tained similar results. That is, when ball-pulling produced programed consequences, rocking movements did not occur. Second, chlorpromazine blocked the stereotyped rocking movements during the periods when the alternative activity produced no programed consequences.

Finally, the data clearly show that reinforcement had stimulus properties. That is, when a free reinforcer was delivered during extinction of the ball-pulling response, immediate resumption of ball-pulling occurred (*10*). This effect was not changed as a function of the drugs used.

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5 February 1968

Observation Learning in Cats

Abstract. *In two experiments cats acquired a stimulus-controlled approach or avoidance response by observational or conventional shaping procedures. Observer cats acquired the avoidance response (hurdle jumping in response to a buzzer stimulus) significantly faster and made fewer errors than cats that were conventionally trained. Observer cats acquired the approach response (lever pressing for food in response to a light stimulus) with significantly fewer errors than cats that were conventionally trained. In some cases, observer cats committed one or no errors while reaching criterion.*

Electrophysiological studies in our laboratories have made it necessary to train many cats to perform conditioned approach and avoidance responses. Experimental schedules have sometimes been disrupted because of the slow acquisition of such responses or by the failure of some cats to reach criterion after extensive training. In the course of seeking more effective methods of rapidly and reliably training our animals to make discriminative responses, we designed two experiments to investigate the acquisition of stimulus-controlled approach and avoidance responses via an observational procedure. Each experiment required the observing animal to acquire and perform a response not previously in his repertoire, without overtly performing it during the observation period.

In the first experiment, 14 young adult cats were used. Six naive "observer" cats composed group 1, six naive "student" cats composed group 2, and two fully trained cats served as "teachers." The apparatus consisted of a standard operant conditioning cage. A lucite hurdle, 6 inches (15 cm) high, bisected the 24- by 24-inch shock-grid floor of the cage.

Each naive observer cat from group 1 was first placed in the training cage alone. A buzzer was presented for 15 seconds, and one foot shock was administered unless a hurdle jump had been performed. After one such "empathy" trial, the observer cat was placed in a small cage with a mesh front, directly behind the training cage. Although no attempt was made to coerce observation, the observer cat was in a position to watch a matched naive student cat from group 2 receive 20 conventional *training* trials of the conditioned avoidance response daily, followed by *performance* of the same number of trials by one of the fully trained teacher cats. This procedure was repeated daily until the student cat reached a criterion of 90 percent performance for 3 days in a row. The observer cat was then subjected to 20 training trials daily until he reached the same criterion. In three cases, observer cats began avoidance training before their matched controls reached criterion, because they had performed an avoidance response on their daily empathy trial.

Figure 1 compares the acquisition of the conditioned avoidance response by animals in these two groups. In five of the six pairs, the observer cat (solid circles) learned the conditioned avoidance response much more rapidly than the student cat (operant, open circles). One observer cat did not acquire the response faster than his group 2 control, although his initial performance was better. This cat became ill after 3 days of training and his schedule was interrupted for several days. It is particularly striking that two cats in group 1 immediately performed at high levels, requiring a total of only one and two shocks each to reach criterion. A two-tailed t-test comparing the total number of failures to perform on the part of the student and observer cats throughout the 6-day period was significant ($P < 0.001$).

In our second experiment, 22 young adult cats were used. Group 1 consisted of six naive observer cats. Two trained cats served as "lever press teachers." In order to establish social compatibility in the training cage, each naive cat shared a home cage with its teacher throughout the training period. An observer cat, together with its teacher, both deprived of food for 24 hours, were placed in a standard, operant conditioning cage. No barrier separated the two cats, and neither was restrained. During three observation sessions, the teacher cat performed approximately 30 approach responses daily, pressing a lever within 15 seconds after onset of a 5-cycle/sec flickering light. The lever was mounted in one wall of the cage, 7 inches above the floor and 3 inches to the left of a dipper, which delivered food. The exact number of trials presented to the teacher cat was limited by the observer cat's attentiveness or apparent readiness to perform. The number of teacher responses apparently observed was recorded, and an attempt was made to achieve daily observation of 30 trials. After the observation session, the teacher was removed from the training cage and approximately 30 test trials were presented to each naive observer cat. The number of test trials presented to observer cats during the first 3 days varied considerably, but they all received 30 test trials for the last 3 post-observation days.

To insure that a stimulus-controlled bar press is not somehow facilitated by the presence of two cats in the training cage or by any effects of exploration or familiarization per se, a second group of six cats (group 2) similarly observed a cage-mate receive food by

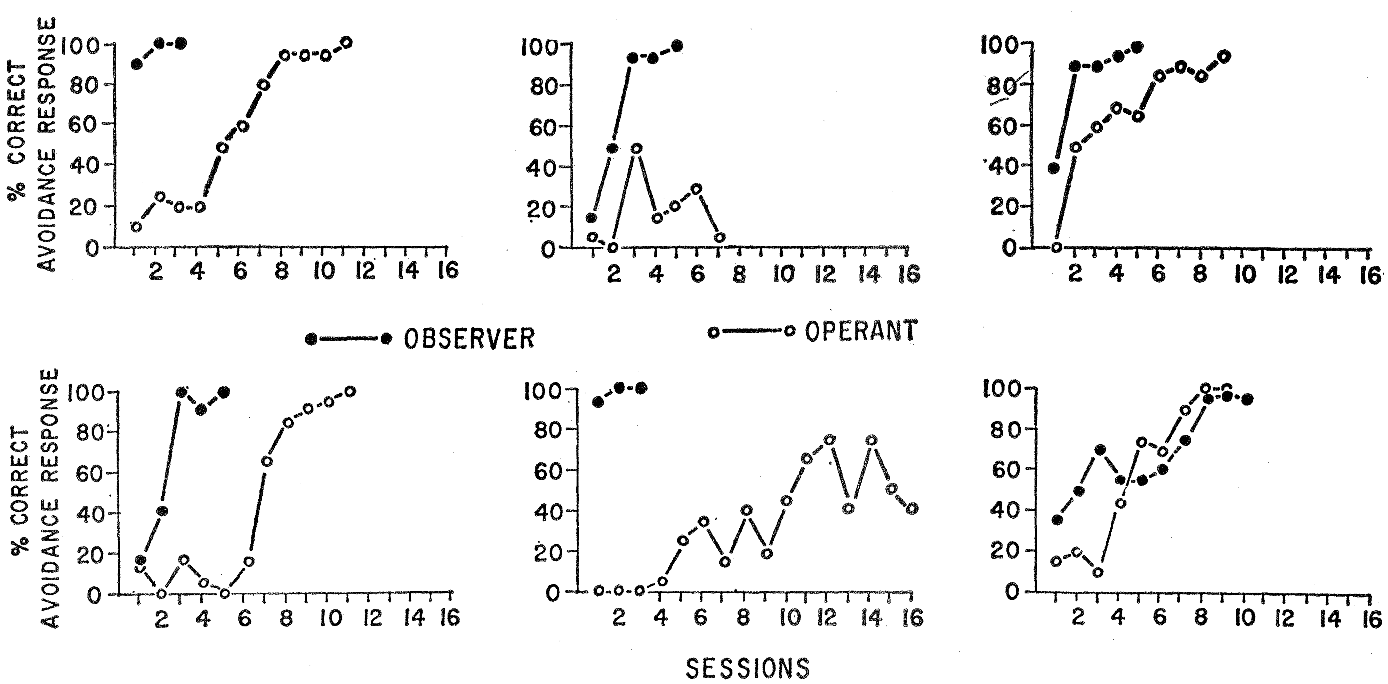

Fig. 1. Observation learning of an avoidance response (hurdle jump) to an auditory stimulus.

merely moving to the food dipper within 15 seconds after stimulus onset. The naive observers in this group watched 30 teacher responses each day for 3 days, and received 30 test trials daily for a total 6-day period. During these test trials, the observers were rewarded for lever pressing as well as for dipper approach.

Finally, in order to compare the standard operant acquisition of a stimulus-controlled lever press with that acquired by an observational procedure, a third group of six cats (group 3) was operantly "shaped" to press a lever for food in response to the flickering light. They received 30 trials daily for a period of 6 days. For this group, any effective depression of the lever, whether directly by paw, by elbow, or by oral manipulation, was considered a correct response. It should be noted that this is a broader definition of an acceptable response than was used with the observer cats, who were required to press the lever with their paws.

Figure 2 shows that the observer cats in group 1 (solid circles) acquired a discriminated lever-pressing response quickly, with four of the six cats reaching 90 percent correct performance by the third day. One of these cats performed at the 100 percent level on the first day, after observing only three teacher trials. A second cat reached 100 percent performance on the second day, after observing only 16 teacher trials. The mean number of trials observed by group 1 cats throughout the

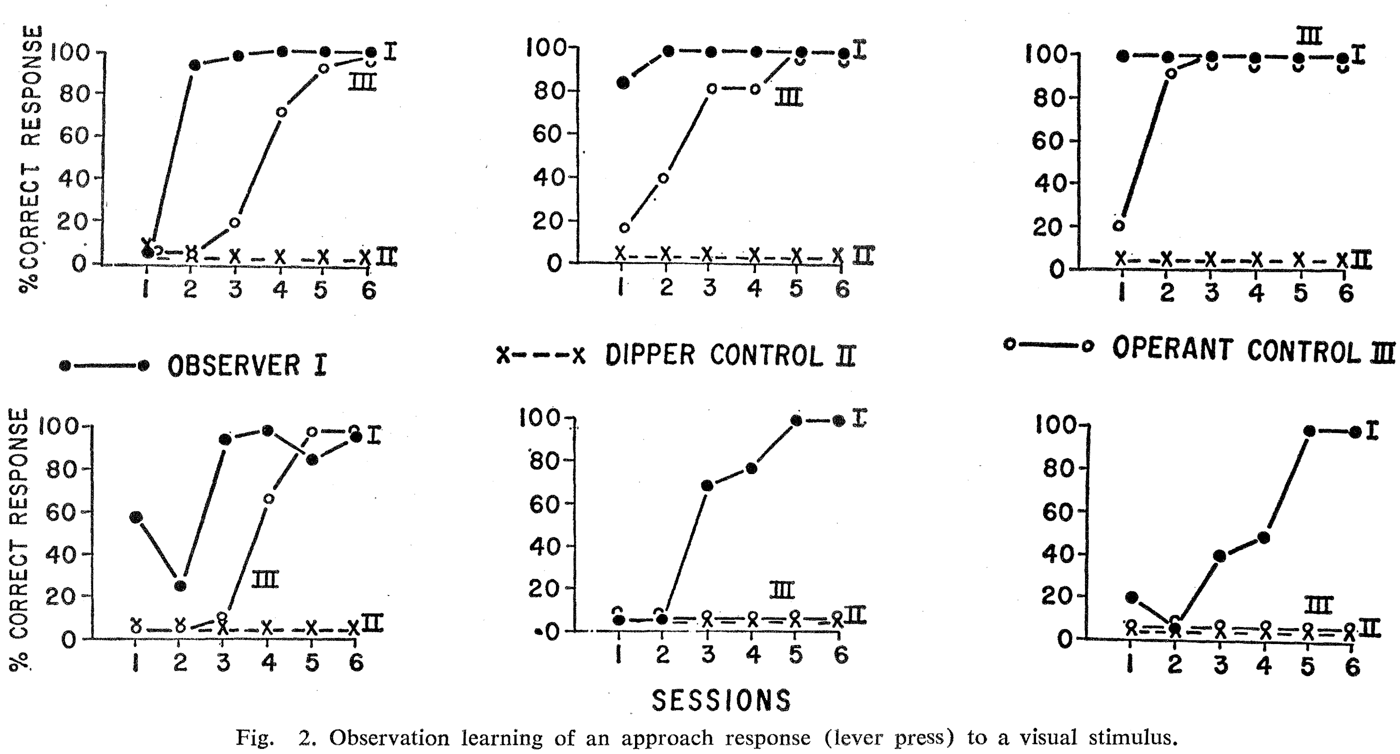

Fig. 2. Observation learning of an approach response (lever press) to a visual stimulus.

experiment was 32. These results are apparently attributable to observation of a lever-pressing response, rather than to any facilitation offered by the presence of two cats in the cage, since cats in group 2 (crosses) failed to press the lever even once during the entire experiment. The group 2 situation actually seems to inhibit lever-pressing, but as a function of observation learning. Conventionally shaped animals (group 3) acquired the lever-pressing response more slowly than the observers, with two animals failing to make a single lever press throughout the 6-day training period (open circles). A two-tailed t-test comparing group 1 and group 3 for total number of failures to perform during the 6-day period was significant ($P < 0.01$). Moreover, the level of stimulus discrimination was significantly higher in the observer group, as measured by the number of spontaneous lever presses performed by criterion animals in both groups. Specifically, on the sixth day, the operant group had a mean number of 89 intertrial lever presses, as compared to an observer mean of 28 intertrial presses.

It should be stressed that several of our observer cats, in both the approach and avoidance situations, performed correctly at the first opportunity and committed few or no errors while reaching criterion. Some of these animals behaved as though they "knew" what they were doing. Thus, learning mechanisms seem to exist which are capable of integrating diverse perceived stimuli into a meaningful whole, without direct reinforcement and without overt performance of the response.

Many physiological theories of learning assume that learning is a gradual phenomenon, requiring repeated reinforced performance of a response, and consisting of the establishment of neural pathways that connect brain regions receptive to the sensory stimulus to areas which mediate the behavioral response. Such learning theories have been derived from the facts of classical or instrumental conditioning. Yet, numerous experiments in latent learning (*1*) and observational or vicarious process learning (*2–5*) demonstrate that learning can take place without reinforcement and with little or no performance of the response which is required. Perhaps because of its theoretical significance, controversy has existed regarding the mediating mechanisms (*3, 4, 6, 7*) and reproducibility (*4, 5*) of observational learning. In part, this may be due to different definitions of observational learning which have led to a variety of experimental designs using different species.

Undoubtedly, conditioning techniques have been of great utility in the quantitative study of learning. Yet the impressive speed and efficiency of observational learning, contrasted with the potentially catastrophic slowness and need for repetition which often characterize conventional conditioning, suggest that the latter may well be a phenomenon of limited relevance, utilizing relatively unnatural mechanisms. Observational learning may be the primary method of acquiring language, ideas, and social habits in man, and such learning may also play an important role in the adaptation and survival of lower organisms (*7*). Thus, the behavioral and physiological study of more natural learning situations may be essential for adequate understanding of learning mechanisms.

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7 February 1968

2,5-Dimethoxy-4-Methyl-Amphetamine: New Hallucinogenic Drug

The report (*1*) on the effects of a hallucinogen, 2,5-dimethoxy-4-methyl-amphetamine (STP, or DOM), due to a number of methodological inadequacies can be accepted only as an interesting collection of observations and not as a definitive assessment.

That suggestion or expectation in a subject affects the outcome of an experiment is common knowledge, particularly where hallucinations are induced (for example, in sensory deprivation experiments). Snyder, Faillace, and Hollister state "subjects were told that they would receive a drug . . . presumably a hallucinogen . . . ." These instructions are somewhat more than a suggestion that hallucinations were to be expected. Hallucinogens have achieved great notoriety, and their psychological effects are widely known. It is probable that suggestion influenced the results ascribed to DOM.

The authors quote one subject who compared the supposed effects of DOM to a "halfway decent pot experience." Even minimal prior drug experience might have been an additional uncontrolled factor. The report points out that sensitization to the effects of DOM may be a result of previous drug experiences. Without an adequate control the effects of suggestion and of past drug use in producing DOM hallucinations cannot be determined.

The method of obtaining reports of symptoms is somewhat suspect. Self-reports and questionnaires in general are of dubious validity and reliability, and answers may be easily faked. The physiological signs reported are apparently objective enough, but cannot be presumed to be due solely to the effect of the drug and not to fatigue, stress, or the attention given to the subjects by the experimenters. The authors did not indicate whether reported deviations differed significantly from baseline measurements of healthy, normal persons. Quantitative estimates of the relative potencies of DOM, lysergic acid diethylamide (LSD), and mescaline are therefore unwarranted.

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22 January 1968