A DEVICE FOR AUTOMATIC AUDIO TAPE RECORDING¹

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Adaptation of a commercially available timer for use as a means of operating an audio tape recorder several times during the day is described. Data on a mother's rates of commanding her children were collected via both physically present observer and recorder methods in order to compare the usefulness of the recordings with direct observation. There was a high positive relationship between observer-recorder command rates, with the observer rates being consistently higher, when data were collected via both methods simultaneously as well as at different points in time.

Methods of observation typically have involved the presence of an observer in the setting of interest. It has been found that observers produce various effects on the behavior of individuals whom they observe. A review of the literature on observer effects and data on the nature of some of these effects was presented by Patterson and Harris (1968). These writers pointed out the previous application of a telemetering device for broadcast of verbal subject interactions to an audio tape recorder located at a distance from the subject (Purcell and Brady, 1966). Purcell and Brady's child subjects knew that they were being recorded during certain periods, and data were presented to show adaptation by the children to the use of the transmitter. These data consisted primarily of judges' and house parents' ratings, which were devised to measure behavioral changes in the children and their attention or preoccupation with the radio transmitting equipment which they wore. One disadvantage of the transmitter was that radio communication was poor in certain locales and it could not be used at a distance.

Another alternative to the use of a human observer for collection of data on some variables is direct use of the audio tape recorder, but a recorder cannot operate indefinitely without change of tape, and awareness by the persons under observation that the recorder is operating probably has some observer effect. Ideally, to minimize observer effect, it is necessary to install a recorder to operate at given times during the day so that individuals being recorded do not know at what times the recordings are made. This paper describes a device for automatically activating a recorder at various times during the day. The device was packaged so that the observed individuals did not know the exact times of the recordings. Data obtained from a single family over a period of six weeks using this automatic recording device were compared with data obtained via human observer.

APPARATUS

Figure 1 is a photograph of the automatic audio recorder apparatus. On the right is shown the timer (Intermatic Model 12001, available from most hardware stores—cost \$6.87). This timer activated the cassette recorder at given time intervals during the day, and was chosen because it required the least adaptation for our purposes. Another timer (Intermatic model T185) was first tested, but it produced a loud audible click when it made contact to activate the recorder. As purchased, the model 12001 was suitable only for cycling single periods of approximately 15 min or

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longer. However, the two switches could be modified so that each could start and terminate a cycle of at least 20 min, but the period length was highly unstable. To achieve reliably more than two on-off periods of less than 15 min, and thus be able to monitor sounds frequently for short intervals during each 24-hr cycle, the timer was modified.

Details of the adaptation of the timer may be seen in Fig. 1. The switch on the timer was disconnected and a Plexiglas disc (cost \$1.00) 9 in. in diameter was bolted on the center pole of the rotating timer dial. This disc, and its markings from the center of the disc to its edge, are shown to indicate how the disc was substituted as a timer dial. Metal clips made of $\frac{3}{8}$ in. aluminum stock were machined and a slot was made on the edge of each clip such that the clip could be inserted onto the disc easily and stay in its place. Thus, the clips could be moved anywhere on the edge of the disc opposite the corresponding time of day or night when the recorder was to be activated. The power cord from the recorder was

connected to the timer, and the timer power cord supplied power to both units. The timer was set in a light metal chassis (available from any wholesale electronic distributor, cost \$5.00) fitted with a cover and a padlock (cost \$.56) so that it could be locked during operation. Leads from the remote switch on the Sony model TC110 cassette recorder (cost \$100.00) were slipped through a hole on the chassis and adhered to the chassis with Epoxy glue. To the end of these remote leads was soldered a single pole, single throw, normally open microswitch (Potter & Brumfield #A1G1-117-1, cost \$2.00). (If the recorder does not have a remote jack, the microswitch can be connected in series with one lead of the recorder power cord.) The microswitch was set so as to clear the plastic disc but be activated by the metal clips as they moved by and made contact with it. As soon as the metal clips, under control of the timer movement, went past the switch, the recorder stopped. In this manner, the width of the metal clips on the plastic disc face controlled the amount of time the

Fig. 1. Photograph of the audio recorder kit showing how the timer was modified.

recorder was on, and the placement of the clips controlled the time at which the recorder was activated.

For use with the family on whom data using this recorder kit were acquired, 7-min recording periods were required. Each of four clips were machined in size to a dimension of 20 by 12 by 4 mm. The 4-mm width of the clip end determined the length of the period. The four clips were set to operate the recorder for 7 min during each of four daily periods for a total of 28 min of recording on a half-hour per side tape cartridge. A small amount of accuracy was lost due to minute variations in the dimension of the clip edge that contacted the switch such that the total time of the recording using the four clips actually varied between 27 and 29 min per day. The photograph shows two 7-min clips set at 7:30 AM and 7 PM, and a 14-min clip at 5:45 PM. To set the recorder kit for the day, the plastic dial was moved counter clockwise so that the micro-switch pointed to the actual time of day, and the clips were set at the times recordings were needed. The chassis was locked, and the recording buttons on the recorder were pressed down. This operation set the recorder to be activated remotely by the adapted timer. The chassis and recorder were set in a canvas suitcase (cost \$5.60), and the microphone with its switch set on operate was attached to a corner of the suitcase where small holes were made in the canvas. The suitcase was then locked, and set down so that the microphone faced the family audience.

Description of the subjects and observation setting. Data using the audio recorder kit and a physically present observer were compared in a home setting that included a divorced mother and her three children, ages 7, 6, and 2 yr. The mother, who had a fourth-grade reading level and no vocational skills, was supported mainly by state welfare funds. Their home was a 26 by 18 ft frame building divided into living room, bedroom, kitchen, and bath. An observer had been going into this home once weekly for several months to collect data on the 6-yr-old boy, Steven, who was identified as a management problem and had been in an experimental behavior modification program (Bernal, 1971). During presence of the observer, the family engaged in any activity they wished, so long as they stayed within sight of the observer. The television set or radio was

on during the major part of both observation and recordings.

It was requested that the mother permit the placement of the recorder in her home in order to monitor the behavior of all the children every weekday. The mother readily agreed to this type of monitoring because she desired help in improving her management of all the children. The older children as well as visitors knew that the recorder was present, and the mother selected the earliest and latest time of the day that she would allow recordings to be made. She was assured that if she believed some event which she did not wish to be overheard had been recorded, the whole tape for the day would be erased in her presence; she never exercised this option. Times for activation of the recorder at 7:30 AM, noon, 2 PM, and 6:15 PM were selected by the investigators as those when both Steven and his mother were most likely to be present. The mother knew there was possibility of monitoring whenever all the children were at home, and that the recorder operated only on weekdays. An assistant collected and changed the tapes every weekday, and the recorder kit was placed in the living room, near the chair where the observer sat during the weekly home observation on Wednesdays from 3 to 4 P.M.

Definition of the behavioral measure. The measure used to compare observer-recorder data was the actual frequency of commands to Steven by his mother. For the recordings, a command was defined as a clearly audible statement telling or asking the child to start or stop doing something. Reminders occurring after the initial command were also counted as commands, and the reminder could consist of repetition of the child's name after the command when a pause followed the command. For example, a continuous flow of commands was, "Steven, come here, come to me, Steven. . . . Stevie!" In this example, the first three words were counted as one command, the second four words as a second command or reminder, and the final "Stevie" following a pause was the third command. For the observation, a command was defined additionally as nonverbal gestures consisting exclusively of pointing to the child being commanded and then pointing or other hand-signalling in the direction the child was to move.

Treatment of observer-recorder data collected at different points in time. Command frequencies were tallied on a sheet divided into 15-sec time samples (TSs). At times, counting of commanding behavior was somewhat arbitrary due to the mother's tendency to repeat various versions of the same command again and again. For this reason, interobserver agreement was checked stringently by counting the number of TSs in which one observer agreed with the other on the frequency of commands given to Steven within each TS. Number of TSs on which both observers agreed regarding occurrence and nonoccurrence of commands was divided by total number of TSs (240 TSs per hour) to yield an agreement score. The observer agreement for two home observers during 1-hr observation was 0.80, and agreement for 1 hr of audio-recording was also 0.80. The same second observer checked both home and recorder agreement. The first or criterion observer was naive regarding the family history, problems, and intervention procedures, but was aware of the presence of the recorder, although not of the recording times. Before scoring the tapes, the dates on them were covered and the tapes were presented to the observers in mixed chronological order.

The major comparison of observer-recorder data involved recordings collected throughout the week and an hour of observation once a week. In order to compare the recorder data against the standard provided by the observer data, it was necessary to have the number of TSs obtained via the two collection methods represent an equivalent amount of time. Therefore, the frequency for the first 28 min of observation was used as the observer data, and the recorder data were prorated to 28 min when there was data loss. Only data from tapes containing at least 28 TSs were used, and data from days when the total number of segments did not add up to 112 TSs were prorated to 28 min using the formula:

$$\frac{\text{number of commands}}{\text{number of TS recorded} - \text{number of TS lost}} \times \frac{x}{112 \text{ segments}}$$

Treatment of observer-recorder data obtained during the same time periods. During two consecutive weekly home observation pe-

riods, the criterion observer carried in a hand-bag an extra cassette recorder supplied with a cartridge that recorded for 1 hr on each side. The family was not informed of the presence of the second recorder in order to prevent bias due to its presence. It was assumed that the mother would have permitted the use of this recorder since she had already consented to recordings throughout the day. The tape and observation TS pacing was synchronized by having the observer clear her throat several times at 15-sec intervals as she began to score in the home. The criterion observer scored commands to all three children from the 2-hr recording and then divided the recorder and observer data into 10-min segments and computed the number of commands within segments.

RESULTS

Data losses. The amount of data obtained via recorder varied depending upon loss of data due to (1) absence of Steven or his mother in the home, (2) unintelligibility of speech in the recording because of background noise, and (3) equipment malfunction. Equipment malfunction consisted of failure to trigger the microswitch because the clip was not properly positioned, tape jamming, experimenter error in setting the timer and recorder, and shutoff of the equipment when the children hit against it. Recordings of at least 27 min per day over six weeks or 30 days of time would have yielded 3240 15-sec TSs. Data losses in TSs for the six weeks of time were as follows: absence: 599; noise: 27; malfunction: 172. A total of 2442 TSs were obtained, *i.e.*, 75% of the data were saved. Absence of Steven or his mother in the home accounted for 19% of the data loss. The range of TSs lost per day due to absence was 0 to 67 with a mean of 20 and standard deviation of 20. Other data losses were considered too negligible to describe further. The Pearson *r* between the obtained daily recording lengths and command frequencies was 0.35, indicating a definite but small relationship between daily recording lengths and command frequencies.

Figure 2 represents the observer command frequencies per 28 min of time plotted over 13 weeks. Data collection via recorder began at week 7, and command rates from the recordings are shown in the figure. Reinforce-

Fig. 2. Comparison of mother's rates of commands to Steven obtained via observer and recorder.

ment of the mother's reduction of commands was initiated at week 11 but this fact is incidental to the topic at hand. Recordings were discontinued at week 12 when summer vacation began because the family schedule was too irregular to yield sufficient recorder data.

There was a marked relationship between the observer and recorder data, although the recorder tended to yield lower supervisory rates than the observer. The Pearson product moment coefficient between the observer and recorder scores was 0.89, significant at $p < 0.02$. The observer data for six weeks before use of the recorder were shown to suggest that introduction of the recorder into the home did not have any apparent effect upon the observer rates. Empirical support for this suggestion was not provided by subsequent removal and reintroduction of the recorder since the data collection was terminated at week 13.

Comparison of observer-recorder data obtained simultaneously. The Pearson r between number of commands per 10-min segment obtained via observer and recorder was 0.86, significant a $p < 0.01$, indicating a high degree of relationship. Since the same criterion observer made the observation and then

scored the tape, thus introducing a practice effect into the tape scoring, the second observer scored the 2 hr of recorder data, and her agreement with the criterion observer, determined by the same method described earlier for interobserver agreement, was 0.95. Thus, there was reasonable assurance that the criterion observer's scores were not primarily a result of having already scored the same period of time while having the advantage of visual information.

The recorder was the less sensitive method of obtaining command measurement. For the 2 hr, the observation data yielded a higher score on 11 of 12 10-min segments. The difference in command frequencies per 10-min segments ranged from 1 to 9 with a mean difference of 3.5 commands.

DISCUSSION

The family described here was financially indigent, the mother was infrequently able to leave the children, she cooperated extensively with the investigators, and there was a relatively invariant family schedule from day to day during the school months. These factors

assured the usefulness of automatic recordings made during the day without family knowledge regarding the exact times of the recordings. Usefulness of the recorder kit may depend upon similar factors, particularly the family's willingness to be monitored and their degree of trust that the investigator will comply with all conditions regarding time and use of the recordings. The variables under study must be audible and clearly specifiable, using only the sound recording. Auxiliary microphones can be placed in strategic spots to increase recording space, or located in such a way as to restrict it, and recording times can be tailored to the subjects' schedules. An assistant changed the tapes, but in practice the timer can be locked up and a neighbor, friend, or relative selected by the family can change the tapes daily.

Observer command rates were higher than the recorder when data were collected at both different and simultaneous points in time. The most likely explanation for this difference was that the observer was able to measure more commands because he had the additional visual information regarding nonverbal commands. The present data were intended as suggestive of the usefulness of the recorder, and do not necessarily justify its use as a substitute for the observer. For each variable under study, the investigator will wish to make independent determinations for his own unique purposes of rates provided by both methods.

Cost of all items for the recorder kit except for the recorder itself totalled \$21.03. Recorders vary considerably in cost, and a less

expensive one can be used. To the cost of the recording kit and cassette tapes must be added data reduction time. In this project, the assistant was paid at the rate of \$2.39 per hour. Thus, data reduction time at \$1.20 for each 28-min day of data added up to \$6.00 per five-day week. The observer cost amounted to the basic salary plus \$0.11 per mile for travel. If high observer-recorder correlations exist for variables under study, the observer is the less expensive of the two data collectors. However, the utility of the recorder kit is for subjects living at such a distance from the investigator that travel costs exceed the lower cost of the hour's weekly observation, provided someone uninvolved in the goals of the study can change the tapes. The automatic recorder is also useful as a procedure for the study of observer effects, especially when measured variables can be shown to be highly susceptible to physically present observers.

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