Operant control of vocal behavior in the monkey *Cebus albifrons*¹

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Abstract

Vocalizations of three monkeys (*Cebus albifrons*) were established as operants: they increased in frequency when followed by positive reinforcement and yielded to stimulus control.

Problem

In an attempt to distinguish human from animal vocalizations, Skinner (1957, appendix) described animal cries as instinctive, innate, well-defined emotional responses, thereby distinct from human vocalizations which may be modified by reinforcement. Since then, a number of experiments have demonstrated that subhuman vocalizations are amenable to operant conditioning. The vocal responses (VRs) of parakeets, chickens, dogs, mynah birds, cats (reviewed by Irwin, 1964 and Warren, 1965) and dolphins (Lilly, 1965) have been placed on FR schedules and brought under stimulus control. Meier (1964) claimed to have obtained instrumental aversive conditioning of the VRs of infant rhesus, but from his limited description it is impossible to be certain that operant conditioning had been accomplished. Thus the present experiment was designed to determine if nonhuman primate vocalizations can be controlled with operant conditioning methods.

Subjects

Ss were 6 pre-pubescent male monkeys (*Cebus albifrons*). Ss 3, 4, and 8, who successfully completed the experiment, were naive; as were S 9, who died, and S 10 who stopped all vocalizing after 39 shaping sessions. S 2, who had previously been used in an eyeblink conditioning experiment, was unable to master the discrimination.

Apparatus

The experimental chamber consisted of an 8 cubic ft sound-deadened enclosure. The inside was lined with wire screen connected to a constant current unit so that when S contacted both the wire and floor he received a mild shock. This prevented noise-producing actions on the walls and fixtures of the box but did not cause overt pain responses. Illumination was provided by a 15 w fluorescent light. The food receptacle was a translucent box placed behind a 2 in square opening located at S's eye level. Secondary reinforcement, which followed each criterion-meeting VR within 0.5 sec. and had a duration of 0.3 sec., consisted of yellow lights behind and above the food box and a 200 cps tone. The microphone and the discriminative stimuli (blue lights) were located behind the food box.

Following a suggestion of Polidora & Schneider (1964) a mixture of three different kinds of 0.045 gm pellets

were randomly dispensed as reinforcers. These were Ciba whole diet banana pellets, dextrose pellets, and Grape Nuts pellets, the latter produced in our own laboratory.

The microphone activated a Grason-Stadler Voice-operated-relay (VOR). Responses and reinforcements were recorded on counters and an event recorder. With a filter, the frequency response of the VOR was 1000 to 3000 cps. Although this filter eliminated much of the response of the VOR to extraneous noise, it was impossible to completely eliminate all such responses, therefore E monitored the VRs and constantly observed S through a one-way glass. During the initial shaping E reinforced and recorded all appropriate VRs, but later the microphone output and a hand switch were programmed in series. If a sound was not a VR, E did not close the hand switch and thus extraneous sounds were neither recorded nor reinforced. During discrimination training the VR had to exceed 0.1 sec. and 52 db and be between 1000 and 3000 cps. VRs not meeting these criteria were recorded by E on a separate channel of the recorder.

Procedure

Shaping was begun after 4 to 8 sessions of magazine training. Shaping sessions for Ss 3 and 4 were 20 min. once a day and 30 min. for S 8. These were continued until each S reached a stable level of responding (for detailed description, Myers, 1965). In later shaping a VR uttered in the middle of the chamber did not trigger the VOR; therefore Ss were shaped to vocalize into the food box.

An FR3 schedule was used during all discrimination testing since this produced the most stable performance. During discrimination training Ss were reinforced only in the presence of S^D and extinguished during S^Δ . A program tape presented the stimuli at fixed but randomly varied intervals of 0.5, 1, 2, 4, and 8 min. Over a 30 min. session the intervals of S^D equalled those of S^Δ . Sessions for Ss 3 and 4 were 30 min.; and for S 8, 60 min. The S^D for S 3 was the presence of a blue light projected through the translucent food box; S^Δ was the absence of this light. The reverse conditions held for Ss 4 and 8. As soon as the ratio of rate of responding in S^Δ to that in S^D reached 10% for three consecutive 10 min. periods, the stimulus conditions were then reversed and training continued until criterion had again been reached.

Results

Duration of shaping varied among Ss, taking 58, 56, and 49 sessions for Ss 3, 4, and 8 respectively. Dis-

Fig. 1. The rate of criterion-meeting VRs during discrimination and stimulus reversal for Ss 3, 4, and 8. Each pair of points for Ss 3 and S 4 represents 10 min. of testing time; for S 8, each pair represents the average 10 min. of 30 min. testing. The "x" represents the terminal operant level for 5 min. of rewarded responding on an FR3 schedule. The arrow represents the period in which the discriminative stimuli were first reversed after criterion had been reached.

crimination was attempted with S 8 after a stable rate was established in only 12 sessions, but resulted in failure and shaping was continued. The average 10 min. rate of criterion-meeting VRs during shaping for Ss 3, 4, and 8 on CRF were 23, 42, and 41; on FR3, 64, 107, and 72; and on FR3 during 10 min. of S^D , 70, 151, and 85. In Fig. 1 the learning curves are presented for both original discrimination and reversal for the three Ss who mastered the discrimination. The criterion-meeting VRs were quickly brought under stimulus control with Ss 3 and 4, but more slowly with S 8. There was some tendency for non-criterion-meeting VRs to increase during S^A . These were predominately uttered from the back of the apparatus and were of a completely different quality from the vocal operant. With these VRs included in the learning curves the discrimination is still quite apparent.

Three distinct kinds of VRs were recorded. The criterion-meeting VRs were a clear musical "Ooo." As determined by a Kay Sonograph they were 0.1 to 0.2 sec. in duration with a fundamental frequency of 1500-2000 cps. Soft VRs were calls of insufficient loudness and duration to trigger the VOR and were usually a low soft "grunt" uttered from the back of the

apparatus. The third type of vocalization was recorded with a separate hand switch and was a brief high pitched "chirp" (6000 to 10,000 cps, 1/30 sec.). As these calls were just at the threshold of E's hearing and were far above the frequency capacity of the microphone, they were never rewarded. Nevertheless, they increased in early shaping and decreased or disappeared in later shaping. Shaping seemed to progress only as these chirps dropped out. By the time each S was on discrimination testing, chirps were rare.

Discussion

This experiment demonstrates that the vocalizations of the Cebus monkey may be successfully controlled by operant conditioning procedures. This capability is not a species specific characteristic but instead, is a general principle of behavior occurring in the higher primates, including man, as well as in most other mammals and in birds. It is clear that Skinner was premature in proposing that vocal behavior below the human level is difficult if not impossible to modify with operant conditioning methods.

The vocal response learned by animals is subject to the same conditioning procedures that—as Skinner (1957) has emphasized—play such an important role in the development and maintenance of human verbal behavior. There is, of course, much more to human verbal behavior than has been demonstrated in animal vocal conditioning experiments. Skinner (1957, appendix) argues in anticipation of such experiments that there are other more fundamental differences between the conditioning of human verbal behavior and the conditioning of animal vocal responses. As things stand, the vocal responses of nonhuman animals and humans seem to be acquired and maintained in basically the same way.

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