THREE MANIPULANDA FOR THE STUDY OF HUMAN INFANTS' OPERANT PLAY¹

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Behavior analysis techniques for studying human infants' operant performance for visual and auditory reinforcers in normal environments require the use of toy-like devices suited to the stimulus sensitivities and limited response capability of infants at various levels of sensorimotor development. This note describes three "toys" that have been used in conjunction with a comprehensive automatic system to monitor babies' free-operant play over extended periods in their cribs and playpens. The toys, and the system of which they are a part, provide automatic response recording and experimental control over a variety of audio-visual stimulus effects which are the consequence of the infant's exploratory-manipulative responding. Dimensions and construction details of the apparatus and results of studies can be obtained upon request from the author.²

These manipulanda were developed to offer various combinations of distinctive features found to be especially desirable in studying exploratory-manipulative behavior in infants. The most important of these features and the reasons for incorporating them are (a) close proximity between the point of response action and the sources of cue and reinforcement stimuli, to simplify the infant's recognition of the relationship between response and reinforcement; (b) position and/or sequence variability of visual reinforcement and content variability of auditory reinforcement, to increase the effectiveness of reinforcers in sustaining performance over time; (c) omnidirectional action of manipulanda in the horizontal or vertical plane, to facilitate re-

sponding in younger infants and in older infants with motor handicaps. The third design feature was not incorporated in the toy shown in Fig. 2.

Two-Choice Toys

Figures 1 and 2 show toys that permit two separate response and stimulus feedback options. With these, one can test for differentiation of an infant's responses between (a) two identical stimulus conditions—thus testing for position preferences that may be important factors in infant behavior output; (b) one stimulus and one non-stimulus condition; (c) two different classes or levels of stimuli.

The toy pictured in Fig. 1 employs light stimuli only. It is used primarily with infants under six months old who have limited mobility and who do not satiate rapidly to the simple reinforcement of light onset. It is hung from an overhead bracket above the crib, positioned so that a baby lying supine can reach up and touch the sub-miniature lamps,

Fig. 1. Two-barrel suspended toy.

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L_1 and L_2 , mounted on the bottom of Plexiglas cups, Cu . The cups are hung by tubes, T , from low-friction universal joints, J . The pressure of the baby's touch from any direction causes foil-covered cones, Co , to swing against the foil-covered inner edges, E , of Plexiglas barrel, B . Contact between the cones and the edges of the barrel closes a 1.5 v dc circuit, activating an external response recorder and light feedback control, thus illuminating whatever lamps in the toy are programmed in a given play session. The height of the cone on the tube is adjustable so that the excursion at the base of the cups required for circuit closure may be regulated from $\frac{1}{4}$ in. to $3\frac{1}{2}$ in. Rubber dampers, D , inside the barrels eliminate accidental circuit closures due to contact bounce and movements of the crib. The two lamps on each side of the toy may be controlled separately to serve cue and reinforcement functions. The device is 10 in. wide by 11 in. high.

The toy in Fig. 2 is employed with normal infants older than six months who have more mobility and who require a greater range of stimulus complexity and variability to sustain performance. The response knobs at either end are sections of Plexiglas rod attached to the arms of telegraph keys mounted inside the white plastic case. These knobs glow, as cue or reinforcer, when the red pilot lamps mounted behind them are switched on. The seven other pilot lamps, of assorted colors, are supplied from the external control unit in various patterns of single and multiple illumination when successive responses are made on the knobs. In addition to offering light reinforcement the toy also contains a music box, a household door chime, and jacks connecting

Fig. 3. Single-manipulandum side-mount toy.

a stereo tape-player to external loudspeakers. Responses on the knobs activate these stimulus sources as regulated by the control unit.

Single-choice Toy

Strong position biases with the two-choice toys frequently confound the emergence of normal and handicapped infants' selective play for audio-visual reinforcers. The influence of position habit is eliminated with single-manipulandum toys such as the one shown in Fig. 3. This toy allows infants to demonstrate selective behavior in a successive discrimination situation. The manipulandum is a clear plastic bottle mounted to the base of an omni-directional switch behind the white plastic panel. A 2-oz force on the bottle in any direction produces a circuit closure. Seven sub-miniature pilot lamps are mounted inside the manipulandum. Like the jewels mounted on the face of the panel, these lamps can be regulated by the automatic programming equipment. This toy also contains a chime and a loudspeaker to provide audio reinforcement.

Toys like these have been employed to monitor more than 500 hr of infant play for experimentally controlled perceptual reinforcers. They are used in four ways: (a) to

Fig. 2. Two-choice side-mount toy.

trace the short-term and developmental course of infants' responding for specified feedback stimuli; (b) to test preferences between different classes or levels of feedback stimuli; (c) to evaluate sensory discrimination and performance differentiation as a diagnostic measure

with severely handicapped infants who do not perform in orthodox clinical procedures; (d) to provide amplified feedback stimulation to handicapped infants capable of only minimal responses.