YOKED CONTROL WITHOUT A DUPLICATE APPARATUS: A RESPONSE RECORD-PLAYBACK SYSTEM

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In a yoked control design, experimental and control subjects are paired, and the behavior of each experimental subject is used to modify the stimuli presented to the corresponding control. For example, consider a Skinner box shock escape experiment in which control subjects are given shock-off periods unrelated to their bar pressing behavior. With a yoked control design, each control subject would receive exactly the same temporal sequence of shock-off periods as did its corresponding experimental subject.

The yoked control design has been widely used to investigate the effects of different response-event contingencies on behavior (Church, 1964). The usual practice has been to run both subjects of an experimental-control pair simultaneously in identical apparatus. However, when apparatus costs are large, a single apparatus combined with a response record-playback system may be preferable. The resultant doubling of running time will not be too costly if the experiment is fully automated and a laboratory employee is available to change subjects after each session.

A response record-playback system may be constructed using an ordinary magnetic tape recorder. Responses (*e.g.*, bar presses) are coded on the tape as short bursts of 1000 cycle sine wave voltage. This can be done with a pulse former. With the response manipulum connected to the pulse former's "operate", the normally open terminals can be used to switch short bursts of the 1000-cycle voltage into the tape recorder's input jack. The 1000-cycle signal may be obtained from an audio oscillator, or, more economically, from a code practice oscillator (*e.g.*, Eico Model 706). When the tape is played back during control sessions, the bursts of 1000-cycle voltage trigger a sensitive ac relay circuit (attached to the recorder's external speaker jack). The momen-

tary closures of the relay will correspond to the responses of the experimental subject.

A sensitive ac relay circuit has been designed for this type of tape recording system by Kintz (1965). In this circuit, a transistor amplifier boosts the tape recorder's output to a level sufficient to drive a plate relay. Any commercially available audio power amplifier would serve the same purpose. An amplifier proves unnecessary if the plate relay is replaced with a relay of greater sensitivity.

The ac relay circuit used (Fig. 1) consists of a diode for half wave rectification, a filter capacitor, and a Barber-Colman "Micropositioner" dc relay Type AYLZ-7309-100. It triggers at .14 ma, has a 2300-ohm dc coil resistance, and costs \$25.00 from Lafayette Radio Electronics. An input of 0.5 v ac triggers the circuit, a voltage level easily within the output range of ordinary tape recorders. (More voltage sensitive "Micropositioner" relays are available, but because of their lower dc coil resistance, they may require a larger filter capacitor than the 1 mfd shown in Fig. 1).

The system has proved quite reliable. Pen recorder tracings of the responses during recording (experimental session) and during

Fig. 1. The sensitive ac relay circuit. The dc relay shown on the right is a Barber-Colman "Micropositioner," Type AYLZ-7309-100; the numbers near the relay refer to octal socket pin connections.

playback (control session) have been identical in all cases. This was accomplished with a relatively inexpensive, non high fidelity tape recorder which had already seen years of service in another laboratory.

The method described above will convert any ordinary tape recorder to a response record-playback system. The Sony Model 211-TS recorder, as Buckhout (1965) notes, has built-in facilities for discrete event recording. Hence, it can record responses without requir-

ing an external tone source or external ac relay circuit.

REFERENCES

- Buckhout, R. An inexpensive laboratory stimulus programmer. *J. exp. Anal. Behav.*, 1965, 8, 320.
Church, R. M. Systematic effect of random error in the yoked control design. *Psychol. Bull.*, 1964, 62, 122-131.
Kintz, R. T. The tape recorder as a programmer. *J. exp. Anal. Behav.*, 1965, 8, 294.