ing in minnows need not be associated with the actual production of behaviorally significant and controllable sounds by the fish. On this basis they concluded that it has developed in response to mechanical and incidental sounds produced by the fish and the environment. From our data, however, it appears that many minnows produce "biological" sounds that can act as stimuli in reproductive activities, although the actual nature of the function of the sound has not been experimentally tested. The sound's association with reproductive activities, and its increase in rate with temperature elevation and injections of testosterone, seem to place the knocks and purrs of *Notropis analostanus* in the class of "biological" sounds. It might be hypothesized that the sound repulses under some conditions (as when two males of *N. analostanus* fight) and attracts under others (as when males of *Gila margarita* follow females to spawn). Hypotheses like these are numerous in the literature. Tavolga's experiments (*2*), which demonstrate that the grunts of the goby attract, and Moulton's playback (*3*) of sea robin calls to sea robins, which resulted in answering back, are the only experiments demonstrating the functions of sounds for fishes, except for occasional startle responses reported by various authors.

The sounds with frequency components as high as 11,000 cy/sec, produced by the cyprinid we studied, contain frequencies which are well fitted to the sensitive hearing ability of ostariophysid fishes. Perhaps this more sensitive hearing has been one of the causes for their success in the fresh waters of the world (over 70 percent of the primary fresh-water fishes of the world are ostariophysids). The statement by Moore and Newman (*9*) that natural noises in fresh waters are so great as to make unlikely the use of any sounds for attraction or repulsion of fish seems unjustified, or at least premature, although it may be true for the salmonids with which they worked. *Notropis analostanus* produces these sounds in fairly rapid and noisy water of small streams where they spawn, but, the sounds are made when the fish are close to each other.

The fresh-water minnows' "biological" sounds, their ease of handling, and the fact that they will go through normal behavior, especially spawning, in the laboratory, make these fish excellent subjects for the study of sound. This is less true for most marine fishes at this time.

HOWARD E. WINN
JOHN F. STOUT
Department of Zoology, University of Maryland, College Park

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Avoidance Conditioning and Alcohol Consumption in Rhesus Monkeys

Abstract. Measures of intake of water and of a solution of 20-percent alcohol in water were determined in rhesus monkeys before, during, and after avoidance training. Alcohol consumption increased during, and decreased after, avoidance sessions. Water intake remained the same or decreased during avoidance sessions and stayed at this level after the sessions.

Masserman and Yum (*1*) reported that cats often develop a definite preference for a solution of alcohol in milk, if they are given alcohol during a conflict conditioning procedure. Aside from these data, little is known about the effects of various conditioning procedures on alcohol intake.

In the experiment reported here we investigated the effects of an avoidance conditioning procedure (*2*) on the alcohol consumption of rhesus monkeys. Avoidance conditioning can cause gastrointestinal lesions, ulcers, and elevations in plasma levels of 17-hydroxycorticosteroids and norepinephrine in monkeys (*3*). Since analogous forms of behavioral stress are thought to play an important part in the development and maintenance of human addiction to alcohol, it seemed reasonable to inquire whether avoidance conditioning would have similar effects upon the monkey's alcohol consumption.

The subjects were two 6-lb rhesus monkeys (male and female) maintained in restraining chairs (*4*). Crackers and water were available to the animals for 1 hour each day.

The first, or "preavoidance," phase of the experiment lasted 43 days, during which time base-line measurements of alcohol and water intake were made. During each 23-hour period between feedings one of three conditions was in effect: (i) an alcohol bottle alone was present (20-percent solution of 95-percent grain alcohol in water); or (ii) a water bottle alone was present; or (iii) both an alcohol and a water bottle were present. The order of presentation of conditions on successive days was as follows: alcohol, alcohol-and-water, alcohol, water, alcohol, alcohol-and-water, water.

In the second, or "avoidance," phase, which lasted 54 days, the animals were trained to press a lever to avoid electric shocks. The response-shock and shock-shock intervals were gradually decreased over a period of approximately 2 weeks to final values of 1 second each. That is, the monkey was shocked once each second as long as it failed to press the lever, but every time it pressed the lever it postponed the electric shock for 1 second. If the animal pressed the lever more frequently than once each second

Table 1. Mean alcohol and water intake. Preav., the last 3 preavoidance weeks; Av., the last 3 avoidance weeks; Postav. I, the first 3 postavoidance weeks; and Postav. II, the last 3 postavoidance weeks. The following *t*-test comparisons were significant at the .05 level or beyond. Monkey No. 1: *a* compared with *b* or *c*, *d* with *b* or *c*, *a* with *d*; *e* with *f*, *g* or *h*; *i* with *j*, *j* with *l*, *m* with *n*, *o*, or *p*. Monkey No. 2: *a* compared with *b* or *c*, *d* with *b* or *c*; *i* with *j* or *k*, *l* with *j* or *k*.

Monkey No.	Intake (ml/23 hr)			
	Preav.	Av.	Postav. I	Postav. II
		Alcohol intake: only alcohol available		
M1	48.0 (*a*)	113.8 (*b*)	113.7 (*c*)	80.1 (*d*)
M2	53.9 (*a*)	85.6 (*b*)	70.6 (*c*)	57.2 (*d*)
		Water intake: only water available		
M1	295.9 (*e*)	115.2 (*f*)	114.0 (*g*)	119.8 (*h*)
M2	232.9 (*e*)	237.5 (*f*)	233.8 (*g*)	253.3 (*h*)
		Alcohol intake: alcohol and water available		
M1	27.5 (*i*)	49.8 (*j*)	39.2 (*k*)	22.4 (*l*)
M2	33.3 (*i*)	76.4 (*j*)	70.6 (*k*)	40.6 (*l*)
		Water intake: alcohol and water available		
M1	295.0 (*m*)	90.8 (*n*)	75.8 (*o*)	85.2 (*p*)
M2	212.5 (*m*)	208.6 (*n*)	217.7 (*o*)	204.3 (*p*)

it would never be shocked. After the daily feeding, 1 hour of avoidance training was alternated with 1 hour of rest for a total of 20 hours (10 hours of avoidance training plus 10 hours of rest). An uninterrupted 3-hour rest period followed the last avoidance session of the day. A red, flashing light in front of the animal was on during avoidance sessions and off during rest sessions. The same daily sequence of water, alcohol, and alcohol-water conditions was followed as during the preavoidance phase.

In the final, "postavoidance," phase, which lasted 56 days, the avoidance schedule was no longer in effect and the red, flashing light was never turned on.

Each animal's alcohol and water intake was recorded daily. Table 1 shows the mean alcohol and water intake, in milliliters per 23 hours, during (i) the last 3 preavoidance weeks; (ii) the last 3 avoidance weeks; (iii) the first 3 postavoidance weeks; and (iv) the last 3 postavoidance weeks. Transitions from one intake level to the next were gradual.

When alcohol solution alone was available (except for crackers and water during the feeding period), both animals drank considerably more alcohol per day when they had to press the lever to avoid shocks than during the preavoidance phase. Their alcohol intake remained at a high level for the first 3 postavoidance weeks. By the beginning of the last 3 postavoidance weeks monkey No. 2 had returned to its preavoidance level of alcohol consumption, whereas monkey No. 1 did not return completely to its initial level.

Two factors argue against the possibility that the elevation in alcohol intake during the avoidance phase reflected an increased caloric demand caused by the large amount of work performed by the animals to avoid shocks: (i) alcohol intake remained high during the first 3 postavoidance weeks, even though the monkeys rarely pressed the lever; and (ii) the amount of solid food eaten by the animals each day did not change during the avoidance phase.

When water was the only fluid available to the monkeys, monkey No. 2 did not change its water intake in any consistent fashion throughout the experiment. During the avoidance phase monkey No. 1 showed a surprising drop in water intake, which persisted through the postavoidance phase. Neither animal changed its water intake during the 1-hour feeding periods. Since water consumption either remained the same or decreased during the avoidance phase, the increase in alcohol consumption does not reflect a general elevation in fluid intake by the monkeys.

Even when both fluids were available to the monkeys, their alcohol consumption increased during the avoidance phase. It remained high throughout the first 3 postavoidance weeks but returned to approximately the preavoidance base line by the beginning of the final 3 postavoidance weeks. During the avoidance phase, animal No. 1 again drank less water than before, and it continued to do so thereafter. However, animal No. 2 showed no consistent changes in water intake.

Drinkometer records showed striking differences between the animals' preavoidance- and avoidance-phase drinking patterns. On an alcohol-only or an alcohol-and-water regimen the monkeys, before avoidance conditioning, drank alcohol at a fairly uniform rate throughout the day, but during the avoidance phase and the first 3 postavoidance weeks, they drank the major portion of their daily alcohol within the first 2 or 3 hours. Also, on an alcohol-and-water regimen the animals invariably drank 20 to 30 milliliters of water before taking any alcohol during the preavoidance phase, but during the avoidance phase they consumed large amounts of alcohol before drinking any water. Paralleling their return to the base-line levels, the subjects also returned to their preavoidance-phase drinking patterns by the beginning of the last 3 postavoidance weeks.

The appearance of the animals on both the alcohol-only and the alcohol-and-water regimens during the avoidance phase indicates that they became intoxicated within the first few hours after feeding. They seemed heavy-lidded and lethargic, failed to display the aggressive responses typical of rhesus monkeys, and were easily petted and handled. They were quite normal throughout the preavoidance period and during the avoidance phase of the water-only regimen. The monkeys displayed no appreciable changes in their rate or pattern of lever pressing on days when alcohol was available, although they did receive slightly fewer shocks on days when they had only water.

ROBERT CLARK
EDWIN POLISH

Department of Psychology, Walter Reed Army Institute of Research, Washington, D.C.

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An All-round Soil Percolator

Abstract. A description is given of a soil percolator which has been used both for instructional purposes and for microbiological research and has been found accurate and easy to operate. It could be used for aerobic and anaerobic experiments with a soil under water-saturated conditions.

For a diversity of studies within the field of soil microbiology the percolation technique has proved useful. In principle the technique consists in letting a solution of known composition filter through a soil column held in a tube of glass or other material and, by analysis of the percolated solution, describing the biological or nonbiological transformation it has undergone when in contact with the soil. Lees (*1*) introduced an automatic soil percolator, which was later modified (*2*), and Audus (*3*) described an apparatus which could be used for the measurement of soil-produced CO_2. More recently, Greenwood and Lees (*4*) obtained good results with a rocking respirometer, based on the percolation principle, which makes possible the measurement of both gas-exchange and reaction products from a soil sample. Theories on the percolation technique have been discussed by Lees (*2*).

Although the percolation technique might be a valuable tool in soil microbiology, percolation studies have not become very popular. This may be due mainly to the fact that percolation apparatus are not available commercially, and that the construction of one of the percolators described in the literature seems somewhat complicated.

A rather simple and inexpensive soil percolator which has proved useful and adequately accurate for nitrification and decomposition experiments is described below. The apparatus has also been used in laboratory exercises in microbiology at the University of Gothenburg for some years and has been found convenient and instructive as a means of demonstrating the microbiological processes in soil.

A mounted percolator is shown in Fig. 1. It consists of two identical round-bottomed Pyrex glass tubes *A* and *B* with a side outlet near the open end and a bottom outlet. Tube *B* is closed with a bored rubber stopper and connected with *A* by a glass tube and rubber tubing. The passage through this connection is controlled by a screw clip *C*. The second connection between *A* and *B* is through the three-way stopcock *D* and a long capillary glass tube *E* (bore 0.75 to 1.0 mm), all parts being assembled with not-too-heavy vacuum rubber tubings. Air pressure or suction is applied through the side outlet in *B*. The dimensions of the ap-