drift in the Serpasil (IM) curve may indicate a fatigue effect or perhaps a partial extinction of the avoidance response due to the tranquilizing properties of this drug. The chlorpromazine (IM) run, which was characterized by an extremely rapid rate of release and recovery, was stopped after approximately 45 minutes because of the large number of shocks the animal was receiving. Each curve was obtained approximately 15 minutes after drug administration, and at least 2 weeks intervened between drug administrations. The curves shown here represent the second or third determination for each drug. Good reproducibility of each drug effect was obtained in all cases.

It is clear, then, from the data for three subjects, that the lever positioning response is easily conditioned and quite stable. The data from one subject indicates that this measure is at least partially sensitive to factors known to produce fatigue and tremor, and appears to differentiate among several classes of drugs. In addition to exploring the effects of other drugs on lever positioning, future research will focus on dose-response relations and drug interactions with such behavioral variables as the orientation and physical characteristics of the lever, the width of the "safe" region, and the probability of being shocked for incorrect positioning.

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Punishment Inhibits an Instrumental Response in Hooded Rats

Abstract. Punishment led to the cessation of a food-rewarded bar-pressing response in hooded rats deprived of food for 23 hours. The response remained inhibited for 2 weeks, and only one of four rats resumed responding when food deprivation was increased to 47 and 71 hours.

Recently Appel (*1*) reported an experiment in which punishment of squirrel monkeys led to the lasting cessation of a previously well-learned bar-pressing response. Appel concluded that punishment has a stronger and more lasting effect on monkeys than on rats or pigeons, contrasting his findings with those of a study by Estes (*2*). In Estes's study the most severe condition consisted of administering shocks to the rats for every bar press during the first hour of extinction; responding was diminished but did not cease. Estes's study has led to the widespread impression that punishment only temporarily reduces the tendency to make a response, especially when the response is necessary to fill a strong need (*3*). Using pigeons, Azrin (*4*) found that punishment contingent upon each response tended to reduce responding maintained by food reward. However, with continued punishment, response rate recovered to an extent dependent upon intensity of shock. Only when very severe shock was employed did responding cease. In view of Azrin's findings and those of Appel, we feel that Estes's failure to obtain cessation of responding may have been due to an insufficient number of punishment trials or insufficiently severe punishment to produce an aversive habit strong enough to predominate over the bar pressing which had been rewarded by food. To test whether bar pressing for a food reward can be eliminated in rats by punishment of the response, an approximate replication of Appel's experiment was performed with hooded rats.

After 22 hours of food deprivation, four hooded rats were trained in a Skinner box to associate the click of the food magazine with reinforcements of 0.05-g spherical pellets. The rats then learned to press a bar to obtain pellets, and they were maintained on continuous reinforcement for the remainder of the 1-hour session in which this took place. This was followed by 4 days of gradually lengthening fixed-interval schedules until the rats responded regularly on a 4-minute fixed-interval schedule. The rats were fed for an hour in their cages after each day's session, and water was continually available in the cages. After four 1-hour daily sessions on the 4-minute fixed-interval schedule, punishment was introduced on the fifth day with the same reinforcement schedule effective. The punishment was contingent upon each bar-pressing response. It consisted of 1-ma electric shocks delivered through the grid floor; the duration of shock was 100 msec for three of the rats and 500 msec for the fourth. Punishment was continued until no bar pressing occurred during a full 1-hour daily session. This criterion was reached in a maximum of 4 days and a maximum of 13 punishments. The rats were not run again for 14 days, during which the 1-hour-per-day feeding schedule was continued. Then, after 23 hours of food deprivation, the rats were placed in the box for 1 hour with the 4-minute fixed-interval schedule in effect. There was no punishment for responding. The rats were tested again the next day after 47 hours of deprivation, and after 71 hours of deprivation the following day.

Table 1. Summary of results of experiment in which hooded rats learned a response to obtain food, the response was inhibited by punishment, and the inhibition persisted when the punishment was removed and the rats were retested after being deprived of food for varying periods of time.

Rat No.	Responses during practice		Responses during punishment (total)	Reinforcements during punishment	Responses during retest after food deprivation of			Reinforcements during retest (total)
	Mean	On 4th day			23 hr	47 hr	71 hr	
1	425	420	6	4	1	425	345	23
2	626	594	10	9	0	0	2	2
3	285	141	13	3	32	0	4	7
4	547	429	2	2	0	1	0	1

As seen in Table 1, while the rats had pressed the bar on the average of 470 times an hour on the 4-minute fixed-interval reinforcement schedule, they required very few punishments to cease responding altogether—only two for rat No. 4 which had received 500-msec shocks. After 2 weeks of rest, they produced virtually no responses after 23 hours of deprivation even though the first response was rewarded by food. (The 32 responses by rat No. 3 consisted of bursts produced by leaning on the bar four times—the only responses during the hour.) The difference between the mean number of responses per hour before punishment and the mean number in the first hour 14 days after punishment is highly significant ($t = 5.7$; $p < .001$). In the absence of punishment, it is highly unlikely that responding would have virtually ceased in 14 days. Skinner (*5*) found that a learned operant endured for 4 years without intervening practice.

Even under conditions of severe food deprivation, three of the rats did not commence to press the bar for food reward. Under 47 and 71 hours deprivation the fourth rat began pressing at about his average rate before punishment. This seems to indicate that the bar-pressing habit was not removed by the punishment but was suppressed by a competing aversive tendency. In this rat, increased hunger apparently provided sufficient motivation to overcome the aversion. That his aversive habit may have been weaker and more easily overcome is suggested by the fact that of the three rats receiving 100-msec shocks, he received the fewest punishments.

While Estes's rats had not stopped pressing the bar after an hour of punishment for each response—an average of 81 punishments, in the present experiment no more than 13 punishments were necessary to stop bar pressing. Since moderate punishments were used in both this experiment and that of Estes, the difference may well be in the strains of rats. This is supported by the fact that differences in emotionality have been found among different strains of rats (*6*), and hooded rats learn the conditioned squeak reaction with shock as the unconditioned stimulus much more rapidly than do white rats (*7*). Estes's rats may also have ceased responding if punishment had been severe enough or continued long enough. On the basis of the present investigation it can be concluded that, as Appel found with squirrel monkeys, in hooded rats punishment continued until responding ceases has a marked and prolonged effect on the performance of the punished response. Whether the same effect can be obtained in other strains of rats needs further investigation. Our results also suggest that the effects of intensity of shock are worthy of further study.

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References

1. J. B. Appel, *Science* **133**, 36 (1961).
2. W. K. Estes, "An experimental study of punishment," *Psychol. Monographs No. 263* (1944).
3. J. Deese, *The Psychology of Learning* (McGraw-Hill, New York, 1952), pp. 116–125.
4. N. H. Azrin, *J. Exptl. Anal. Behavior* **3**, 123 (1960). For other important work on punishment, see N. H. Azrin, *ibid.* **2**, 301 (1959) and N. H. Azrin and W. C. Holz, *ibid.* **4**, 343 (1961).
5. B. F. Skinner, *Psychol. Rev.* **57**, 193 (1950).
6. G. Lindzey, D. T. Lykken, H. D. Winston, *J. Abnormal and Social Psychol.* **61**, 7 (1960).
7. M. J. Herbert, *J. Gen. Psychol.* **34**, 67 (1946).

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Mask for Controlling Visual Input in Cats

Abstract. Analysis of visual function frequently requires control of visual input. The present report describes a mask which can be used for achieving this control in a variety of experimental situations.

The particular study for which this mask was designed required a complete separation of the inputs to the two eyes (*1*). Transilluminated red and blue light panels were used, and corresponding color filters were placed in the mask to provide for stimulation of each eye by frequencies widely separated on the visual spectrum. Input to a single eye was effected by simply making both light sources identical in color.

Slight modification of the mask shown here would allow the experimenter to substitute different filters with ease, even during a single training session. It should not be difficult to mount lenses (for example, inverting prisms) in the mask instead of filters. This mask could also be used in various other situations such as pattern discrimination problems, studies of interocular transfer and hemispheric dominance, and open field tests. It is particularly easy to put on, and is worn for periods of an hour or longer with no signs of discomfort or distraction. It is therefore especially useful in frequently repeated training and testing situations of limited duration.

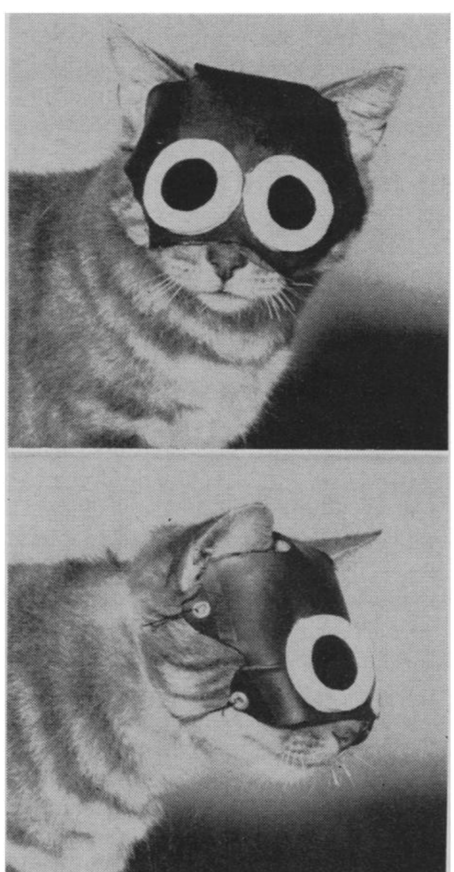

Fig. 1. Front and side views showing mask in position.

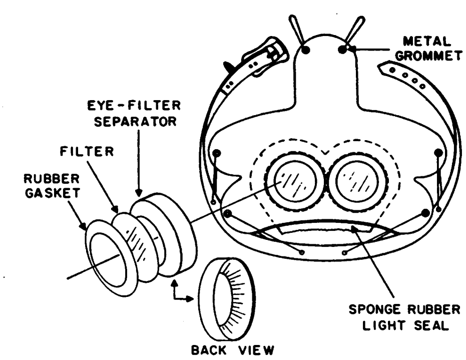

Fig. 2. Diagrammatic sketch of mask with color filters.

The photographs (Fig. 1) and the diagrammatic sketch (Fig. 2) are for the most part self-explanatory. The following suggestions, however, may prove helpful:

1) It is important that the apertures be made sufficiently large to allow for complete freedom of eye movement. If they are too small, eye irritation will result. The possibility of light leakage is precluded by the sponge rubber light seal surrounding the apertures.

2) Ample separation of the filters from the eyes is critical. We found the use of cork advantageous because of its light weight and the ease with which it can be shaped.

3) The vibrissae and hair around the eyes should be clipped short.

4) Animals adapt much more readily if they are allowed to wear the mask without filters for short periods on each of several days prior to the onset of training. It is especially helpful to let them eat with the mask on (*2*).

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References and Notes

1. A rubber mask which covered one eye of the experimental animal was designed some years ago by R. E. Myers. Its basic design was utilized in developing the mask described here.
2. This work was supported in part by grant M-3372 from National Institutes of Health, U.S. Public Health Service, and was completed during the tenure of the senior author as special research fellow, NIH (grant MF-4083).
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