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CERTAIN PECULIARITIES OF THE UNCONDITIONED SALIVARY REFLEX IN DOGS AFTER CONDITIONED LIGHT AND SOUND STIMULI OF VARIOUS STRENGTHS

by

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UNEDITED ROUGH DRAFT TRANSLATION

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ABSTRACT: The fact that conditioned stimuli influence the course of unconditioned secretion is well known. It has been customary to explain the difference in the course of unconditioned secretion after application of so-called strong and weak conditioned stimuli in terms of premises of the law of strength, taking into account only the physical intensity of the conditioned stimuli. Research attention has not yet been timed to the influence of signal modality on the course of unconditioned secretion. When sound stimuli are applied the excitation and inhibition processes are concentrated rapidly, but slowly when visual stimuli are used. These differences in neurodynamics as functions of the modality of the conditioned stimulus permit the assumption that they may also appear in the manner in which conditioned signals influence the course of the unconditioned salivary response. This paper is devoted to clarification of this question. Experiments on three dogs are described and results indicate that unconditioned secretion begins at a higher level after the sound signal than the light signal. English translation: 9 pages.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

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CERTAIN PECULIARITIES OF THE UNCONDITIONED SALIVARY REFLEX IN DOGS AFTER CONDITIONED LIGHT AND SOUND STIMULI OF VARIOUS STRENGTHS

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The fact that conditioned stimuli influence the course of unconditioned secretion is well known (Ganitkevich [3], Klochkov [4], Kostenetskaya [5], Pavlova [8], Pavlovskaya et al. [9], Petrovskiy and Fedotov [10], Stozharov [12], Fedorov [13], Yaroslavtseva [14] and others).

It is customary to explain the difference in the course of unconditioned secretion after application of so-called strong and weak conditioned stimuli in terms of the premises of the law of strength, taking into account only the physical intensity of the conditioned stimulus. The attention of researchers has not yet been turned to the influence of signal modality on the course of unconditioned secretion.

At the same time, there is reason to suppose that this factor may be of importance. In recent years, a number of reports have demonstrated singularities in the movement of nervous processes in the auditory and visual analyzers of dogs (Adrianov and Mering [1], Popova [11]). When simple positive and differentiated sound stimuli are applied, the excitation and inhibition processes are concentrated quite quickly, but slowly when the stimuli are visual (Adrianov and Mering [1]). Phenomena of irradiation of nervous processes from the auditory analyzer to the visual analyzer are noted against the background of stable conditioned reflexes, while it has not been possible to detect the inverse irradiation from the visual to the auditory analyzer (Adrianov and Popova [2]). These authors take the position that the data obtained cannot be accounted for solely in terms of the varying strength ratios of the conditioned signals or peculiarities of the type of higher nervous activity in the animal, but that various structural peculiarities of the auditory and visual analyzers are in operation here.

These differences in neurodynamics as functions of the modality of the conditioned stimulus permit the assumption that they may also appear in the manner in which conditioned signals influence the course of the unconditioned salivary response. The present paper is devoted to clarification of this question.

METHOD

Three dogs in which the classical salivary conditioned reflexes to simple sound and light stimuli had been developed were used in the experiments.

Dogs Urs and Lika: positive sound stimulus – 2000-hz tone 74 db above the human audibility threshold, from Alvar photophono stimulator; positive light stimulus – a bright screen situated at a distance of 1 m from the muzzle of the dog; screen illuminance 290 luxes.

Dog Bobik: positive auditory conditioned stimulus – 56-db bell; light stimulus – bright screen at a distance of 1 m from the dog's muzzle; screen illuminance 104 luxes.

Duration of conditioned stimuli 25 sec, including 15 sec isolated action; interval between applications 2-4 minutes. Reinforcement 40 g of powdered sugar mixed with finely chopped piece of meat weighing 5 g (Urs, Lika), or 40 g of bone-sugar powder (Bobik).

In the course of the experimental day, 6-7 conditioned stimuli were applied to each dog. The unconditioned secretion was recorded at 10-second intervals for 60-90 sec following administration of the food.

For all dogs, the data taken for analysis refer to the period of stabilization of the conditioned-secretion value and its latent period. Those combinations preceded in the experiment by differentiation stimuli were excluded from the calculation. Further, we did not include secretion after stimuli administered first and last in the experimental sequence. A total of 262 measurements of unconditioned secretion were used for reduction after reinforcement of the conditioned auditory stimulus and 257 after reinforcement of the light stimulus.

For comparison of the physical strengths of the light and sound conditioned stimuli, we made an approximate conversion of their energies into specific powers expressed in watts per square centimeter (Koshkin and Shirkevich [6]). The following figures were obtained.

For Urs and Lika: an illuminance of 290 luxes corresponds to a specific power of $4.495 \cdot 10^{-11}$ watt/cm^2; sound volume 74 db higher than 10^{-9} watt/cm^2, i.e., the physical strength of the sound was almost 50 times that of the light.

For Bobik: an illuminance of 104 luxes, which corresponds to a specific power of $1.612 \cdot 10^{-11}$ watt/cm^2. The specific-power value for 56 db is between 10^{-10} and 10^{-11} watt/cm^2, i.e., the physical strength of the sound was approximately five times greater than that of the light.

RESULTS

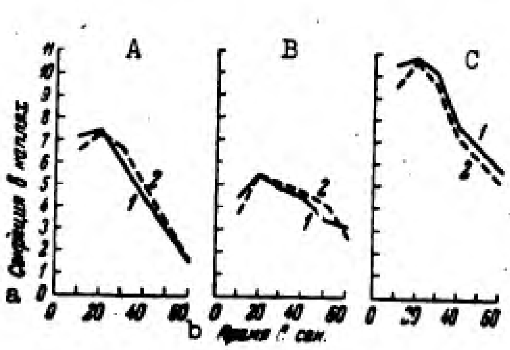
The results of statistical reduction of the unconditioned-secretion variational series are shown in the table. It indicates for each stimulus the number of secretion measurements n; the arithmetic mean values M were calculated for each 10-second period, together with the

Unconditioned-Secretion Variational-Series Characteristics for 10-sec Intervals

1 Кличка собаки	Характеристики вариационных рядов 2	3 Раздражитель	4 Время в секундах 10	20	30	40	50	60
5 Урс	n	6 звук	67	67	67	67	67	64
		7 свет	92	92	92	92	92	90
	M	звук	7,12	7,43	6,04	4,55	2,94	1,75
		свет	6,51	7,36	6,66	4,90	3,21	1,82
	$m \pm$	звук	0,21	0,12	0,19	0,24	0,13	0,19
		свет	0,16	0,14	0,20	0,33	0,21	0,14
	T		>2	>2	>2	<2	<2	<2
	P		<5%	<5%	<5%	—	—	—
8 Лика	n	звук	104	104	104	104	102	97
		свет	84	84	84	84	83	82
	M	звук	4,31	5,42	4,91	4,54	3,88	3,00
		свет	3,73	5,29	5,0	4,75	4,14	2,60
	$m \pm$	звук	0,19	0,19	0,16	0,16	0,15	0,18
		свет	0,21	0,18	0,15	0,19	0,17	0,18
	T		>2	<2	<2	<2	<2	<2
	P		<5%	—	—	—	—	—
9 Бобик	n	звук	91	91	91	91	91	91
		свет	81	81	81	81	81	77
	M	звук	10,69	10,90	10,12	7,78	6,65	5,77
		свет	9,38	10,88	9,86	7,39	6,39	5,25
	$m \pm$	звук	0,17	0,18	0,20	0,23	0,23	0,28
		свет	0,25	0,26	0,23	0,24	0,28	0,30
	T		>2	<2	<2	<2	<2	<2
	P		<1%	—	—	—	—	—

1) Dog; 2) characteristics of variational series; 3) stimulus; 4) time in seconds; 5) Urs; 6) sound; 7) light; 8) Lika; 9) Bobik.

average errors m of the arithmetic mean; the measure of accuracy T was determined and, if the difference was confirmed to be significant, the probability of error P. For greater ease of inspection, the figure shows the arithmetic-mean curves for each dog.



Unconditioned secretion following conditioned sound and light stimuli; 1) level of unconditioned secretion after conditioned sound stimulus; 2) after light stimulus. A) Dog Urs; B) Lika; C) Bobik. a) Secretion in drops; b) time in seconds.

Urs (A in figure). Unconditioned secretion begins at a higher level after the sound signal than after the light signal. The difference M amounts to 0.61 drop, and the significance of this difference is confirmed statistically at an error probability smaller than 5%. The secretion maximum occurs on the second ten-second period, and is followed by a steep descent of the curve. On the third ten-second segment, secretion in response to light becomes heavier than after a sound stimulus. In this dog, the difference M is significant for the first three ten-second periods of secretion with an error probability smaller than 5%.

Lika (B in figure). The same general relationships are observed as in the case of Urs, but the absolute level of unconditioned secretion is lower and the drop in level takes place more gradually. The difference M is confirmed statistically for the first ten seconds (0.58 drop) with $P < 5\%$.

Bobik (C in figure). In this dog, the absolute level is highest. Unconditioned secretion remains at a lower level over the entire 60 seconds following light than following sound. The difference M over the first 10 sec amounts to 1.33 drops with $P < 1\%$.

The following observations were made for all three dogs: 1) in all cases, the secretion maximum falls into the second ten seconds; 2) the difference in the course of the unconditioned reaction is statistically confirmed for the first 10 sec; secretion following sound begins at a higher level than that following light.

DISCUSSION

V.V. Rikman (unpublished experiments, cited from F.P. Mayorov [7]) and A.M. Pavlova [8] found that after weak conditioned stimuli, the unconditioned salivary reflex is stronger than after strong signals. However, V.V. Petrovskiy and Yu.P. Fedotov [10], V.K. Fedorov [13] and

A.A. Pavlovskaya et al. [9] found that the relationships between the strength of the conditioned stimulus and the nature of the change in unconditioned secretion after the signal depend on individual peculiarities of the animal's nervous system. This apparent contradiction might also be explained by methodical errors of the experiments. Thus, V.K. Fedorov [13] writes: "The numerical data (concerning the influence of the conditioned stimulus on unconditioned secretion — L.A.) are not highly demonstrative, and in some cases the changes that we reported are minuscule." For this reason, it is difficult to draw reliable conclusions without statistical verification. Where small numbers of observations were used, random fluctuations may have made it impossible to perceive the true picture. And how large these fluctuations are can be seen from the following example: for the dog Bobik, the unconditioned secretion was higher in the first 10 sec than in the second in 10 cases out of 81, and the same in 14 cases. Nevertheless, these are random deviations that are smoothed out by the general relationship if the number of observations is made large enough.

Simple comparison of the arithmetic means (which are particularly subject to error when the number of observations is small) does not lead us to reliable conclusions. Example: A.M. Pavlova [8] reports two unconditioned-secretion variational series — after a strong conditioned stimulus and after a weak one. First series: 61, 62, 65, 67, 68, 69, 70, 71, 71, 74. The M of the series, according to the author, is 68.2, although in fact $M = 68.0$. Second series: 69, 71, 78, 70, 67, 77, 67, 66, 71, 75, 73. For some reason or other, $M = 72.4$ is given, although for this series $M = 71.27$. The author draws her conclusions on the basis of simple comparison of the means. We have calculated average errors of the arithmetic means for these series, and they are: for the first series ± 1.19, for the second ± 1.27. Here the measure of accuracy

$T < 2$; the author's conclusions were not confirmed statistically and the influence of accident is strong in these series.

Very often, authors do not report the numbers of observations or arithmetic means at all, and this also casts doubt on the correctness of their conclusions. It appears to us that the question as to the influence of strong and weak conditioned stimuli on the course of unconditioned secretion cannot yet be regarded as solved.

In our study, the ratios between the physical strengths of the sound and light were different. Thus, on the basis of specific power, the light stimulus for Bobik was approximately one-fifth as strong as the sound stimulus, while for Urs and Lika, the sound was almost 50 times stronger than the light. The sound stimulus for Bobik was approximately 10 times stronger than for Urs and Lika; the light stimulus for Bobik was one-third as strong as for Urs and Lika. Nevertheless, the different power relationships between the signals have no major influence on the dynamics of unconditioned secretion: we observe the same relationship in all three dogs, i.e., a higher level of unconditioned secretion during the first 10 sec after sound than after light. Thus, the modality of the signal is found to be more substantial in this respect than its strength, something that may be attributed with good probability to functional peculiarities of the auditory and visual analyzers.

CONCLUSIONS

1. Positive conditioned sound and light stimuli influence the course of unconditioned salivation during the first ten seconds after reinforcement.

2. After a positive conditioned sound stimulus, unconditioned secretion begins at a higher level than it does after a corresponding light stimulus. This difference is statistically certain.

3. Signal modality has a more substantial influence on the course of unconditioned secretion than does signal strength.

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