A MULTIPLE-CHOICE VISUAL DISCRIMINATION APPARATUS

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This apparatus was designed to program stimuli to teach complex visual discrimination tasks (Hively, 1962; Hively, 1964). It has been extensively used with pre-school and kindergarten children, and could be adapted for use with other primates.

An over-all view of the apparatus is shown in Fig. 1. Programming and recording circuitry are housed separately. An automatic slide projector projects stimuli onto the windows of the operandum. The S responds to the stimuli by touching the windows. A switch beneath each window is wired in series with a photocell which may be activated by a spot of light from the projector. These are the basic elements of the apparatus.

Details of the operandum are shown in Fig. 2 and 3. The windows are $\frac{1}{4}$ in. plexi-glass, coated with a commercial preparation

Fig. 1. General view of the apparatus.

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²Reprints may be obtained from the author, Minnesota School Mathematics and Science Center, TSCE 210, University of Minnesota, Minneapolis 55455. A wiring diagram and component list for a matching-to-sample control circuit (Hively 1962, 1964) may also be obtained from the author.

Fig. 2. Front view of operandum with faceplate and two center choice-windows removed.

for rear projection screens (Polacoat Inc., Blue Ash, Ohio). They are hung on steel pins as shown in Fig. 2, the diameter of the holes in the windows being just slightly larger than the diameter of the pins, allowing the windows to swing slightly. The bottom of each window rests against the pin of a microswitch. Pressing the window operates the switch, and

Fig. 3. Back view of operandum (wiring not shown).

the switch housing limits the travel of the window. The spring in the microswitch returns the window to its original position when pressure is removed. Depending upon the size of the window, it may be necessary to locate more than one microswitch along its lower edge and to wire them in parallel. The apparatus shown has two large windows, each with two microswitches, and four small windows, each with one. The windows are held in place by a faceplate, which prevents them from falling off the pins, but does not exert pressure against them. Dotted lines in Fig. 2 indicate openings cut in the faceplate.

Figure 3 shows the placement of the photocells. Wiring for the switches and photocells is carried to a cable connector located in the hood.

Figure 4 shows the lay-out used in making 35mm transparencies for use in this apparatus. Each set of stimuli, together with one or more coding spots which actuate the photocells, is photographed on a single slide. The lay-out can be thought of as being superimposed on the front of the operandum: dotted lines indicate the windows. The dimensions shown may be scaled up and down as necessary to photograph stimuli of different sizes. In inches, they correspond to the dimensions of the projected image at the plane of the windows.

Figure 5 shows the photography set-up. Following the dimensions of the lay-out, a black cardboard mask is constructed, with holes beneath which the stimuli-to-be-photographed may be placed. (A two-choice matching-to-sample set-up is shown.) White coding-tabs are hinged to the left side of this mask. In

Fig. 5. Photography set-up.

production the stimuli are laid on the easel, the mask is placed over them, the appropriate coding-tab or tabs are folded so that they lie flat by a sheet of plate glass while the picture is taken. (All surfaces should be painted flat black to avoid reflections in the glass.)

A good deal of care must be taken in photographing and mounting the slides to make sure that the positioning is accurate when the slide is projected. The outside dimensions of the layout in Fig. 4 correspond to the dimensions of the standard 35mm "frame." A good procedure is to outline this rectangle on the mask with white tape and to focus the camera (using a piece of ground glass at the plane of the film) so that the frame just fits the aperture of the camera. On the processed film each frame will then be outlined in white and this may be used to center the film in the cardboard mount. Ordinary commercial mounting is not sufficiently accurate. Some commercial processors will hand-mount the slides according to specifications for an additional fee.

To achieve consistent results when preparing a large number of slides, it has been found necessary to buy a large stock of color film all with the same emulsion number and to store it under refrigeration. The exposed films are sent to a large regional laboratory for development. Films developed by local quick-service vary considerably from one batch to another. The films are returned uncut and hand-

Fig. 4. Photography lay-out.

mounted locally. If these precautions are taken, the positioning of the slides is accurate enough for most purposes.

The *Kodak Carousel* Projector is quite reliable. It also reverses automatically, and if desired, the apparatus can be wired so that it reverses upon command from a photocell, *i.e.*, when it reaches a given slide.

REFERENCES

- Hively, W. Programming stimuli in matching to sample, *J. exp. Anal. Behav.*, 1962, 5, 279.
Hively, W. Parametric experiments with a matching to sample program, Harvard University Teaching Machine Project, final report, 1964.