Shaping, auto-shaping and observational learning with rats[1]

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Shaping, auto-shaping, and observational learning were compared as methods for training albino rats to press a lever for milk reinforcement. The shaping procedure was generally superior, but 9 of 10 rats also learned under auto-shaping. This would seem to be the best procedure for training large numbers of rats. All animals learned under observation, although this procedure generally took longer. The observational procedure employed here more clearly limited learning to the effects of observation alone, as compared to observational procedures which had been employed in earlier experiments.

Two recent experiments (Corson, 1967; Powell, 1968) have compared shaping and observational learning as methods for training rats to press a lever for positive reinforcement. The results of these experiments differed, with Corson finding the observational technique to be somewhat superior while Powell found the opposite.

The observational procedure used by both experimenters consists of placing a naive S in the test chamber with a trained S, thus providing the opportunity for the naive S to learn the desired response through observation. The shaping procedure is well known and has been described frequently (Skinner, 1951; Blough & Blough, 1964). It employs differential reinforcement of successive approximations to the criterion response.

An analysis of the observational procedure employed by both Corson and Powell suggests that the observational aspect of the situation may be of relatively little importance in the acquisition of the response. Placing both animals in the test chamber permits the naive S to have access to the reinforcer when the manipulandum is operated by the trained S. This, in fact, was observed to be what happened invariably in this laboratory. One result of the observational procedure, then, is that the naive S is magazine trained. The relative importance of this result as compared to observation in the Corson and Powell experiments can only be speculated upon at this point.

Two recent experiments (Brown & Jenkins, 1968; Sidman & Fletcher, 1968) have employed auto-shaping procedures to train animals to respond for positive reinforcement. Brown and Jenkins found that unconditional forward pairings of a key-light stimulus and food resulted in the reliable emergence of key-pecking behavior in pigeons. Sidman and Fletcher employed basically the same procedure with monkeys and showed that repeated pairings of lighted keys with reinforcement generated key-pressing behavior. These results suggest that magazine training alone is a critical factor in the acquisition of an instrumental response, and may account entirely for the learning which resulted from the observational procedure employed by Corson (1967) and Powell (1968).

On the other hand John, Chester, Bartlett, & Victor (1968) found that cats more quickly acquired both a signalled avoidance response (hurdle jumping in response to a buzzer) and a lever pressing response for food when trained by an observational procedure as compared to conventional training procedures. These authors did not describe in detail what they meant by "conventional" training procedures. Their description of the signalled avoidance procedure would suggest that the conventionally trained group was simply exposed to the experimental contingency. The group trained by conventional methods to respond for positive reinforcement was described as being "operantly shaped to press a lever for food in response to a flickering light."

The present experiment was undertaken to assess the relative effectiveness of shaping, auto-shaping, and an observational procedure in training rats to press a lever for positive reinforcement. The observational procedure employed did not allow the naive S to have access to the reinforcer during training, so that any learning that might develop in this situation could be more clearly attributed to observation.

METHOD

The Ss in this experiment were 27 naive albino rats whose ad lib weights ranged from 200 to 300 g. The animals were divided into three groups with 10 under auto-shaping, 8 under shaping, and 9 under observational learning. Their weights during the experiment were maintained within ±10g of 80% of their ad lib weight. The apparatus was a standard Ralph Gerbrands operant conditioning chamber with a single lever. Borden's sweetened condensed milk diluted by an equal volume of water was used as the reinforcer. This was made available to the animal on a CRF schedule for lever pressing. All Ss were approximately 23 h food deprived at the start of each session. They had free access to water in their home cages throughout the experiment.

Experimental sessions were 30 min per day under each of the three procedures. A session consisted of a 15 min training period followed by a 15 min test period. The criterion for final performance was 50 or more responses during the test period. If the naive S began to respond reliably under the shaping or auto-shaping procedure, the test period was initiated at that point, rather than waiting until the training period had elapsed.

In the shaping procedure the animals were first dipper trained and were then differentially reinforced for successive approximations to the criterion response.

Auto-shaping consisted of a dipper presentation every 30 sec during the training period. These presentations were independent of the animal's behavior. Under both shaping procedures a 7½ W bulb mounted 2 in. above the dipper enclosure was lighted during the 4 sec dipper cycle. This bulb was also lighted under all procedures whenever a lever press response was made which produced the reinforcer.

In the observation procedure, the naive S was placed in the experimental chamber with a trained model for 15 min. They were separated by a clear Plexiglas partition which divided the test chamber in half, and did not permit the naive S to have access to the dipper or manipulandum. Only two model rats were used and these consistently made 75 or more responses during the training period. The models were also kept at approximately 80% of their ad lib weight. After the 15 min observational period, the model rat and the Plexiglas partition were removed.

Training was discontinued under any of the procedures if the animal failed to meet the criterion after 20 sessions.

RESULTS AND DISCUSSION

The number of test sessions to criterion is presented for each rat in Table 1, with the mean and median values being given for each group. An analysis of variance revealed that the only significant difference was between shaping and observational

Table 1
Number of Test Sessions to Criterion

Shaped		Auto-Shaped		Observational	
Ss No.	Sessions	Ss No.	Sessions	Ss No.	Sessions
1	3	9	7	19	6
2	5	10	5	20	11
3	6	11	2	21	6
4	5	12	2	22	11
5	2	13	3	23	7
6	3	14	5	24	5
7	4	15	5	25	14
8	6	16	7	26	12
		17	4	27	8
		18	20		
mean = 4.3		mean = 6.0		mean = 8.9	
median = 4.5		median = 5.0		median = 8.0	

learning. The F value here was significant beyond the .025 level. These results again indicate that shaping is a more effective procedure than observation, but they do show that rats can acquire an instrumental response where observation seems to be the principal factor involved in learning. It is interesting to note that the mean number of sessions under shaping of 4.3 in the present experiment closely approximates the mean of 4.1 under the same condition in the earlier Powell study. This is true even though different shapers were involved.

The present results also indicate that an auto-shaping procedure can be effectively employed for training rats. Nine of 10 animals exposed to this condition learned the lever press response. Even including the data for the S that did not learn, the results for auto-shaping were not significantly different from the results for the shaped animals. If we exclude the data for this one S, it would, of course, make the results for auto-shaping more similar to those for shaping. It would also produce an analysis of variance of the data for auto-shaping and observation with an F value significant at the .05 level. The efficacy of auto-shaping demonstrated here indicates that where economy of time and effort is a major consideration to the experimenter, this procedure would be the best to use of the three examined.

The animal which failed to learn under auto-shaping did not make one lever press response over the entire 20 sessions even though he fed reliably from the dipper. This animal was then shaped in one session. He emitted his first response after 7 min and subsequently made 70 responses in the next 15 min.

The relative superiority of shaping procedures with rats and observational procedures with cats as reported by John et al (1968) may very well be a species difference. Cats spend a great deal of their time observing things in their environment. Practically anything that moves will attract and hold their attention. This would appear to be one aspect of their predatory pattern of behavior. It might be anticipated that other predators would also show rapid acquisition of particular responses through observation.

Albino rats, on the other hand, have notoriously poor vision and do not attend to visual stimuli in the same manner that cats do. It is realized that many of the foregoing statements are based only on naturalistic observation, but nevertheless this seems to be a reasonable basis at present to account for the differences in observational learning between cats and albino rats.

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NOTE

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