TITLE: Counting Together:
Precision Teaching Rationale - 69

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Book of REadings

Running Head: Precision Teaching Basics

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Prologue

My hope is that you will be changed by your "exposure" to, and the "experience" of, reading this paper. As Skinner (1968) has clearly analyzed, education is often described in these metaphorical and theoretical terms. However, there are no data on the metaphors of "exposure" and "experience." In fact, no specific behavior or acts are necessarily involved in these metaphors. This is partly because such behavioral metaphors refer to such broad aspects of human action. But, like most imaginative symbols, these ancient metaphors require rigorous up-to-date analysis. The events and acts suggested by implication can be pinpointed readily. In today's analysis we have the basic categories of stimulus, response and consequence. These events do lend themselves to data collection and thus to a refined analysis.

To improve our understanding and your "learning by experience, by doing and by trial and error," I encourage you to start a personal project using this chapter as your stimulus and reading as your response. You need:

1 pencil (or writing instrument)

a watch or clock

a piece of paper for recording and tabulation

a copy of the equal ratio chart paper (see exhibit A)

A simple, yet significant personal improvement project can be to increase the rate of words you read per minute. Why not record how many words per minute you read in this chapter, and use the "experience" to facilitate your understanding of Precision Teaching? Simply record the time when you start reading and time yourself for ten minutes (or so), write down the data and we will use this information as the chapter develops. A cumulative word count is provided along the margin to help you recording.

Introduction

For two years pupils, teachers, resource teachers, counselors and principals have been using Precision Teaching procedures to help youngsters. Projects have been conducted in regular and specialized classrooms and schools in and around Eugene, Oregon. After briefly describing how we use Precision Teaching, I will explore four basic parts of the rationale with you.

Classroom Projects:

Elementary school teachers in our area have a class load of approximately twenty-six youngsters and they teach roughly five major curriculum areas every school day. Secondary level teachers are usually responsible for one curriculum area, often teaching one hundred fifty to two hundred youngsters a day (Haughton and Betterton, 1969). In either elementary or secondary levels, our teachers are trying to process approximately one hundred eighty units of information concerning their youngsters' performance, daily. That is eyeballing a lot of "data" every day, even if each youngster does only one assignment a day.

It is difficult to monitor so much daily information precisely. We need some kind of permanent daily performance records especially since teachers are called upon to summarize each youngster's performance at grading periods. Therefore, the recording system must be practical. Most suggestions for anecdotal daily recording (notebook, diary [Thomas, 1969], or individual folders) are extremely time-consuming, subjective, and unwieldy. And yet our teachers do need accurate information to meet individual learning needs and to report to students, parents, and administrators.

Precision Teaching offers practical, yet precise, assistance to classroom teachers. The procedures are practical because the recordings are made on natural events (academic or management areas) by those in the classroom already. Students count and chart their own performance rates or may help to change the noise or activity level by personally recording "talk-outs" or "out-of-seats." Every person, including the teacher, keeps track of their own performance rate and is involved in the process of deciding on appropriate educational aims. Because performance rates are up-dated each day, they are of day to day importance in tailoring educational plans to individual requirements. Since performance rate can be taken easily on most academics, the correct and error rate form the basics in our precision analysis of how a youngster performs.

Daily Charting:

We are trying daily charts of academic performance to help meet the necessity for precise, objective individualized information. Some examples of performance we record are: oral reading, mathematics problems, spelling words, musical notes read, finger placement, geography and social studies problems. The essential datum is in terms of frequency accomplished per unit time. Examples of these standardized data are number of arithmetic problems done (correct and errors) per minute, or number of words read correctly and incorrectly per minute during a work period. This frequency per unit time is then converted into rate per minute and is plotted daily. Each child plots his own performance rate, on an equal-ratio chart. Both correct and error rates are considered important as refined measures of the quality of performance. Specific examples will be developed later in the chapter.

These daily charts of performance are kept up-to-date by the youngsters. While the youngsters chart for several important personal reasons, this also reduces the bookkeeping chores required of the teachers while training the pupils to monitor their own performances. However, though the youngsters maintain their charts, the data are shared with the teacher, often on a daily basis. Thus, the charts provide practical, precise information both to the youngster and to the teacher while generating permanent academic records on daily performance.

Teacher Use of Data

It is difficult to plan instruction for a group and still meet individual needs. Each youngster "exhibits" his own learning pattern. But how do we see the pattern? Counting and charting together is part of the answer.

Individual charts of performance rates are helping teachers to improve the effectiveness of their plans. Up-to-date daily charts show each youngster's pattern. For example, they show which youngsters are proficient, while helping the teacher locate those who are having difficulties. Thus, instructional decision-making is improved when data are used properly. Youngsters who reach and establish proficiency may move on within the curriculum or go to enrichment projects while the teacher aids youngsters with acquisition difficulties.

Standardized Data

Since we are concerned with the performance of a youngster in several curricular areas, some data standardization is useful. For example, we want to relate his performance in language arts to that in social studies and mathematics. Therefore, we use a standardized, equal ratio chart (as you will use in the personal project you have just begun) and we compute problems completed per minute. Charted academic rates, plotted on the standardized chart allow us to compare performance quality across several areas. Of course, correct and error rates are crucial, in fully analyzing the speed and accuracy of academic production so they are plotted separately. These rates per minute are our common references to the quality of performance.

Sharing Data:

Standardized data help the teacher to do refined analyses of youngsters' performances. Whenever desirable, these precise and exact data are shared with the parents, peers, and advisers of each youngster. Teacher-parent communication expands once a parent learns that all performance records are in the correct and error rate format on the equal ratio chart (Gislason, 1969).

We have also expanded and improved communication among teachers and principals (Geary, 1968). For example, since teachers usually plan work periods of varying durations, it is difficult to relate production from one curriculum area to another or performance in one room with that of another. However, when all data are reported as performance per unit time (correct and errors per minute) we can make direct comparisons of the recorded performance. A common set of data and charts also improve our ability to make fairly sophisticated field evaluations of different instructional materials, procedures, and effects (Starlin, C., 1969; Starlin, A., 1969; Reavis and O'Neil, 1969; Haughton, 1969; Haughton and Betterton, 1969b; Alper and White, 1969; Zimmerman, 1969a).

Precision Teaching Rationale:

1. Measurement or a Prescriptive Technique?

2. Performance Rate

3. Pictoral Analysis

4. Is-Does Formula

1. A Measurement or a Prescriptive Tehcnique?

Many people confuse the rationale of Precision Teaching with certain remedial methodologies. For example, some equate Precision Teaching with Rogerian therapy (Alper, 1969), Alderian therapy, behavior modification, direct insturction, and even the various engineered classroom designs. This is unfortunate, because a basic tenet of Precision Teaching is to develop precise measurement systems rather than specific remedial tactics.

The current strategic plan is to discover accurate and precise classroom measurement procedures. This involves developing direct daily rate recording and charting which will suit most remedial tactics. For example, when you wish to compare two different classroom management procedures Precision Teaching data helps. (Koenig, 1968; Caldwell, 1967; Shores and Haubric, 1969). Also, when we wish to choose between procedures within a classroom, project data that are rated and charted aid reaching rational educational decisions.

<u>Precise Recording</u>:

There are numerous examples of the consequences of precise measurement outside of Education. Consider precision in the kitchen. When the project is a special cake, we carefully follow a certain recipe and we conduct exact measurements. When making beverages, we measure ounces and tablespoons or teaspoons of freeze-dried powder (Folger, 1969). Yet, we practice no such precision when we conduct educational projects with youngsters. It seems that people are more interested in carefully measuring kitchen and athletic events than gaining accurate classroom performance records. Because of this, our best timing devices are designed for the kitchen and come from Sears and Roebuck (1969); while our counters, usually used by golfers (Lindsley, 1968), are purchased in sporting goods stores. Suggestions or theories on how to improve cooking or coaching are often subjected to a rigorous analysis using quite precise measurements. A recent example was Roger Bannister's training plan to break the four minute mile. Careful measurement and timing helped test his theory. Bannister theorized that if he ran the half mile in two minutes he could do the mile in four. Precise measurements and hard running proved his theory correct. Inaccurate records would have left us ignorant about the validity of his theory and might have defeated his efforts.

At this time there are a number of theories and suggestions on "How To Do Education" and remediation. On the other hand, there is an almost complete lack of precise, accurate classroom information or data to support or refute available theories. Therefore, at the present time, we in Precision Teaching are placing our emphasis on MEASUREMENT. This is important as a <u>strategic position</u> rather than just a tactic, and reflects the heritage of Ogden R. Lindsley (1956) learned from B. F. Skinner (1938) and S. S. Stevens (1959).

<u>Comparison</u>:

Careful, continuous records of academic performance will help us choose <u>between</u> instructional possibilities. Direct records of <u>each</u> youngster's performance in various curriculum areas tell us exactly how he <u>is</u> performing while allowing us to predict future performance levels. And so, since we will be able to predict outcomes we will be able to introduce different techniques to improve performance if it falls below desired levels.

After deciding on our educational aims, project data will also tell us which procedures effectively produce behavior that meets our aims.

Evaluation:

The current educational system is like a nation with refined rockets but no measurement systems. We would have difficulty reaching a destination without accurate guidance systems based upon accurate, directly-recorded and continuous measurement. It is sobering to realize that undirected, massive forces and velocities cannot reach specific goals. Without careful, continuous performance records, our rockets will not take man to far planets. In fact the energies released might destroy man. For no matter how exact after-the-fact measurements are, a *post mortem* analysis will not help ongoing attempts reach distant objectives. Even twelve seconds of information blackout during the Apollo 12 caused serious concern to astronauts and ground controllers, for the corrective link was broken. When that link broke we did not know if flight correction was required and we would not have known if any change involved was appropriate. We need data throughout our flight; consequently, our records must be concurrent, direct, precise, accurate, and subjected to continuous analysis. Obviously, once such an analysis is available it is possible to take necessary corrective action any time during a project when and if adjustments are required. When adjustments are not necessary, we continue measuring.

However, today we in Education launch children into the first four years of school, and we seldom take direct records of performance. (Bauernfeind, 1963).

Over 60 million are already launched. Are these youngsters in orbit? Or are they headed toward functional and desirable educational aims? Or, are they on a crash course?

If you wish to use a classroom procedure which will increase your students correct reading rate, standardized Precision Teaching measures provides precise data on which classroom procedures actually increases your students' correct reading rate, while decreasing error rates. There is nothing within Precision Teaching basics which implies or requires that any theoretical, remedial or intervention plan be followed. Each person decides his educational aims, then decides upon appropriate tactics. Charted performance rates show you how effective and efficient your plans are.

Our understanding of academics comes from a careful daily analysis of ongoing performance changes that are continuously recorded. These continuing systematic classroom comparisons and evaluations of performance will produce a truly adjustive educational system. A system in which the feed-back of curriculum acting upon pupil and pupil acquisition of curriculum will become a continuous, adjusting interaction.

Daily performance records are not visionary. Each day hundreds of learners maintain direct records of their performance in such local school districts as Eugene, Springfield, and Bethel, Oregon as well as in other centers. These direct records are shared with the educational team--pupil (protegé), teacher (manager), and supervisor (adviser). Much remains to be learned about continuous instructional adjustments based on daily performance, rate comparisons and evaluations. One of the functions of shared team data is to help collect these data to speed necessary refinements.

Field Tools

Next, I would like to share our basic tools in field analysis. Although we have several interrelated tools, here, we will only discuss the performance rates and daily Behavior Chart. Such tools as the four basic steps (Lovitt chapter), and the Behavior Bank are important and compliment daily chart use. However, the Behavior Chart has many important charact ristics and a complete understanding of them merits a thorough treatment. Therefore, we will concentrate now on developing, and analyzing the chart and the rationale for performance rate measures. Since rated performances are plotted on the chart, we will discuss this aspect in detail.

Performance Rate

A basic element in precision teaching is the use of performance rate as the basic and standardized measure. Although rate (responses per minute) was introduced by Skinner over 30 years ago (Skinner, 1938) and has been used widely in physical sciences, no one has explored the rationale for the use of rate in educational projects. I would like to discuss this now since direct rate recording is such an important issue.

Rate measures are composed of the frequency of an event divided by the duration of the time sample. In Precision Teaching we use the number of problems completed divided by a standard time unit (minutes), or we may use the count of a management response divided by the number of observed minutes for a standardized measure.

Rate = Count and Time:

In academic areas, teachers often record performance rates on typical classroom worksheets. For example, the assignment may be to use adverbs or adjectives in a creative writing exercise (See figures 1, 2, and 3). Suppose a pupil writes for ten minutes and writes 11 adverbs. The performance rate is $\frac{\text{11 adverbs}}{\text{10 minutes}}$ which computes to 1.1 adverbs per minute.

Another example could be that of a youngster completing twenty-five basic addition problems (e.g., $\begin{array}{r}2\\+6\\\hline\end{array}$ or $\begin{array}{r}5\\+4\\\hline\end{array}$ or $\begin{array}{r}7\\+0\\\hline\end{array}$) in one minute. Suppose that twenty of them are correct and five wrong; in this project we compute both correct rate ($\frac{20}{1}$ = 20 per minute) and error rate ($\frac{5}{1}$ = 5 per minute).*

Insert Figures 1, 2 and 3 about here

Or, in a peer tutoring session, a peer may record 375 words read correctly with twelve errors in a three-minute period. Thus, correct rate is $\frac{375}{3} = 125$ words per minute, while his error rate is $\frac{12}{3} = 4$ words per minute. The use of performance rate allows us to analyze how to help a protege because we see his data in: 1) a standard unit of measurement (movement cycles per minute) for use in and communication across situations (school, home, etc.), and 2) ratio relationships.

Rate or Percentage?

Percentage of correct and errors has been our basic and standard measurement in education for some time. One of the reasons for this is that percentage values make the ration between correct and errors is made quite clear. In other words we learn about the quality of performance from a percent summary.

However, performance rate gives us the same information about quality and is a more sensitive measure as well.

Let us suppose, for example, that a child does 100 problems and gets 80 of them correct and 20 incorrect. We see that the relationship between them is a factor of 4. He does 4 times as many correct as he does errors. Now, to look at this from the vantage point of performance rate, let us suppose that he took ten minutes to do these problems. This would mean that

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*Correct and error rates are plotted on separate charts to aid analysis.

PTC-11

SCHOOL__________ GRADE____ DATE______ NAME__________

+E ENDING TIME________ NUMBER CORRECT________ CORRECT RATE________

BEGINNING TIME________ NUMBER ERRORS________ ERROR RATE________

TOTAL TIME________

A

4 + 3 =
6 + 5 =
1 + 4 =
9 + 7 =
0 + 0 =
5 + 7 =
8 + 6 =
7 + 6 =
2 + 5 =
3 + 7 =

B

2 + 2 =
7 + 8 =
0 + 5 =
7 + 4 =
5 + 9 =
3 + 9 =
1 + 0 =
6 + 8 =
1 + 0 =
9 + 3 =

C

7 + 5 =
9 + 2 =
3 + 6 =
6 + 7 =
5 + 1 =
8 + 0 =
4 + 1 =
0 + 1 =
1 + 5 =
2 + 0 =

D

4 + 2 =
1 + 7 =
6 + 9 =
0 + 7 =
2 + 8 =
3 + 8 =
9 + 5 =
7 + 4 =
5 + 2 =
8 + 3 =

E

6 + 0 =
2 + 1 =
9 + 9 =
8 + 5 =
5 + 6 =
7 + 0 =
1 + 1 =
0 + 2 =
3 + 1 =
4 + 4 =

F

3 + 4 =
1 + 9 =
7 + 9 =
2 + 6 =
8 + 4 =
6 + 2 =
5 + 5 =
0 + 3 =
4 + 6 =
9 + 0 =

Fig 1

1

Oct 1969

Fig 2

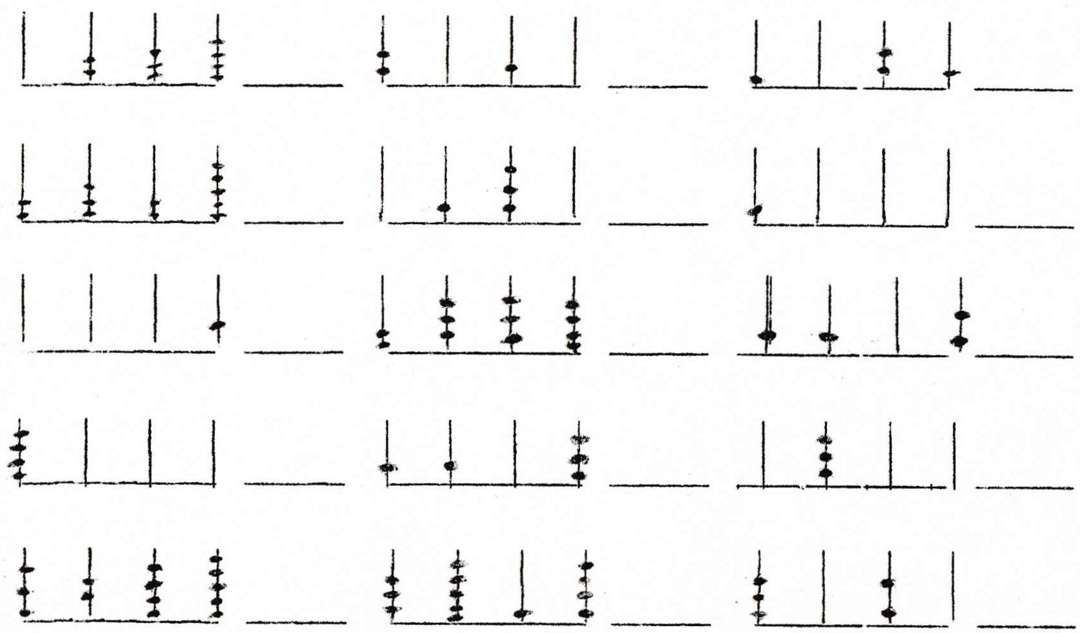
Name ______________________ Soc. Sec.# _____________ Grade ________ School ____________ Date __________

Sample Manager _____________________________ Time _____________ Sample (mark) /1 / /2 / /3 / /4 / /5 /

/B / /D/ /A /

Concepts: Part F. Decimal Place Value

Directions: The lines of the abacus show place value. Write what you think each number represents on the line beside each abacus.



	Movements	
	per row	sub-total
Row 1	11	
Row 2	11	(22)
Row 3	9	(31)
Row 4	11	(42)
Row 5	12	(54)

Total correct ________ error ________

Rate correct ________ error ________

M. Gaasholt Nov. '69

he completed 80/10 minutes = 8.0 per minute correct and 20/10 minutes = 2.0 per minute errors. The relationship between 8 per minute correct and 2 per minute correct is a factor of 4! Thus by dividing both frequencies by time, we have retained the ratio relationship so important in analyzing the quality of the student's performance, while using a more direct and sensitive record as our measure.

Rate is more sensitive to performance changes than many other measures. There are several reasons: a) there is an arbitrary ceiling of 1.0 if we use proportion and of 100 if we use percentage, however, 100 percent does not represent adequately the variety of different performances that can attain 100 percent; b) to interpret whether a student is working faster or slower we must have both the number completed and the duration. For example, two youngsters can be 100 percent correct, yet one completes a page of 100 facts in two minutes, and another completes the page in 10 minutes. It is clear that one child is working at the rate of 50 problems correct per minute, while the other is working at the rate of ten correct per minute. Percentage does not accurately or adequately represent an important difference in these performances. While percentage represents quality it does not tell us how effectively or proficiently the youngster performs, c) furthermore there is an implication in the use of percentage or proportion that the two elements (i.e., correct and error rates) measured are reciprocal. That is, if a correct performance increases, then an error performance will decrease. This is the case <u>only</u> if accuracy shifts. However, speed of either performance may change, and leave the proportion correct and error unchanged or alter the relationship in a variety of ways. For example, if a youngster is performing for ten minutes and completes eight correct per minute and two errors per minute, and then completes the work in five minutes and leaves the ratio of a factor of 4 unchanged, he would be completing the problems in sixteen per minute and four per minute for correct and error rates respectively.

Yet, various other outcomes are possible. He could increase his rate correct to 18 per minute and hold his error rate at two per minute. This change would be reflected in a percentage change from 90 to 10 correct, and errors, but give no indication of the doubled performance rate. On the other hand, a youngster, could move to the 90 to 10 percent relationship by completing 90 correct and 10 incorrect in a ten-minute period.

Figure 4 indicates the possible different performance rate combinations

Insert Figure 4 about here

and compares them to the two possible outcomes when percentage is used. Holzschuh (1965) analyzed a classroom project by comparing the sensitivity of performance rate and percentage. He found that performance rate was forty times more sensitive to performance changes when compared to percentage measures.

3) The third point is that rate indicates proficiency, whereas percentage reflects accuracy, but not speed. We use the term proficiency to indicate accuracy and speed. In this respect rate is a more dynamic record of performance than is percentages. Let us take a simple example in the area of basic facts arithmetic. A child who completes his basic arithmetic computations at the rate of one every ten minutes correct may complete the whole sheet without an error. However, it would take him a thousand minutes (over 16 hours or three school days) to complete one hundred problems. This obviously is careful and accurate but not proficient performance. A percentage summary informs us of the static, but not the dynamic aspect of

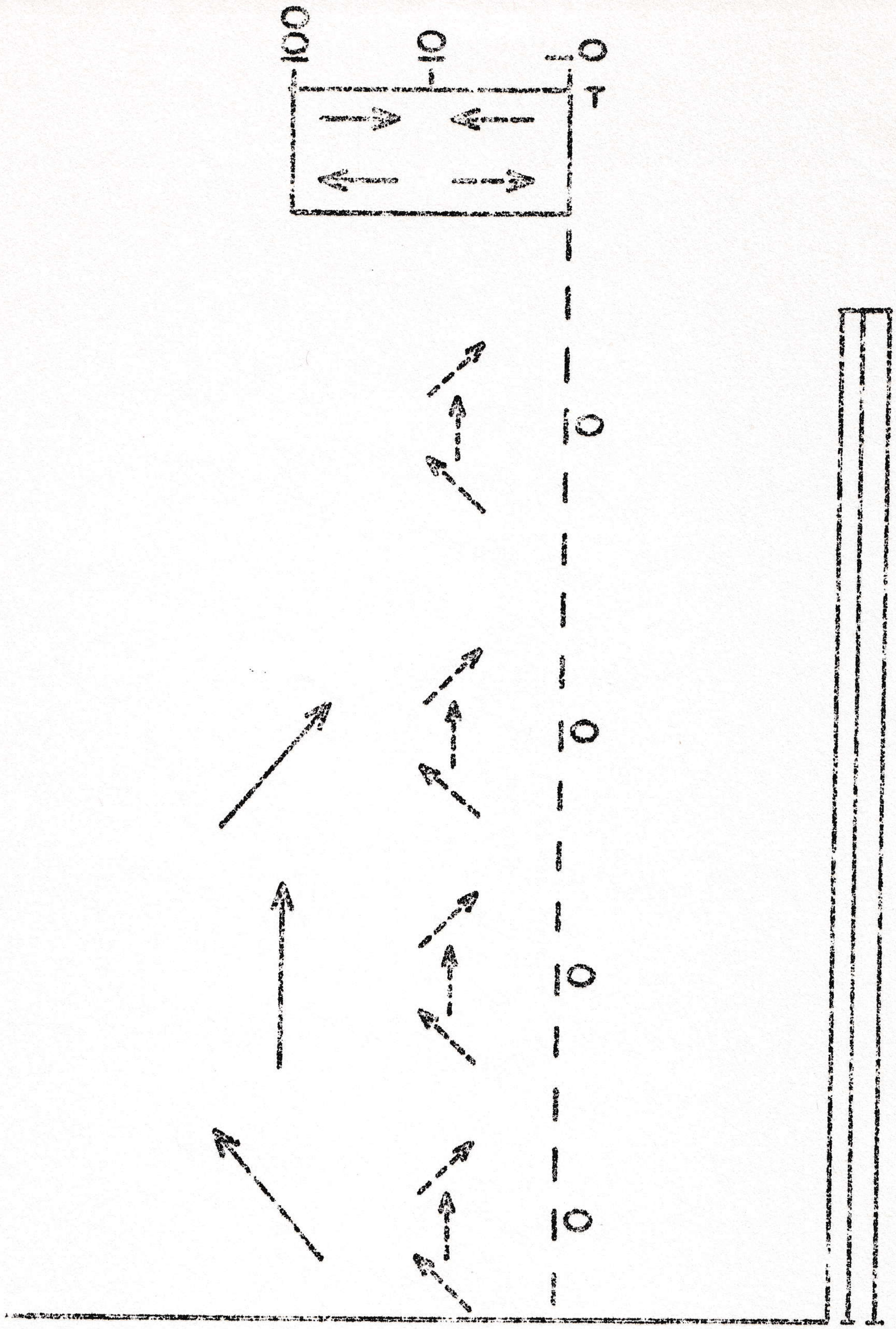


FIG. 4

performance. In a similar vein, a child might be able to print his name at the rate of one letter every two minutes. Therefore, it would take him about fifteen minutes to print his name if it contained seven letters.

As any teacher knows, accurate performance is not always proficient performance. Performance rate, on the other hand, indicates both speed and accuracy, hence proficiency because it includes two factors -- time, and number correct.

The usually reported statistics of t-scores, stanines, Z scores and even quartiles suffer from the accuracy and proficiency problem. What proficiency is implied by a 9 stanine? Only that the student is in the top ten percent of <u>those tested</u>. But what measure indicates that these "top" students are proficient? You and I might score in the ninth stanine of a running group--does this imply we are ready to break the 3:50 mile? Unfortunately the answer is "no", because the scores have to be related to a proficiency level before they can be properly interpreted.

Understanding Proficiency and Competency:

To guarantee proficient and competent proteges we need information about the quality <u>and</u> the amount a youngster completes. These data are so important that we have begun a collection of rates at which proficiency appears to occur (Reavis and O'Neil, 1969; Kunzelmann, 1965) to aid project planning and execution. These proficiency data (correct and error rates) are necessary for adequate project planning and evaluation. Since performance in future topics depends on a thorough, adequate knowledge of basics, it is important to establish proficiency, that is, an appropriate speed and accuracy, at each step. As proficiency is established on one step, the student essentially earns access to the next by establishing proficiency.

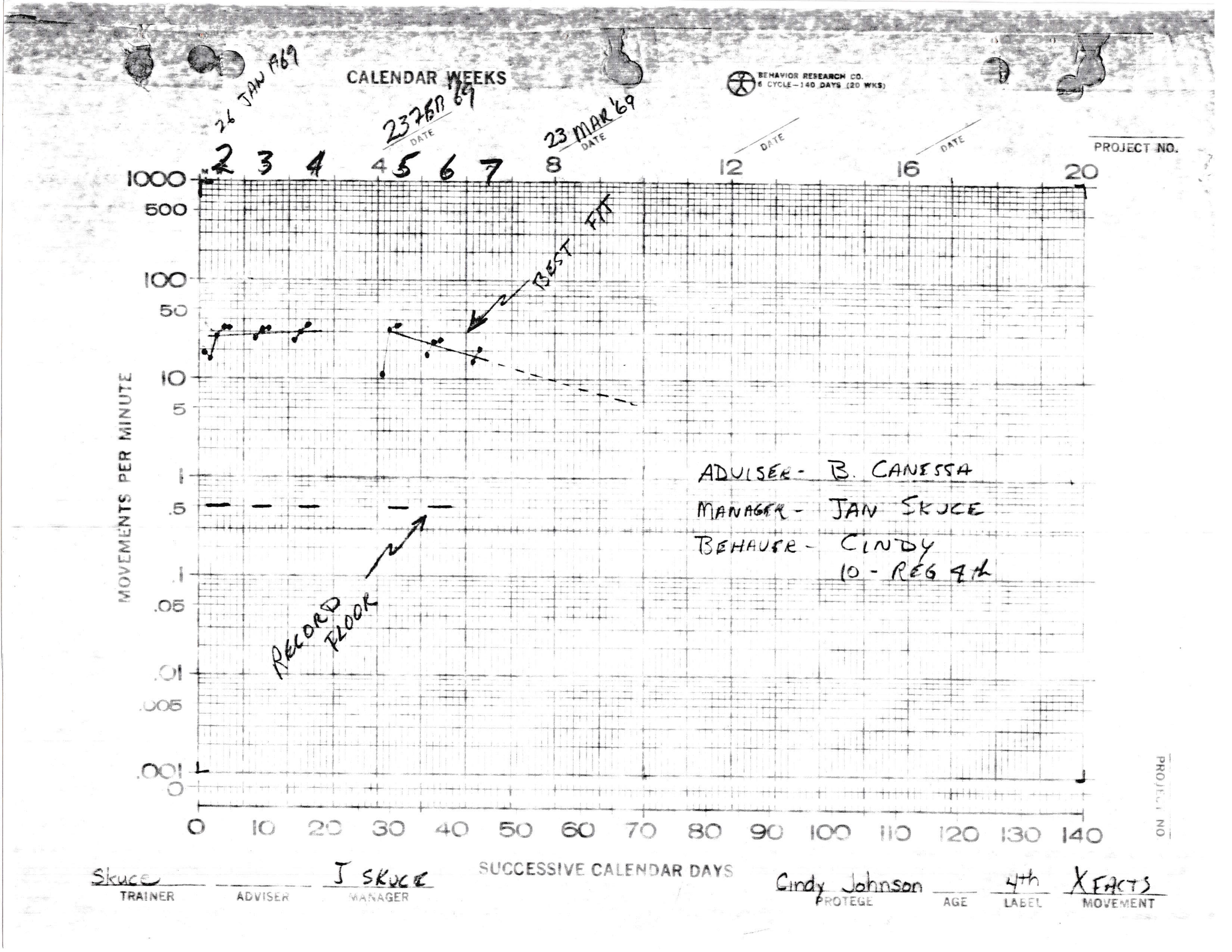
This is a marked break with the tradition of planning curricula for certain blocks of time. These data (figure 5) from Janet Skuce's room illustrate

Insert Figure 5 about here

the cumulative effects of advancing through a curriculum, in this case basic arithmetic facts, on a calendar plan instead of determining proficiency. Each week youngsters worked on a new basic fact independent of their proficiency. Over the weeks and automatic presentation of new materials their overall performance dropped. Janet learned from this experience and on review, each youngster attained at least thirty per minute correct before moving on to the next step in these facts.

It is true that we don't have to (or always desire to) do things as fast as possible. However, we do need to know <u>how much</u> of a high quality performance to expect in a given period. Therefore, our information about youngsters should include:

1) directly recorded performance rates. Ideally these records are taken daily using the regular curriculum.
2) a description of his correct rate compared to error rate. For example if his correct and error rates are 20.0 and 4.0 respectively, then he is 5 times (X5) more right than wrong (equivalent to 83% correct).
3) a functionally defined proficiency level; for example, 30/minute correct, 0 error rate, in arithmetic basic facts, or 100 words per minute correct in oral reading.
4) a direct comparative statement concerning each youngster's performance, that is relative to the proficiency level or educational aim. If the proficiency level is 30 correct per minute and zero errors,


26 JAN '69
CALENDAR WEEKS
23 FEB '69
DATE
23 MAR '69
DATE
DATE
DATE
BEHAVIOR RESEARCH CO.
6 CYCLE—140 DAYS (20 WKS)
PROJECT NO.
2 3 4 4 5 6 7 8 12 16 20
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
0
MOVEMENTS PER MINUTE
BEST FIT
RECORD FLOOR
ADVISER - B. CANESSA
MANAGER - JAN SKUCE
BEHAVER - CINDY
10 - REG 4th
PROJECT NO
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
SUCCESSIVE CALENDAR DAYS
Skuce
TRAINER
ADVISER
J SKUCE
MANAGER
Cindy Johnson
PROTEGE
AGE
4th
LABEL
X FACTS
MOVEMENT

a youngster who performs at 15.0 correct per minute is a "divide by two (÷ 2)" below the proficiency level, whereas one who performs at 60 per minute is "times two (x 2)" above proficiency.

5) a quantitative relationship of this youngster to his peers, if this information is desired. Here, mathematical factors can be used also. If the group middle rate at 30 per minute correct, Billy performs at 45; therefore he is x 1.5 of the group middle. Or, stanines, t-scores, and quartiles could be used to describe his relationship to peers or the reference group. Note, too, that to have a full and comprehensive picture of a youngster's performance we must have these descriptive data on both the correct and error rate.

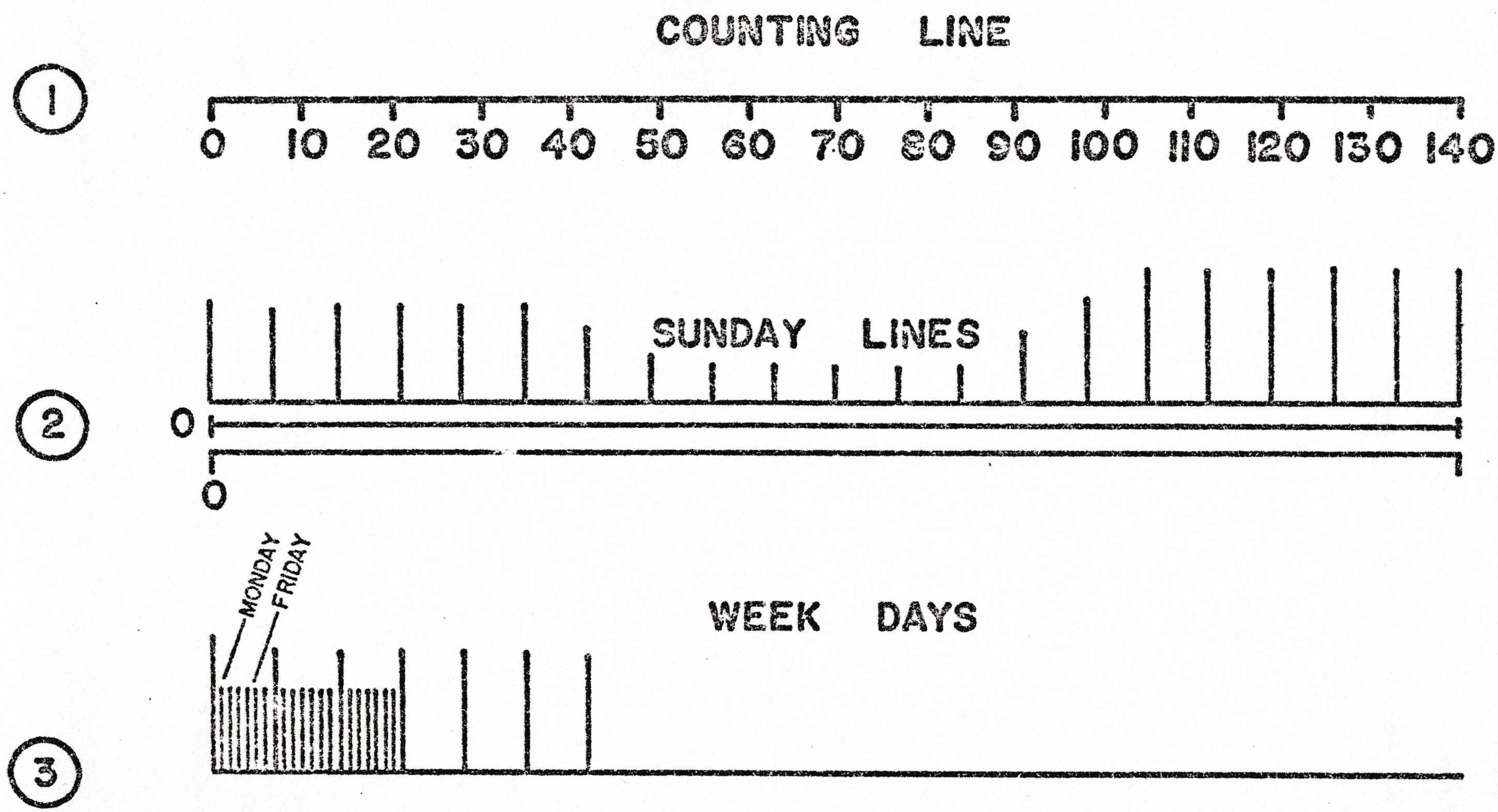
3. Pictorial Analysis

A picture is worth a thousand words. Since "our ears believe others, our eyes believe themselves," (Hall, 1869) Precision Teaching emphasizes a pictorial analysis on a standardized Behavior Chart.

I will introduce the daily chart (DC-7) as we often do when instructing teachers and others how to plot performance rates. The first step in "building" the chart is to look at the chart across the bottom. Here we show that the chart covers 140 successive calendar days blocked off on the counting line in figure 6 (often the overhead projector is useful and these figures are designed for that purpose). The next aspect to point out is the heavy

Insert Figure 6 about here

lines which occur every seventh line. These lines indicate Sundays. The intermediate lines represent all other days of the week, Monday through Saturday.



COUNTING LINE
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
SUNDAY LINES
0
0
MONDAY
FRIDAY
WEEK DAYS

FIG. 6

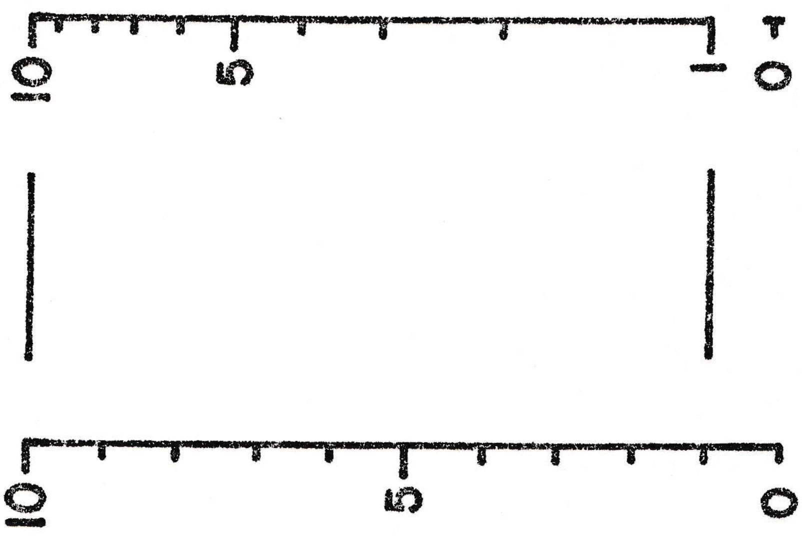


FIG. 9.

This demonstration illustrates dramatically that a child who doubles from five to ten per minutes gets five spaces on the equal interval or arithmetic Scale, while the other child only gets one unit. In terms of individualizing feedback relative to a particular child, equal interval scales do not satisfy most of our ideas about giving equal feedback for equal gains.

Coloring the grid on the equal ratio scale (right side) from one to two and from five to ten each indicate a performance doubling. It is obvious that each change shares the equivalent amount of space. Thus we see that the equal ratio paper is specifically designed to show feedback on the ratio of change, as well as representing the actual rate too. Since we are interested in individualizing the youngster's information and in analysis of his ratio of change, the equal ratio grid is our most reasonable graphical format.

Then, moving to the full chart (figure 10), the students observe, the relative positions of two proteges whose rates change by the same absolute amount. A protege starts at one per minute and goes up to 30 per minute correct and another goes from 100 per minute up to 130 per minute correct. Now, both proteges have increased by 30 problems correct. However, the chart paper indicates that the ratio of change is markedly different. This important point is usually "understood" without the chart, but is concealed by an arithmetic scale where both students receive 30 units (see Figure 10). It is clear from the equal ratio sample that one child increases by a factor of 30 times while the youngster who starts at 100 per minute increases by 1.3 times.

Insert Figure 10 about here

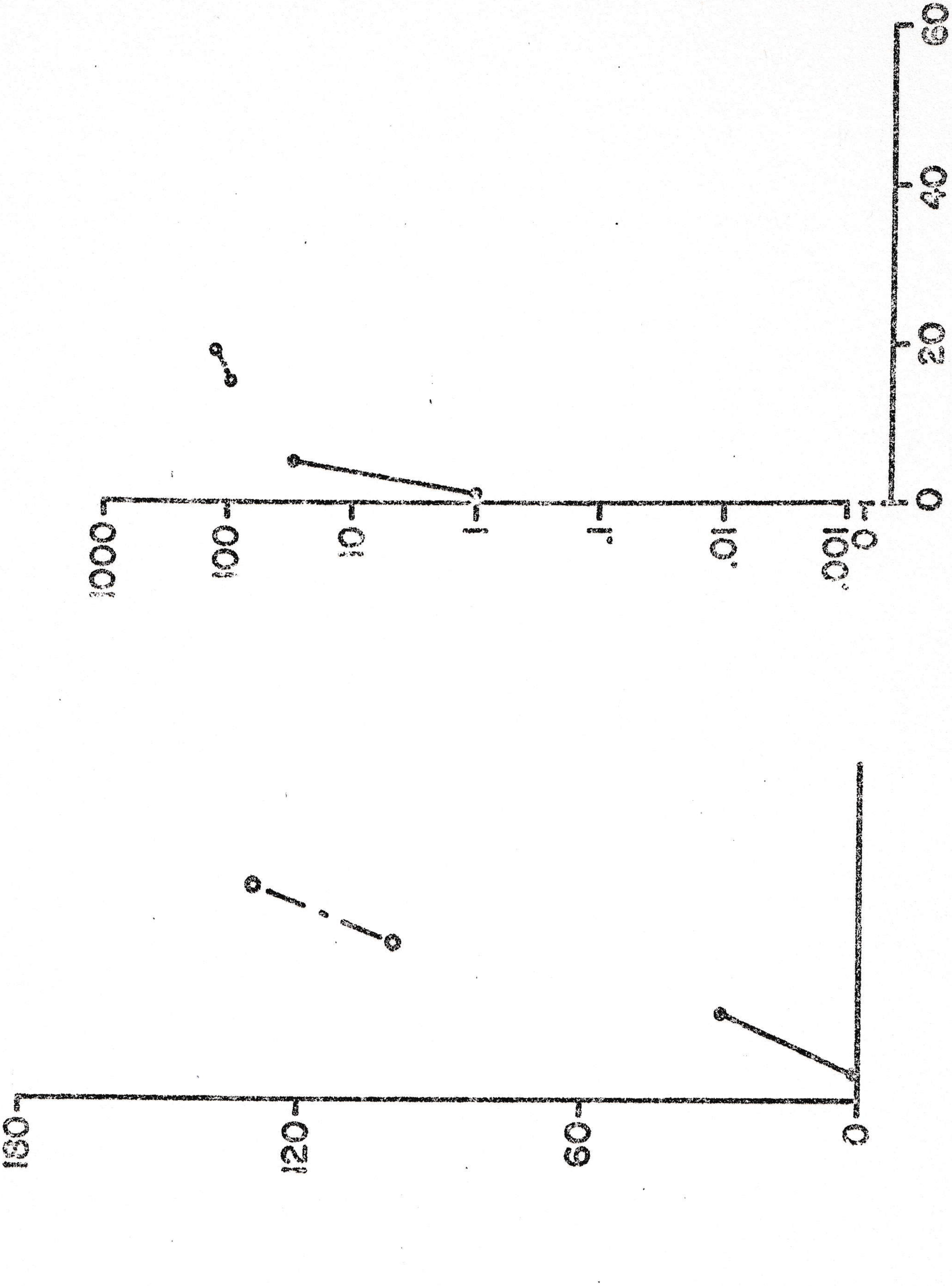


FIG. 10

Since <u>ratio</u> changes and <u>rates</u> of change are more important and more significant than the absolute amount of change, the equal ratio daily chart gives us this information visually and immediately. It also gives us the absolute numbers to work with, so we have both the relative amount of change (the ratio) and the absolute number for analysis.

Behavior Range:

Why have a range (see Figure 11) from one movement every thousand minutes ($\frac{1}{1,000}$ or .001) up to a thousand movements per minute (1,000 movements per minute)? This range is necessary to encompass the wide rate range of people's movements.

We often record and chart fractional or decimal rates that occur below one per minute. In a classroom, a protege may interupt once in 100 minutes, therefore her rate would be $\frac{1}{100} = .01$ interuptions per minute. Observation periods can last ten, one hundred, and up to a full waking day sampling 1,000 minutes. For example some low rate performances occur once or twice in 1,000 minutes at .001 and .002 respectively. Therefore it is necessary to plot these rates on a chart that handles these low rates as

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Insert Figure 11 about here

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well as such high rate performances as oral or silent reading rates involving hundreds of movement cycles per minute. These and other high rates recording over one hundred per minute require the upper cycle on the chart. Our concern over standardization and our desire to compare relative rates requires the full six cycles.

Is a chart containing the full six cycles necessary and functional? How much behavior or how many youngsters' behavior require all six cycles when plotting their rates? At this point we study the following sequence.

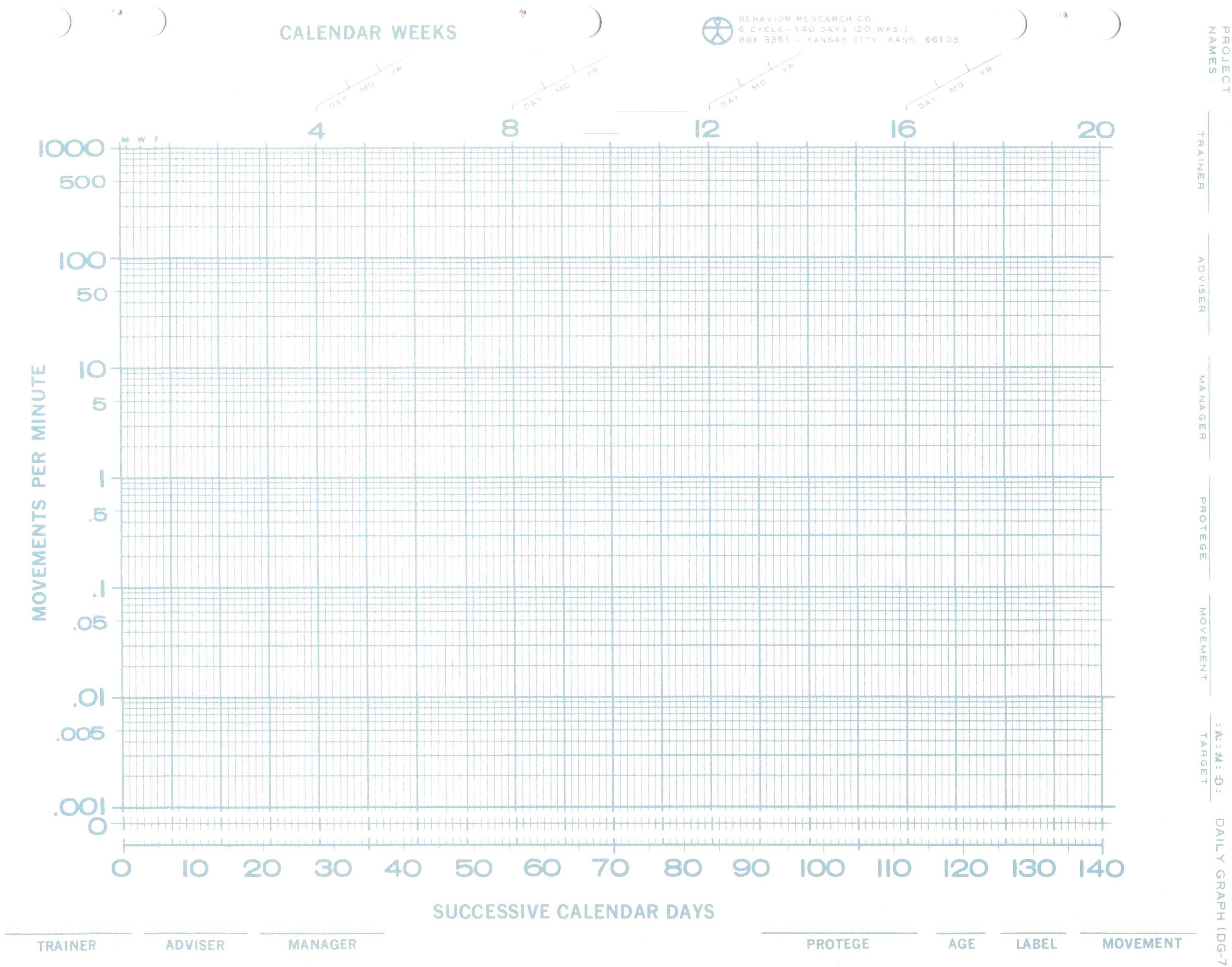

CALENDAR WEEKS
BEHAVIOR RESEARCH CO.
6 CYCLE - 140 DAYS (20 WKS.)
BOX 3351 — KANSAS CITY, KANS. 66103
DAY MO YR
4
8
12
16
20
MOVEMENTS PER MINUTE
1000
500
100
50
10
5
1
.5
.1
.05
.01
.005
.001
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
SUCCESSIVE CALENDAR DAYS
TRAINER
ADVISER
MANAGER
PROTEGE
AGE
LABEL
MOVEMENT
PROJECT NAMES:
TRAINER
ADVISER
MANAGER
PROTEGE
MOVEMENT
TARGET
:A: :M: :D:
DAILY GRAPH (DG-7)

FIG. 11

Koenig (1968) analyzed the performance of six proteges in his special education classroom. One of Koenig's protege's deceleration targets was animal noises (figure 12). The equal interval grid up the left side spans from 0 noises per minute to .12. Figure 13 represents Fred's arithmetic rate and the scale up the left side is from zero to six problems correct per minute, while figure 14 has a scale of zero to 300 and presents his silent reading rate. Since Fred is in a classroom we want to relate the performance in one area to that in another. We might want to analyze these graphs and discuss behavior, but it is difficult to compare data when they do not share a common up-the-left-side. The reason for this, is that equal interval scales are difficult to relate when a wide behavior range is represented.

Insert Figures 12, 13, and 14 about here

Perhaps in analyzing Fred's data we are primarily interested in academics, so we take the scale zero to 300 and chart the range of Fred's silent reading along with his interquartile and middle, then his arithmetic rate and his animal noises (see Figure 15). The only problem with this is that while we "see" silent reading, we have a terribly squashed view of his performance in arithmetic, while animal noises appear to be zero. This is so because the arithmetic scale tends to expand the high end and we are unable to locate low rates within such a scale.

On the other hand if we are interested in his animal noises (the management area), we could try to put the other performances on the animal noises scale. When you do this (see Figure 16) you find that animal noises show up quite nicely but we are unable to compare this behavior with academics because this scale explodes them off the graph! We cannot represent his

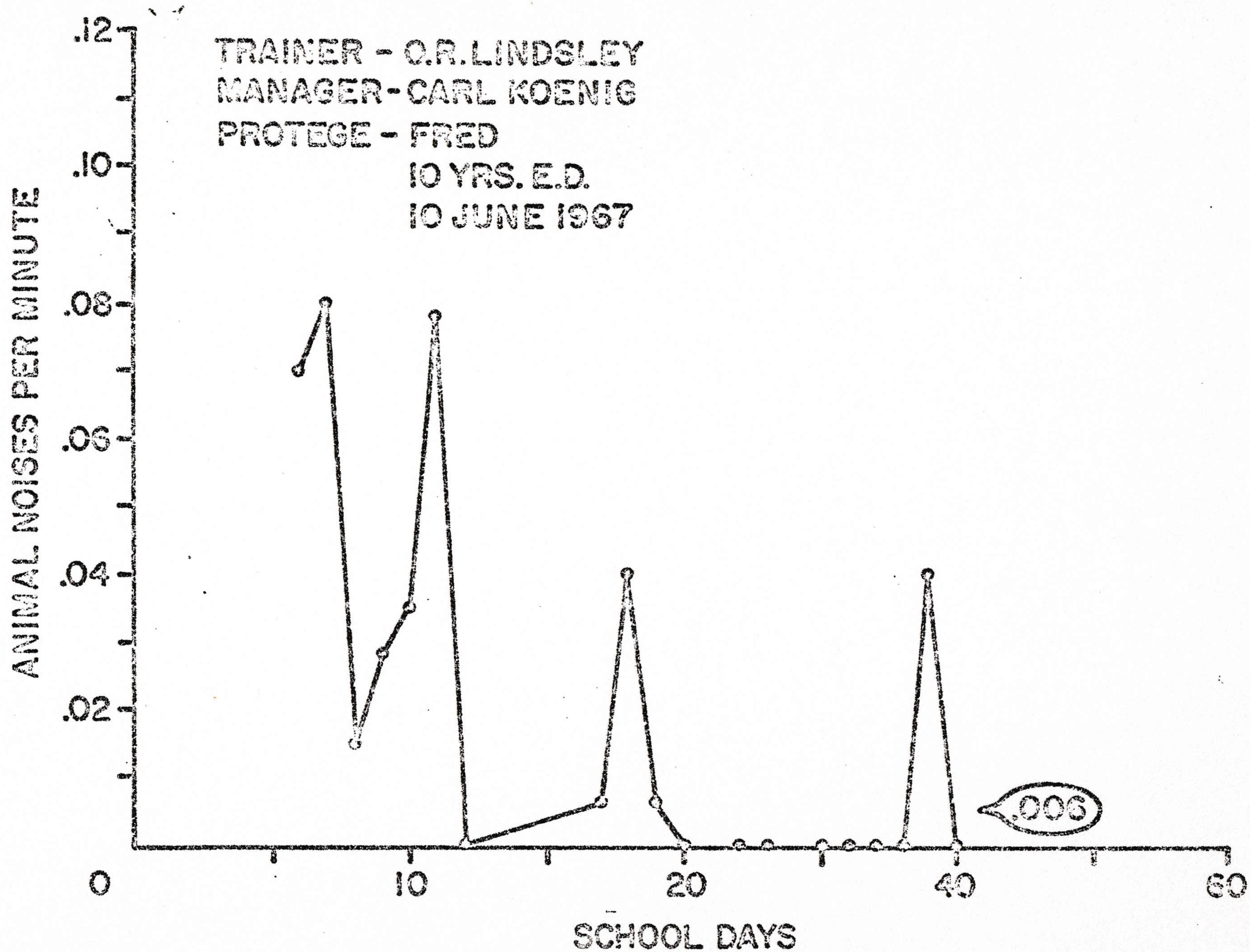
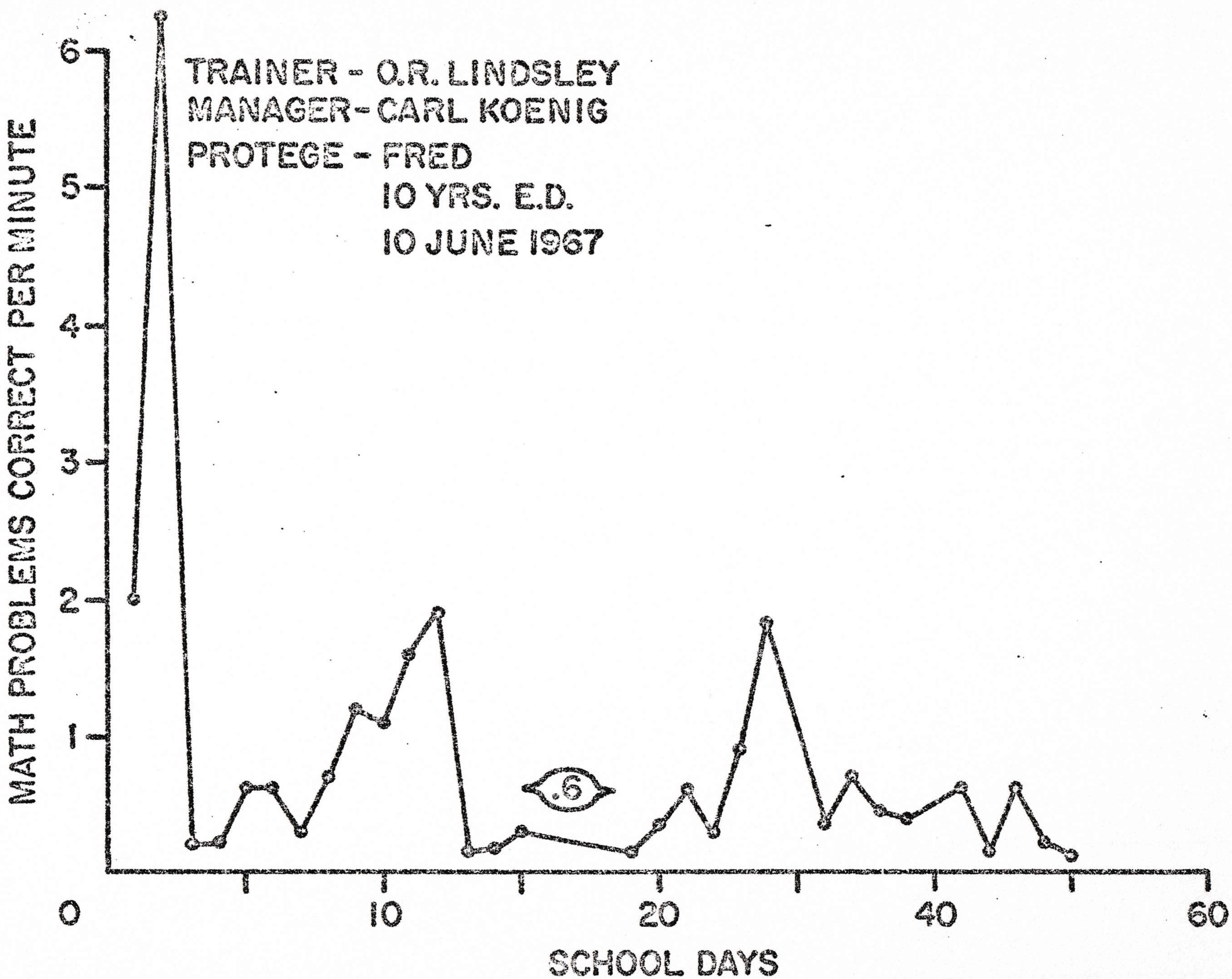

TRAINER - O.R. LINDSLEY
MANAGER - CARL KOENIG
PROTEGE - FRED
10 YRS. E.D.
10 JUNE 1967
ANIMAL NOISES PER MINUTE
.12
.10
.08
.06
.04
.02
0
10
20
40
60
SCHOOL DAYS
.006

FIG. 12



TRAINER - O.R. LINDSLEY
MANAGER - CARL KOENIG
PROTEGE - FRED
10 YRS. E.D.
10 JUNE 1967
MATH PROBLEMS CORRECT PER MINUTE
0
1
2
3
4
5
6
.6
10
20
40
60
SCHOOL DAYS

FIG. 13

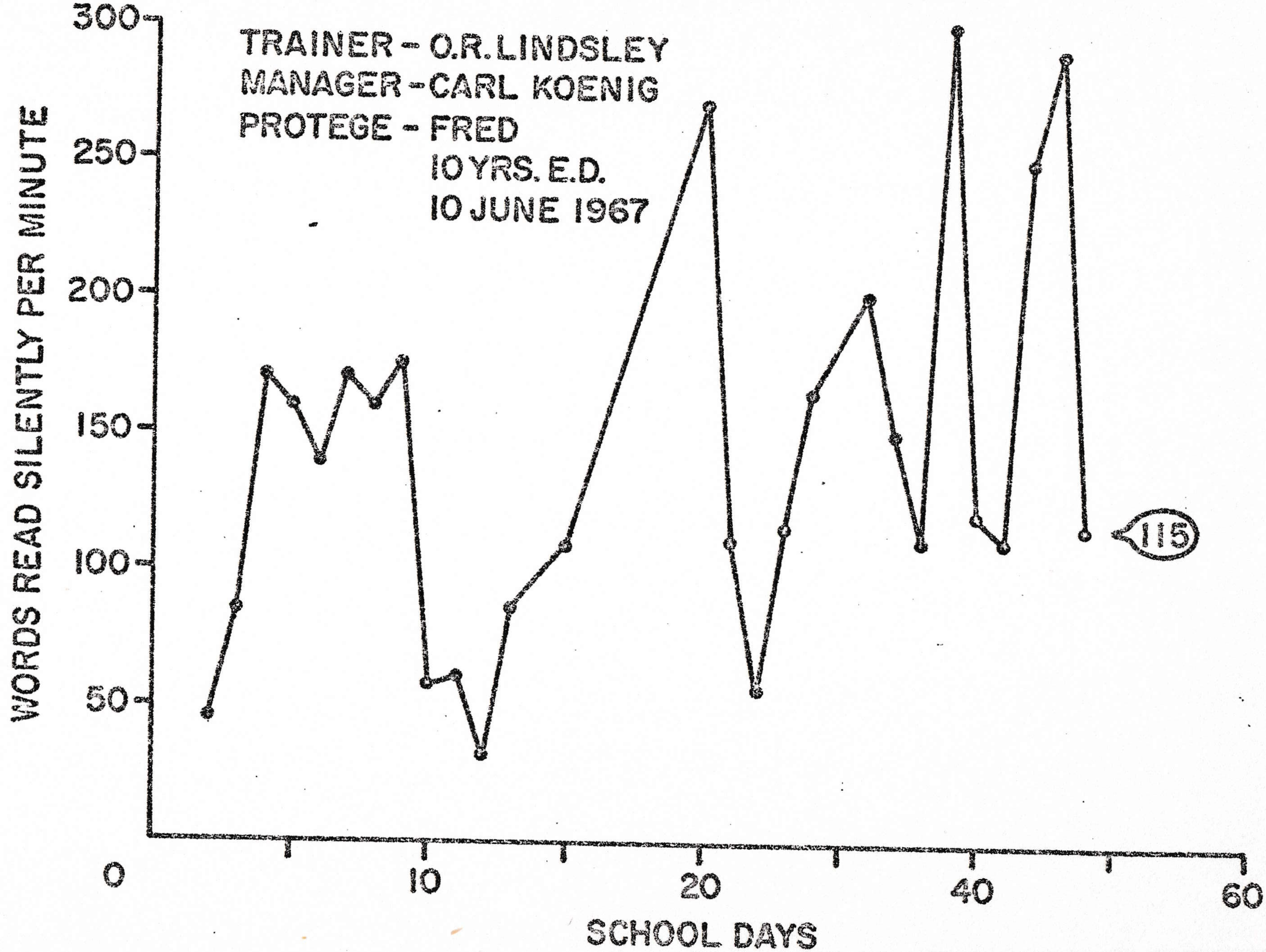

TRAINER - O.R. LINDSLEY
MANAGER - CARL KOENIG
PROTEGE - FRED
10 YRS. E.D.
10 JUNE 1967
WORDS READ SILENTLY PER MINUTE
300
250
200
150
100
50
0
10
20
40
60
SCHOOL DAYS
115

FIG. 14

arithmetic performance on this sheet, and it would take 1,072 additional sheets to represent the silent reading performance on an arithmetic scale of this sort! We are left, therefore, with the problem of trying to under-

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Insert Figures 15 and 16 about here

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stand Fred's various performance rates without a graphical format that will encompass all of these rates.

This is where the daily behavior chart becomes extremely useful. Figures 17, 18, and 19 are a re-charting of Fred's animal noises, arithmetic performance, and silent reading rates. Now, we are able to look at and analyze each rate in perspective because they are all on the equal ratio

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Insert Figures 17, 18, and 19 about here

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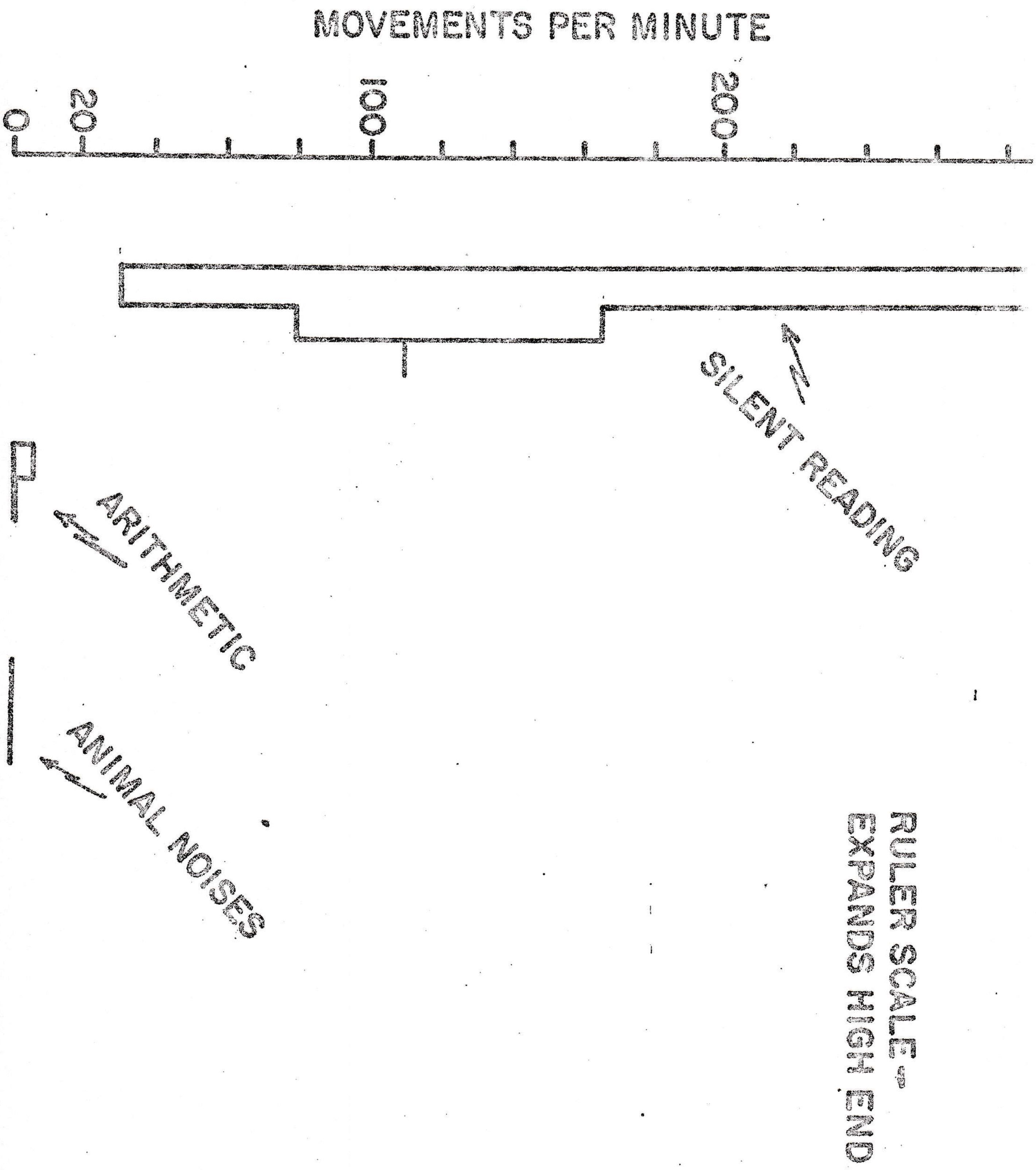
grid. Animal noises occur in the first two cycles, and arithmetic occurs in the third and fourth cycles whereas reading rates occur in the fifth and sixth cycles.

The equal ratio layout of up-the-left-side represents handles all of these rates because the spacing is equal to the ratio of change rather than to the arithmetic or absolute quantity of change. Thus, the chart represents rates from one thousand per minute to one every thousand minutes on the same grid. In passing we should note that, although the full day lasts 24 hours or 1440 minutes long, requiring a portion of a seventh cycle to .0007, most <u>waking</u> days are about 1,000 minutes. Therefore the chart stops at .001.

It is interesting, by the way, that Fred's three rates were originally "stretched and laminated to fill" the full space across-the-bottom, (the calendar information) as well as requiring distortion up-the-left-side is

FIG. 15


MOVEMENTS PER MINUTE
0
20
100
200
SILENT READING
ARITHMETIC
ANIMAL NOISES
RULER SCALE-
EXPANDS HIGH END

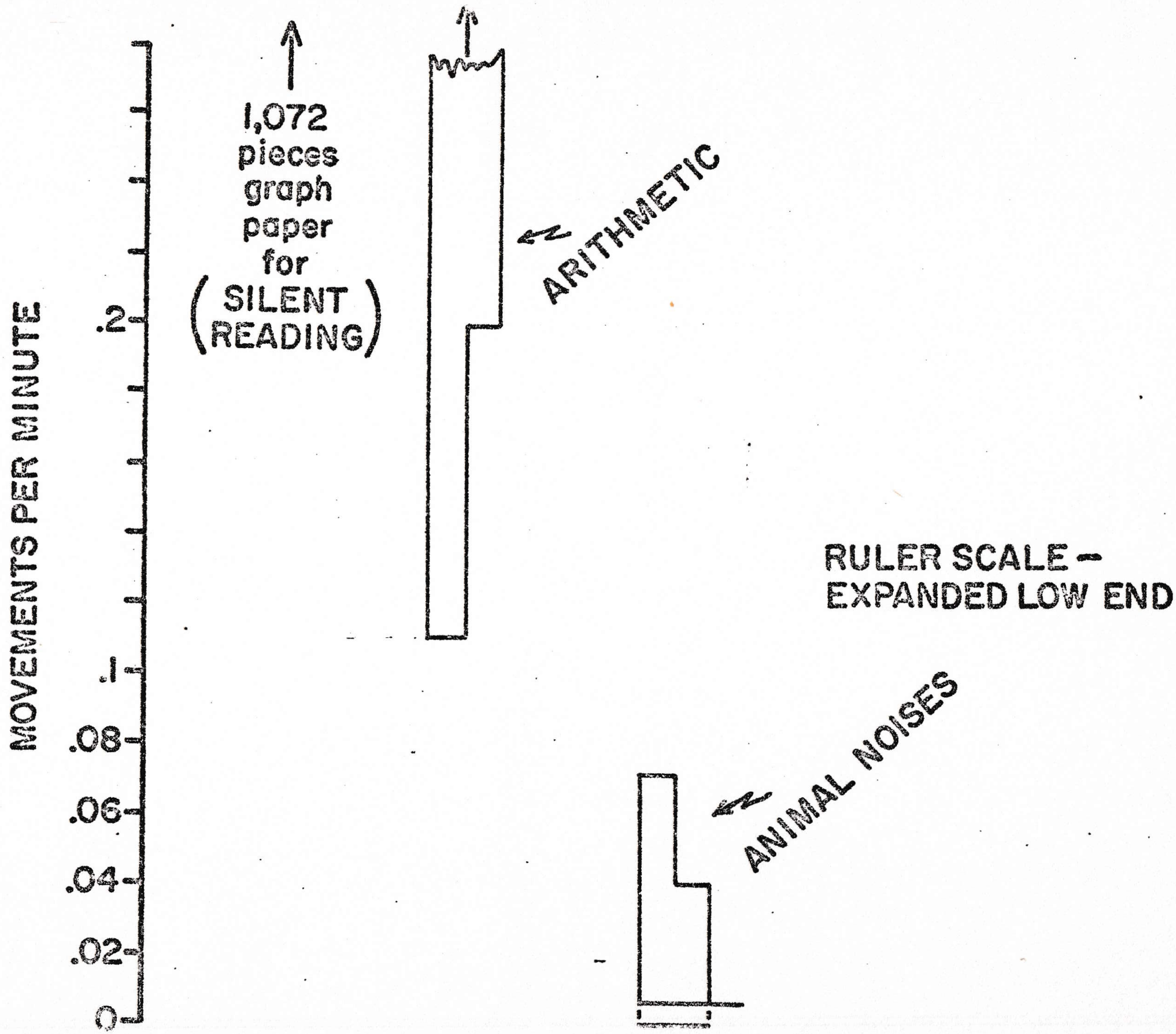

1,072 pieces graph paper for (SILENT READING)
ARITHMETIC
RULER SCALE – EXPANDED LOW END
ANIMAL NOISES
MOVEMENTS PER MINUTE
.2
.1
.08
.06
.04
.02
0

FIG. 16

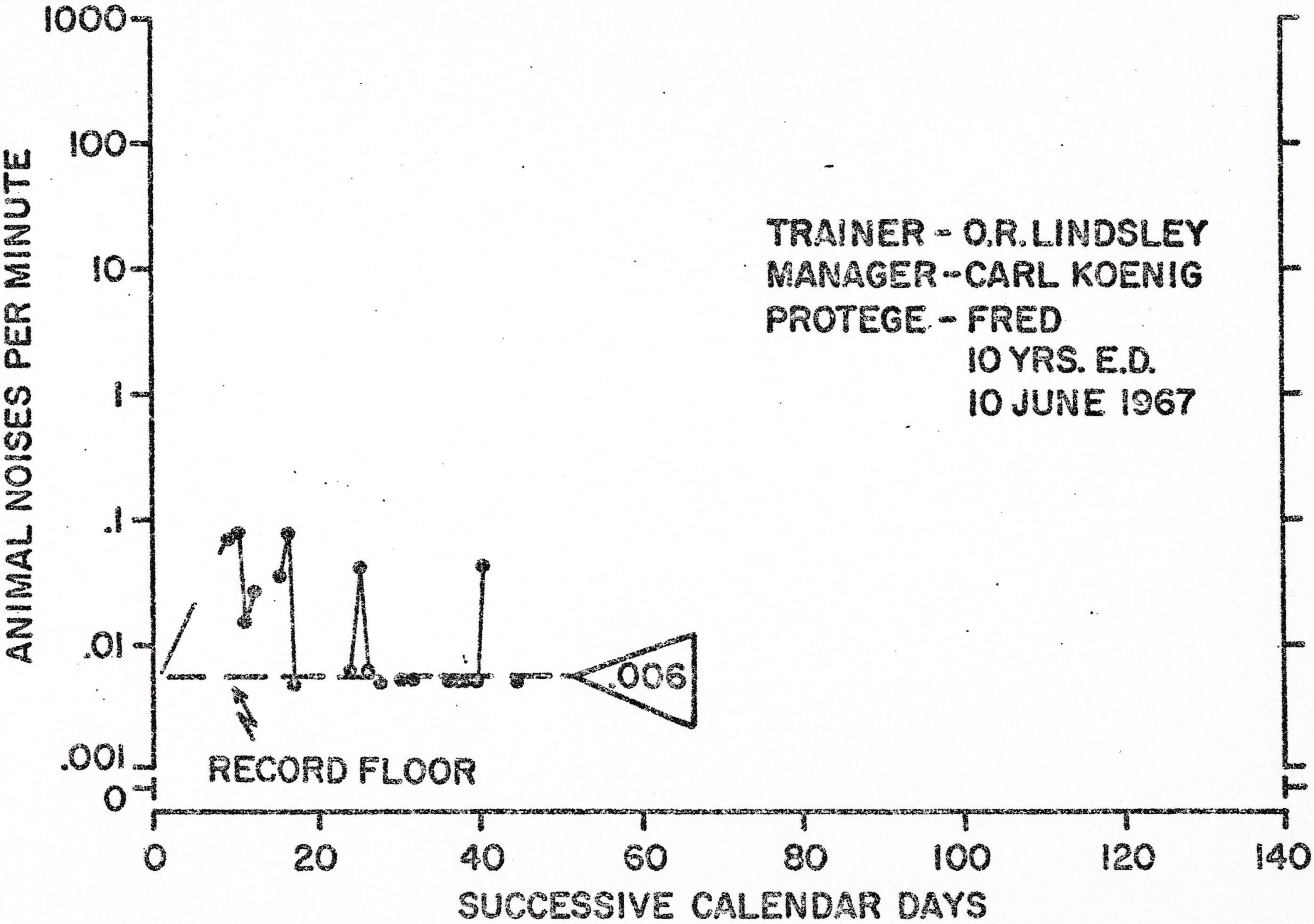

TRAINER - O.R. LINDSLEY
MANAGER - CARL KOENIG
PROTEGE - FRED
10 YRS. E.D.
10 JUNE 1967
ANIMAL NOISES PER MINUTE
1000
100
10
1
.1
.01
.001
0
.006
RECORD FLOOR
0
20
40
60
80
100
120
140
SUCCESSIVE CALENDAR DAYS

FIG. 17.

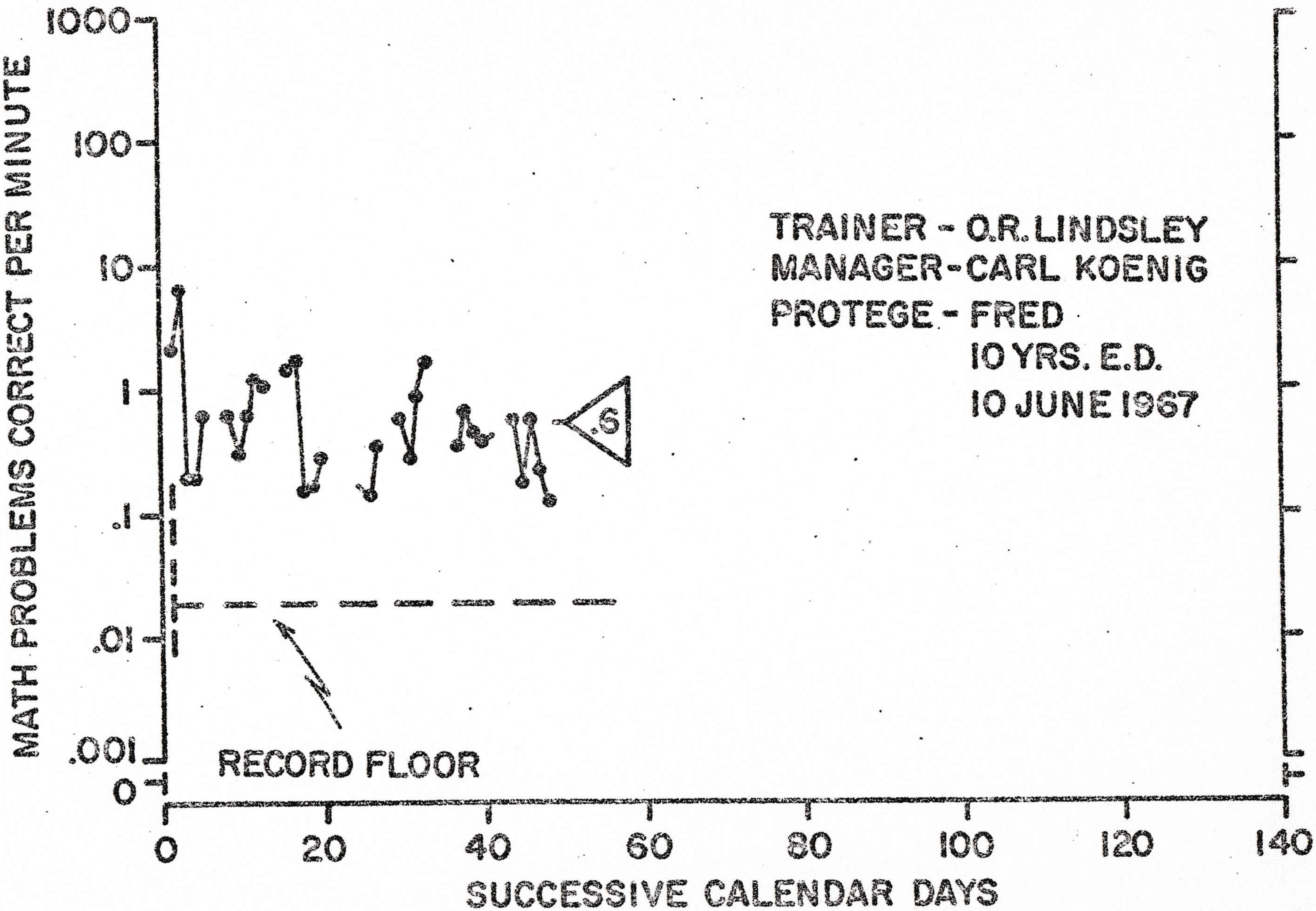

1000
100
10
1
.1
.01
.001
0
MATH PROBLEMS CORRECT PER MINUTE
TRAINER - O.R. LINDSLEY
MANAGER - CARL KOENIG
PROTEGE - FRED
10 YRS. E.D.
10 JUNE 1967
.6
RECORD FLOOR
0
20
40
60
80
100
120
140
SUCCESSIVE CALENDAR DAYS

Fig. 18

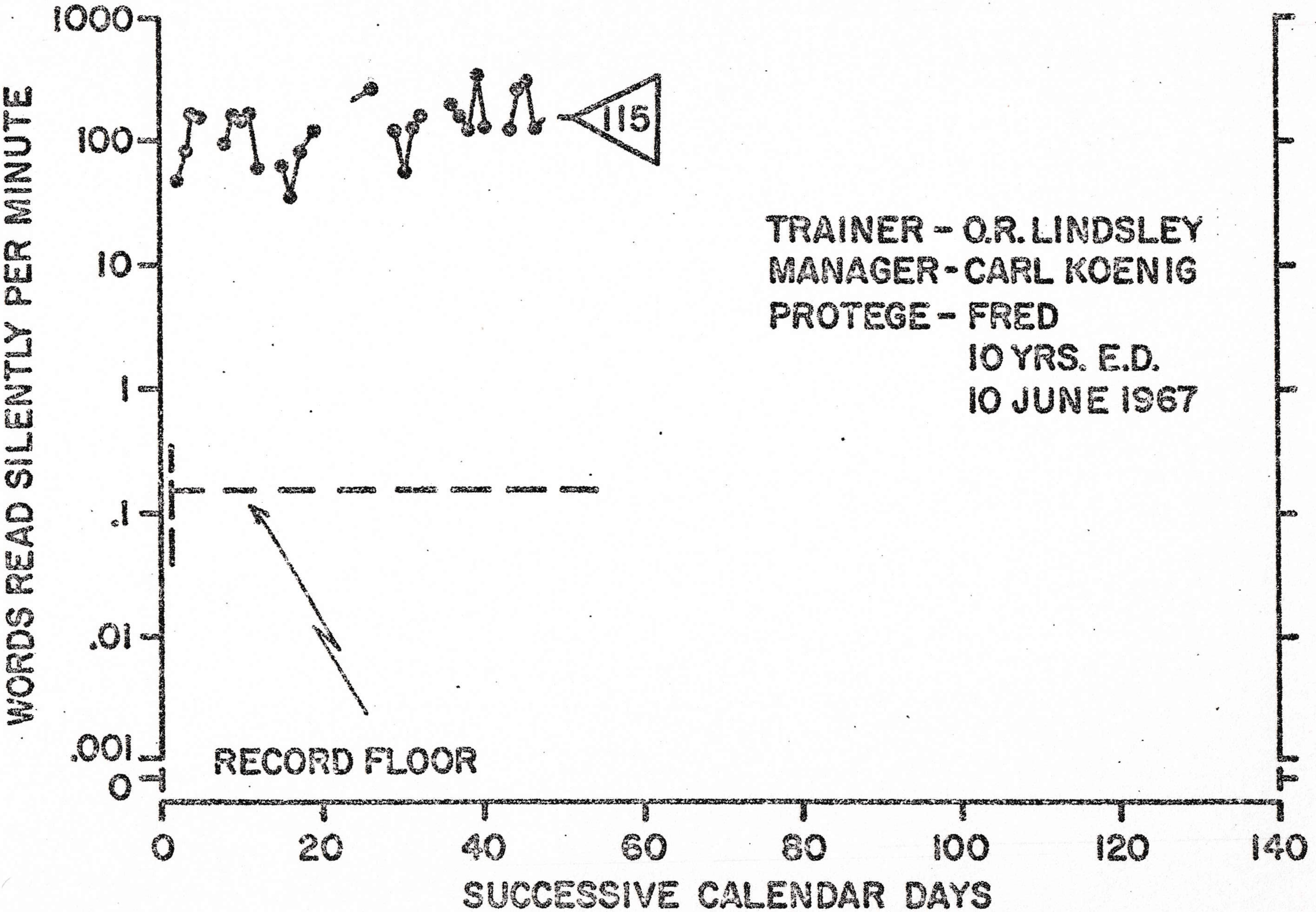

1000
100
10
1
.1
.01
.001
0
WORDS READ SILENTLY PER MINUTE
115
TRAINER - O.R. LINDSLEY
MANAGER - CARL KOENIG
PROTEGE - FRED
10 YRS. E.D.
10 JUNE 1967
RECORD FLOOR
0
20
40
60
80
100
120
140
SUCCESSIVE CALENDAR DAYS

FIG. 19

the critical area of information in terms of the performances we are measuring. Consequently, a relatively important aspect of the chart (number of sessions and elapsed days) is left stable, while the important performance rate dimension is altered so that we are unable to follow performance in their ratio relationships.

Before leaving this point the importance of standardizing the across-the-bottom of charts should be stressed. Goldiamond ( ) observed that one procedure took roughly three times as long as another, however used the <u>same</u> space to represent both projects. Therefore, a reader might mistakenly interpret that there was little to choose between the projects. However, most practitioners would choose the shorter procedure. Clearly, a standardized across-the-bottom aids an extremely rapid evaluation of projects, their duration and the rapidity of effects produced.

Figures 20 and 21 show the summaries of six children in Koenig's project. Here we see that the data concerning each child span all the cycles on the daily chart.

Insert Figures 20 and 21 about here

To complete the rationale on the six cycle, equal ratio chart, we have developed Table 1 which lists, in considerable detail, the different aspects of the chart paper. These decision-making characteristics round out the explanation for the rationale of the six cycle daily chart paper and from this we move on to more technical aspects of the charting.

Insert Table 1 about here

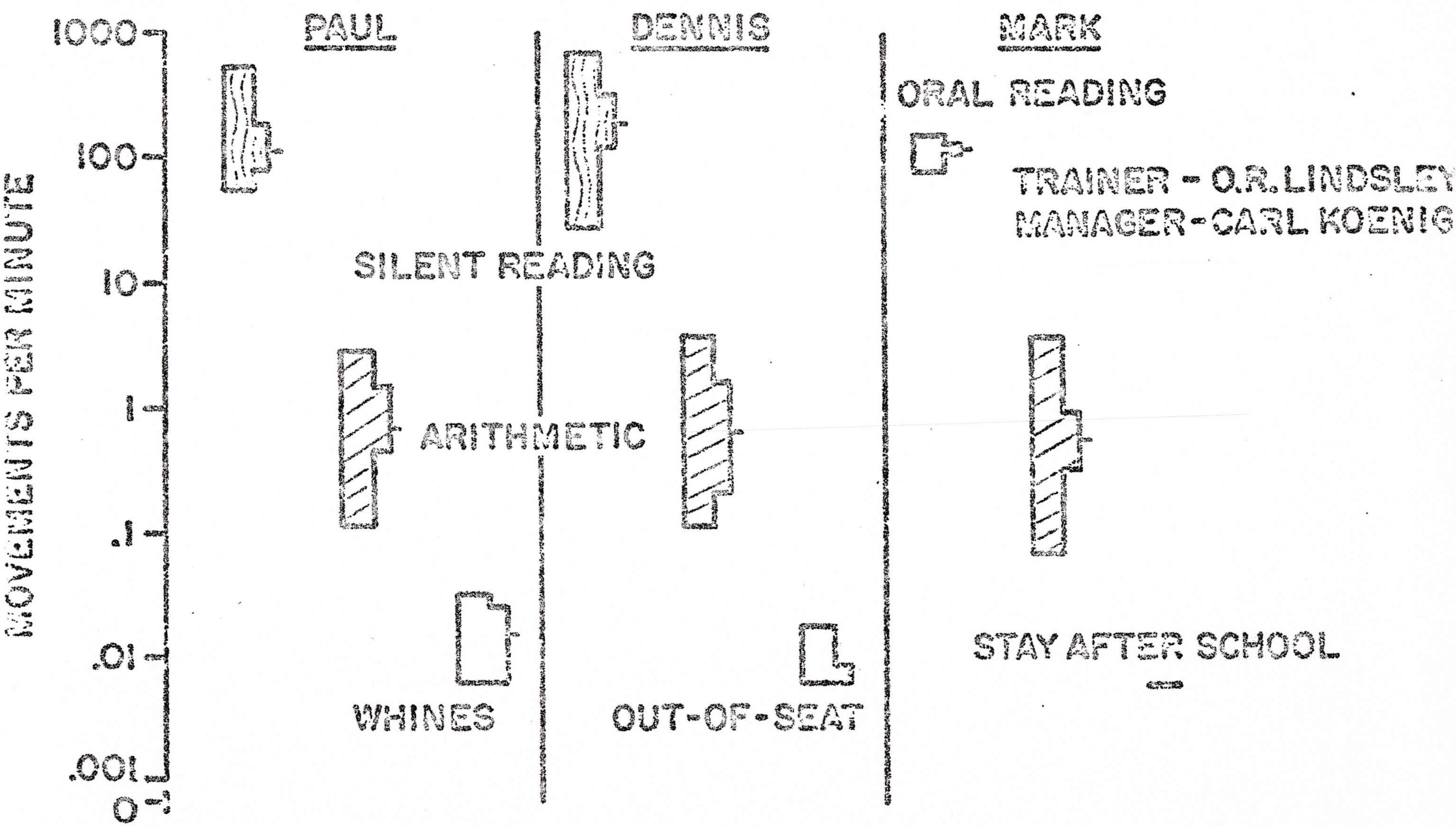

PAUL
DENNIS
MARK
ORAL READING
TRAINER - O.R. LINDSLEY
MANAGER - CARL KOENIG
SILENT READING
ARITHMETIC
WHINES
OUT-OF-SEAT
STAY AFTER SCHOOL
MOVEMENTS PER MINUTE
1000
100
10
1
.1
.01
.001
0

FIG. 21

TABLE 1

6 April 1969

Behavior Charting

Term	Definition	Charting Conventions
RATED DAY	A day in which the movement could have occurred and was recorded.	1. Chart point on daily chart 2. Connect points with lines, skip all no chance and phas change space. Chart in pencil only, no colors Use dot for acceleration target (e.g., •——•) and x's for decel ation target (e.g., x——x) <u>Each movement cycle on a separate chart.</u>
NO CHANCE DAY	A day in which the movement has no opportunity to occur.	Skip day on daily chart.
IGNORED DAY	A day in which the movement could have occurred but was not recorded.	Draw line across day on daily chart.
PHASE CHANGE SPACE	The space following the last rated day of one phase and the first day of the next phase. Preferred [illegible]	Draw a vertical line on the cha in the phase change space. Don connect data points. [illegible]
RECORD CEILING	The highest measurable performance rate, determined by the program or program events.	Draw dashed horizontal line on the chart at the maximum rate. Dashes should occur across Sunday lines e.g.,
RECORD FLOOR	The lowest measurable performance rate, other than zero, determined by length of time sample (i.e., 1/time sample = record floor).	Draw a horizontal dashed line on the chart at the record floor. Dashes should occur across week day lines. e.g.,
MIDDLE ACCELERATION RATE	Mid-point of rated days in each phase	tail of tear drop points at mid-point (middle), number inside tear drop.
MIDDLE DECELERATION RATE	Mid-point of rated days in each phase	tail of triangle apex p at mid-point (middle), n ber inside triangle.
ZERO RATE	No movement cycle recorded within <u>the time sample</u>.	Chart point directly below recor floor.
CALENDAR SYNCHRONIZE	Standard time for starting all charts (i.e., the first day of school).	It requires two charts to cover full school year. The first Mon of the first chart is the Monday the first week of school. The f Monday of the second chart is th Monday of the 21st week.

Charting Conventions

There are a set of charting conventions which have been developed to standardize the use of the chart in plotting data. Some of these are explained in Table 2. These conventions have been refined over the last three years and continue to be refined. It is advisable to use all conventions as they make it much easier to interpret daily information.

Insert Table 2 about here

The Record Floor:

Durations of classroom observations are important. As in any science this duration relates to the issues of reliability and validity. The record floor indicates the place at which the daily chart becomes insensitive and therefore bears directly on the validity of the data. For example, if you look at Figure 21 you will see that with a one minute time sample, we would not be able to "see" or record any performances below the one per minute line. The reason for this is that the lowest measurable rate during a one minute sample would be a complete movement cycle or one (1.0). Thus a deceleration target is charted at either one if it occurs once or, if it did not occur, we would have a frequency of 0. We chart a 0 observation just under the record floor. This indicates that the performance is below the record floor but at an unspecifiable point. In other words, the chart is "blind" below one per minute and we cannot use the 0 located below .001 to indicate an occurence which we did not see. Therefore our conclusions are related to a one minute period. We and our readers must be aware of this to aid interpretation and the validity of the data and their interpretation.

TABLE 2

Advantages of Cycle Equal Ratio Chart

1. Encompasses range of movement cycle rates - (10^3 to 10^{-3})
   a. allows standardization of chart across many areas
   b. is a rate chart
   c. allows charting of rates from once a day to 1,000 cycles per minute
   d. separates 0 occurrence as an issue - i) you can't shape a 0 performance, ii) indicates a 0 on deceleration as distinct from .001 or record floor limits
   e. other graphs are insensitive or are truncated - arithmetic scale distorts data
   f. prevents "stretching" to fill available space - height and width are standardized

2. Presents record floor and record ceiling

3. Six cycles, equal ratio keep rate changes proportional no matter where rate begins or moves to:
   a. you can read exact rate and its proportional relationship to previous rated days
   b. facilitates figuring amount of change directly from the chart
   c. rate finder, using log scale itself simplifies charting
   d. separates low rate (often management problems) from higher rate (often academics). Covers wide range of work with people.
   e. can compute changes easily

4. Facilitates individual analysis and tailoring

5. Seven days allows use in home and school and calendar coordination (20 weeks per chart)

6. Daily charting improves predictions and provides constant feedback to protege and manager

7. Best fit lines are good approximations to an "average effect" over time analysis and allow effective predictions of future data.

8. Calendar coordination allows direct correlational analysis of synchronized projects

9. Acceleration finder a) allows direct analysis and prediction due to range and proportionality of scales. For example, one cycle is a change by a factor of 10.

10. Right size for charts, 35 m. movies, TV and overhead projectors TV capable compatible

11. "A picture is worth a thousand words!"

Can you add to the list?

Suppose that we lengthen our observation period to five minutes; then the record floor drops to .2. The floor drops to .2 because we can record at least: $\frac{\text{1 movement cycle}}{\text{5 minutes}} = .20$. On figure 21 a dashed line at .2 indicates the record floor for a five minute observation period.

Insert Figure 22 about here

Zero is used to plot data only when you have a recording period of 1,000 minutes, or a full behavior day. Then, if the movement cycle we are recording does not occur within the 1,000 minutes, you plot on the zero line. Several implications of the record floor are listed in Table 3.

Insert Table 3 about here

The chart design, with zero plotted below the record floor or an arbitrary distance below .001 is a stimulus keeping us aware of nature of a "zero" rate. The record floor indicates that a longer observation period may be necessary to "see" the movement cycle. If we are trying to record something that happens once every fifty minutes (a rate of .02) the act may not even occur during a 10 minute (.10 record floor - see figure) observation period. It seems to be a good general rule to have an observation period long enough so that the record floor is at least a full cycle below the lowest anticipated rate. Therefore the observation period for a movement which occurs at .02 per minute would be .002 or five hundred minutes. This duration of five hundred minutes implies at least ten counts of the pinpointed movement cycle. Other tactical or practical considerations might require a shorter observation period, in these situations knowing the observation period allows the prediction of how many counts will likely occur in that period.

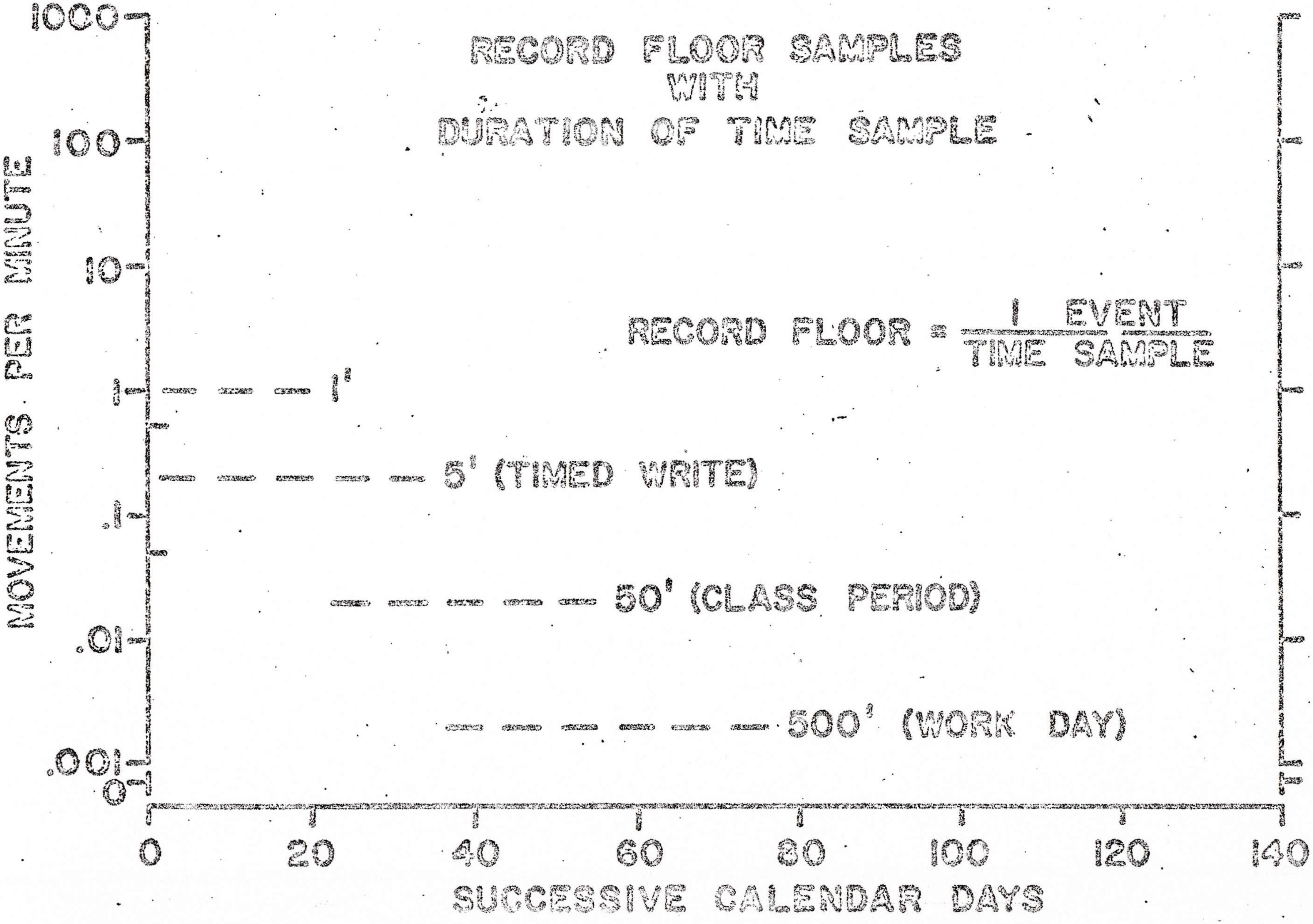

RECORD FLOOR SAMPLES
WITH
DURATION OF TIME SAMPLE
RECORD FLOOR = 1 EVENT / TIME SAMPLE
1'
5' (TIMED WRITE)
50' (CLASS PERIOD)
500' (WORK DAY)
MOVEMENTS PER MINUTE
1000
100
10
1
.1
.01
.001
0
20
40
60
80
100
120
140
SUCCESSIVE CALENDAR DAYS

FIG. 22

Table 3

Record floor implications:

1. duration - of time sample

2. frequency - rate times the duration (32 words x 5' = 160 words typed)

3. relevance or significance - prediction

4. endurance - tells you how long the protege works

5. reliability of data - longer, and repeated samples are better

6. validity of data - 60 wpm - but for only 1'?

7. when record floor rises (shift from 10' sample to 5') data are clarified because one error in 10' - .10 whereas an error in 5' is .20. The apparent increase is due to the shortening of the time sample.

8. on the other hand, when record floor drops (shift from 10' to a 100' sample) you may a) "see" errors because less of the chart is "blind," b) increase the power of your data by covering more of the 1,000 behavior day.

9. highly variable record floors makes for extremely complicated data analysis (Zimmerman, 1969). A constant record floor simplifies analysis.

Finally, the chart aids instruction of the arbitrary nature of "zero". Equal ratio cycles begin with a derivative of 1. There is no zero in an equal ratio scale. Hence, zero, located just below .001 on the equal ratio chart could be one or six inches away from the grid! On the other hand, zero on equal interval scales is a unit distance from the first division of the scale. This makes it appear that zero has a fixed and even known relationship to other values in the scale. Unfortunately this is not the case. And furthermore, the equal interval scale implies a continuum relationship between existenee and non-existence of an event. Philosophers know better. In fact they still heatedly argue over a "proof" for existence ( ). Teachers realize that something a youngster does not know has to be taught very differently from something he doesn't do too well. This sensible straightforward analysis is confirmed and supported by the chart's design.

IS-DOES

Lindsley introduced this descriptive (IS) and functional (DOES) planning system in an imaginative article (Lindsley 1964) which has been recently updated (Lindsley 1969). There are five basic components:

1. Program-time, duration, place.

2. Program Events-events designed to elicit acts such as music notes, printed words, arithmetic problems including a teacher's vocal instructions.

3. Movement Cycle-acts either academic or management. Each act must have a beginning and end, thus going through a full cycle.

4. Arrangement-the if-then connection between movement cycle and events that occur when the movement has occured.

5. Arranged Events-events that occur when there is a movement, and that are designed to accelerate, decelerate or hold the movement cycle's rate.

Since educational aims often involve both acceleration or deceleration we have developed a double description form (figure 23) that simplifies designing lesson plans (Waechter, 1968). Such a form insures planning for

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Insert Figure 23 about here

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all relevant aspects of a project. Each person on the project team helps to develop a comprehensive lesson plan, using the description form which involves most of the components. This format keeps us reminded that a plan is not complete until we have at least <u>considered</u> the relevance of each component while the double description form reminds us that we have to plan for both acceleration and deceleration. For example, a deceleration project that does not include entries on the acceleration side fails to provide for the <u>development</u> and acceleration of appropriate movement cycles <u>during</u> the deceleration periods. Without an acceleration plan, the danger is that we will conduct (or advise) an effective out-of-seat-deceleration while not paying equal attention to improving academic skills. On the other hand, an academic acceleration plan that does not include entries for the deceleration of errors is also incomplete. We have found that error rates can accelerate even faster than correct rates, thus we need to chart <u>and</u> plan for errors too.

Place Value:

The position or order in the descriptive or functional components in the formula is extremely important (Lindsley 1965). In mathematics our interpretation of numbers is determined by a standardized place value system. For example, a number in isolation, 2, could be misinterpreted. Adding the decimal place, 2.0 removes ambiguity. The decimal and zero as

ACCELERATION

P	PROGRAM EVENT	No. Items	MOVEMENT CYCLE	A	ARRANGED EVENT	No. Items

RATED TARGET ______

DECELERATION

P	PROGRAM EVENT	No. Items	MOVEMENT CYCLE	A	ARRANGED EVENT	No. Items

RATED TARGET ______

FIG. 23

a "place holder"eliminates the possibility of misinterpretation. In the same way, locating components as in the description form aids our planning, execution and discussion of projects.

Reducing confusion is important. Some terms, such as motivation, refer to several components at the same time. The IS description helps us to break this term into its different aspects, assigning each to a component. Thus, we become more precise in our analysis. Furthermore, we keep events in their relationship to each other by careful use of the description.

Natural and Synthetic Events:

Often we locate stimulating or consequating events that are directly related to the classroom setting. We call these natural events. When a youngster earns the next level of the curriculum as the arranged event or accelerating consequence for proficiency we consider this a natural relationship. The natural consequence of proficiency or mastery is the challenge of a new level to accomplish. A synthetic accelerating event might work just as well, but because it is synthetic it must be artifically introduced.

Breaking the description into its various components encourages us to look for aspects natural to the project setting that can be used to stimulate or consequate responses. Natural program events or arranged events are usually easier to use and readily available in the project environment. However, sometimes we use a mixture of natural and synthetic events. Since the IS descriptions are as exhaustive listings as practical, we identify synthetic items and often try to phase them out or replace them with more natural events during the project.

Teacher IS Descriptions:

Each teacher, as well as other team members, design several lesson plans using the equation to become familiar using the components to increase sharing and to guarantee coverage of all relevant aspects of the plan. Figure 24 is a lesson plan designed by Genie Poe for Chris, a child who needed both careful planning in reading and also the deceleration of a management target -- his out-of-seat without permission movement cycles. Another lesson plan, designed by Boyd Mortenson (figure 24) covers basic division facts (correct and error) in a junior high retarded classroom. Again you'll notice that the plan includes categories for both the youngsters and the teacher. The movement cycle is correct division facts and the deceleration target is the error rate. Notice that Boyd incorporates per-

Insert Figures 24 and 25 about here

formance rate in the arrangement. Each protege's rate must be above the middle (greater than the middle rate) of the week before to earn arranged events: the next assignment, five cents and one credit toward the game center. He also has an arrangement (A) set up for error rate. If a youngster's error rate exceeds the middle of the previous week he repeats the assignment and he has the word "failure" written on his assignment sheet.

We often neglect to indicate a plan for the teacher. IS descriptions are important to help us anticipate the teacher's program event, movement cycles and arranged events. Here, the division facts done correctly are the <u>program</u> <u>events</u> for the teacher. Boyd's movement cycle is to give the student five cents and of course a credit towards the game center. The teacher's consequence is that the youngster goes on to the next assignment.

Target Area Out of seat during reading

Eric Haughton	Genie Poe	Chris	Regular Classroom
	Eric Haughton	Genie Poe	Chris	Regular Classroom

Trainer	Advisor	Manager	Protege	Location
	Eric Haughton	Genie Poe	Chris	Regular Classroom

	ACCELERATION					DECELERATION				
Name	Program (P)	Program Event (PE)	Movement Cycle (M)	Arrangement (A)	Arranged Event (AE)	P	PE	M Cycle	A	AE
Chris						9:00 – 9:30	Lippincott Reader 2–1 "It's time to work on your reading Chris"	Out of seat without permission	1:2	Take a point Tell Chris to sit down
Chris	9:00 – 9:30	Lippincott Reader 2–1 "It's time to work on your reading Chris"	Words read correctly (orally)	middle > of 3 last week	Give a point "You're working hard today" Pat on back	9:00 – 9:30	Lippincott Reader 2–1 "It's time to work on your reading Chris"	Words read incorrectly (orally)	1:0	None
Teacher	9:00 – 9:30	Child in seat working on reading	Give a point "You're working hard today" Pat on back	3:2	Chris smiles accelerates rate of reading	9:00 – 9:30	Chris is out of his seat	Take a point "Chris please sit down"	2:2	Chris sits Chris frowns

FIG. 24

Target Area Math

	Eric Houghton	Boyd Mortensen	Whole Class	Jr. High Special Class
Trainer	Advisor	Manager	Protege	Location

ACCELERATION						DECELERATION				
Name	Program (P)	Program Event (PE)	Movement Cycle (M)	Arrangement (A)	Arranged Event (AE)	P	PE	M Cycle	A	AE
Youngster in classroom	11:00 6' 11:06	Basic division fact sheet	Division facts done correctly	middle >of:3 week before	5 cents. next assign. one credit toward game center	11:00 6' 11:06	Basic division fact sheet	Division facts done incorrectly	middle >of:2 week before	Repeat assign "failure"
Teacher	11:00 – 11:06	Division facts done correctly	T. gives 5¢ and one credit	2:1	Youngster goes on to next assignment	11:00 – 11:06	Division facts done incorrectly	T. says you failed	1:1	Youngster repeats assignment

FIG. 25

Figure 26 is a detailed plan for a child lasting roughly 20 minutes. This plan drawn up by Ann Starlin, the manager, for her protege Jeff at the DeBusk Center at the University of Oregon. The adviser was her husband Clay Starlin and I have the position on the team as trainer. The first assignment Ann and Jeff do together is writing B's and D's. Next they

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Insert Figure 26 about here

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move to blending words in the Hegge, Kirk and Kirk remedial reading drills and they end up reading from the Merrill Linguistic Reader. Notice again that Ann plans for both acceleration and deceleration targets. This is especially important when, the youngster requires special remedial help.

DOES or Functional Elements:

The formula discussed so far are descriptive, however we are always searching for events that have specific effects. The terms Program, Program Event, Movement Cycle, Arrangement and Arranged Event form the descriptive part of the formula. These components described and discussed earlier, simply <u>describe</u> environmental events. Thus, the IS formula is particularly helpful to <u>describe</u> and <u>plan</u> a project. No <u>function</u> is assigned to events until they have a proven function with a protege.

When a teacher decides to use a particular reading book (say Merrill Reader 1) or an arithmetic series (GCCMP or SRA) we don't know how the youngster will react. He may exhibit many movement cycles, though very few responses. That is, the protege may make many reading, procedural, or computational errors with few correct. Consequently the materials would be called Program Events rather than Stimuli. Once he approaches proficiency the materials clearly act as Stimuli and <u>are no longer</u> Program

Houghton PTC #17 Dist.4J 12/5/68

Date Winter 1968

Target Area Reading

Eric Houghton	Clay Starlin	Ann Starlin	Jeff	DeBusk Center Rm.135-N
Trainer	Advisor	Manager	Protege	Location

ACCELERATION						DECELERATION				
Name	Program (P)	Program Event (PE)	Movement Cycle (M)	Arrangement (A)	Arranged Event (AE)	P	PE	M Cycle	A	AE
Jeff	8:00 1' 8:03	T. dictates either /d/ or /b/. "Remember you get to chart if they are all right"	writes /b/ or /d/ correctly	±12:3	Jeff charts "Good work" Pat on back	8:00 1' 8:03	T. dictates /d/ or /b/	writes /b/ or /d/ incorrectly	1:0	No AE
Teacher	8:00 8:03	Jeff writes /b/ or correctly	"Good work" Pat on back	2:1	Jeff says "I am pretty smart aren't I?"	8:00 8:03	writes /b/ or /d/ incorrectly	records the error	1:1	presents next dictated letter
Jeff	8:03 5' 8:08	Hegge, Kirk and Kirk Remedial Reading Drills	blends all the words in 1 row correctly	1:2	"Good Reading" T. reads next row	8:03 5' 8:08	Hegge, Kirk and Kirk Remedial Reading Drills	makes an error in blending word(s) in 1 row	1:2	T. says "Jeff read another row." Jeff reads another row.
Teacher	8:03 8:08	Jeff blends all the words in 1 row correctly	"Good Reading" T. reads next row	2:2	Jeff smiles Jeff listens to teacher read	8:03 8:08	makes an error in blending words in 1 row	T. tells Jeff to read another row	1:1	Jeff reads next row of words
Jeff	8:08 10' 8:18	Merrill Linguistic Reader I Tape Recorder "I will tape your reading. when you read a sentence like this (demonstrate) will get to listen to the tape".	reads sentence correctly	1:2	"Good Reading" Jeff listens to tape	8:08 10' 8:18	Merrill Linguistic Reader I Tape Recorder	reads sentence incorrectly	1:2	does not get to listen to tape reads another sentence
Teacher	8:08 8:18	Jeff reads sentence correctly	"Good Reading"	1:1	Jeff reads another sentence	8:08 8:18	Jeff reads sentence incorrectly	T. instructs Jeff to read another sentence	1:1	Jeff reads another sentence

FIG. 26

Events. The shift from IS to DOES is described in figure 27 and yet the

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Insert Figure 27 about here

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testing of each point in the equation is not quite as simple as this figure might suggest. Each term in IS has a corresponding term in DOES. These terms, Disposition (D), Stimulus (S), Response (R), Contingency (K), and Consequence (C) are used only when there are data to indicate function with a protege. (For a more extensive description see Lindsley, 1969).

The distinction between events that function and those that have no specific function has important implications in diagnosis. Ideally, since we almost always use a youngster's behavior as our index we should carefully identify his available responses. Whenever we slip into movement cycles our diagnostic picture will be out of forms. Once we have identified a response we must then identify its holding or accelerating consequences. Here again, if we are trying to evaluate a youngster's reactions to some visual materials and fail to control motivational dimensions our diagnostic picture will be out of focus again. Consequently, this analysis clearly indicates that we must have R - K - AC before we can proceed to:

$$\left.\begin{matrix} PE_1 \\ PE_2 \\ PE_3 \end{matrix}\right\} \quad R - K - AC$$

Unfortunately the more typical diagnostic picture is:

PE - M cycles - A - AE.

With the extreme case being where the A and AE components are completely omitted. While this situation may have been understandable in the past, it is clear that information from testing situations in which the tester knows little or nothing about the youngster's equation is both unacceptable and unuseable (Haughton 1967). While we may begin with M cycle - A - AE we

IS-DOES

DISCERNMENT PROCEDURES — COMPONENT SHAPING OR BUILDING

P	PE	M	A	AE
↓	↓	↓	↓	↓
D	S	R	K	C
DISPOSITION	STIMULUS	RESPONSE	CONTINGENCY	CONSEQUENCE

COMPONENTS — EACH HAS DEMONSTRADED BEHAVIORAL FUNCTION

FIG. 27

must first of all move to R - K - C and then we can assess the effects of other program and arranged events.

Project Decisions

IS-DOES plans and the equal ratio chart aid decisions in several ways. Suppose a teacher wants to accelerate a performance that is rated at once in a hundred minutes (rate = .01/minute). This means that the maximum frequency of a consequation is one in a hundred minutes even if she "ays off" on each act, on a 1:1 arrangement. Since each movement cycle only occurs once every hundred minutes this is also the maximum arranged event rate. We would not expect a marked, immediate acceleration with this arrangement. There are several courses of action open in this situation, such as slicing the pinpoint so as to rate a component movement cycle that occurs at a higher rate, thus making it more likely to occur and thus more easily accelerated. It is easier to "catch" the movement if it occurs 1.0 times per minute than if it occurs .01 times per minute. Another alternative, when other movement cycles are being recorded, is to choose a movement that already has a higher rate and that may be accelerated more easily. An increase in this rate may induce a higher rate in the target movements, thus making them easier to accelerate because opportunities to present arranged events or consequences increase.

The chart, because it represents rates relatively, also helps us to determine when to move from continuous to more intermittant forms of consequation. Therefore we are aware of when to shift from acquisition to holding tactics. Since holding procedures are less costly and a desired terminal goal of most projects, the chart helps us to be efficient and wise in our desire to improve youngsters' performance rates.

A dramatic instance of refined planning occurs when a desired rate is recorded at zero. A zero rate movement must be guided or built, since, having no occurrence it cannot be accelerated. Several options are available when a movement cycle's rate is at zero. We can lengthen the observation period in hopes of recording a rate and thus begin by shaping. Or we can explore alternative tactics to elicit, build or guide the desired movement cycle. Since we cannot shape a movement cycle that does not occur, the chart clearly indicates that we need to explore the other alternatives. Another alternative is to identify an ongoing performance and change its form to the desired response by shaping procedures. The chart highlights all these options by graphically indicating the relative nature of zero and by precisely locating the rates we do have to change.

Rather sophisticated acceleration analyses of projects may be completed in the field, in part because both the bottom and the left side of the Chart have been standardized[3].

Discussion

There are many aspects of Precision Teaching we have not discussed. Some of them are developing rapidly as more youngsters, parents, teachers, administrators and University types become involved. This is an exciting and stimulating period of growth in the refining and development of Precision Teaching. Certain fundamentals will probably receive even greater emphasis in the future. These are likely to be such aspects as protege involvement, district-wide decision making, interpersonal recording along with recording and changing private thoughts and urges along with a growing emphasis on a comprehensive curricular sequence based on performance rates and precise proficiency levels.

Each of these areas is worth extensive writing and even more worthy of detailed, careful project exploration and thinking. To discuss each briefly, to try to give the flavor of and taste for the potentials, we will spend a brief idea-walk. Come, take my hand.

Protege Involvement:

Youngsters have been a largely overlooked element in the planning and design of educational environments. Seldom do we trust their judgement. The grip of an archaic scholasticsm locks most of education in a frigid, authoritarian manacle.

Students are politely and impo itely requesting a change.

Several thousand elementary students in Eugene are part of a change. They are charting their own performance. They are sharing their data with their teachers and together working out an effective, individually tailored learning plan. These youngsters are not "exposed" to education, they are involved in learning by recording data daily on their personal progress.

The data they collect helps them make decisions about their education. They are excited. For the first grader this step represents not only learning about the 3 Rs, but learning about himself. Each protege begins personal learning, and experiences the joy of personal knowledge, as he begins his performance charts. He is involved in the decision making related to his needs and requirements from the beginning.

Youngsters are learning science, its processes, strengths and limitations, from their own personal experiences.

Rated Curriculum Sequence:

As we learn more and more from the thousands of ongoing curriculum projects, we are beginning to see a pattern. Each response has its movement cycle and each movement cycle has its set of prerequisites. By developing each prerequisite to an appropriate proficiency level, before introducing new materials, acquisition moves smoothly and rapidly. Holding a response at a proficient level is simplified because all precursors have been thoroughly learned. Consequently, many previous ideas about rational sequences are being borne out. Other ideas are being refined.

However, proficiency levels must be determined. Once determined each protege must reach (or approximate) that proficiency level before going on to the next curriculum step. We have few established proficiency levels right now. They need to be determined urgently. As proficiency levels are established, appropriate instructional sequences must be studied. Perhaps a variety of sequences will be available to increase our ability to individually tailor curricular sequences. As our degrees of ignorance decrease our degrees of freedom will increase.

As we learn about proficiency and how long it takes to establish, we will be in a better position to make rational curriculum decisions. Some response that may be useful, that a protege can establish proficiency within an hour may be retained whereas a curriculum area that has dubious value and that requires 200 hours for proficiency may be suspended. (We could also become more efficient in our instruction!).

District-Wide, Continuous Decision Making:

At the present time our data for decision making is collected sporadically and often using nationally standardized testing devices with tenuous local validity. Directly recorded, daily performance rates change the base of our information to the local level. Then, depending on the efficiency of the data processing we can make, curricular decisions to refine up-date or to try new materials immediately. Furthermore, because data are collected and plotted daily, those interested in following the effects of these decisions can know immediately if the results are the same, better or worse than those produced by previous materials.

The ramification at the school district level are so numerous that I will not even try to even mention them exhaustively. Two major divisions would be strongly influenced. Curriculum Supervision and Pupil Personnel Services are two obvious beneficiaries from the demise of our anecdotal system and the adoption of more data-oriented approach. Music, mathematics, language arts and social studies consultants often make highly specific classroom suggestions. Are they carried out? Are the suggestions helpful and do they improve pupil performance? Charted performanace rate records will clarify these areas.

Concerned Pupil Personnel directors often wonder if their departments are operating effectively. Most of the data they receive is actuarial. Psychologists gave so many tests, the exact number of youngsters seen by speech correctionists, a certain number of youngsters in Special Education classes and perhaps the number of reports to the District's nursing service.

Did youngster's benefit from these contacts? There is a universal assumption that youngsters do benefit. Let us face it. Some efforts help youngsters, others leave them unchanged and still others make them worse (Slezak, 1968).

It is time we knew accurately and rapidly the effects of our efforts. So we can take pleasure in our accomplishments and improve our tries with those youngsters who require repeated attempts, plans and refinements to aid them.

Interpersonal Recording:

There is a great cry in the land for people to gain more knowledge and understanding of each other. We are applying the same recording principles in the study of this area. Each person counts something he does or tells his peer of a mutually agreed upon movement cycle. Each charts their own behavior so we avoid "counting on someone else"! The pun is serious in the sense that we must become more responsible for our acts. It may be easy to see the mote in someone else, but somewhat more difficult to record your own rate. Yet, we need "the help of our friends" to understand and change our personal behaviors. Counting together to solve problems is our theme.

Each personal project in interpersonal recording is planned using the IS description form. The elements of each project are discussed and thoroughly analyzed. Some projects last extended periods others are designed around a particular problem and are phased out when the appropriate responses are established.

Most of the recording techniques, especially those in which another person tells you of the pinpointed movement cycle, greatly increase contacts and interaction. In and of itself, this is not necessarily a "good thing", however there do seem to be large benefits from increasing highly specific and carefully pinpointed communication. When anger is involved, we have found that it is sometimes best to "cool it" as certain events can aggrevate an already bad scene. Sometimes it is best to shut your mouth and write a note! We have recently found that fights or disagreements are preceded by several days of reduced sharing about disturbing or displeasing interactions. So far our pleasurable interaction data do not seem related in any consistent way (Haughton 1969b, Clark 1969, Starlin and Starlin 1969, McCune 1969).

We are watching carefully and continuously publishing these interpersonal recording projects in the Behavior Bank. We hope that the computer analysis of these daily, ongoing, rated projects will lead us to significantly more awareness and understanding than using the computer in a dating game.

Private, Urge and Thought Recording:

Human nature is not going to change by good intentions, alone. Personal change requirespure grit, holding your breath (sometimes) along with a wise choice of consequences and directly recorded data. We find that people <u>can</u> gradually gain understanding of how they operate when they do personal projects. They find out their strengths -- just how much they can do on will power alone. At the same time we learn just how much clay is in our feet!

For some time we insisted that all counts involve public movement cycles, however, now we encourage private counts. Private events are extremely important to each of us. Although these events were always important, some behaviorally oriented workers seem to reject the phenomena. Admittedly, there is much to be learned about the area. We hope that the data on private urges will follow the general outlines of data from thousands of overt projects. If these data differ in significant ways, it then remains a topic of serious, enthusiastic study to determine the source of the difference. Gradual growth of rated data in this area will accelerate and refine knowledge in this area (Haughton 1970, Waechter 1970).

Meanwhile, individuals are carefully recording and changing items of considerable personal significance. Much of our current discussion of these projects sounds very "clinical" because we are on the forefront of our knowledge and still use poorly pinpointed names as working terms. Projects have been completed in the area of recurrent, disturbing thoughts, certain fears and various urges which required acceleration or deceleration (Clark 1969).

Perhaps personal direct recording of private events is one of the most exacting and potentially fruitful of recent Precision Teaching developments. Certainly we understand this area least. However the consequences of learning about and gaining understanding and control over private responses hold potential benefits to all mankind.

A Future

Chart Daily:

While the current strategic emphasis and effort is on establishing continuous, daily direct recording and charting, this will shift in the future. The chart and IS description have direct curriculum implications. The development of these implications awaits refinement based on exhaustive studies. It is certain, that as direct recording and classroom daily charting grows, neither teachers nor youngsters will be content with previous acquisition patterns. Furthermore we expect increased involvement of principals, curriculum specialists and parents as familiarity with these data grow.

Plan Daily:

As use of precise information increases our plans will become more flexible. Accurate data will help the youngster and his teacher predict curriculum consumption, plan for it and to adjust materials if performance differs from their predictions. Such daily planning and monitoring will create a truly adjustive learning system.

Growing Daily:

We are just entering a period analogous to the shift from hunting to agriculture. A period of serious, intensive cultivation of people is our next main frontier. Although inner and outer geophysical space are exciting and will provide center stage exitement, our pressing task is that of developing proficient and excited people to inhabit these areas. These people are going to solve the problems of pollution, poverty, over-population and war. Too, these newly strengthened people will be our emissaries to man's outermost reach. While these are their challenges ours is a simple and straightforward one. The challenge is to create youngsters who are learning about themselves as they learn about the world. This is the true art of precise teaching. To teach a curriculum which includes external and internal knowledge. Although just a fragile beginning, daily charting, careful personal planning accompanied by daily growth is the beginning of the cultivation period of human potential. We have had those who talked of Utopia and Erehwon. Now, by counting together, we can build a rational community based on perenially shared data on personal growth.

Footnotes

1. Many have contributed to this paper. Each protege who shared his data has helped improve our procedures. The managers who have conducted projects have refined Precision Teaching by their data and many helpful suggestions. Several advisers, Marie Gaasholt, Martin Waechter, Meryl Lipton, John Clark, Clay Starlin, and peers, Oystein Gaasholt, Harriet McCune and Tom Lovitt have contributed greatly to this manuscript. Their perserverence and forebearance in working with my drafts is beyond the call of reasonable duties. Their efforts exemplify the cooperation that characterizes our development. I thank and love them for their affection and commitment to quality.

2. Marie Gaasholt suggested this outline. Much of the quality of this chapter is due to Marie's generous and gentle assistance.

3. For more information on the Behavior Bank, the Acceleration Analysis and services available, write:

Precise Behavior Communications
P.O. Box 3937
Kansas City, Kansas 66103

Legends

Figure 1 These basic addition facts are a sample of a full series including subtraction, multiplication and division developed by Jim Tapp, Principal of Twin Oaks School.

Figure 2 A rated set of drill sheets for fundamentals in music are in use in Springfield and Eugene. These sheets were developed by Bill Brusse, coordinator of the music curriculum in Springfield, Oregon schools. This is an example from the set.

Figure 3 Fundamentals in intermediate mathematics have been pinpointed and practice sheets designed for drill, diagnosis and remediation by Marie Gaasholt, doctoral candidate in Education at the University of Oregon.

Figure 4 Correct and error rates can each vary in at least three ways. Because percentage values are reciprocal they co-vary. Performance rate, on the other hand vary independently.

Figure 5 Performance rates gradually decelerate when new facts are introduced on a weekly schedule instead of waiting for youngsters to reach a proficiency level.

Figure 6 Across-the-bottom portion of the daily chart (DC-7) showing: a) number of days b) Sunday lines c) week days.

Figure 7 An exploded portion of the daily chart showing the numerical value of each line and the equal ratio distribution of these spaces.

Figure 8 Two cycles taken from the daily chart.

Figure 9 A direct comparison of an equal interval scale and an equal ratio scale. Note how each scale represents a doubled rate, using from 1.0 to 2.0 per minute and 5.0 to 10.0 per minute. The two scales also show the arbitrary nature of zero (0) and how this is handled more effectively by the equal ratio scale.

Figure 10 Here both proteges change by a constant absolute number, that is 30.0 movements per minute. The equal interval scale show them the same, whereas the equal ratio scale shows the proportional change.

Figure 11 This is the full copy of the daily chart (DC 7) showing the 140 days (or 20 weeks) across the bottom and the 6 equal ratio cycles up the left side.

Figure 12 Fred's animal noises plotted on an equal interval scale of 0 to .12 movement cycles per minute.

Figure 13 Fred's arithmetic rate correct plot on a second equal interval scale ranging from 0 to 6 per minute.

Figure 14 Silent reading is considerably faster than either animal noises or arithmetic so again a new scale is required, 0 to 300 in this case.

Figure 15 Condensing all of Fred's data on an 0 to 300 movement per minute squashes arithmetic and noise rate so they cannot by analyzed.

Figure 16 Using a 0 to .20 scale allows us to "see" the noise rate, but not arithmetic or reading. In fact it would take 1,072 pieces of graph paper to represent Fred's silent reading rate.

Figures 17, 18 and 19 Here we have all of Fred's recorded movement cycles on the equal ratio daily chart. Animal noises occur in the first and second cycles, arithmetic in the third and fourth while silent reading occupies the fifth and sixth cycles.

Figures 20 and 21 All of six proteges each require all six cycles when plotting their behavior rates.

Figure 22 Sensitivity of the chart is indicated by the position of the record floor. As the observation period lengthens, the record floor drops. A full day record (1,500 minutes) has a record floor of .001 thus using the full chart.

Figure 23 An IS description form designed to aid planning for both acceleration (left side) and deceleration (right side) targets.

Figure 24, 26 and 26 IS descriptions for their proteges developed and used in their classrooms by Genie Poe, Boyd Mortenson and Ann Starlin. These plans are comprehensive, including IS descriptions of appropriate teacher movements also.

Figure 27 The change from IS to DOES showing the components of both formulae and their relationship to each other.

Tables

1. Charting conventions we have found useful to follow when plotting on the six cycle, equal ratio chart paper.

2. A listing of some of the advantages of the equal ratio behavior chart.

3. The record floor helps us interpret the validity and reliability of project data.

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