appear to support the idea that Charles River rats do tend to produce both physiological and behavioral data that are in close agreement with much of the published data in the area of hypothalamic hyperphagia. The hyperreactivity to taste stimuli found with lesioned Charles River rats appears to be the same as that reported by Corbit (1965) and Corbit & Stellar (1964). The fact that both lesioned and intact Ss showed high percentage suppression scores on the first test may be a function of a difference in quinine taste thresholds (or preference thresholds) for Charles River rats. Thus, while the absolute values found with Charles River rats may not correspond to those found by other authors, the ordinal relationship between lesioned and intact Ss appears identical.

No data appear to be available concerning the reactivity of the VMH-lesioned rat to touch. Data from a shock threshold study (Turner, Sechzer, & Liebelt, 1966) and several studies reporting reactivity to handling (e.g., Grossman, 1966; Marks, 1970) indicate that the VMH-lesioned S is probably more reactive to this class of stimuli than are intact Ss. These data were replicated with the Charles River rats.

The physiological data indicate that changes in body composition are almost exclusively in the form of additional fat in the lesioned S. While intact Ss of the Charles River strain have greater percentages of body fat than rats of other strains, the relationship between amounts of fat in lesioned and intact rats is the same as that reported by Han (1967) and Bates, Nauss, Hagman, & Mayer (1955). The FFA mobilization data appear to be the same in Charles River rats as those reported by Starr et al (1966) for Sprague-Dawley rats.

All the data collected in this study appear to demonstrate quite clearly that Charles River rats produce the same type of data following VMH lesions as do other strains of rats. In addition, a greater ease of handling, combined with a greater resistance to surgical stress, makes these Ss potentially more useful in some experimental situations than other strains. While it cannot be denied that there may be some differences between the Charles River and other strains of rats, this study has found differences only of degree and not of kind, suggesting that Jacobs's conclusions may not be correct.

REFERENCES

BATES, M. W., NAUSS, S. F., HAGMAN, N. C., & MAYER, J. Fat metabolism in three forms of experimental obesity: Body composition. *American Journal of Physiology*, 1955, 180, 301-303.

BROWN, G. E. The effects of septal and olfactory bulb lesions on stimulus reactivity. Unpublished doctoral dissertation, Texas Christian University, 1970.

CORBIT, J. D. Hyperphagic hyperreactivity to adulteration of drinking water with quinine HCl. *Journal of Comparative & Physiological Psychology*, 1965, 60, 123-124.

CORBIT, J. D., & STELLAR, E. Palatability, food intake and obesity in normal and hyperphagic rats. *Journal of Comparative & Physiological Psychology*, 1964, 58, 63-67.

GOLD, R. M. Hypothalamic hyperphagia: Males get just as fat as females. *Journal of Comparative & Physiological Psychology*, 1970, 71, 347-356.

GROSSMAN, S. P. The VMH: A center for affective reaction, satiety, or both. *Physiology & Behavior*, 1966, 1, 1-10.

HAN, P. W. Hypothalamic obesity in rats without hyperphagia. *Transactions of the New York Academy of Sciences*, 1967, 30, 229-243.

JACOBS, H. L. Discussion. *Annals of the New York Academy of Sciences*, 1969, 157, 1115-1116.

KENNEDY, G. C. The hypothalamic control of food intake in rats. *Proceedings of the Royal Society (London)*, B, 1950, 137, 535-548.

KENNEDY, G. C. The role of depot fat in the hypothalamic control of food intake in the rat. *Proceedings of the Royal Society (London)*, B, 1953, 140, 578-592.

LIPTON, J. M. Effects of high fat diets on caloric intake, body weight, and heat-escape responses in normal and hyperphagic rats. *Journal of Comparative & Physiological Psychology*, 1969, 68, 507-515.

MARKS, H. E. The effects of type of lesions and percentage body weight loss on measures of motivated behavior in rats with hypothalamic lesions. Unpublished doctoral dissertation, Texas Christian University, 1970.

STARR, S. E., RAWFORD, J. D., & HAESSLER, H. A. Dynamic of development of metabolic and compositional alterations of depot fat in hypothalamic obese rats. *Metabolism*, 1966, 15, 39-45.

THOMAS, D. W., & MAYER, J. Meal taking and regulation by normal and hypothalamic hyperphagic rats. *Journal of Comparative & Physiological Psychology*, 1968, 66, 642-653.

TURNER, S. G., SECHZER, J. A., & LIEBELT, R. H. Sensitivity to electric shock after ventromedial hypothalamic lesions. *Experimental Neurology*, 1967, 19, 236-244.

VALENSTEIN, E. S., & COX, V. C., & KAKOLEWSKI, J. W. Sex differences in hyperphagia and body weight following hypothalamic damage. *Annals of the New York Academy of Sciences*, 1969, 157, 1030-1048.

WALKER, D. W. The relationships among percentage body weight loss, circulating free fatty acids, and consummatory behavior. Doctoral dissertation, Texas Christian University, 1968.

Reflex "training" in frogs*

W. C. CORNING and R. LAHUE
University of Waterloo, Waterloo, Ont., Canada

It has been reported that repeated stimulation of a point on the dorsal skin of the frog will result in a specific enhancement of the wiping reflex of that zone. Tests of the specificity of this enhancement demonstrate that all areas of the skin and all wiping reflexes are sensitized when the animal is given reflex "training." Handling controls indicate that the increased nonspecific response rate may be due to factors other than learning.

When a point on the dorsal skin of intact or spinal frogs is stimulated, a wiping reflex is occasionally elicited. This reflex is specific to the stimulated zone: a point anterior to the scapula (anterior zone) results in a wiping by the ipsilateral front leg; stimulation of the skin posterior to the scapula (major zone) results in a wiping by the ipsilateral hind leg; and stimulation of the hind regions (caudal zone) elicits a wiping by the heel. It has been reported that repetitive stimulation of a specific point will result in an increased elicitation of the wiping reflex, an enhancement which is specific to the point stimulated and which is retained for over 20 days (Franzisket, 1963). These findings were reported for both intact and spinal animals (*Rana esculenta*) and have created considerable interest in

the frog as a "simple system" in which to do research on learning and memory mechanisms (Bullock & Quarton, 1966; Corning, 1968). We attempted to replicate this reflex training in *Rana pipiens*, paying particular attention to the specificity of the enhancement. Additionally, we included handling controls that would provide a clearer interpretation of the reflex modification.

METHOD

Stimulation procedures followed those detailed by Franzisket (1951, 1963). In 10 intact frogs, using the skin markings as a guide, a specific point on the dorsal surface of the major zone was stimulated 100 times per day for 11 days, with a 10-sec interval between stimulations. The specificity of the response modification was assessed by testing the reactivity of other sites on the first day of training and on the day after completion of training. These sites consisted of the contralateral homotopic point and two points in the ipsilateral and contralateral anterior zone. We refer to these tests as "reflex

*This research was supported by a faculty research fellowship granted to W. Corning by the University of Waterloo and by a National Research Council grant, APA 0351.

Table 1
Average Percent Response Levels During Specificity Tests in *Rana pipiens*

	Initial Levels		Final Levels	
	Mean	SD	Mean	SD
Reflex Specificity Tests				
Original "training" site	7.8	6.7	62.7	24.7
Contralateral homotopic point	8.9	10.4	61.7	24.0
Ipsilateral anterior zone	31.7	23.0	84.5	11.9
Contralateral anterior zone	26.7	18.6	68.0	7.3
Receptor Specificity Tests (12th Day)				
Original "training" site	72.1	23.5		
Point 1 cm anterior or posterior	77.6	16.9		

specificity tests," since they permitted comparative measures of the wiping reflex responsiveness in inactive limbs. After training, we also tested another point, 1 cm anterior or posterior to the stimulated point. These tests are considered "receptor specificity tests," as they measured the degree of specificity within the ipsilateral zone of the stimulated limb. The control group consisted of 10 animals that were used to provide an indication of any changes in reflex sensitivity that might occur as a result of laboratory housing and daily handling. The Ss of this group were presented 100 stimulations on the first day in the

same manner as previously described, and on the following 9 days were placed in the testing bowl for 15 min but were not stimulated. On the 11th day they were given another 100 stimulations at the same point.

RESULTS AND DISCUSSION

Our findings are summarized in Table 1 and in Fig. 1. From the data in Table 1, it can be seen that, in contrast to the findings of Franzisket, there was no specificity in the reflex enhancement. When one is "trained," all are enhanced. The same held true for receptor specificity tests; displacement of stimulation 1 cm within the zone was found to result in

an equal responsiveness. There was a statistically significant increase in the number of wipes when the 1st day is compared with the 11th day ($F = 25.62$; $p < .0001$). However, there was no statistically significant difference between the "trained" group and the handling controls ($F = .2412$). These results are portrayed in Fig. 1. While the mean percent response of the "trained" group was higher, the responsivity of the handling group also rose, suggesting that handling and laboratory housing can be confounding factors in the behavior modification. While the change in reflex level may have a true learning component, the techniques outlined by Franzisket have not clearly demonstrated this, since handling controls were not included in those studies. If sensitization is the critical factor, then the remarkable "retention" levels reported by Franzisket and also observed by us¹ can readily be explained. The continued maintenance and handling of frogs in the laboratory ensures a heightened reflex sensitivity.

The nonspecificity of the reflex enhancement would also tend to support a sensitization interpretation in *Rana pipiens*. It should be emphasized again, however, that Franzisket measured the specificity of enhancement and reports that reflex enhancement was restricted to the activated limb and to the point on the skin that was stimulated. The discrepancy between these observations and the present data may represent a species variation between *Rana pipiens* and *Rana esculenta*. If so, then it represents a rather remarkable difference in capacity for specificity in response modification between two similar species.

REFERENCES

- BULLOCK, T. H., & QUARTON, G. C. Simple systems for the study of learning mechanisms. *Neurosciences Research Bulletin*, 1966, 4, No. 2.
- CORNING, W. C. The study of brain functions: Strategies and techniques. In W. C. Corning and M. Balaban (Eds.), *The mind: Biological approaches to its function*. New York: Wiley, 1968.
- FRANZISKET, L. Characteristics of instinctive behavior and learning in reflex activity of the frog. *Animal Behaviour*, 1963, 11, 318-334.
- FRANZISKET, L. Gewohnheitsbildung und bedingte Reflexe bei Rückenmarksfroschen. *Zeitschrift für vergleichende Physiologie*, 1951, 33, 142-178.

NOTE

- "Retention" tests conducted 3 weeks later showed that there was little diminution in response levels in the "trained" group ($m = 56.6$). In fact, some animals showed almost perfect "retention" 80 days later without any intervening training.

Fig. 1. Average percent response of "trained" (clear bar) and control (striated bar) groups. Vertical lines on bars indicate standard deviations.