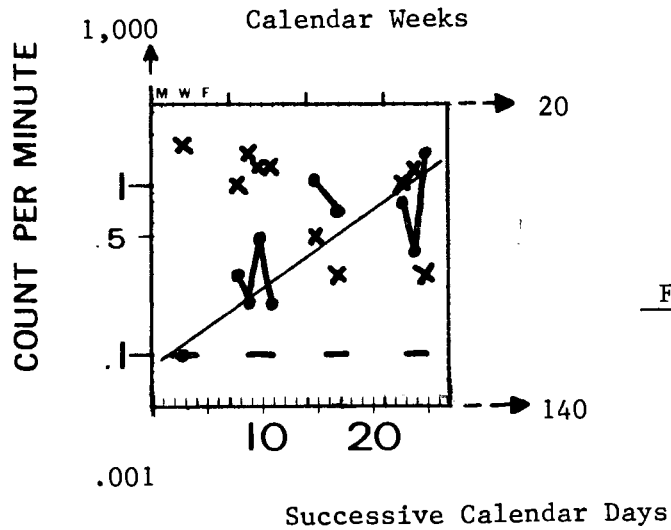


Chart 2. A Daily Standard Celeration Chart  
Truncated Proportionally by One-half

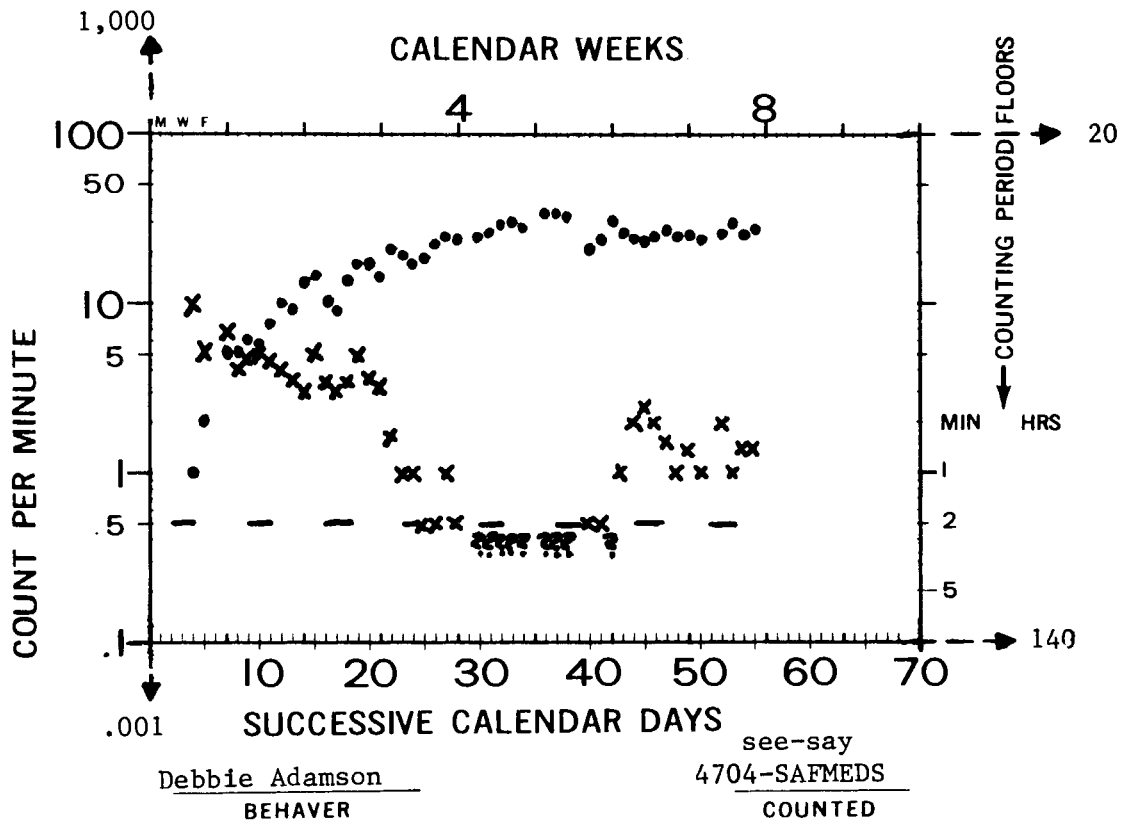
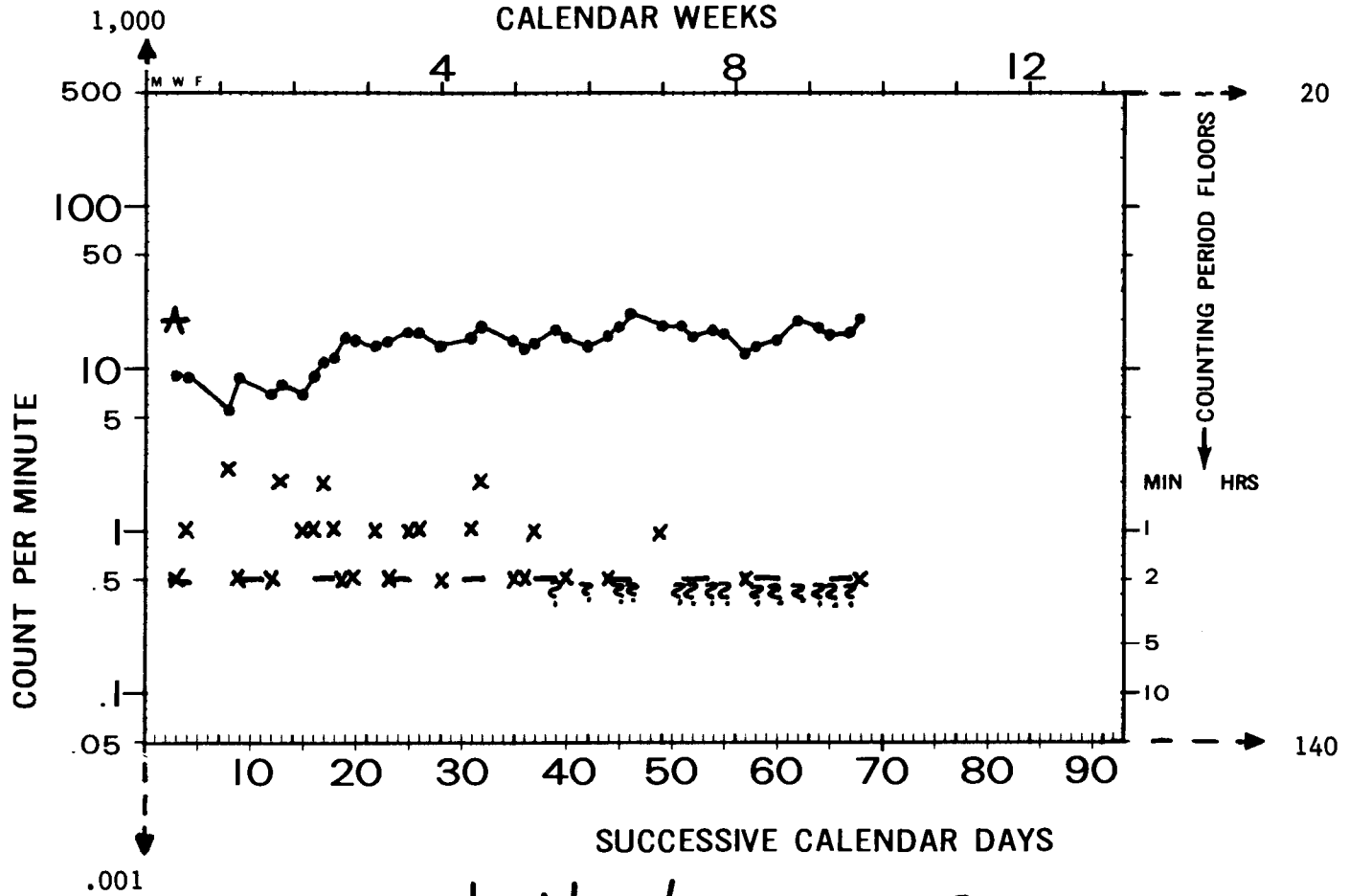


Chart 3. A Daily Standard Celeration Chart Truncated Proportionally by One-third



Lori Lardry      see-say  
 BEHAVIOR      AGE      LABEL      COUNTED  
 4704-SAFMEDS



distance along the up-the-left (frequency) scale. If there is no counting period floor or no aim mark, measure the distance from a point  $\frac{1}{2}$  below the lowest frequency or from the "0" frequency line to a point  $\times 2$  above the highest frequency. Then, determine the number of weeks, months, years, or decades you wish to display on the chart and add one of these periods of time. Then, use Table 2, 3 or 4 to determine where the Chart should be truncated.

Table 2

-----  
 Truncating Proportionally  
 The Weekly Standard Celeration Chart  
 or  
 The Weekly Summary  
 Standard Celeration Chart  
 -----

Months Needed	Dist. Meas.	Trunc. Cycles/Wk.	Where: Line	Fract. Trunc.
1-6	=x100	2	34	2/3
7-9	=x1000	3	50	1/2
10-12	=x10000	4	67	1/3
13-16	=x100000	5	88	1/6

Table 3

-----  
 Truncating Proportionally  
 The Monthly Standard Celeration Chart  
 or  
 The Monthly Summary Standard Celeration Chart  
 -----

Years Needed	Dist. Meas.	Trunc. Cycles/Mo.	Where: Line	Fract. Trunc.
1-3	=x100	2	41	2/3
4-5	=x1000	3	60	1/2
6	=x10000	4	81	1/3
7-8	=x100000	5	106	1/6

Table 4

-----  
 Truncating Proportionally  
 The Yearly Standard Celeration Chart  
 or  
 The Yearly Summary Standard Celeration Chart  
 -----

Decades Needed	Dist. Meas.	Trunc. Cycles/Yr.	Where: Line	Fract. Trunc.
1-3	=x100	2	34	2/3
4-5	=x1000	3	50	1/2
6	=x10000	4	67	1/3
7-8	=x100000	5	88	1/6

When preparing the text of the journal article, refer to each truncated Chart as a Daily (or the appropriate version) Standard Celeration Chart truncated proportionally by  $\frac{1}{3}$  (or the appropriate fraction). For example, you might describe a chart like this, "Figure 1 is a Daily Standard Celeration Chart truncated proportionally by  $\frac{2}{3}$ ... As shown in Figure 1,..."

In sum, a Standard Celeration Chart that is truncated proportionally results in the least amount of compromise to standard measurement and the least amount of possible reader confusion. When journal format will not allow the display of the Standard Celeration Chart in its original size, I recommend submitting Standard Celeration Charts truncated proportionally with indications of what parts of each scale are missing. I further recommend suggesting to the editor that, in the interest of standard behavior measurement, you would like to have the charts printed exactly as submitted. If the article is accepted for publication and the editor requests that the charts be reduced in size, I recommend resubmitting charts that are simply truncated. Although these charts may tend to confuse some readers, they are the next nearest approximation of the Standard Celeration Chart. If these truncated charts are accepted, be sure to change the text and refer to each chart according to how much it was truncated along each scale. For example, you might describe a chart like this, "Figure 2 is a Weekly Standard Celeration Chart truncated by

4 cycles along the Count Per Week scale and by 30 weeks along the Calendar Weeks scale... Figure 2 displays..."

If anyone would like to propose amendments to these two options or suggest additional options, I would appreciate hearing from you. I would also like to hear from anyone who attempts to implement these options. Finally, if your Chart-based article appears in another journal or you read a Chart-based article in another journal, let us know. We will share the reference with JPT readers and with John Eschleman, who is keeping the Precision Teaching Bibliography up-to-date.

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