MOMENTARY TIME SAMPLING AS AN ESTIMATE OF PERCENTAGE TIME: A FIELD VALIDATION

RICHARD A. SAUDARGAS AND KATHLEEN ZANOLLI

UNIVERSITY OF TENNESSEE-KNOXVILLE

This study examined the percentage time estimates of momentary time sampling against the real time obtained with handheld computers in a natural setting. Twenty-two concurrent observations were conducted in elementary schools by one observer who used 15-s momentary time sampling and a second who used a handheld computer. Results for the six behaviors showed a close correspondence between the momentary time sampling percentage observation intervals and the real time percentage observation time, although 15-s momentary time sampling tended not to sample low-frequency short-duration behaviors. The results confirmed laboratory findings that short-interval momentary time sampling estimates percentage time accurately for a wide range of behavior frequencies and durations, and suggested that observers using momentary time sampling in a natural setting are able to obtain accurate data.

DESCRIPTORS: time sample, methodology, naturalistic observations

One of the most common measures of behavior is an estimate of the percentage of time a person engages in a behavior. The usual method of obtaining an estimate of this measure is to use some form of time sampling. Time sampling involves dividing time into discrete units and then coding the occurrence or nonoccurrence of behaviors within the defined time units. Two commonly used time sampling schemes are partial interval (PI) and momentary time sampling (MTS). Both PI and MTS involve dividing time into blocks of seconds and then coding the occurrence or nonoccurrence of behaviors based on a decision rule. The decision rule for PI is that a behavior will be coded if the behavior occurs at least once within the time block. The decision rule for MTS is that a behavior will be coded if it is occurring at the moment the time the block ends (or begins). In neither PI nor MTS is the frequency or duration of behavior within a time block considered. Conceptual and empirical articles examining PI and MTS have typically concluded that PI overestimates percentage time of behavior whereas MTS gives a reasonably accurate estimate of percentage time when brief intervals (30 s or less) are used (e.g., Powell, Martindale,

Kulp, Martindale, & Bauman, 1977; Tyler, 1979). Two additional conclusions have been reached about MTS (Ary, 1984). First, the higher frequency of state changes, the greater the difference between the actual percentage of time and the MTS estimate. Second, MTS is equally likely to underestimate or overestimate the percentage of time a behavior occurs.

The conclusion that MTS is superior to PI in providing an accurate estimate of percentage time has been reached using computer simulation and laboratory videotapes of actual behaviors (e.g., Green & Alverson, 1978; McDowell, 1973; Powell, 1984; Powell et al., 1977; Tyler, 1979). In computer simulation research, behaviors of systematically varying rates and durations are programmed, whereas in videotape research, the behaviors are measured in real time. Both the computer simulation and the videotape studies then overlay PI and MTS of varying interval blocks onto the real time measures and make comparisons between the percentage of real time and the estimates obtained from PI and MTS.

Because MTS is accurate in laboratory settings, a next logical step is to make direct comparisons between a measure of real time and MTS with trained observers in a natural setting. Making such comparisons would answer two questions: (a) whether MTS accurately estimates percentage time

Correspondence and reprint requests should be sent to Richard Saudargas, Psychology Department, University of Tennessee, Knoxville, Tennessee 37996.

across a wide range of behavior frequencies and durations as they occur naturally in time and (b) whether trained observers can accurately record data using MTS in a single observation pass as is done in applied studies in the natural environment. Recent developments in computer technology have made such a comparison possible. This study examined the percentage time estimates of MTS obtained on a multibehavior observation code against the real percentage time obtained with handheld computers.

METHOD

Subjects and Setting

Sixteen elementary school children were observed (2 first graders, 1 second grader, 5 third graders, and 8 fourth graders). The students, from eight classrooms in six elementary schools, were observed while they engaged in independent activities that consisted of completing workbook pages, ditto sheets, and boardwork. The teachers conducted reading groups during this time. Observations occurred over 2 months.

State-Event Classroom Observation System

Observations were conducted using the State-Event Classroom Observation System (SECOS) (Saudargas & Fellers, 1986; Saudargas & Lentz, 1986). SECOS is a multibehavior observation system designed for use in classroom research and for assessments of handicapped children, and contains six state behaviors and 12 event behaviors. State behaviors are those of varying durations; the measure of interest is an estimate of the percentage of the observation time the state behavior occurred. Event behaviors have brief durations of approximately equal length; the measure of interest is frequency or rate of occurrence (Altman, 1974; Saudargas & Lentz, 1986). Research has shown that the behaviors observed with SECOS can differentiate among learning disabled children (Fellers & Saudargas, 1987; Slate & Saudargas, 1986a), seriously emotionally disturbed children (Slate & Saudargas, 1986b), gifted children (Fellers & Saudargas, 1988), and normal children at different grade levels (Saudargas & Zanolli, 1989).

The six state behaviors on SECOS for which percentage observation time is of interest were analyzed for this study: *schoolwork*, defined as the child attending to academic assignments; *looking*, defined as the child looking away from the academic assignment; *other activity*, defined as the child involved with objects or materials not part of the academic assignment such as sharpening pencils, getting out or putting away materials, and playing with toys; *child interaction*, defined as the child interacting with a peer; *teacher interaction*, defined as the child interacting with the classroom teacher; and *out of seat*, defined as the child's buttocks being off a chair. All the behaviors were mutually exclusive with the exception of out of seat (i.e., the child could engage in the other five behaviors while in seat or out of seat).

There are two versions of SECOS. The paper and pencil version (SECOS-MTS) uses 15-s MTS to estimate percentage observation time on the six state behaviors, and frequency counts are made on the 12 event behaviors. The coding procedure consists of combining MTS with frequency counting. At the beginning of each 15-s interval, the observer codes the occurrence or nonoccurrence of the six state behaviors. During the remaining time of the 15-s interval, the observer codes the frequency of the event behaviors as they occur. To obtain the percentage of intervals in which a state behavior occurred, the number of intervals a state behavior was coded is divided by the total number of intervals observed and multiplied by 100. The rate of each event behavior is obtained by dividing the frequency by the observation time.

On the handheld computer version (SECOS-C), the 18 SECOS behaviors are recorded on a Hewlett-Packard HP71-B handheld computer, which keeps track of real time and frequencies for all behaviors (Saudargas & Bunn, 1989). When a behavior occurs, the observer presses a computer key corresponding to the behavior. After an observation, the handheld computer data are transferred to a personal computer for data analyses. The percentage of observation time for each state behavior is obtained by dividing the total time the behavior occurred by the total observation time and multiplying by 100. Behavior rates are obtained by dividing

the frequency of each behavior by the total observation time.

Observation Procedures

The observers were two graduate students trained in the use of SECOS. One conducted the observations using the SECOS-MTS, and the second used the SECOS-C. The observers entered each classroom during independent seatwork and conducted the observation. To facilitate communication about when to begin and end the observation, the observers stood next to each other while conducting the observation. The two observation methods are so different that the possibility of the observers cueing each other regarding occurrences and nonoccurrences of behavior was remote. To be certain that the observers began and ended each observation at exactly the same time, the SECOS-MTS observer signaled the beginning of the first observation interval and the end of the last observation interval. Each observation period lasted for 20 consecutive min. Two children were observed three times each, 2 children were observed twice each, and the remaining 12 children were observed once each.

Interobserver agreement had been obtained on the SECOS-MTS and SECOS-C for each observer on training videotapes and in ongoing field research at the time this study was conducted. Separate interobserver agreement was not obtained for this study because of the practical problems of having a third or fourth observer in the classroom. However, interobserver agreement data for each observer with observers in other studies were as follows: For the SECOS-MTS observer, interobserver agreement averaged for the six behaviors was 86% and ranged from 78% to 94% (agreements divided by agreements plus disagreements). For the SECOS-C observer, interobserver agreement averaged over the six behaviors was 83% and ranged from 72% to 91%.

RESULTS

The observation session comparison between percentage observation time for the computer data and the percentage observation intervals for each

of the six behaviors is presented in Figure 1. Overall, the correspondence was very close between MTS percentage of intervals and the real time percentage obtained by the computers. In four of the 22 observations (Observations 4, 11, 14, 16), discrepancies of 9% or greater were obtained in the schoolwork category, and relatively large differences were also obtained for these same observations in the looking category.

One important outcome was the tendency for 15-s MTS not to detect behaviors that occurred for a very low percentage of time. During observations in which the computer observer coded a small amount of time for a behavior, the MTS observer often did not record the behavior at all. This pattern was especially noticeable for teacher interactions that tended to occur infrequently and for short durations. Teacher interactions were not scored by the MTS observer during 13 observations, but during 11 of these 13 observations, the computer observer coded some, albeit brief, teacher interactions.

DISCUSSION

The results of this field study confirmed the laboratory finding that 15-s MTS closely approximates actual percentage of time across a range of naturally occurring behaviors. The results suggest that trained observers using MTS in a multicategory observation system will obtain accurate data in the single observation pass available to them in field settings. Because we were interested in the accuracy of the SECOS (which uses 15-s MTS), no other time sampling intervals were selected for comparison. It is likely that longer MTS intervals would have replicated previous laboratory work showing that increasing MTS interval length increased error (Powell, 1984; Powell et al., 1977).

Although the data obtained from each method were very similar, measurement error occurred. During a few observations, relatively large differences between MTS and the computer were noted on the schoolwork category, with a corresponding opposite difference in the looking category. These discrepancies may have occurred because of observer disagreements about the category in which to code a behavior. Even though the observers were

Figure 1. The 15-s MTS observation intervals and the computer percentage observation time for the six behaviors. Three observations were conducted on Student 1, three on Student 2, two each on Students 3 and 4, and one each on the remaining students. The data points are connected with lines to make the relationships easier to see. The data are plotted in the order in which they were obtained.

highly trained and had excellent reliability in other studies, obtaining interobserver agreement for this study might have helped to explain the differences. These differences also may have occurred because the frequency of state changes was higher during these observations (Ary, 1984). That is, the students alternated between attending to their schoolwork and looking at high rates. Although the computer would code these state changes and the resultant time accurately, MTS might not.

The finding that 15-s MTS tended not to detect short-duration behaviors is important if those behaviors are of interest and percentage observation time is the response dimension of interest. One way to increase the probability that important, yet infrequent, behaviors with very short durations are sampled would be to use a PI coding scheme in which the occurrence or nonoccurrence of the behavior at any time during the interval is coded. Such a strategy has been widely used in applied behavioral research. However, the use of PI time sampling systems is unacceptable, in our view, because they yield data that do not correspond with real behavior frequencies or durations (e.g., Powell, 1984). Although it may be possible to score the occurrences of low-frequency and short-duration behaviors with a PI time sampling system, the resultant data would be inaccurate and conclusions drawn from such data might be incorrect.

A more acceptable alternative for sampling short-duration behaviors would be to shorten the MTS interval. In the present study, a 5-s MTS interval might have detected the behaviors not sampled by the longer 15-s interval. Of course, a very brief interval might decrease the number of behaviors that could be coded reliably by a human observer using paper and pencil procedures. Nevertheless, it would be better to record fewer behaviors using MTS, because the percentage time data would be more accurate and the resulting conclusions would be more justifiable and replicable.

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