SESSION IX MICROPROCESSORS IN THE UNDERGRADUATE TEACHING LABORATORY: A SYMPOSIUM

Dana Main, *Presider*

A laboratory in experimental psychology using the TRS-80

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Twenty-three BASIC language programs have been written to allow the TRS-80 and other microcomputers to perform most of the classical experiments normally used in teaching a laboratory course in experimental psychology. Most programs allow experiments to be run as though the computer was the specialized apparatus normally used. This facilitates a realistic and interactive learning experience for the students.

In 1973, I wrote and filmed a series of audiovisual modules for use in teaching a laboratory course in physiological psychology. My goal was to allow the students to experience the color visual aspects of a physiological psychology laboratory when, for reasons of lack of trained faculty or laboratory apparatus, their college was unable or unwilling to provide hands-on laboratory experience. Although well received, with many hundreds of modules distributed, the total absence of interactive, hands-on learning left me very dissatisfied.

I had owned my own personal computer since 1968, when I purchased a huge \$800,000 RCA 500-series computer from government surplus for \$50. Almost continuous maintenance problems and the high prices of my subsequent DEC PDP-8, PDP-8/S, PDP-8/I, and PDP-11 computers prevented my even considering using a computer as an instructional tool. By 1979, however, I owned Radio Shack, Apple, PET, and Sorcerer computers and began to consider creating programs that would allow an inexpensive computer to duplicate all of the specialized instrumentation normally used in laboratory courses in psychology. An appraisal of the capabilities and weaknesses of the four major personal microcomputers led me to the conclusion that the Radio Shack, with its character-oriented editor, was the most desirable system on which to write initial programs.

My goal in writing the programs was to facilitate as much student-experiment interaction as possible. I wanted to avoid the noninteractive simulations that simply duplicate the classical experiments in the field.

The computer was simply to replace a piece of laboratory apparatus and to act as a statistical calculator for analyzing and plotting the experimental data. The students would still participate in the roles of experimenter and subject, and they could select the various parameters prior to beginning the experiment.

With the exception of one program involving mathematical simulations of schedules of reinforcement and video display of a rat, with the resulting cumulative records, all of the programs adhere to the initial plans. A list of the programs and a brief description follows.

PROGRAM DESCRIPTIONS

Reaction Time

From 1 to 10 stimuli and responses can be selected. Number of trials, intertrial intervals, ready signal, and randomized foreperiods can be selected. At the end of the experiment, data analysis options include mean, variance, standard deviation, standard error, coefficient of variation, t test between foreperiods or stimuli, raw data display, recording of data on a tape, displaying a frequency distribution with variable bin size, and adding more trials to the existing data. An assembly language program may be loaded to allow 1-msec timing resolution.

Quantification of the Müller-Lyer Figure

The classical psychophysical methods of adjustment, limits, and constant stimuli can be selected to allow determination of the point of subjective equality, constant error, difference limen, and interval of uncertainty.

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Quantification of the Horizontal-Vertical Illusion, the Poggendorf Illusion, Line-Length Judgments, and Size of Rectangle Judgments

These programs are the same as the Müller-Lyer figure.

Concept Formation

Nine concepts consisting of star-circle figures are presented as paired associates. The subject learns to name each concept. Correct responses and errors are analyzed in terms of number, mean, and latency for each trial and may be displayed or plotted on a histogram.

Verbal Learning

The computer acts like a memory drum to present preprogrammed or discretely entered words in serial or paired associates configurations. Correct responses and errors are analyzed in terms of number, mean, and latency for each trial and may be plotted on a histogram.

Multiple-Field Tachistoscope

Rapid sequential presentation of words, numbers, or small graphic symbols may be selected. Response latencies are recorded and may be statistically analyzed or plotted on a variable bin-size histogram. An assembly language program may be loaded to allow 1-msec timing resolution.

Visual Illusion Demonstration

Ten classical visual illusions including the phi phenomenon may be selected and displayed.

Psychophysical Scaling of Line Length Using Category Scaling or Magnitude Estimation

The classical psychophysical methods are used to allow a subject to scale line length. Graphic plots of the data and/or least squares lines on linear, log, or exponential axes may be selected. Stimuli other than lines may be easily programmed.

Visual Acuity

Threshold visual acuity across the visual field is measured using the classical Landolt C stimulus pattern. Data are displayed in the form of isoacuity curves on the video screen.

Operant Conditioning

A laboratory rat's barpressing performance is simulated on 10 schedules of reinforcement. A cumulative record is generated and displayed, and its scale can be changed at will. The mathematical models of responding may be easily changed to observe their effects on the cumulative record. The computer may also be interfaced to a real rat bar. The video screen will then display the actual cumulative record of the rat.

Latency Analyzer and Histogram Plotter

The computer may be connected to any external set of contacts so that external responses can be recorded. It then times and stores latency information and allows statistical analysis or variable bin-size histogram plots of the latency data.

Interresponse Time Analyzer and Plotter

The computer can store interresponse times between external events and statistically analyze or plot them on a variable bin-size histogram.

Event Recorder

The computer can record and store up to five external events along with the exact times of occurrence of each. The data are stored in a matrix and can be analyzed or recorded on magnetic tape for later use.

Cumulative Recorder

Responses fed into the computer are displayed on the video screen as a cumulative record. The calibration scale of the vertical axis may easily be changed to compress or expand the plot.

Human Maze Learning

A new T-maze is randomly constructed every time this experiment is run. The number of errors, trials to criterion, and latencies are analyzed and displayed in numerical form or plotted on a histogram.

Signal Detection

A signal in the form of a letter is flashed on the screen in a randomly selected location while noise in the form of other letters or symbols is simultaneously presented. The hit, false alarm, miss, and correct rejection rates are calculated and displayed, along with an ROC curve.

Pursuit Rotor

Using a light pen, the subject attempts to follow a spot of light that moves on a path around the screen. Velocity, path, and size of target may be varied. Time on and off target and errors on each trial may be displayed numerically or on a histogram plot.

Mirror Tracing

While viewing the video screen in a mirror, the subject attempts to trace a complex or simple figure with the light pen. Time on and off target and errors on each trial may be displayed numerically or on a histogram.

Operant Conditioning Control Program

Using external input and output leads attached to the computer through a simple interface, 10 common schedules of reinforcement may be programmed. Critical parameters such as the size of the ratio in the fixed-

ratio schedule may be selected before or during the experiment.

Laboratory Control System

This BASIC language program allows the microcomputer to utilize the state programming techniques of the SKED® system to establish and run virtually any experiment. The program supports up to six inputs and outputs and 10 states for a single experimental station.

The feedback from over 100 psychology departments that have used the programs has been enthusiastic and positive. Students remain interested and involved in the experiments and the reliability of the microcomputer allows students to concentrate on the experiment rather

than on the equipment problems that plague most laboratories.

Each of the programs is written in the BASIC computer language and can easily be modified to suit any user. Teachers enjoy rewriting segments of the programs to suit their individual needs and biases, and several have created new programs that will soon be added to the series. As a fringe benefit, many faculty members have discovered how easy it is to add word processing capabilities to the basic microcomputer and are using them for writing reports and letters of recommendation, and even for keeping track of student grades and grant budgets.

All programs are distributed by Life Science, 1 Fenimore Road, Bayport, New York 11705 [(516) 472-2111].