

# AN AGGRESSIVE REACTION EVOKED IN DOGS BY A PROLONGED UNILATERAL APPLICATION OF ACID

A. A Travina

The Laboratory of the Pathology of Higher Nervous Activity (Head - Corresponding Member AMN SSSR Professor K. S. Abuladze) of the L. P. Pavlov Physiology Section (Head-Active Member AMN SSSR P. S. Kupalov) of the AMN SSSR Institute of Experimental Medicine (Director-Corresponding Member AMN SSSR Professor D. A. Biryukov) Leningrad (Presented by Active Member AMN SSSR P. S. Kupalov)

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It has been shown in K. S. Abuladze's Laboratory that when a lengthy stimulation is applied to one side of the tongue, a stable residual (latent) excitatory zone is formed [2, 3, 4]. As a rule, the excitation is concentrated, and does not spread to centers on the opposite side.

We have investigated the effect of repeated applications of an acid stimulus to one side, the radiation of the excitation, and the development of a strongly aggressive response.

by stimulation of the left half of the tongue by decinormal hydrochloric acid for 30 seconds. Records were made of the salivary secretion on both parotid glands, which was recorded in scale divisions; the conditioned response was measured during a 20-second application of the conditioned stimulus alone, and the unconditioned response was measured 1 min after the onset of application of the unconditioned stimulus.

## RESULTS

### METHODS

The experiments were carried out on two dogs, Pepper and Tsiskari, both of which of the excitable type. Tsiskari showed a well-marked defensive reflex. Unilateral stimulation was applied to one side of the exposed portion of the tongue [1]. The conditioned stimulus was a metronome, which was presented for 20 seconds and reinforced

Table 1 shows the results of two experiments performed on January 6, 1955, and May 21, 1956, and it can be seen that in response to a metronome reinforced by stimulation of the left side of the tongue, a conditioned reflex occurs only on the left side. With repeated application of the stimuli, on the day of the experiment the unconditioned secretion on the left side was somewhat in-

TABLE 1. Results of Experiments on Dogs, Performed January 6, 1955, and May 21, 1956

Time	Interval (in min)	Conditioned stimulus	No of conditioned applications	Time lag (in sec)	Unconditioned stimulus	Parotid gland			
						left		right	
						conditioned secretion	unconditioned secretion	conditioned secretion	unconditioned secretion
Experiment of January 6, 1955. Dog Tsiskari.									
11 sec 10 min.	—	Metronome	20	20	HCl, N/10, on left side of tongue	6	130	0	30
11 » 14 »	4	»	21	20	»	8	137	0	20
11 » 18 »	4	»	22	20	» »	10	142	0	17
11 » 22 »	4	»	23	20	» »	11	145	0	15
Experiment of May 21, 1956. Dog Pepper.									
11 » 10 »	—	»	45	20	HCl, N/10 on left side of tongue	17	165	0	58
11 » 4 »	4	»	46	20	»	22	160	0	35
11 » 8 »	4	»	47	20	» »	20	160	0	37
11 » 22 »	4	»	48	20	» »	20	170	0	35

creased, while on the right it was decreased; there was no "intermediate" secretion.

The experiment was repeated on both dogs for four months, after which, in Pepper, in response to the conditioned stimulus of the metronome, a secretion appeared on the right side, i.e., on the side opposite to that which received the unconditioned stimulus. When the left side of the tongue was repeatedly stimulated, there was no reduction in the secretion on the right side, but it was actually increased.

There was an "intermediate" secretion from both sides. In Tsiskari, the same results were found, but during the experiment the animal moved about very restlessly, whimpered, snarled, and tried to bite the experimenter.

Table 2 shows typical results of two experiments made on June 10, 1955, and October 5, 1956.

Table 2 shows that now in both dogs the secretion frequently occurred not only on the left but also on the right side. When the unconditioned stimulus was repeatedly applied to the left side, secretion from the right side was not reduced, as in the previous experiments, but actually increased. Secretion occurred on both sides in between stimulations. In addition, Tsiskari behaved aggres-

sively. These results show that when unilateral stimulation with acid is prolonged, the excitation is irradiated.

When similar experiments were repeated on Tsiskari, the restlessness and aggressive behavior were enhanced. The dog bit the experimenter and the assistant who led him into the room. Frequently, when tied on a lead in a room, the dog became so excited as to break her lead and attack people she had never seen before. The aggressive reaction became so strong that it became necessary to discontinue the application of acid conditioned and unconditioned stimuli, and to feed the dog with a meat mixture, on the stand and then to develop feeding conditioned reflexes. When food stimuli were given, the dog became much quieter and when the experiment was repeated with conditioned and unconditioned food stimuli, the previous aggressive behavior disappeared completely.

Usually, when conditioned stimuli were applied and were reinforced on one side of the tongue only, the conditioned reflex developed only on that side. When unilateral unconditioned stimuli were applied, salivary secretion occurred chiefly on the same side, though there was also a small amount from the opposite side. Repetition of the unconditioned stimuli led to a decreased secretion on the opposite side. In this case, when the metronome

TABLE 2. Results Obtained on June 10, 1955, and October 5, 1956

Time	Conditioned stimulus	No of coincidences Time lag (in sec)	Uncon- ditioned stimulus	Parotid gland				Remarks
				left		right		
				con- ditioned secretion	uncon- ditioned secretion	con- ditioned secretion	uncon- ditioned secretion	
Experiment of May 10, 1955. Dog Tsiskari.								
11 sec. 30 min.	Metro- nome	234 20	HCl, N/10, on left side of tongue	8	170	0	50	Dog whimpered.
11 » 34 »	»	235 20	»	9	185	0	45	Dog growls and rushes about. When the collect- ing bulb is removed, dog at- tempts to bite.
				Intermediate secretion				
11 » 38 »	»	236 20	» »	10	195	5	70	
				Intermediate secretion				
11 » 42 »	»	237 20	» »	15	185	6	80	
Experiment of October 5, 1956. Dog Pepper.								
11 » 25 »	»	254 20	HCl, N/10, on left side of tongue	20	155	7	40	—
11 » 29 »	»	258 20	»	28	165	10	55	—
				Intermediate secretion				
11 » 33 »	»	259 20	» »	25	170	10	70	—
				Intermediate secretion				
11 » 37 »	»	260 20	» »	27	180	8	85	—

was applied and was reinforced by stimulation of the left half of the tongue, secretion occurred not only on the left but also on the right side; when the unconditioned stimulus was applied repeatedly to the left side, there was no reduction in the secretion from the right side, which actually increased. Also, there was some salivary secretion from both sides occurred between stimuli.

Therefore, in this experiment, when unilateral acid stimuli were applied, in the balance between the basic nervous processes in the acid center were disturbed and the excitation irradiated. Probably the excitation evoked by the acid stimulus on the tongue was so powerful that inhibition was ineffectual against it. It appeared that in the excited animals, prolonged unilateral acid stimuli cause a breakdown in the inhibitory process which restrains the localized excitation at the acid center; this breakdown in turn leads to irradiation of the excitation, not only in the acid center of the ipsilateral side but also in that of the opposite side. When repeated unilateral stimuli are applied to dogs of the excitable type having well-developed defensive reflexes, irradiation of the excitation includes not only the secretory but also the motor links of the complex unconditioned defensive center. The result is a very aggressive response. In these cases, when the acid stimuli are discontinued and the dog is fed on the stand and conditioned feeding reflexes are developed, the aggressive behavior ceases. In this way, the development of a zone of excitation in the feeding center facilitates inhibition of the increased excitability in the defen-

sive center. A strong region of excitation in an antagonist center inhibits the aggressive reaction center by negative induction.

#### SUMMARY

Prolonged unilateral application of acid to the tongue by K. S. Abuladze's method to two dogs of the excitable type produced an irradiation of the excitation, due to breakdown of the inhibitory process, so that the focus of the acid center remained strongly excited. The excitation spread to the acid center of the opposite side. In dogs with a strongly developed defensive reflex, the excitation irradiated from the acid center to the motor defensive center, and so provoked an aggressive reaction. The latter could be inhibited by the creation of a strong focus of excitation in the food center.

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\*Original Russian pagination. See C. B. Translation.