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AUTHOR Sitko, Merrill C.; And Others

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ABSTRACT

A prototype computer-assisted teaching training system (CATTS) was developed to help train special education personnel. CATTS is a comprehensive system which produces systematic observation, real-time analysis, storage, and feedback of specific observation coding data relevant to special education classroom teacher-pupil interactions. An investigation demonstrated the relative effectiveness of CATTS instantaneous (visual) and delayed (printout) feedback in increasing various cognitive and management behaviors of preservice teacher-trainees in a controlled classroom setting. It was found that CATTS is a versatile and comprehensive delivery system which can be applied in many ways to analyze real-time process variables within behavior training fields. Two statistical tables and three graphs include a schematic diagram of the arrangement of a CATTS station. (Author/JY)

The Effectiveness of a Computer-Assisted Teacher Training System (CATTS) in Generating Specific Teacher Behaviors in a Preservice College Teaching Environment

Merrill C. Sitko, Melvyn I. Semmel, and Jerry Olson

Center for Innovation in Teaching the Handicapped

Indiana University

Abstract

The present paper discusses the application of a computerized feedback system to teacher training and the study of teacher-pupil interactive behavior in classrooms. A prototype computer assisted teaching training system (CATTS) is described in detail. Moreover, the efficacy of CATTS as a training system is empirically demonstrated. The paper specifically discusses an investigation which demonstrated the relative effectiveness of CATTS instantaneous (visual) and delayed (printout) feedback in increasing various cognitive and management behaviors of preservice teacher-trainees in a controlled laboratory classroom setting. The feasibility of utilizing the prototype computerized feedback system for in situ training in other training environments involving behavior analysis and behavior modification is also indicated. In essence, CATTS is a versatile and comprehensive delivery system which can be applied in many ways to analyze real-time process variables within behavior training fields.

Overview

Our current plan for presentation of this paper is to develop our talk around a slide show format. The presentation will be roughly broken into three sections. The initial section will be a description of the Computer Assisted Teacher Training System (CATTS) supplemented with slides showing the general configuration of the laboratory, coding and teaching stations. The second section will describe the teacher training program and the third section, again supplemented by slides and sample printouts, will describe the analysis and results.

The presentation will not be a verbatim reading of the paper, but instead will be a discussion of the application of the CATTS delivery system to our teacher training focus and its potential application to other behavioral teaching programs.

Educators have, in the past decade, participated in the technological revolutions provoked by advances in computer development. Most large school systems use computers for scheduling, general accounting, grading and other automatic functions which previously demanded the long and arduous labor of relatively skilled personnel. In addition, the advent of "real-time" systems and shared time arrangements has brought the capabilities of rapid analysis and feedback directly into the learning situation through programmed instructional techniques and various audio-visual approaches. Computer-monitored instructional programs are currently attempting to reach large numbers of pupils with fewer numbers of teachers. Others seek to individualize instruction for specific children. Undoubtedly, as such efforts progress and cost factors are controlled, we will be faced with the reality of an educational technology revolution in education within the coming decade.

The question which arises then is "Can we presently utilize computer technology for preparing teachers to work effectively with children in both special and/or regular class settings?" To our knowledge, little attempt has been made to explore and evaluate the potential contribution of computers in clarifying training objectives and improving teacher competencies in existing teacher education programs. Hence, there is a current need for the exploitation of computer technology in teacher training programs in education.

Research and developmental activities directed toward realizing a cost-effective Computer-Assisted Teacher Training System (CATTS) for training special education personnel have continued at the Center for Innovation in Teaching the Handicapped (CITH), Indiana University, for the past four years under the direction of M. I. Semmel (1972, a, b). CATTS is conceptualized as a closed-loop cybernetic system capable of producing continuous instantaneous and/or delayed feedback of relevant teacher-pupil interaction data to a teacher trainee in the classroom, so that modification of behavior can be realized through regulatory teaching moves in accordance with predetermined training objectives. The comprehensive system is designed to produce a feasible, cost-effective means of systematic observation, real-time analysis, storage, and feedback of specific observation-coding data relevant to special education classroom teacher-pupil interactions. An immediate visual feedback delivery system and corresponding data summaries have been developed for in situ and after-session feedback of relevant teacher-pupil variables in practicum teaching environments.

CATTS SYSTEM CONFIGURATION

The system configuration of CATTS is visualized as consisting of three interdependent stations: Teaching Station, Observation-Coding Station, and Analysis-Encoding Station. Figure 1 illustrates this configuration with a schematic diagram of the present CATTS installation at CITH.

Teaching station. The CATTS Teaching Station consists of classroom(s) which accommodate various auditory and visual feedback devices. Space is also available for visual observation and an input device to direct computer entry of classroom behavior. Visual feedback devices are placed so that the teacher can have access to the feedback information during teaching with a minimum of classroom disruption. These various feedback display devices are controlled directly by the computer.

Application of visual displays into the Teaching Station vary from the closed-circuit televised images currently employed, which originate from a cathode-ray tube (CRT) computer display to various external visual devices, which convey feedback information to the classroom by changing light patterns.

Observation-Coding Station. The Observation-Coding Station provides the link between the events occurring in the classroom and the computer analysis of these events. Visual observation of classrooms takes place within the classroom itself, within an observation room adjoining the classroom, or through a closed-circuit television connection. Three methods of data input are employed by the CATTS system: a directly-connected coding box device; a Touch Tone telephone access system; and a portable recording unit for off-line data collection. The first two methods permit real-time data collection for instantaneous feedback applications. The third method extends the CATTS system's data collection ability beyond the physical limitations of any direct computer connection into the field, which allows baseline and delayed feedback observations.

At present, the computer-connected coding device with which the observer enters his observations consists of a small hand-held box with 12 Touch Tone configured pushbuttons. The other direct input connection is the Touch Tone telephone system. Currently, the CATTS system can accept data independently and simultaneously from 12 directly connected coding devices. This input time-sharing capability allows simultaneous data collection from various locations to fulfill classroom observation requirements for independent projects.

Analysis Encoding Station. The Analysis-Encoding Station contains a PDP-12 digital computer and associated computing hardware required for the on-line processing of pushbutton-coded data which are gathered and transmitted from Observation Coding Stations. In addition to processing the incoming data, the computer system is configured to allow for the control of various display devices used in Teaching Stations and provides for hard-copy printouts, storage, and transfer of data to remote computer systems for further analysis. It is at this station that the operator or project director initiates the computer program options available in CATTS. The teleprinter console, through software program control, permits the operator to select specific CATTS programs or options that satisfy various project data collection and feedback requirements.

The selection of the mode and content of feedback to the teacher at the Teaching Station is initiated from the console. If a CRT display is chosen as the method for feedback, the operator determines the content of the display by assigning the incoming data, by code, to different computational functions for the computer to calculate and display as feedback. The nature of the display also is selected from the console and allows feedback information to be presented either in alpha-numeric or graphic form.

Upon completion of an observation session, the raw data are stored upon local computer magnetic tape units and become accessible for various data analysis applications. Analysis programs are available on both the PDP-12 computer and Indiana University's remote computer facility. Prior to remote computing center data analysis applications, the data are transferred by a telephone connection into permanent disk and tape storage files which are accessible by either batch or time-sharing analysis programs.

The associated PDP-12 teleprinter, which also serves as the communications link to the CATTS program, provides hard-copy data summary printouts for instant inspection throughout the data gathering stage. These printouts provide such information as the frequency and event times of coded tallies and the actual feedback functions currently being displayed to the teacher. At the end of a real-time session, a selection of various data summary programs and printouts is available for delayed feedback applications.

PROJECT DESCRIPTION

In order to empirically demonstrate the efficacy of the CATTS system the present project was undertaken. This project attempted to demonstrate the relative effectiveness of computerized instantaneous and delayed feedback in generating specific teacher behaviors in a preservice teaching environment. The project built on previous developmental work involving the CATTS system. Specifically the purpose of the project was to demonstrate the effect of CATTS immediate visual and delayed (printout) feedback on increasing various cognitive and management behaviors of teacher-trainees in a controlled laboratory classroom setting. In all the study entailed three major phases; first, participation by trainees in observation system training; second baseline of trainees' cognitive demands and behavioral control strategies in the classroom; third, measurement of trainees' cognitive demands and behavioral control strategies under CATTS instantaneous and/or delayed feedback conditions.

In the first or Discrimination Phase of the project the 27 special education preservice trainees learned two category observation systems entitled COG-STRAT and MAN-STRAT. Categories on the COG-STRAT included teacher and pupil cognitive styles of interaction, while MAN-STRAT categories focused on pupil on- and off-task behavior and strategies of teaching management of pupil behavior. All trainees were trained to code all categories on the two systems. Acquisition of observation-coding skills was facilitated by the computer-aided training device called DITRMA. The total time for trainee acquisition of the COG-STRAT system varied from 8 to 10 hours, while MAN-STRAT training took slightly longer. Following observer training, both criterion-related and intracoder measures were obtained respectively for COG-STRAT and MAN-STRAT observers via videotaped criterion tests. All trainees achieved initial criterion-related agreement (Inter-rater reliability) scores $<.85$. In addition to initial criterion-related agreement, initial intraobserver agreement measures were obtained for both systems. All trainees exceeded the preset standard of .75 for both pupil and category identification. In fact almost all exceeded a .85 standard. Maintenance checks for criterion-related agreement were similarly performed about one-third the way through the study, except different videotapes were used. The majority of the trainees exceeded the .85 standard on the maintenance check.

In each of the two teaching phases (i.e., Baseline and Feedback), trainees taught language art lessons they had prepared. Lesson objectives that trainees used for lesson plan preparation were stated in behavioral terms. Expected pupil terminal behaviors indicating the pupils attainment of a concept or ability to perform a task were the basis for a given objective. The trainees were required to submit a written lesson plan for each 30-minute lesson they taught one week prior to teaching for comment and evaluation. In the teaching phase of the study, each practicum student was randomly assigned to teach the same group of EMR children, once each week for the duration of the study. There were four to five children in each group and there were three such groups. These groups were drawn from a class of EMR children whose regular classroom was located in a classroom adjacent to the Teacher Education Laboratory at CITH. The grouping of pupils for instruction by trainees was based upon the similarity of instructional needs and the social maturity of the pupil. Each group of pupils received a total of one hour of supplementary reading instruction by the teacher trainees per day. The same group of children was taught by one trainee for half an hour and by another trainee for half an hour. In addition each trainee coded another trainee in his group at least once a week on the COG-STRAT system. Coders were randomly assigned to teachers such that each teacher was observed by a different coder in his group each time. Assignment of trainees to day of teaching was random. Teaching room assignment was also rotated between three classrooms in the TEL facility. Trainees coded classroom interaction on button boxes which were hooked up to a PDP-12 computer located in the TEL. Coding for each lesson continued for 30 minutes after which the computer automatically shut off the coding terminals.

A single organism multiple baseline across subjects design was selected for the two teaching phases of the project. In the baseline condition, trainees taught the lessons they had prepared without receiving feedback of any kind. The number of lessons taught without feedback varied from trainee to trainee. The baseline teaching always included at least the first three lessons and varied up to the first six lessons taught. Assignment of trainees to variable baseline teaching trials was random. The second controlled condition was teaching after the trainee received computer printout information or feedback on his baseline teaching performance and a set of instructions in modular form on how to read the computer printout. This feedback was based on both COG-STRAT and MAN-STRAT categories.

After their baseline trials were completed, the trainees were provided with printouts which summarized their performance across frequency, time and rate dimensions for each of the COG-STRAT and MAN-STRAT observation categories. They were then instructed in evaluation procedures for using the printout information to graph the percent frequency of occurrence of behaviors for each of the observation system categories. They were also assigned the task of graphing all categories in the baseline period. At this stage the trainees were also required to evaluate their baseline teaching on the basis of their graphs. They then selected and listed in order of personal preference three of the observation system categories from COG-STRAT and MAN-STRAT systems that they judged as most important to their teaching and wished to work on for improving their teaching performance. Within a week of receiving baseline information, the trainees were required to select a single behavioral category for subsequent improvement. The final selection was arrived at in consultation with a staff member. This choice became, in most cases, the category that was targeted for improvement in subsequent lessons. The trainee also had to indicate whether he wanted to accelerate or deccelerate the percent frequency of occurrence of the target behavioral category in subsequent lessons. In most cases the trainees first choice was an acceptable behavioral category indicative of a relatively stable baseline performance on that category during baseline. All of these activities were carried out after the baseline period and before the trainees taught with feedback.

Following these procedures, the trainees were randomly assigned to one of two feedback conditions. Half of the trainees were assigned to a printout only feedback group, and half to a scope and printout feedback group. The scope feedback group was presented with a self instructional module and instructions from a staff member on how to interpret CATTS video scope feedback. This step was performed prior to the trainees teaching with feedback. During the feedback phase, the weekly lessons continued as during baseline and in addition all trainees received printouts on their latest lesson within two hours after teaching. The group receiving instantaneous video or scope feedback always had a video monitor in their classroom which showed the cumulative percent frequency of occurrence of the targeted behavioral category that the trainee had chosen for teaching behavior change. Hence, this group obtained instantaneous or immediate information on the criterion teaching behavior *in situ* while teaching. In addition they also received printouts summarizing their lessons as did the other group. Both groups were required to graph the percent frequency for the targeted category after the printout was received. This data was recorded on a cumulative individual graph for the category and included the trainees baseline percentages. In addition, all trainees kept a running record of the percent frequency in category for each successive lesson by entering the information for the previous lesson on a graph in the laboratory.

The instantaneous video feedback group was required to fill out a post teaching questionnaire after each lesson they taught. It was expected that the questionnaire would serve to reinforce the trainees attention to the scope during teaching. Among the items in the questionnaire was one in which the trainee was required to estimate the number of times he looked at the video monitor. Another question required the trainee to reconstruct the video feedback display for the entire 30-minute lesson. The number of lessons taught with feedback varied from trainee to trainee. The feedback teaching included at least four lessons and varied up to seven lessons taught depending on the number of lessons taught during the baseline phase. The teaching phases of the project covered a total period of ten weeks, ending May, 1973.

RESULTS

The design used to analyze the CATTS project data was a repeated measures ANOVA design with two between block factors; Groups (G) and Treatments (T), and one within block factor, Periods (P). The original design contained a fourth factor, different variations of baseline and treatment trial combinations, but due to inconsistent teaching schedules and some missing observations, this baseline/treatment factor was never fully completed. Therefore, each subject's trials were collapsed within the various baseline and treatment periods and one average performance rate score per period was calculated.

The rate of responding on the trainees' chosen feedback category was selected for the dependent measure employed in the analyses. This criterion measure was calculated by dividing the frequency of occurrence of the feedback category during any one session by the time of that session.

Table 1 contains the analysis of variance source tables for the feedback category as well as the second and third choice categories. F ratios for the feedback category indicated a significant finding in the period (P) main effect ($p < .01$). An examination of the means in Table 2 and Figure 2 reveal that treatment trials were significantly higher than baseline trials by a 2.8:1 ratio. In addition the Treatment by Period interaction (TP) was also significant ($p < .05$).

Due to this significant interaction a simple main effects analysis (Kirk, 1968) was performed on T and P to qualify these main effects. The results of the simple effects analysis are also indicated in Table 1. Figure 1 illustrates the TP interaction plot.

As expected, the qualification of the Treatment effect (T) indicated that the scope and printout feedback condition (T_2) and the printout only feedback condition (T_1) were not significantly different during baseline trials (P_1), but did reach significance ($p < .05$) during the treatment trials (P_2) by an approximate 2:1 ratio. The Period effect (P) is qualified by showing that the printout only treatment group (T_1) did not significantly increase their mean rate of responding between baseline (P_1) and treatment (P_2) trials, while the CATTS scope display and printout treatment group (T_2) increased significantly (p .10) between baseline and treatment trials by a 3.7:1 ratio.

To further support the simple main effects interpretation, identical results were achieved by performing Tukey post hoc analyses (Winer, 1971) on the means which are plotted in Figure 1.

As indicated above, prior to the trainees selection of their criterion feedback category, they initially chose three teaching behaviors that they specified they would like to work on in the classroom. From this list of three, the final feedback category was selected. As a contrast to the selected feedback category, identical analyses were performed on the second and third choice behaviors that were not included in the concentrated CATTS feedback program. These second and third choice behaviors were not displayed on the scope instantaneous feedback display, but were included on the printout given to both treatment groups together with all of the other behavior categories coded in the classroom.

An examination of Table 1 variance components for second and third choice categories revealed no significant main effect differences or interactions present in the data. Hence, only the criterion feedback category selected from the original chosen three categories was found to improve significantly from baseline to treatment. Figure 3 (a and b) graphically illustrate the mean rate increase from baseline and performance differences from baseline between the three feedback choice categories.

F max tests (Kirk, 1968) were performed on the error terms for all three categories found in Table 1. F max ratios indicated that both the within subjects and between subjects variances error terms for the feedback category were found to be made up from homogeneous within cell components. The within subjects error term for the second choice category was also found to be homogeneous. The F max ratios for the remaining error terms rejected the homogeneity assumption. The application of this test qualifies the interpretation of the second and third choice categories but lends support to the results attributed by CATTS to the chosen feedback category.

APPLICATION OF CATTS

The previous project has demonstrated the efficacy of CATTS instantaneous and delayed feedback in generating specific teacher behaviors in a preservice teaching environment. However, the system's potential for application in other training environments involving real time process analysis is virtually unlimited. Hence, the system is only a tool and with creative applications, can be used in many behavioral settings.

The next logical extension of CATTS' methodology within training environments is to access the CATTS system to inservice teacher training programs within the schools themselves. This extension of the system is in response to our concern for a cost-effective application of CATTS technology to the field of teacher training. CITH has undertaken and is presently analyzing the results of a number of remotely located inservice teacher training studies. The CATTS system is being used in some studies to collect data and provide feedback to teachers within school systems through the implementation of direct telephone and portable data recorder data collection schemes. Data is collected in real-time by a Touch Tone telephone input system and is delivered back to teachers immediately after teaching via the same telephone line to a teleprinter located within the school office. In other inservice studies teacher pupil interaction data is collected by observers with portable data recorders. The data is then mailed and processed at CITH and a printout feedback summarizing the classroom interaction is then returned to the teachers by mail.

Various other applications using the CATTS system also suggest themselves, such as extending current CATTS methodology into the field of regular education, and college and university teaching. For instance, feedback to professors concerning various student reactions or discussions related to classroom presented material would serve to aid professors in their classroom planning and execution. This technology might thereby assist in attaining the goal of improvement of the quality of higher education. To move away from the field of teacher training, CATTS can be applied to one-on-one and small group situations such as counseling, clinical speech and hearing therapy, and clinical psychology sessions. In these situations feedback could provide additional process information to the session participants which would permit the monitoring or potential change of the direction or focus of the session. A further extension of this principle is to employ CATTS into biofeedback types of applications such as a subject's own monitoring of anxiety levels or other such measures of interest. These applications illustrate just a few of the additional areas in which CATTS methodology might be extended.

In conclusion, the present paper has described a computer-assisted system which in real-time collects, analyzes, stores and feedbacks information based upon the application of various behavioral observation systems directed to the teacher training and teacher education field. In essence, CATTS is a versatile and comprehensive delivery system which can be applied in many ways within the teacher training field. CATTS can be of great assistance in the accomplishment of training objectives for competency- or performance-based training programs in teacher education. In our opinion, CATTS represents a quantum leap in teacher training in general. Moreover, with creative application, the system may be used in many ways to analyze and feedback real-time process variables within various behavior training fields.

	FEEDBACK CATEGORY				SECOND CHOICE CATEGORY				THIRD CHOICE CATEGORY			
	SS	df	MS	F	SS	df	MS	F	SS	df	MS	F
Between Subjects	1.5082	23			7.9394	23			6.2206			
Groups (G)	.0711	2	.0356	<1	.7119	2	.3559	<1	1.0766	2	.5383	2.34
Treatments (T)	.1728	1	.1728	2.79	.2806	1	.2806	<1	.1055	1	.1055	<1
Btwn T at P_1	.0000	1	.0000	<1								
Btwn T an P_2	.3455	1	.3455	7.15*								
Within cell		12	.0483									
GT	.1476	2	.0738	1.19	.2739	2	.1369	<1	.8933	2	.4496	1.95
S w/ groups S(GT)	1.1167	18	.0620		6.6730	18	.3707		4.1452	18	.2303	
Within Subjects	1.6212	24			.5104	24			.2725			
Periods (P)	.7301	1	.7301	21.10**	.0054	1	.0054	<1	.0105	1	.0105	<1
Btwn P at T_1	.0962	1	.0962	2.78								
Btwn P at T_2	.8066	1	.8066	23.31**								
GP	.0852	2	.0426	1.23	.0024	2	.0012	<1	.0065	2	.0033	<1
TP	.1728	1	.1723	4.99*	.0609	1	.0609	2.67	.0137	1	.0137	1.02
GTP	.0096	2	.0048	<1	.0306	2	.0153	<1	.0014	2	.0007	<1
PxS w/ groups SP(GT)	.6235	18	.0346		.4111	18	.0228		.2404	18	.0134	
Total	3.1294	47			8.4498	47			6.4931	47		

* $P < .05$
** $P < .01$

Table 1. Analysis of variance tablo for feedback and comparison categories.

MEAN RATE PERFORMANCE

		P_1 BASELINE	P_2 TREATMENT	INCREASE FROM BASELINE
SELECTED FEEDBACK CATEGORY	Printout only T_1	.1350	.2716	.1267
	Scope & printout T_2	.1350	.5017	.3667
	$\bar{X}T_1$ & T_2	.1350	.3817	.2467
SECOND CHOICE	Printout only T_1	.2675	.2175	-.0500
	Scope & printout T_2	.3492	.4417	.0925
	$\bar{X}T_1$ & T_2	.3083	.3296	.0213
THIRD CHOICE	Printout only T_1	.2908	.3542	.0634
	Scope & printout T_2	.2308	.2267	-.0041
	$\bar{X}T_1$ & T_2	.2608	.2904	.0296

Table 2. Mean rate performance on categories and treatment phases.

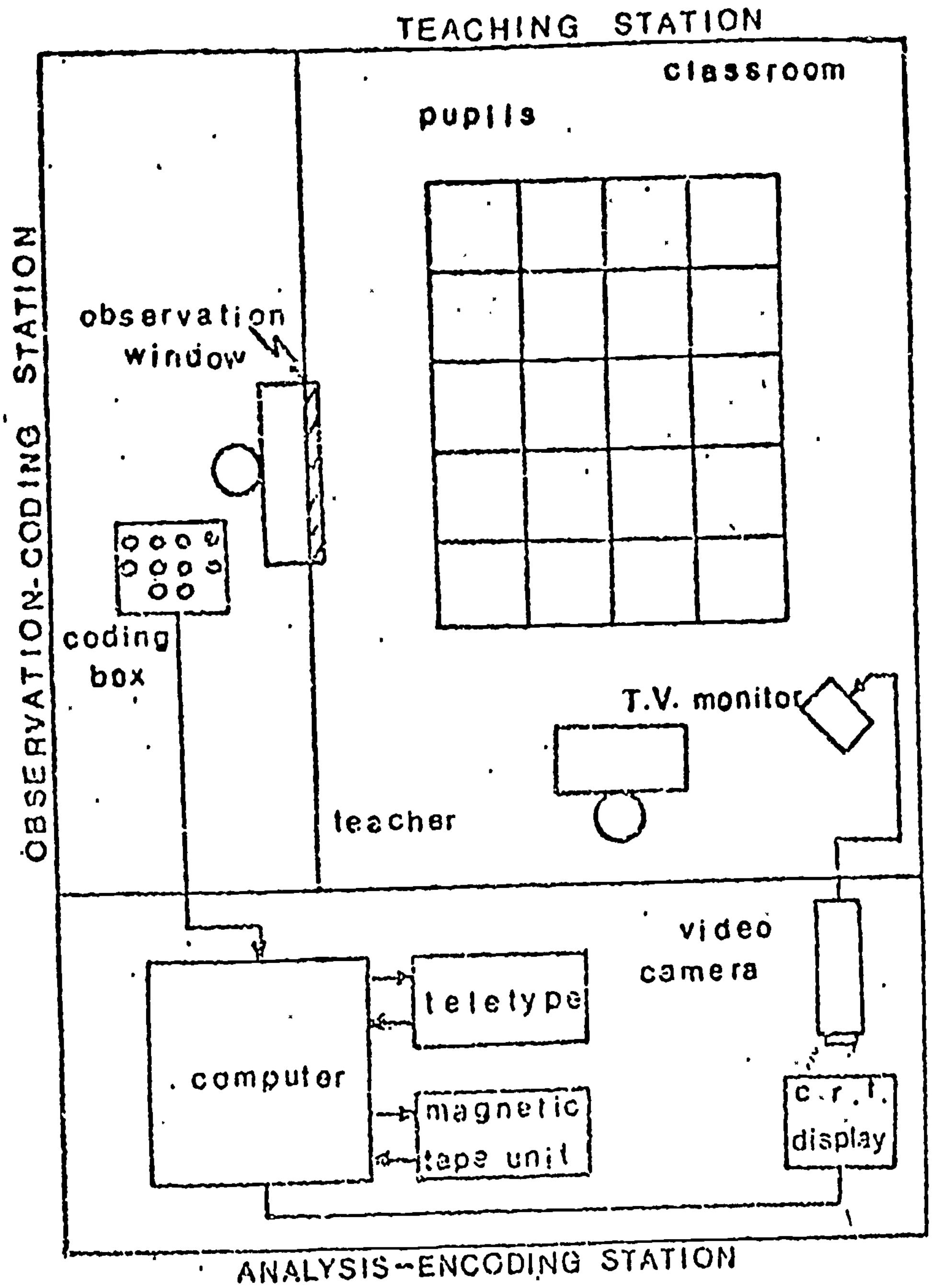


Fig. 1. Schematic diagram of present conceptual arrangement of CATTS stations.

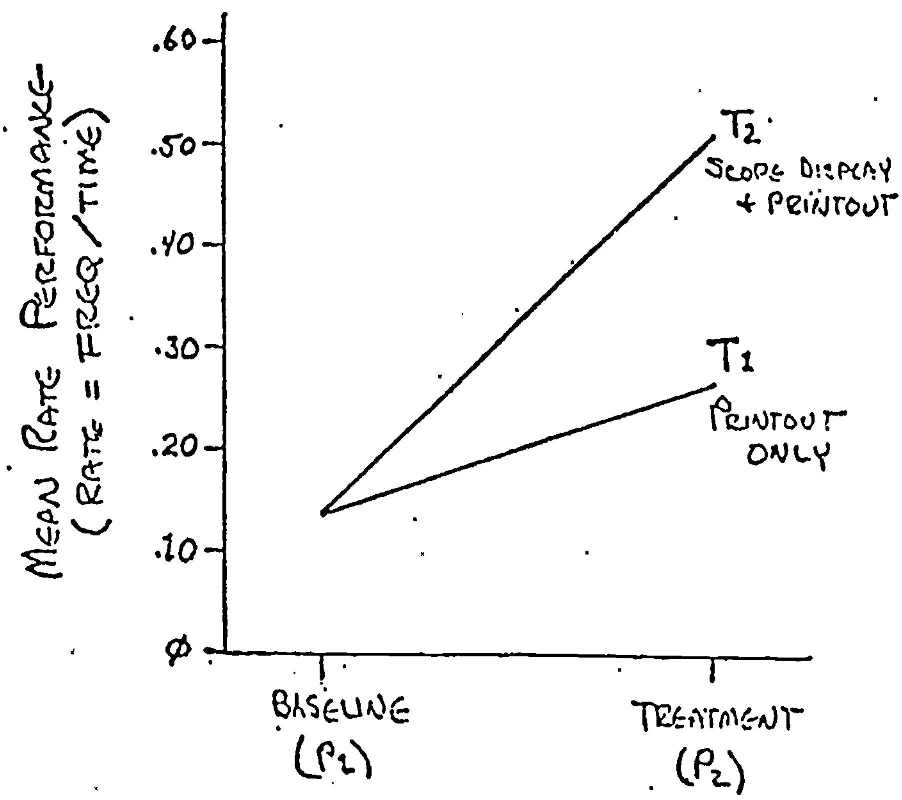
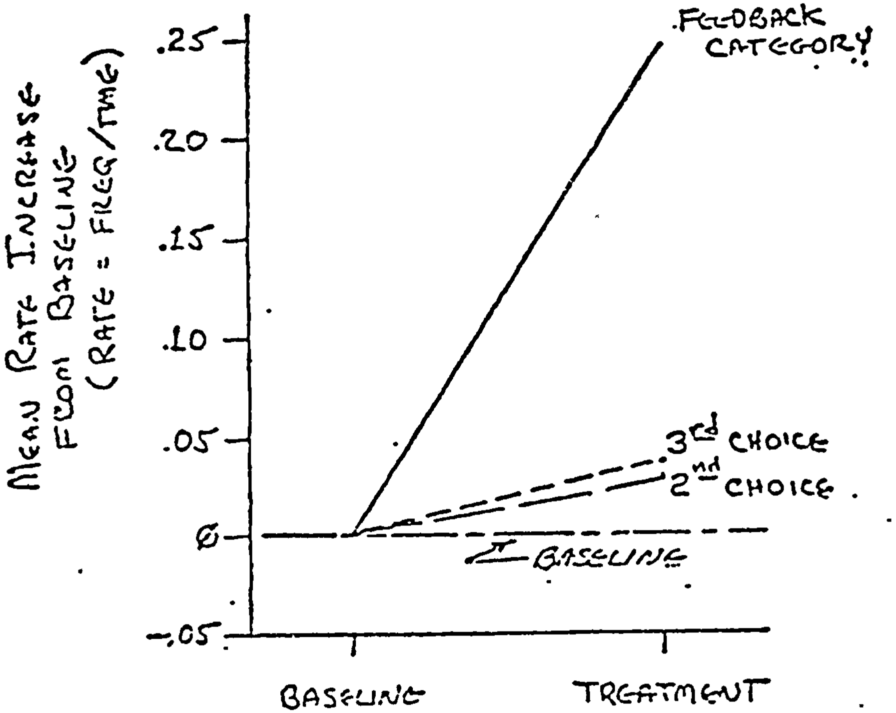
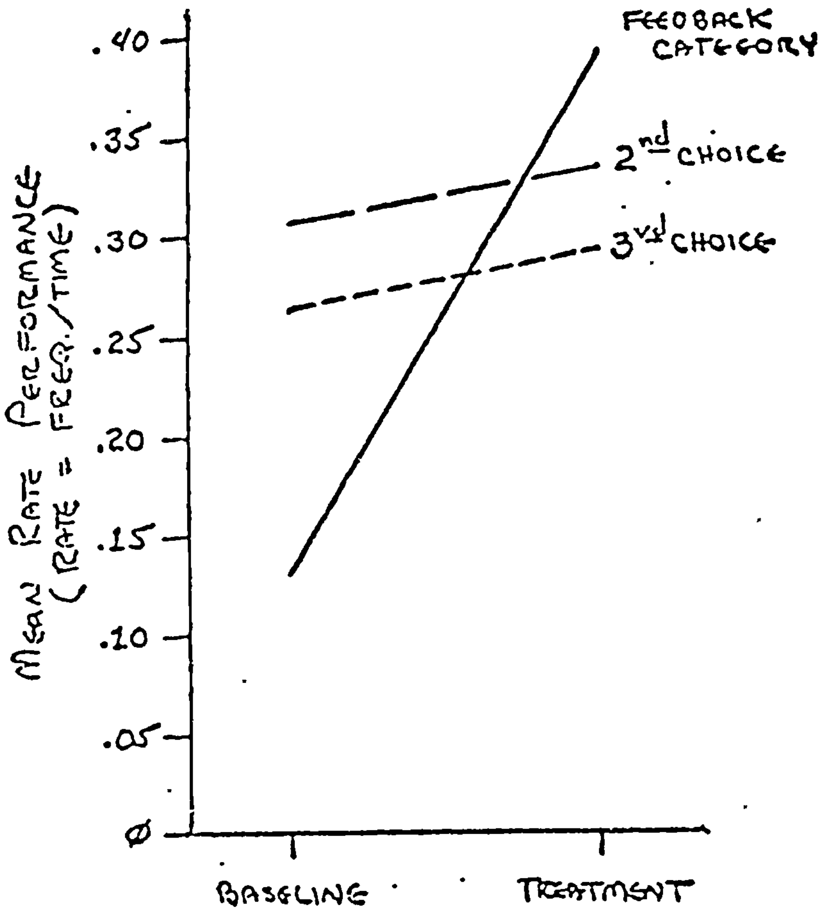


Figure 2. Mean rate performance by treatment across baseline and treatment trials (TP interaction).



a. Mean rate increase from baseline



b. Mean rate performance

Figure 3a & b. Mean comparisons between feedback category and second and third choice categories.

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