EXPERIMENTAL BIOLOGY

Human Chronotope Status during Short-Term Visual Deprivation

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Measuring of an individual minute and individual decimeter by humans with open eyes and eyes closed for 1 min was evaluated. All chronotope parameters were highly individual, but the distribution of time and space measuring values was different. The individual decimeter and, to a lesser extent, chronotope individual decimeter were less in humans subjected to short-term visual deprivation than in subjects with open eyes. Variability of individual minute measuring by humans was less pronounced than the variability of individual decimeter measuring. These differences in variability were less pronounced in the chronotope measured units in subjects with open eyes and were not detected in subjects with short-term visual deprivation.

Key Words: *chronotope; individual minute; individual decimeter; time measuring; space measuring*

Coordinated work of organs of sensations is essential for perception of the time and spatial relationships of the environment by man [3]. The eye plays the leading role in spatial perception. Real events in human environment are linked with space and time [4]. This opinion is based on the concept of the chronotope as a complex of time and spatial relationships between objects and phenomena in human environment and integral perception of time and space intervals by human cortical dominants.

The chronotope is formed by the totality of time and spatial units, the measuring of which creates the integral perception of the spatial and time organization of events and phenomena in the world by man.

We studied measuring of time and space by humans (their chronotopes) during short-term visual deprivation.

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MATERIALS AND METHODS

The study was carried out in 10 healthy men aged 16-18 years. Chronotope was studied as described previously [1]. Individual minute (IM) was determined for each of examined subjects; a line 1 dm long served as the measured length (individual decimeter, ID). For evaluation of universal space-and-time, the examinee was asked to draw (slowly) a 10-cm line over one min; the beginning and end of this period and of the time for drawing the line were marked with an acoustic signal. The time was measured with a chronometer, the length of the line drawn was measured with a ruler. These parameters were called the chronotope IM (CIM) and ID (CID). The volunteer measuring IM and CIM was not allowed to count in mind or to mark the rhythm by any mode. The parameters were measured 3-6 times in each volunteer.

During experimental series I the measuring was carried out with the eyes open, in series 2 with the eyes closed during the test (during 1 min).

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RESULTS

Volunteers with open eyes were divided into 3 groups by the duration of IM (60, 30, and 10% subjects, respectively, Table 1). The duration of IM greatly varied in different subjects (132% of 1 min), the IM value varied from 9 to 142% (mean value 57.0±10.9%; Table 2).

The volunteers in series I were also divided into 3 groups by the results of ID measuring (Table 1): 50, 30, and 20% subjects.

The range of differences in ID reached 78% of 10 cm, the variability of ID in different individuals ranging from 11 to 66% (mean value 31.0±2.7%; Table 2).

The data on the distribution of IM and ID values in young healthy subjects and range of individual values were presented previously [1].

By the duration of CIM in series I the volunteers were distributed into 3 groups (50, 20, and 30%), virtually not differing from the distribution by IM parameter.

The difference of CIM from 1 min reached 175% (1.3 times greater than IM), the variability of CIM in some individuals varying from 3 to 129% (mean value 51.0±12.5%) and virtually not differing from IM variability.

The volunteers formed 2 groups by the results CID measuring. CID<1 dm was observed in volunteers Nos. 1, 3, 4, 8, and 9, which did not coincide with the distribution by CIM value. The mean CID was 7.8±1.1 cm and did not differ from the mean ID value. CID of about 1 dm was noted in volunteers Nos. 2, 5, 6, 7, and 10 (mean value 10.4±0.1 cm). The percent distribution in the groups was 50 and 50%.

The range of CID values was 71% of 10 cm, the variability of CID in some individuals ranged from 10 to 68% (mean value 33.0±4.7%), similarly as for ID (Table 2).

In series 2 of experiments the volunteers were divided into 3 groups by the results of IM measuring (Table 1). IM<1 min (mean value 40.0±1.3 sec) was recorded in volunteers Nos. 1, 4, 7, and 10, some of them had IM<1 in series 1 as well. IM of about 1 min was recorded in volunteers nos. 2, 3, and 5 (mean value 57.0±3.2 sec), and IM>1 min in volunteers Nos. 6, 8, and 9, the mean value 93±10 sec. These groups included 40, 30, and 30% examined subjects, respectively, this somewhat differing from the distribution in series 1. In the group with IM>1 min its duration in series 2 was by an average of 23% shorter than during series 1 ($p<0.05$).

The difference of IM values from 1 min reached 138%, the variability of IM measured by some volunteers ranging from 7 to 139% (mean value 62.0±7.9%). These values do not differ from those in series 1 (Table 2).

Measuring of ID in series 2 of experiments enabled us to divide the volunteers into 3 groups (Table 1). ID<1 dm was recorded in volunteers Nos. 1, 3, 4, 7, 8, 9, and 10 (2 subjects more than in series 1). The mean length was 6.1±0.3 cm, which was 21% less than during series 1 ($p<0.01$). ID ~1 dm was recorded in volunteers Nos. 5 and 6 with the mean length of 10.6±0.1 cm, ID<1 dm in volunteer No. 2 (12.7 cm). The percentage of subjects in these groups was 70, 20, and 10%, respectively, this also differing from the distribution in series 1.

The difference between ID and 10 cm reached 119% in different subjects, which was somewhat more than in series 1, and the variability of this parameter in some individuals ranged from 8 to 66% (mean value 40.0±7.5; Table 2).

The mean ID in all subjects examined in series 2 was 35% less than in series 1 ($p<0.05$; Table 1).

CIM was different in all volunteers during series 2; 3 groups were distinguished by its duration. IM<1 min was observed in volunteers Nos. 1, 4, 7, 8, and 10 (mean value 43.0±3.8 sec), about 1 min in volunteers Nos. 3 and 5 (mean duration 62.0±1.8 sec), and >1 min in volunteers Nos. 2, 6, and 9 (mean duration 107.0±2.1 sec). These groups comprised 50, 20, and 30% volunteers, respectively, which was similar to the distribution during series 1.

The range of CIM values in different subjects reached 162%, similarly as in series 1, the variability of the parameter varying from 7 to 210% (mean value 66.0±18.0%), which also differs little from the results of series 1.

The mean CIM in series 2 virtually did not differ from the value in series 1.

By CID values in series 2 the volunteers were divided into 3 groups. CID<1 dm was observed in volunteers Nos. 1, 3, 4, 7, 8, 9, and 10 (mean value 6.7±0.4 cm), about 1 dm in volunteers Nos. 2 and 6 (mean value 9.9±0.1 cm), and >1 dm in volunteer No. 5 (11.4 cm). The distribution in the groups was 70, 20, and 10%, respectively. The distribution of volunteers by the CID value differed significantly from that in series 1 and was the same as for ID in series 2.

The variability of CID in the examined subjects was 92% of 10 cm and varied in different subjects from 10 to 190% (mean value 64.0±13.8%), which was 1.9 times more than in series 1 ($p<0.05$).

The CID value in series 2 was 14% less than in series 1 ($p<0.05$).

The variability of ID in comparison with IM in series 1 and 2 was 46 and 35% less, respectively ($p<0.05$). In series 1 CID was 35% less than CIM, but this difference was negligible, while in series 2 the CIM and CID values were virtually the same.

However, it is noteworthy that them chronotope spatial units are normally less variable than time units,

TABLE 1. Individual and Mean Values of Measured Time and Space in Volunteers (M±m)

Subject No.	Open eyes				Closed eyes			
	IM, sec	ID, cm	CIM, sec	CID, cm	IM, sec	ID, cm	CIM, sec	CID, cm
1	25	9.8	31	10.0	51	5.7	31	6.2
	23	5.9	32	8.4	44	5.5	35	5.4
	40	7.6	31	7.7	26	5.3	45	9.0
Mean	29±5	7.8±1.7	31±1	8.7±1.0	40±7	5.5±1.0	37±4	6.9±1.1
2	49	9.6	77	9.0	43	9.5	54	7.5
	47	11.6	62	11.7	66	11.8	62	11.0
	51	12.2	76	11.0	73	12.3	80	7.4
	64	12.7	87	12.2	75	12.8	112	8.9
	45	11.0	70	10.0	52	14.5	81	12.9
	64	12.5	48	10.8	55	15.5	72	11.7
Mean	53±3	11.6±0.5	70±1	10.8±5.0	61±5	12.7±0.5	77±1	9.9±0.9
3	62	8.0	75	7.9	41	6.8	66	5.9
	58	6.5	59	6.4	67	5.8	62	3.7
	55	8.4	61	7.0	57	6.1	66	6.8
Mean	58±2	7.6±0.6	65±0.5	7.1±4.2	55±1	6.2±2.5	65±1	5.5±0.9
4	32	7.0	37	5.9	38	5.2	29	4.5
	29	7.4	35	6.7	36	4.6	31	5.9
	27	7.6	62	7.6	39	5.0	45	5.2
	36	9.0	57	9.9	54	6.3	40	6.8
	30	8.8	55	9.4	33	7.4	41	7.1
Mean	31±2	7.9±0.4	49±2	7.9±0.9	40±4	5.7±3.6	37±3	5.9±0.5
5	30	9.0	31	8.6	45	8.8	46	12.0
	40	10.3	40	10.2	47	9.3	46	10.9
	38	11.6	40	10.2	55	12.3	62	10.0
	36	11.4	46	11.3	58	10.6	54	12.7
	51	11.2	52	10.9	65	11.8	76	11.4
	54	10.8	71	10.5	59	10.2	68	11.5
Mean	42±4	10.7±3.8	47±5	10.3±0.4	55±3	10.5±0.6	59±1	11.4±0.4
6	67	9.6	72	10.4	74	8.2	60	10.4
	97	10.5	79	9.5	92	9.9	94	9.5
	121	9.9	110	10.7	126	10.6	129	4.8
	162	11.8	134	12.8	139	10.3	186	8.8
	132	10.9	93	9.4	174	12.1	154	11.5
	150	11.2	110	10.3	177	12.5	192	13.9
Mean	121±16	10.7±3.3	100±9	10.5±0.5	130±17	10.6±0.6	136±21	9.8±1.2
7	55	13.3	59	10.8	43	10.9	56	9.0
	44	12.5	50	11.5	44	5.8	41	8.8
	35	11.3	52	8.9	41	7.0	61	6.7
	49	9.9	62	9.2	43	6.8	50	6.6
Mean	46±4	11.8±0.6	56±3	10.1±0.6	43±1	7.6±0.9	52±4	7.8±0.7
8	68	7.0	45	5.9	61	5.5	39	5.8
	38	5.5	34	5.7	53	4.4	47	4.0
	56	6.4	38	6.2	69	5.5	45	6.2
	70	6.8	55	7.2	81	6.4	53	4.8
	81	6.4	49	6.8	79	7.3	59	6.1
	58	5.6	51	6.5	98	5.4	61	4.7
Mean	62±6	6.3±0.2	45±3	6.4±0.2	72±6	5.8±0.4	51±3	5.3±0.3
9	70	8.6	112	8.6	87	4.6	136	7.7
	56	7.8	102	7.8	69	4.5	96	6.0
	61	9.8	99	10.3	76	5.8	88	8.1
Mean	62±5	8.7±0.4	104±3	8.9±0.9	77±6	4.9±0.4	107±18	7.3±0.8
10	43	11.1	45	10.9	33	7.1	42	8.9
	44	10.5	42	10.2	38	6.0	36	8.3
	47	10.0	47	9.9	40	6.9	43	8.1
Mean	45±1	10.5±0.4	45±1	10.3±0.3	37±2	6.7±0.4	40±2	8.4±0.2
Mean weighed	55±8	9.4±0.6	62±7	9.1±0.5	61±8	7.1±0.9	66±10	7.8±0.7

TABLE 2. Variability (Ratio of Minimum to Maximum Values, %) of Individual IM, ID, CIM, and CID in Volunteers

Volunteer No.	Open eyes				Closed eyes			
	IM, sec	ID, cm	CIM, sec	CID, cm	IM, sec	ID, cm	CIM, sec	CID, cm
1	60	66	3	30	96	8	45	67
2	42	32	81	36	74	63	107	74
3	13	29	27	23	63	17	7	84
4	33	29	77	68	64	61	55	58
5	80	29	129	31	44	40	65	27
6	142	23	86	36	139	52	210	190
7	57	34	24	40	7	60	37	36
8	113	27	62	22	85	66	56	55
9	25	26	13	32	26	29	55	35
10	9	11	12	10	21	8	19	10
Mean	57±11	31±3	51±13	33±5	62±8	40±8	66±18	64±14

while in patients with dyscirculatory encephalopathy the ratio of variability of the chronotope time and spatial measuring units is inverse, though with a trend to normalization after therapy [2].

Hence, all studied parameters of human perception of the environmental chronotope are highly individual for subjects with open eyes and with eyes closed for a short time. The distribution of time and space measuring is different in different subjects. The mean IM and CIM values for all subjects examined with open and closed eyes were virtually the same, while ID (and less so CID) during short-term visual deprivation was less than in subjects with open eyes, which confirms the important role of the visual analyzer in perception of the environment. It was also noted that the variability in perception of a measured time unit is greater than of a spatial unit by subjects with open and closed eyes. These differences in variability were less manifest in the measured chronotope units (CIM and CID) for subjects with open eyes and were absent in comparison of these chronotope parameters in subjects under conditions of short-term visual deprivation.

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