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AUTOMATED ANALYSIS OF MULTIPLE CHOICE BEHAVIOR

KARL H. PRIBRAM, KENNETH W. GARDNER, GERALD L. PRESSMAN, AND MURIEL BAGSHAW

STANFORD UNIVERSITY AND STANFORD RESEARCH INSTITUTE

The range, precision, and speed of behavioral testing is often facilitated through automation. At present most automatic equipment available is of the operant conditioning type (1). However, the results of many experiments depend on a more intimate analysis of changes in the relation between response, discriminative and reinforcing stimulus on successive discrete trials. Also, as task complexity is increased, the operant type of equipment must be considerably modified if it is not to become too cumbersome in construction and operation.

To overcome these limitations of operant equipment, the following device was designed and has proved, in use, to be a powerful laboratory instrument. Simple or complex, single or multiple choice tasks can be programmed and both stimulus and response events recorded, trial by trial, ready for analysis by any general purpose computer.

The apparatus consists of two sections: the display unit and the control console. These may be separated by as much as 50 ft through the use of three interconnecting cables. The display unit consists of 16 clear plastic windows, and of a feeder mechanism and tray. Behind each window is placed a commercially available removable electronic projection unit which can display 12 different patterns. The plastic windows, through which the projected patterns are visible, are hinged and activate a microswitch when pressure is applied to the window surface. The operation of the display unit is controlled remotely by the console. In addition, for initial training and shaping of behavior, manual control of trial presentations and of reinforcements is provided.

The control console provides the following operations: (a) programs the display of cues on the display unit as determined by settings made manually on the console panel; (b) processes the response information received from the display window microswitch according to instructions entered on the program panel and so provides reinforcements and program changes automatically; and (c) records for each trial, on punched paper tape suitable for analysis by a general purpose digital computer, the cue pattern and position to which response is made as well as the outcome of the response.

This Discrimination Apparatus for Discrete Trial Analysis, has been successfully used in testing subhuman primates for over four months. Mechanical difficulties have been minimal and easily corrected.

The advantages over manual testing which have made operant equipment so valuable are maintained: testing time is reduced, experimenter bias is eliminated and an accurate, complete record of behavior is available for analysis.

An additional advantage over manual testing in apparatus such as the Wisconsin General Testing Apparatus should be mentioned. Ordinarily, place and discriminative stimulus are confounded. The trial-to-trial change of stimuli over 16 positions, shapes the subjects' response to the discriminative stimuli rather than to place. Position habits do not occur. Our experience shows that in a two-choice situation, normal Rhesus monkeys will quickly make discriminations (*e.g.* of the arabic numerals 4 *vs* 6) in DADTA within 250 trials (five runs) that are next to impossible to achieve in manual testing. For certain types of problems such as multiple choice, response to ordered sequences, massed *vs* spaced trial learning, DADTA has also proved superior to the usual operant type of equipment since the discriminative and reinforcing stimuli are flexibly, yet intimately coupled to each response on a trial-to-trial basis.

Data analysis has been handled in various ways depending upon the particular behavior

Fig. 1. Display unit of DADTA. Note 16 clear hinged windows through which patterns can be displayed, and central tray attached to feeder mechanism.

being studied. Simple discrimination (*i.e.* 6 *vs* 4) has required only the recording of a daily score of number of reinforcements by a simple counter attached to the reinforcement dispenser. In a non-ordered sequential task, data generated over several days or weeks have been conveniently analyzed using a Flexiwriter write-out of the array of individual trials. Finer grain analysis of an ordered sequential task has been obtained from the Burroughs 770 computer. In all cases results are written out by the computer in clear English and the information obtained on the paper tape is stored simultaneously for permanent record in a magnetic tape file. When daily computation is needed, tape submitted by 5 p.m. is processed overnight.

REFERENCES

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