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AN ANALYSIS OF INTERVAL SIZE IN A MOMENTARY TIME-SAMPLING PROCEDURE

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In momentary time-sampling an observer glances at the behaver at the end of each of a pre-determined series of intervals. The observer then records whether or not a specific behavior is occurring or a particular posture or "state" is being maintained. Time-sampling is defined by the duration of the measurement session and the frequency of observations. On the Standard Celeration Chart, measurement duration is recorded as the record floor (1/minutes in session) and the frequency of observation determines a record ceiling (number of observations/session length). The graphic distance between the floor and the ceiling, sometimes called the "recording window" (Pennypacker, Koenig, & Lindsley, 1972), reflects the sensitivity or ability of the recording procedure to measure a range of behavior frequencies. The lower the ceiling, the less likely we are to observe all occurrences of a relatively high-frequency behavior. The higher the floor, the less likely we are to observe very low-frequency behaviors or to account for variability in frequency over the course of increasing durations. In designing time-sampling procedures it is generally best to create as large a recording window as possible, with floor and ceiling values determined by compromises between practical concerns and the need to record actual frequencies of the target behavior.

This paper illustrates the effects on measurement sensitivity of choosing different inter-look intervals (i.e., record ceilings).

Method

Subject and Materials

The subject was a 24 year-old woman working in the Behavior Management Unit of a sheltered workshop. For a total of two hours per day, broken into four half-hour periods, she worked in an individual cubicle packaging sets of ten metal springs in small plastic bags. She received payment each day on the basis of completed work.

Measurement Procedure

Each day the manager or her assistant counted the number of bags completed and computed the count per minute performance for the entire two hours. In addition, the observer conducted a two-minute momentary time-sampling procedure. With the assistance of a tape recorded signal which occurred every two minutes, she marked at the end of each interval whether or not the client was engaged in the task at the moment of observation. This procedure continued for 20 working days without any intervention.

Results

Chart 1 displays production rates which averaged about 13 bags per minute over the 20 day period. The solid celeration line is based on a quarter-intersect calculation (White & Haring, 1980) for the first ten days. It projects as a dotted line into the following ten-day period, bisecting the second half of the data with nearly perfect accuracy. Production was relatively stable, and nearly flat (x1.02 per week) over the entire period.

Chart 2 displays data from the two-minute momentary time-sampling procedure. Again, the celeration of the first ten days is nearly flat

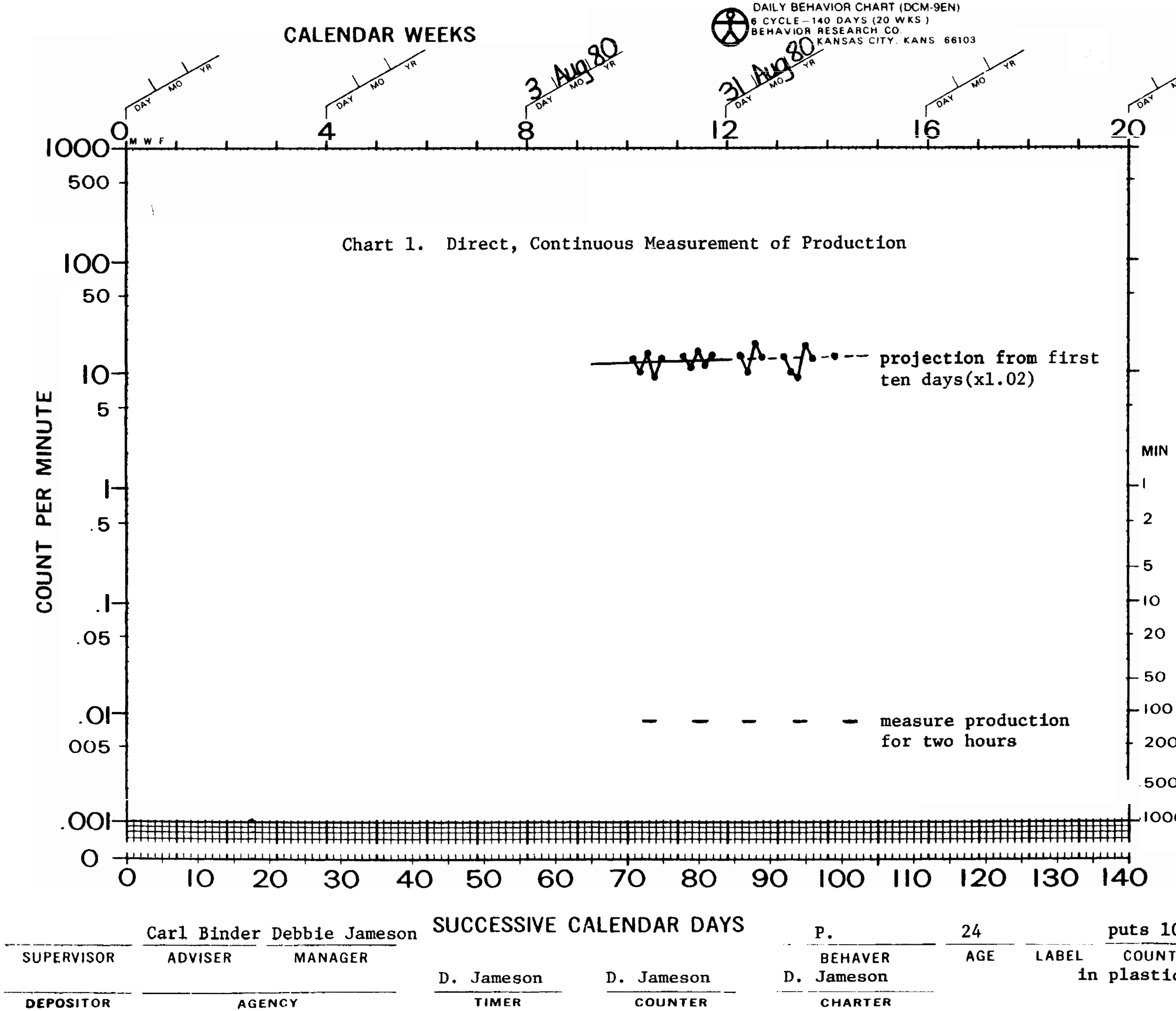

Chart 1. Direct, Continuous Measurement of Production

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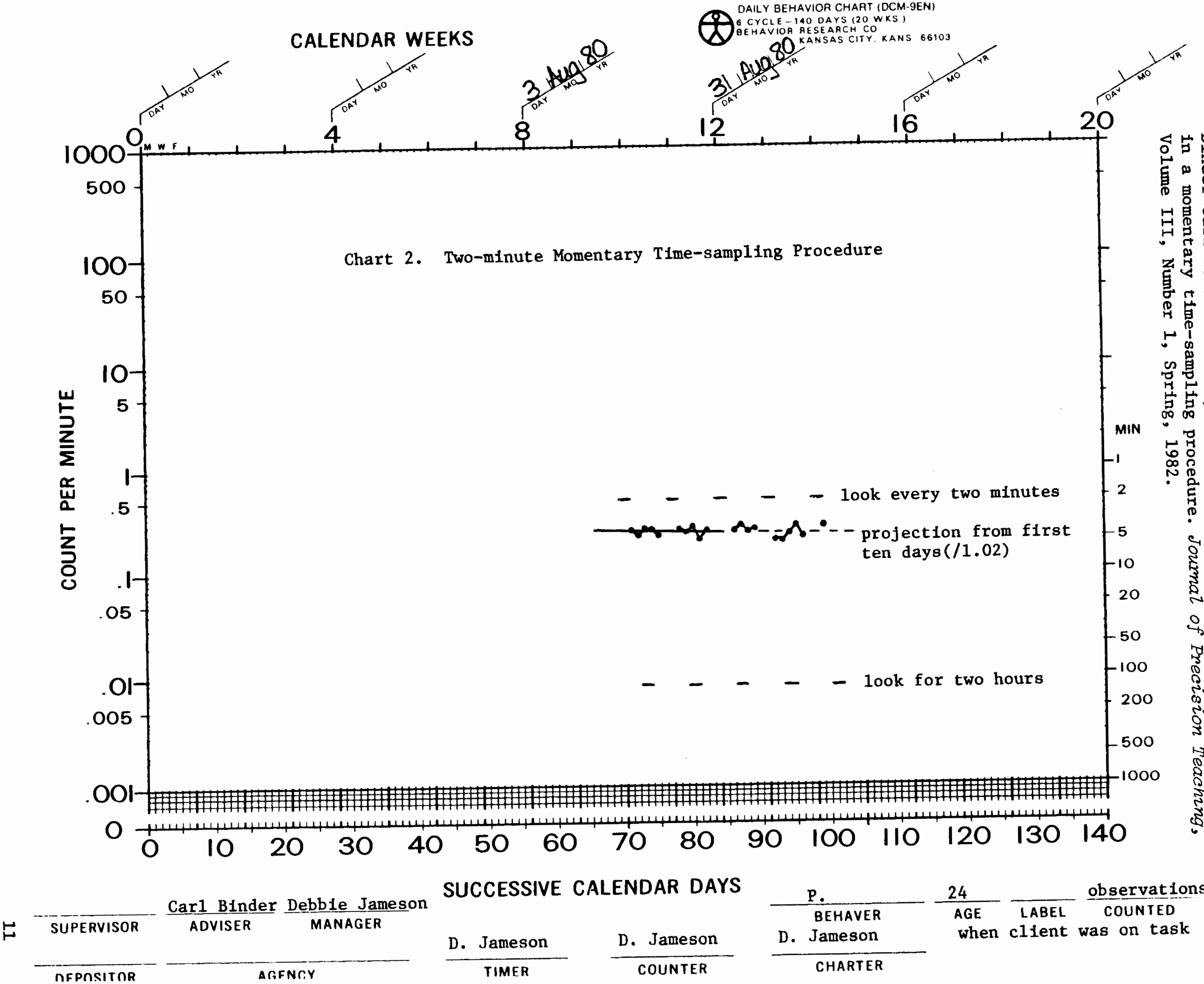

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(/1.02) and its projection bisects the second half of the data with nearly perfect accuracy. There is thus good agreement between the continuous performance measure and the two-minute time-sampling procedure. Note that the ratio between on-task frequency and the record ceiling in Chart 2 is approximately /2.0 indicating that the time-sampling procedure "caught" the client on-task at about 50% of the observations.

Chart 3 represents a four-minute momentary time-sampling procedure calculated from the set of every second observation in the two-minute time-sampling procedure. Again, one celeration line represents a quarter-intersect trend estimation from the first ten data-days projected into the second half of the measurement period. The second celeration line is the actual quarter-intersect celeration for the entire 20 days. The overall celeration (x1.09) based on four-minute inter-look intervals differs from the actual celeration (x1.02) in Chart 1 and also from that based on two-minute intervals (/1.02) in Chart 2. Moreover, with four-minute intervals, the first ten days (/1.20) predicts a trend that is quite different from the actual 20-day celeration. (This disparity can be quantified as a celeration multiplier of /1.31.) Looking at the ratio between the actual celeration line and the ceiling in Chart 3, we have the impression that the client is increasing the proportion of the time she spends on task.

Chart 4 represents a momentary time-sampling procedure with eight-minute inter-look intervals, based on the set of every other observation in the four-minute procedure. One celeration line projects from the first ten days into the second ten days and the other is the overall 20-day celeration line. The disparity between the two is even greater than in Chart 3 (a celeration multiplier of /1.38) and the proportion of time on task (ratio between the solid line and the ceiling) appears to be improving even more. Note also that eight-minute inter-look intervals produce a rather bouncy picture of "on-task" as compared with procedures having more frequent observations.

Discussion

These data illustrate the capacity of momentary time-sampling procedures for distortion and insensitivity. (See Springer, Brown, and Duncan, 1981, for a more general discussion of the problem.) In practical terms, they serve as a warning to those who would use such procedures by arbitrarily choosing a convenient inter-look interval without having first calibrated their measurement procedures to the characteristics of the behaviors and behavers involved. This case does **not** illustrate ways in which discontinuous measurement procedures might affect our decisions concerning the behavioral effects of **interventions.** But it surely suggests that the design of such procedures can lead to incorrect decisions. In the present case, if we aimed to **maintain** on-task behavior, on the basis of a ten-day decelerating baseline with four- or eight-minute inter-look intervals (10-day projections in Charts 3 and 4), we would decide to intervene. On the other hand, if we hoped to **increase** time on-task and looked at the 20-day baselines in the same figures, we might decide **not** to intervene. **According to Charts 1 and 2, neither of those decisions would have been correct!**

Insofar as discontinuous recording procedures involve a form of probabilistic sampling, we would expect their reliability to increase as a function of the number of samples obtained. Quantitatively this number is equivalent to the ratio between the ceiling and floor frequencies, an index of the recording window. In the present example, daily bounce increases as the size of the recording window decreases. And as this variability increases, the celeration projections from the first ten days of data become less reliable. The message is that if we choose a lower number of observations per day, we probably need to obtain a longer baseline before making any decisions or projections. What is more, the disparities between 20-day celerations in Charts 3 and 4 and those in Charts 1 and 2 suggest that with smaller recording windows (i.e., fewer samples per day) we risk obtaining a distorted picture **no matter how long the baseline.** Therefore, if you **must** use momentary time-sampling procedures, be sure to use the widest possible recording window and allow for a period of calibration, as illustrated in the present case, in order to determine the degree of concordance between a direct, continuous measurement procedure and the chosen time-sampling procedure. Better advice is to avoid discontinuous recording procedures altogether.

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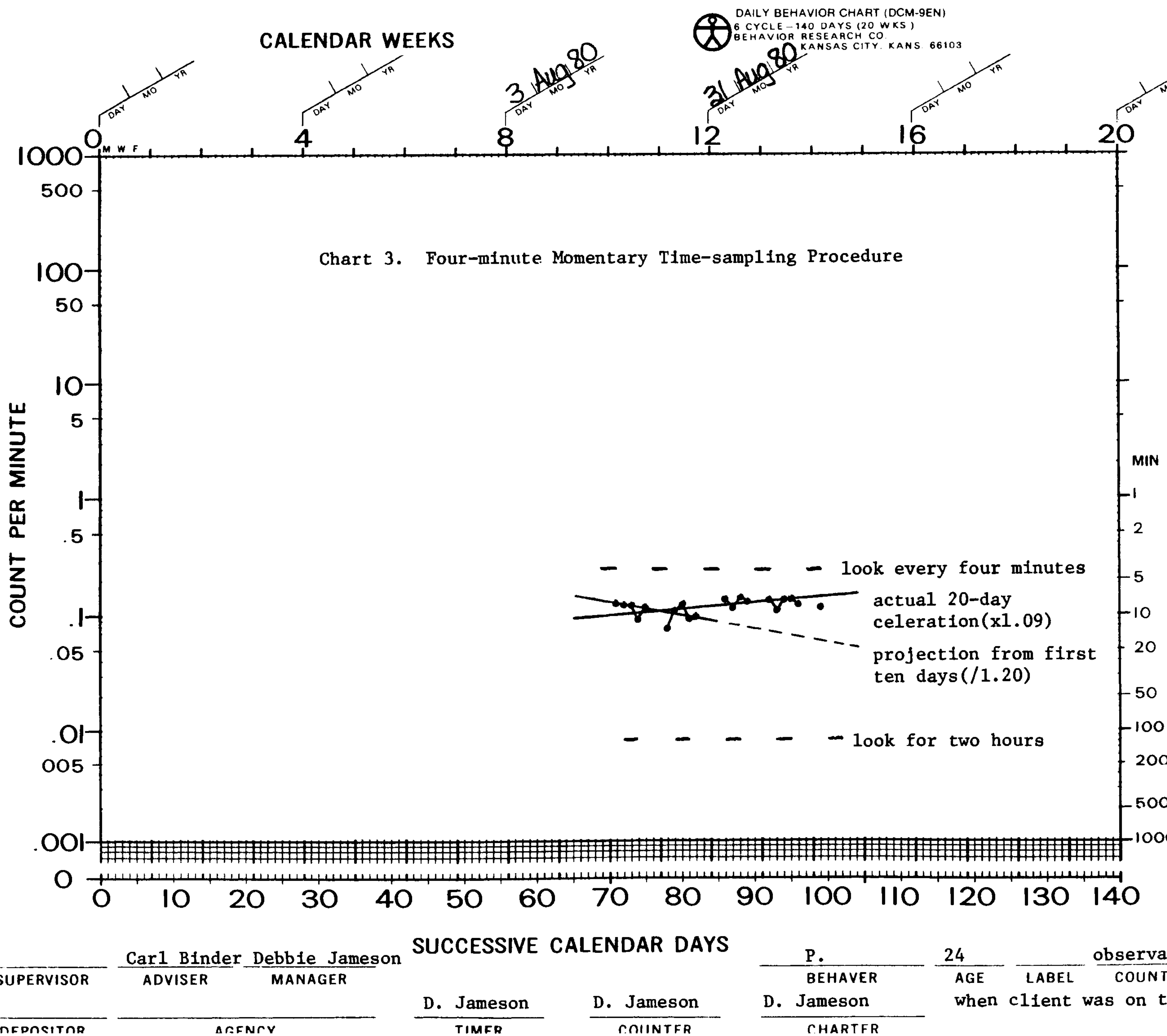

Chart 3. Four-minute Momentary Time-sampling Procedure

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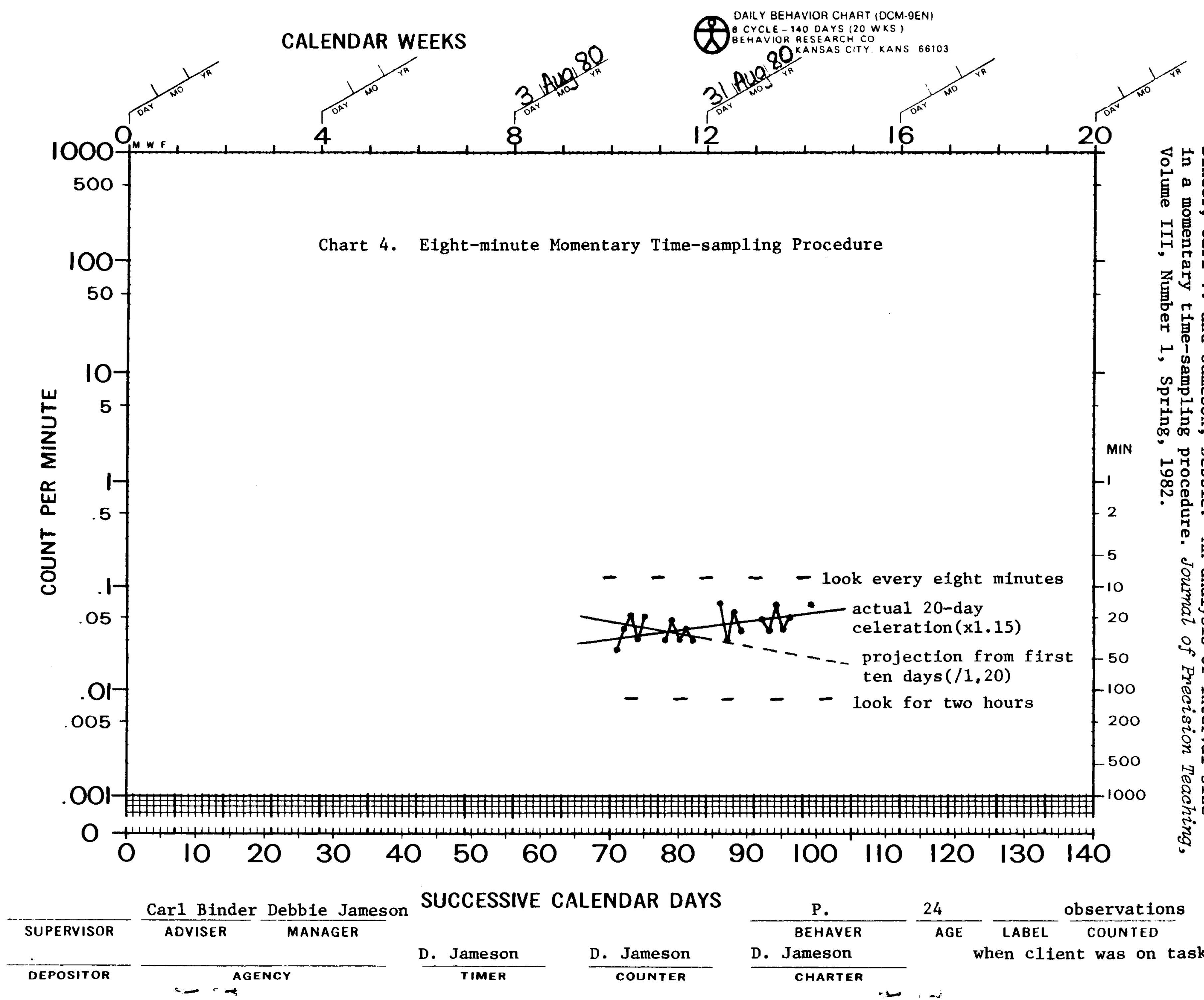

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TECHNICAL NOTE: A SIMPLE CALCULATOR TO COUNTER CONVERSION

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Lindsley (1968) has noted an inexpensive mechanical counter now widely available, and McGreevy (1981) has listed a series of devices that may be used as counters.

When it is desired to have a behavioral event counted without a separate "push the counter" movement, or when the frequency of the behavior is greater than a mechanical counter will accommodate, an option to consider is an electronic counter. Any calculator with a "repeat function" feature (usually part of the "equals" key) can be so used by simply entering the key sequence -1, +1, =; and every subsequent depression of the "=" key will increment the total by 1.

However, this method requires a mechanical depression and release of the "=" key. For some clients, a larger keypad surface may be desired, and for some applications, e.g. wheelchair pressure relief push-ups or refrigerator door openings, a mechanical arrangement to physically push the "=" key may be clumsy or unreliable. Instead, wires may be added to a calculator "=" key contacts such that simply shorting the wires increments the counter. That arrangement permits a wide variety of switches and types of contact devices to be used.

An inexpensive (about $10.00) calculator, the Unsonic 1541L, is very readily converted to such a counter without disturbing any of its calculator functions. With the calculator turned off, the case may be pried open by gently working a screwdriver blade around the joint at the perimeter of the case. Small cracking sounds will indicate that the latches holding the case together are breaking, which is normal. The bottom of the case will come off, exposing a printed circuit board attached at both ends by bare gold wires. At the bottom end of the calculator (away from the display), 17 wires join the printed circuit board to the keyboard back. Strip 1/8" of insulation from two wires of any length or gauge desired (#22 stranded, insulated wire is convenient) and solder one of them to the 7th gold wire and one to the 11th gold wire, counting from either end of the array (see Diagram 1). Pencil marks on the edge of the board next to the appropriate wires will mark the ones to be soldered. Do not allow solder drops or any other contact with the remaining gold wires. The two soldered wires will be separated by 3 untouched ones. If you use #22 stranded wire, then 2 small 1/16" holes drilled anywhere convenient in the case will permit egress of your new leads. Gently lead the new wires out of the calculator case. Make sure that no extraneous contacts or shorts can occur.

Replace the back cover and turn the calculator on. Enter -1, +1, =, and then touch your two new leads together several times. The display will increment each time you short and release the two wires, as you are simulating a depression of the "=" key. These new leads may then be attached to any sort of switching device that makes and breaks contact, and you have an electronic counter with a wide variety of applications.

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Chart-sharing

THE KEY TO SUCCESS

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The client is a 27-year-old mentally retarded male named Cliff. Cliff lives with six other