commanding, and as having a sense of hushed intimacy, while experimenters' voices under the imagination condition were described as businesslike, casual, conversational, brisk, alert, natural, prosaic, and rational.

Although the data were insufficient to permit detection of small effects, several other analyses of possible variables influencing the experimenters' performance were undertaken. It was hypothesized that the experimenter might carry out the role of hypnotist more effectively if he were being rewarded by a good performance from the subject, but comparisons did not support this hypothesis. Whether or not a subject successfully passed the first item did not affect the analysis of the judging. Subjects more easily hypnotized than others (judged by total score on the SHSS) might have performed better in the induction period and thus encouraged hypnotic behavior by the experimenter, but comparison of the results for experimenters testing the better subjects with those for experimenters testing the poorer ones showed no differences. It appears, then, that the significant identification of a hypnotic quality in the experimenters' voices by the judges can only be associated with the experimenters' having carried out a hypnotic induction procedure.

There are two possible interpretations of this finding, which are not mutually exclusive. The first is that going through an induction procedure gave the experimenters time to firmly establish themselves in the role of hypnotist and that this role carried over into the first test item. The second interpretation is that the experimenters, aware of the experimental hypotheses, unknowingly extended themselves more in the induction condition because of their expectancy that subjects would perform better in this condition and because of their wish to confirm the hypothesis. All the experimenters favor the first hypothesis, insofar as they can judge their own behavior, feeling that it was more natural to act like a hypnotist after "warming up" by way of the induction procedure, a sort of psychological "inertia." Regardless of which interpretation is correct, it is apparent that the experimenters were *not* consistent in their treatment of the subjects. Since the effects of this inconsistency or bias are confounded with treatment effects, it is not feasible to assess how much effect this bias had on the differences found between groups; but because the basic assumption of identical testing of the groups has been found to be false, the main experiment was repeated with a tape-recorded testing procedure.

Table 1. Judgments of whether a subject had been hypnotized.

Statistic	Judges						
	A	*B*	*C*	*D*	*E*	*F*	*G*
Total correct judgments among 13 comparisons*	9	10	9	10	10	9	7
P (1-tailed)	.13	.05	.13	.05	.05	.13	.50

* Total $\chi^2 = 31.602$; $df = 14$; $p < .005$.

Many psychologists have read of the importance of experimenter bias, but probably feel it is something a sophisticated experimenter (like themselves!) can avoid. Yet in this study a group of sophisticated experimenters, aware of the importance of testing all subjects identically, trying to do so, and knowing that their performance was being recorded for later judging, were nevertheless unable to treat all subjects identically. Nor were these experimenters aware that they had treated the two groups differently.

Subtle differential treatment of groups of subjects which are ostensibly being treated identically sets up demands with different characteristics for each group. The findings of this study thus have important methodological implications for all studies in which it is possible that the performances of the subjects may be affected by subtle demands and expectations (particularly true in hypnosis research), and insofar as the present results are validated by later studies it will become incumbent upon other experimenters either to eliminate such possible bias and demands, or to compensate for their effect in analyzing and interpreting their data.

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Strychnine: Its Facilitating Effect on the Solution of a Simple Oddity Problem by the Rat

Abstract. *The learning of a brightness discrimination, discrimination reversal, and a simple oddity problem by rats was facilitated when the rats were given injections of strychnine sulfate after daily training sessions. Control rats injected with saline made significantly more errors during training on the first two tasks and failed to solve the oddity problem.*

Primates and higher mammals have demonstrated the ability to solve oddity problems (*1*). However, the rat has been singularly unsuccessful in this task (*2*). In one previous study (*3*), rats were successful only after they were given extensive preliminary training with the absolute stimuli later combined into the oddity task. Since the oddity problem is difficult, any method which would facilitate this form of learning in the rat would be of obvious theoretical importance. Such enhancement would provide information concerning individual differences in learning ability and how these differences relate to the rate at which memory storage might occur.

Numerous studies (*4*) have shown that strains of rats genetically selected for maze-learning ability (*5*) perform consistently as bright or dull. However, in recent studies the differences observed were not obtained when subjects of the two strains were given injections of strychnine sulfate (*6*) or a similar

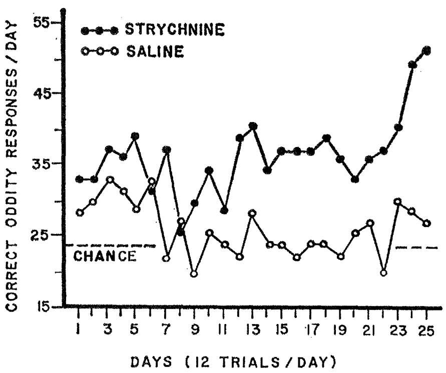

Fig. 1. Total number of correct responses on the oddity trials made by rats injected with strychnine and by the control rats over 300 trials. Abscissa: 25 daily blocks of 12 trials each.

compound (*7*) shortly after, or before, each training session. These studies clearly demonstrated the plausibility of modifying the rate at which demonstrably poor learners will acquire a given task. This rate may also be taken, inferentially, to indicate the rate at which a subject is able to store information in its permanent repertoire. Given this interpretation, the facilitative effect of strychnine has been interpreted as enhancement of consolidation of the memory trace (*6, 7*).

The results of the experiment reported here offer further support for the hypothesis that injections of strychnine given after training sessions facilitate consolidation of the memory trace. The results indicate that such injections facilitate the learning of a three-choice discrimination and discrimination reversal, and facilitate the solution of an oddity problem.

Twelve male Long-Evans hooded-rats, 110 to 120 days old, were first given 7 days (10 trials per day) of preliminary training in the discrimination apparatus. Only one of the three doors allowed access to the goal-box. The subjects were placed in the starting compartment and then the starting door was opened. Thirty seconds after the door was opened the subjects were given a 4-ma shock through a grid floor. After 2 days of this training, all of the subjects responded quickly to the opening of the starting door and required little or no shock before they reached the goal-box. Incorrect responses resulted in a 4-ma shock to the forepaws immediately in front of the incorrect doors. The position of the correct door was varied randomly. On days 1 and 2, the door leading to the goal-box was open, and the remaining doors were locked and covered with medium gray paper. On days 3 through 7 all of the doors were covered with gray. The door leading to the goal-box was progressively lowered. By day 6 all of the subjects had learned to avoid shock by finding the door which led to the goal-box. The interval between daily trials was 2 minutes on day 1 and was progressively decreased to 30 seconds by day 6. This interval remained unchanged throughout the remainder of the experiment. No injections were given during preliminary training.

On day 8 the subjects were divided equally into experimental and control groups and were given ten trials a day in the following stages. During the first stage, half of the subjects in each group were trained in the same discrimination apparatus, in which a black door was the correct door and two white doors were incorrect. The remaining subjects were trained to a correct white door and two incorrect black doors. Upon reaching a criterion of 19 errorless trials out of a total of 20 trials, the second stage, discrimination reversal, was introduced, the subjects of both groups being shifted to the reverse set of doors (correct door opposite in brightness to that to which the rat had already been trained) and trained to the same criterion.

Upon reaching the criterion on the reversal task, the six stimulus sets (according to brightness and position) were combined and presented randomly to the subjects twice a day. To solve the oddity problem, the subject had to choose the odd, correct door—that is, the position and absolute brightness of the correct door did not serve as a consistent cue for reaching the goal-box. Only the odd door was consistently correct. Each subject was given 12 such trials daily until 300 trials had been completed.

Thirty seconds after each daily block of trials, the experimental subjects were given an intraperitoneal injection of a 0.20 mg/ml solution of strychnine sulfate for each kilogram of body weight. This dosage was equivalent to 20 percent of the 50 percent convulsive dose and 12 percent of the 50 percent lethal dose. The control subjects were injected with a corresponding volume of physiological saline. A plus or minus score was recorded for each trial depending upon whether the subject's initial response was to the correct or to the two incorrect doors.

During the first stage of discrimination training, subjects given injections of strychnine made significantly fewer errors before they reached the criterion than subjects given saline (**$p < .01$, Mann-Whitney test**). Similarly, the subjects injected with strychnine made fewer errors than the controls during the second, reversal, stage ($p < .001$, Mann-Whitney test; see Table 1). It should be noted, however, that during the first stage there was a strong preference for black. Both experimental and control subjects which were trained to a black-correct door made significantly fewer errors before they reached the criterion ($p < .001$, Mann-Whitney test; see subjects 4, 5, 6, 10, 11, and 12 in Table 1).

During trials on the oddity problem, the number of correct responses made by subjects in the two groups (see Fig. 1) were pooled into ten blocks consisting of 30 trials each for the purpose of statistical analysis. An analysis of variance over blocks of trials showed that the subjects injected with strychnine made significantly ($p < .005$, *F*-test or variance ratio value) more correct responses than the control animals. The two groups differed at the beginning of oddity training and then made progressively fewer correct responses until, by day 8, the performance of both groups had deteriorated to chance level. This finding was related to the fact that all of the subjects, at the beginning of training on the oddity problem, tended to use the response which was correct during the reversal phase of training. Thus, it would appear that the strychnine subjects began solving the oddity problem by trial 8.

To determine whether the rate of changes over trial-blocks, made by the two groups, was different, the treatment by trial-blocks interaction was partitioned into the first through fifth or-

Table 1. Total number of errors made by experimental subjects (injected with strychnine) and control subjects (injected with saline) before reaching criterion during the first and second stages of discrimination training.

Subject	Strychnine	Subject	Saline
Stage 1. Brightness discrimination			
1	13	7	33
2	30	8	44
3	16	9	25
4	1	10	0
5	4	11	6
6	0	12	5
Stage 2. Discrimination reversal			
1	49	7	50
2	40	8	64
3	44	9	80
4	24	10	54
5	32	11	84
6	26	12	68

thogonal components. Of these components only the linear was significant ($p < .005$, F-test). This analysis showed that the linear function for the group injected with strychnine was positive—that is, these subjects made increasingly more correct responses. The control subjects, on the other hand, tended to perform at chance level ($p = .33$).

The finding that post-trial injections of strychnine sulfate facilitate the learning of a simple discrimination task and a discrimination reversal task is consistent with previous studies of drug effects upon discrimination learning (*8*) and supports the hypothesis that strychnine facilitates consolidation of the memory trace.

The finding that strychnine facilitated the solution of a simple oddity problem was also consistent with the hypothesis given above. However, since the oddity problem has been shown to be extremely difficult, the present findings would suggest that the rat's difficulty in solving such problems results from a memory storage process which is either slow or inefficient. Since oddity training was discontinued before the control subjects showed improvement in performance, the question remains as to whether strychnine enhanced the rate of memory storage or the learning capacity of the subjects. Earlier writers (*9*) have suggested that individual differences in learning capacity are dependent upon differences in rate of memory storage. Further, previous work suggests that the rate of efficiency of memory storage decreases as a function of the difficulty of the task to be learned (*10*). In the present situation, then, it might be supposed that strychnine increased the rate or efficiency of memory storage so that the storage rate exceeded the rate required to solve the difficult oddity problem. The question of rate or capacity, then, is reduced to the same term. This interpretation would require empirical demonstration since it is only inferred from earlier experiments (*9, 10*).

It is important to note that the subjects were injected *after* each daily block of trials. Therefore, the subjects were not influenced by the drug while in the apparatus. Thus, the injections should have influenced only the postulated consolidation process (*6, 7*), not motivation, perception, or other performance variables.

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Perceptual Preferences and Imprinting in Chicks

Abstract. *Whether initially exposed to a strikingly patterned model or to a plain white one, Vantress-cross chicks subsequently preferred to follow the striking model. Controls given the choice at the initial training age, and other (untrained) controls given the choice at the subsequent testing age, did not show a preference.*

We have previously argued (*1*) that imprinting represents the establishment of a perceptual preference and that the visual properties of the model used for imprinting will influence the strength of the bond between subject and model (see *2, 3*). These conclusions were based upon studies with Pekin ducklings (*Anas platyrhynchos*). We now present data from a comparable study with Vantress-cross chicks which confirm and extend our earlier conclusions.

The subjects consisted of 168 incubator-hatched domestic Vantress-cross chicks; they were kept in the dark, without food or water, in groups of three to ten. Forty-two birds were "trained" by individual exposure to a "plain" model (group P); another 42, to a "striking" model (group S). Two control groups of 42 birds each were not trained at all.

The models were life-size mallard duck decoys made of papier maché. The "plain" model was painted a flat white; the "striking" model was basically yellow, adorned with bilaterally symmetrical patches and stripes of bright red, green, blue, and brown—quite unlike the coloring of any species of fowl! The models were suspended over a flat-black table by wires from the arms of a "T," and were rotated according to a fixed schedule: 15 seconds' movement, 5 seconds' pause. The speed of movement was about 20 m/min, five complete circuits of the 1.5-m diameter taking 150 to 165 seconds. Each model carried a loudspeaker emitting recorded sounds. The entire apparatus [described in (*1*)] was acoustically isolated from the experimenter; observations were made through one-way glass.

At an early age (21 days and 12 hours to 22 days and 5 hours after the onset of incubation of the egg at 38.5° to 39.0°C), all chicks in groups P and S were individually exposed to either the plain or the striking model for a total of 20 minutes (training exposure). This age covers the peak of the "critical period" for the elicitation of the following-response, and, presumably, for imprinting (*1*). The model at this time emitted a continuous "Kom - kom - kom - kom" sound. Twenty-four hours later, each chick was exposed to both models simultaneously, each model being suspended from one arm of the "T"; no sounds accompanied this 20-minute test exposure. The controls, which had received no previous training exposure, were tested without any sound accompaniment. The chicks in control group 1 were tested at the training age (21 days and 12 hours to 22 days and 3 hours); those in control group 2, at the testing age (22 days and 12 hours to 23 days and 5 hours).

The observer, using electric timers, scored the duration of the following-response, which was defined as: (i) moving in the same direction as the model and within 30 cm of its tail or 10 cm of its sides, or (ii), after following the model up to the moment of

Table 1. Mean following scores during training and testing.

Group	Mean following score (seconds) To plain model	To striking model	*p* of chance difference
	At training age		
P	159.3		.604
S		202.8	
Control 1	29.9	32.2	.262
	At testing age		
P	98.0	137.0	.0024
S	72.2	156.5	.0003
Control 2	33.5	36.4	.272