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VESTIBULAR REACTIONS TO LONG-TERM CALORIC STIMULATION  
OF THE RABBIT LABYRINTH

G. I. Gorgiladze

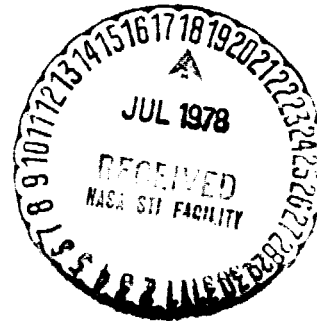
(NASA-TM-75528) VESTIBULAR REACTIONS TO  
LONG-TERM CALORIC STIMULATION OF THE RABBIT  
LABYRINTH (National Aeronautics and Space  
Administration) 7 p HC A02/MF A01 CSCL 06S

N78-27735

Unclas  
23397

G3/51

Translation of: "Vestibulyarnyye reaktsii  
na dlitel'noye kaloricheskoye razdrazheniye  
labirintov u krolika", Zhurnal Vysshey Nervnoy  
Deyatel'nosti, Vol. 28, No. 1, (January-February), 1978,  
pp. 192-194.



1. Report No. NASA. TM-75528		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle VESTIBULAR REACTIONS TO LONG-TERM CALORIC STIMULATION OF THE RABBIT LABYRINTH				5. Report Date July 1978	
				6. Performing Organization Code	
7. Author(s) G. I. Gorgiladze				8. Performing Organization Report No.	
				10. Work Unit No.	
9. Performing Organization Name and Address .SCITRAN Box 5456 Santa Barbara, CA 93108				11. Contract or Grant No. NASw-2791	
				13. Type of Report and Period Covered Translation	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546				14. Sponsoring Agency Code	
15. Supplementary Notes Translation of: "Vestibulyarnye reaktsii na dlitel'noye kalorigheskoye razdrazheniye labirintov u krolika", Zhurnal Vysshey Nervnoy Deyatel'nosti, Vol. 28, No. 1, (January-February), 1978, pp. 192-194.					
16. Abstract  Long-term, periodically repeated caloric stimulation of the labyrinth receptors of the internal ear was studied on eight rabbits with immobilized heads. Warm (20 °C) water was used as a stimulus in a dose of 40 ml per min injected into the auditory meatus.					
17. Key Words (Selected by Author(s))			18. Distribution Statement  Unclassified - Unlimited		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 7	22.

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G. I. Gorgiladze

When there is periodically repeated stimulation of the labyrinth receptors, specifically of the semi-circular canals, the vestibular reactions change substantially. The basic indication of this is their attenuation as a result of the development of a central process of habituation [2, 3, 7]. /192\*

Besides repeated and relatively short-term stimulation, the semi-circular canals can be subjected to more or less long-term effects of a stimulus under certain conditions.

However, the use of long-term accelerations are limited intrinsically by the technical characteristics of rotating laboratory apparatus. Moreover the caloric method of stimulation makes it possible to subject the semi-circular canals to stimulation for practically any period of time.

In the present article the results of investigations of vestibular reactions to long-term caloric stimulation of the labyrinth are reported.

Experiments were performed on eight mature rabbits. The head of each animal was immobilized by a head holder so that the angle of inclination between the oral aperture and the horizontal plane was from 45° to 55° when the head was in a thrown-back position. In this case the horizontal semi-circular canals were placed in an optimum position for calorific stimulation. Calorific stimulation of the

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\*Numbers in the margins indicate pagination in the original foreign text.

labyrinths was carried out with water at 20 °C with the help of a special device [4]. The plan of the experiment was as follows: to begin with, both labyrinths were alternately calorized once by brief-duration test runs (5 ml of water for 2 seconds). Next one of the labyrinths was subjected to many hours of continuous calorization, during which 40 ml of water per minute flowed through the auditory meatus. Electronystagmograms were run off according to a previously described method and analyzed on a M-220A computer by means of a specially prepared program [3]. EEG recordings were made by introducing point electrodes into the parietal and occipital regions of the cortex. Arterial pressure was measured in the femoral artery; the unit for recording respiration was mounted on the abdomen of the animal. All data were recorded on the so-called mingograph manufactured by the Swedish firm Elma-Schönander.

In the case of the long-term calorization of the labyrinths with water at 20 °C nystagmus was observed after an incubation period of 2.5 to 3.5 seconds (from the beginning of the calorization until the first onset of nystagmus). The frequency of the nystagmus rapidly increased and after 40 to 50 seconds it reached a maximum of  $5.0 \pm 0.7$  beats/sec, after which it decreased. The greatest reduction was noted during the first 30 minutes, the first level of significance being reached by the tenth minute ( $P = 0.05$ ). Further decrease in the reaction was noticeably slowed down. After eight hours of continuous calorization, there were  $1.25 \pm 0.1$  beats/sec (Figure 1). /193

The minimum duration of the slow phase when the frequency of the nystagmus was maximum was  $0.09 \pm 0.02$  seconds. After 40 minutes of continuous calorization it increased by a factor of 2.7, and at the end of the experiment it reached  $0.66 \pm 0.12$  seconds. The minimum duration of the rapid phase was  $0.045 \pm 0.008$  seconds. It increased by a factor of almost 2, and at the end of the experiment, it amounted to  $0.143 \pm 0.03$  seconds (Figure 2).

In contrast to the parameters mentioned above, the amplitude of the nystagmus shocks changed differently for the different animals. In the case of six animals it was reduced on the average from 193.5

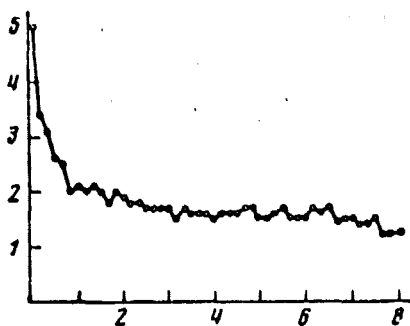


Figure 1

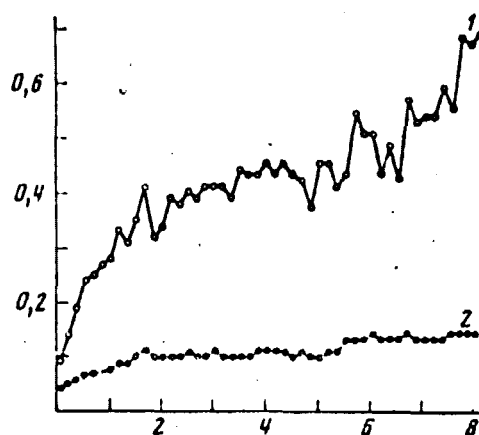


Figure 2

Figure 1. The change in the rate of nystagmus during long-term calorization of the right labyrinth with water at 20 °C. The period in hours of the continuous calorization is plotted along the x-axis; the rate of the nystagmus in seconds [sic], along the y-axis. Each point is the average for eight rabbits.

Figure 2. The change in the duration of the slow (1) and the rapid (2) component of the nystagmus during long-term calorization of the right labyrinth with water at 20 °C. Along the x-axis the duration of the continuous calorization in hours is plotted; the duration of both components of the nystagmus in seconds, along the y-axis. Each point is the average for six rabbits.

to 91.4 mcv. Correspondingly, the speed of both phases of the nystagmus was reduced also (the slow phase, from 2150 to 138.5 mcv/sec, and the rapid phase, from 4300 to 639.2 mcv/sec). In the case of two animals at the end of the experiment, instead of a reduction, a progressive increase in the amplitude was noted, averaging from 80.8 to 810 mcv [sic].

Prolonged calorization of the labyrinths with water at 20 °C was accompanied by significant changes in the EEG. This was manifested by the appearance of a stress rhythm of 4-6 oscillations/sec, observed over a period of 5-6 hours. Arterial pressure fell on the average by 15-20%, reaching its lowest point after 10 minutes, and returning to its initial value after 1 to 1.5 hours. For rabbits at rest the respiration rate was  $61.0 \pm 11.4$  cycles/min. As a rule, after calorization it increased, peaking after 10 minutes, and reaching  $112.2 \pm 14.5$  cycles/min ( $P < 0.05$ ), after which it dropped sharply, and returning to its initial value after 3.5 hours.

15-20 minutes after discontinuing the prolonged calorization of one labyrinth, both labyrinths were calorized by brief test runs at the same temperature. The nystagmus for these runs was weaker by 40-70% in most cases in comparison to the reaction to the same stimulation applied to the labyrinths before the beginning of the prolonged calorization. It was also weaker than the initial reaction /194 on the following days. The change in the EEG and the arterial pressure, which, as a rule, was clearly manifest at the beginning, was absent after the test run.

Intravenous injections of 1 ml of 1% lobeline solution or 20% caffeine solution in the face of a declining nystagmus rate resulted in a sharp increase in this rate for many minutes.

What are the reasons for the attenuation in the nystagmus and other reactions during prolonged stimulation of the vestibular mechanism? If the reason for the attenuation was adaptation, or fatigue of the receptors of the corresponding brain centers, then all reactions should have disappeared simultaneously. Moreover, the reactions produced by the prolonged calorific stimulation became attenuated at different speeds: the changes in arterial pressure disappeared first of all; then the respiration rate returned to normal, and somewhat later, the EEG. The nystagmal reaction weakened significantly; however, it was preserved during the entire period of stimulation. The lack of uniformity in the attenuation of the reactions mentioned with respect to time, the preservation of the effect and its transfer to the other side, the restoration of the attenuated reaction on introducing certain drugs justifies the conjecture that attenuation of the reaction to prolonged calorific stimulation of the labyrinths is the consequence of habituation based on inhibition. In this connection it should be noted that V. N. Chernigovskiy et al. [1, 5, 6], after subjecting the intero- and proprioceptors of the afferent nerves to prolonged stimulation, has established that attenuation of the interoceptive and motor reflexes occurs here basically as a result of the development of inhibition in the corresponding brain centers ("reactive" inhibition in the terminology of V. N. Chernigovskiy).

## REFERENCES

1. Bazanova, I. S.: Electrophysiological Analysis of the Phenomenon of Adaptation in the Somatic Reflex Arc. Author's abstract of doctoral candidate's dissertation, Leningrad, IF AN USSR, 1966.
2. Gorgiladze, G. I.; Kazanskaya, G. S.: Fiziologicheskiy Zhurnal USSR, 1971, v. 57, No. 1, p. 45.
3. Ibid., Doklady AN USSR, 1973, v. 211, No. 4, p. 1005.
4. Gorgiladze, G. I.; Rusanov, S. N.: Fiziologicheskiy Zhurnal USSR, 1971, v. 57, No. 6, p. 910.
5. Ugolev, A. M.; Khayutin, V. M.; Chernigovskiy, V. N., loc. cit., 1950, v. 36, No. 1, p. 117.
6. Chernigovskiy, V. N.: Interotseptory (Interoceptors), Moscow, Medgiz Publishing House, 1960.
7. Brown, J. H., Wolfe, J. W.: acta Otolaryng., 1969, v. 67, p. 389.