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"A Systematic Exploration of the Normal Wink Responses of Humans on Three Different Levels" (Intra-Organic, Reflex, and Voluntary Reinforced). The Types of Controls (Sensory and Associative) and Facotrs Influencing the Operation of the Response on Each Level.

Norman Thompson

"A SYSTEMATIC EXPLORATION OF THE NORMAL WINK RESPONSES OF HUMANS ON THREE DIFFERENT LEVELS" (INTRA-ORGANIC, REFLEX, AND VOLUNTARY REINFORCED). THE TYPES OF CONTROLS (SENSORY AND ASSOCIATIVE) AND FACTORS INFLUENCING THE OPERATION OF THE RESPONSE ON EACH LEVEL.

A Thesis

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This thesis, offered by Norman Thompson as a partial fulfilment of the requirement for the degree of Master of Science in the University of North Dakota, is hereby approved by the Committee under whom he has carried on his work.

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Norman Thompson

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INTRODUCTION

Winking is caused by the contraction of muscle fibers which run transversely across the eyelids in a curved course. The muscles are attached firmly at the outer and inner corners of the eyes. The shortening of the muscles straightens their arched course and so brings the two edges of eye-lids into contact with each other.

The eye-wink operates as an intra-organic act,(by intra-organic I mean stimulated from within, or seemingly so) as a cranial reflex, and as a voluntary reinforced response. Thus we can study and compare these various "levels" of activity in a single mechanism, for they all have in common a single final pathway.

Telford (1931) states that; "problems, as the effect of emotions, mental activity, and "attention" on the autonomic processes can easily be studied by means of the changes in the rates of winking accompanying these various activities. All of the traditional problems on the reflex level, such as summation of stimuli, time relations of reflexes, refractory and hyperexcitable periods as well as inhibition and negative adaptation can easily be carried on. These topics lead into the problems of learning. The wink reflex is readily conditioned. Consequently it offers opportunities for investigation of problems concerning conditioned reflexes, as well as the negative aspects of the learning process, such as the elimin-

ation of responses due to negative adaptation, experimental extinction, and the voluntary inhibition of the reflex."

On the highest level, the eye-wink operates as a positive voluntary response. Rate of winking as well as fatigue problems can be investigated. The eye-wink shows all degrees of control from the intra-organic and reflex to the purely voluntary, and investigations of the relationships existing between the various "levels", their mutual relationships and the factors influencing each in a single mechanism can easily be made.

STATEMENT OF PROBLEM

The eye-wink has been used a great deal in the study of such processes as the reflex, the refractory phase, negative adaptation, and as before mentioned, investigation of such problems as the effect of emotions, mental activity, and "attention" on the autonomic processes. Since the eye-wink has come to hold such a prominent place as a means for the investigation of these processes, and since the eye-wink mechanism is by no means constant in its behavior, it has been found desirable to make a systematic exploration of the eye-wink under three different levels, (Intra-Organic, Reflex, and Voluntary). In this study the purpose is to discover the types of controls (sensory and associative) and factors influencing the operation of the eye-wink responses on each level.

WINK AS INTRA-ORGANIC RESPONSE

"The main control of the eye-blinks seems to be intra-organic". (Ponder and Kennedy, 1927). In this and in other respects these activities resemble breathing.

"While reflex mechanisms doubtless play a minor role , less indeed than was formerly supposed, it is obvious that, under different sorts of stimuli, they may modify considerably the regularity and rate of blinking. Blinking rate and regularity are also, as Ponder and Kennedy have shown, functions of emotional conditions". (Petersen and Allison, 1931 April Jr. of Exp. Psy. p. 144). In this same article on the controls of the eye-wink mechanism Petersen and Allison reported the following; "It is seen that the mean interblink period while the subjects are reading is 13.94 sec. and that when they are cancelling letters it is 26.32 sec. During distant fixation this mean is 21.06 sec., while with near fixation it is only 13.12 sec. These data show very clearly that the blinking rate is influenced by different kinds of mental activity in the subjects and probably also by different degrees of strain in accomodation, by eye movements, etc.; and they agree in the main with the results found by Ponder and Kennedy, who have also shown that the inter-blink period is markedly increased under certain conditions of emotional stress. It is possible that modifications in the blinking rate are far more significant of emotional states than are records of galvanic changes. This problem needs investigation, and may prove to be a valuable one in certain applica-

tions . The ease of getting one's record unknown to him is an important consideration".

The study by Petersen and Allison also brings out the effects of age and sex on the inter-blink period. It is pointed out that the inter-blink period decreases with age and this is in agreement with the findings of Ponder and Kennedy, that the infant makes no true blink responses and that when these responses first appear they occur very seldom.

Telford (1931) found that reading retarted the normal wink. This also is in agreement with the former findings.

RESULTS

APPARATUS AND PROCEDURE.

The apparatus in this experiment consisted of a pair of glasses, with the lenses removed, equipped with a wire contact switch which was attached to the eye with a small piece of adhesive tape. The wire contact was so well balanced that the subject soon became accustomed to it and was not aware of it during the course of the experiment. The switch was connected in series with a recording armature so that a good record was made of the wink on the blacked surface of a kymograph. Another recording armature was connected in series with a pendulum and this recorded the time interval in seconds. The subjects were students of Psychology at the University of North Dakota.

First the subjects were seated comfortably and given a book to read. They were given a few minutes to become accustomed to the apparatus before the record was made. Second, the subjects were given two place numbers to multiply mentally by two place numbers. Third, the subjects were engaged in ordinary conversation. The duration of each part of the experiment was about two hundred seconds.

DATA AND INTERPRETATION.

Table I show the results from four subjects subjected to the foregoing experimental conditions. The responses are "intra-organic"obtained while subjects were given mental problems, reading and engaged in ordinary conversation.

TABLE I

Subj.	A			B			C			D		
	M	σ	N	M	σ	N	M	σ	N	M	σ	N
Read.	32.1	8.45	13.	13.87	3.7	27.	4.13	1.67	172.	5.4	2.5	129.
M.Ar.	18.0	4.66	18.	3.16	1.2	105.	1.26	1.04	265.	1.1	.9	172.
Conv.	7.5	1.52	64.	7.96	3.1	62.	2.10	1.5	255.	1.6	1.6	157.

Graph of the means on the following page.

RELIABILITY DIFFERENCES.

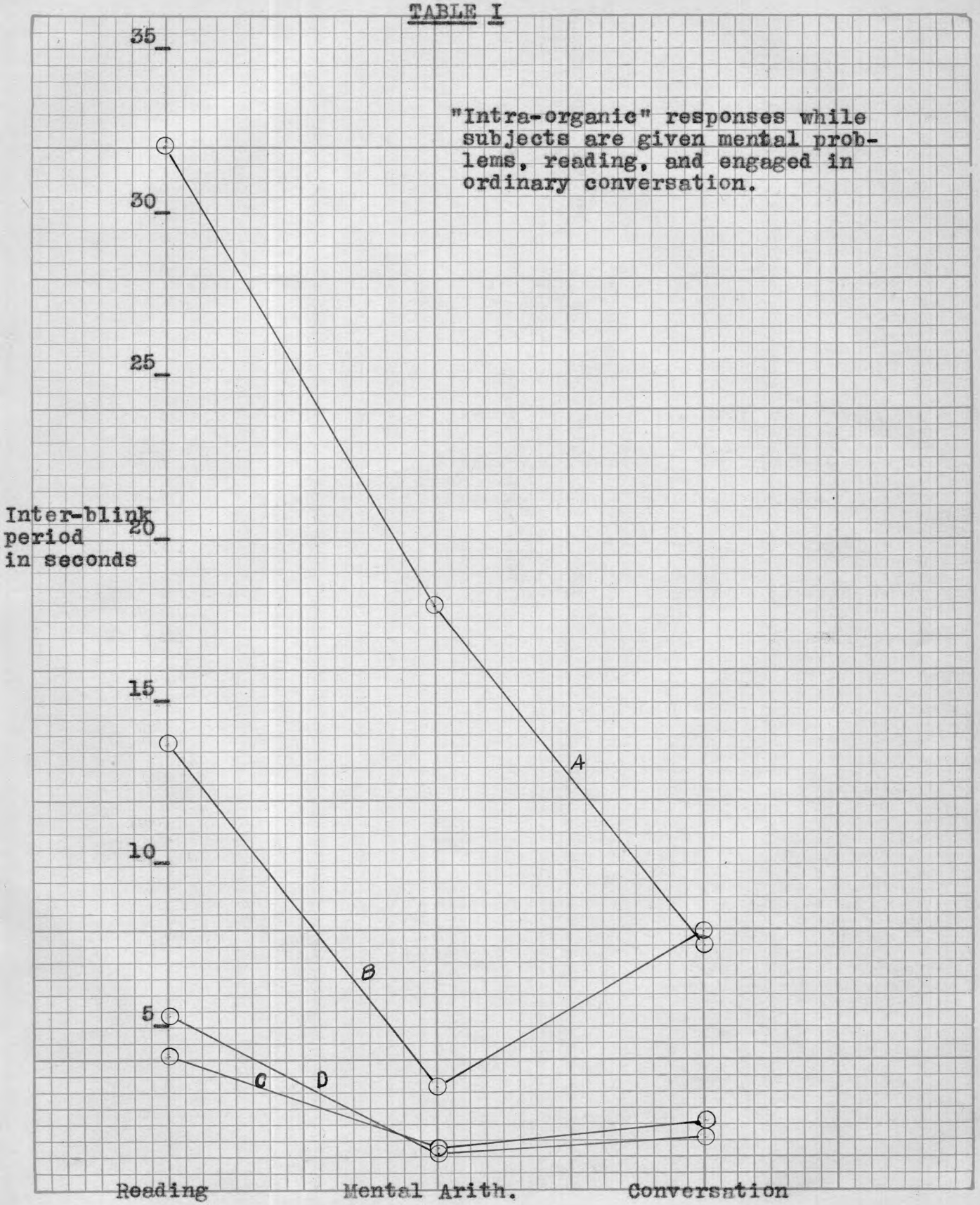
Subj.	A			B			C			D		
Compared	Diff.	σ_{Diff}	$\frac{Diff.}{\sigma_{Diff}}$	Diff.	σ_{Diff}	$\frac{Diff.}{\sigma_{Diff}}$	Diff.	σ_{Diff}	$\frac{Diff.}{\sigma_{Diff}}$	Diff.	σ_{Diff}	$\frac{Diff.}{\sigma_{Diff}}$
R-MA.	14.1	2.6	5.5	10.7	.7	14.8	2.8	.14	20.4	4.4	.23	18.4
R-Co.	24.5	2.4	10.4	5.9	1.4	4.1	2.1	.15	12.8	3.9	.26	14.8
MA-C	10.4	1.1	9.7	4.8	1.3	3.8	.9	.12	7.1	.5	.15	3.3

M is the mean inter-blink period in seconds.
N is the number of wink responses taken.

The pooled results show the largest inter-blink period for the reading and the shortest for the mental arithmetic. The inter-blink period for the conversation was longer than for the mental arithmetic and shorter than for the reading. Only one individual (A) showed a larger inter-blink period for the mental arithmetic than the conversation and this individual

TABLE I

"Intra-organic" responses while subjects are given mental problems, reading, and engaged in ordinary conversation.



showed less sign of emotional stress when performing the mental operations. It was also observed that this individual could perform the multiplications more easily than any of the other subjects. There is a possibility that the difference, between the inter-blink periods of mental arithmetic and conversation, may be a measure of that persons ability to carry out mental processes. There is at least an opportunity for further study that may prove valuable in the investigation of the higher mental processes.

Table II gives the results for a group of thirty six subjects under the same experimental conditions as those of table III with the exception of the recording devise. In this group the students counted each others blinks. This method is not as accurate as the former but the difference is not sufficient to effect the final results. Petersen states that this method is quite reliable and Telford (1931) found that the inter-blink period was effected very slightly by the consciousness of being observed.

TABLE II

Subjects	Group of 36		
	M	σ	N
M. Arith.	54.43	3.99	36
Read.	14.36	2.71	36
Conv.	44.47	1.59	36

Subjects Compared	Group of 36		
	Diff.	σ_{Diff}	$\frac{Diff.}{\sigma_{Diff.}}$
Re. M. Ar.	40.07	5.85	6.95
Re. Conv.	30.11	3.79	7.94
M. Ar. Con.	9.96	3.25	3.06

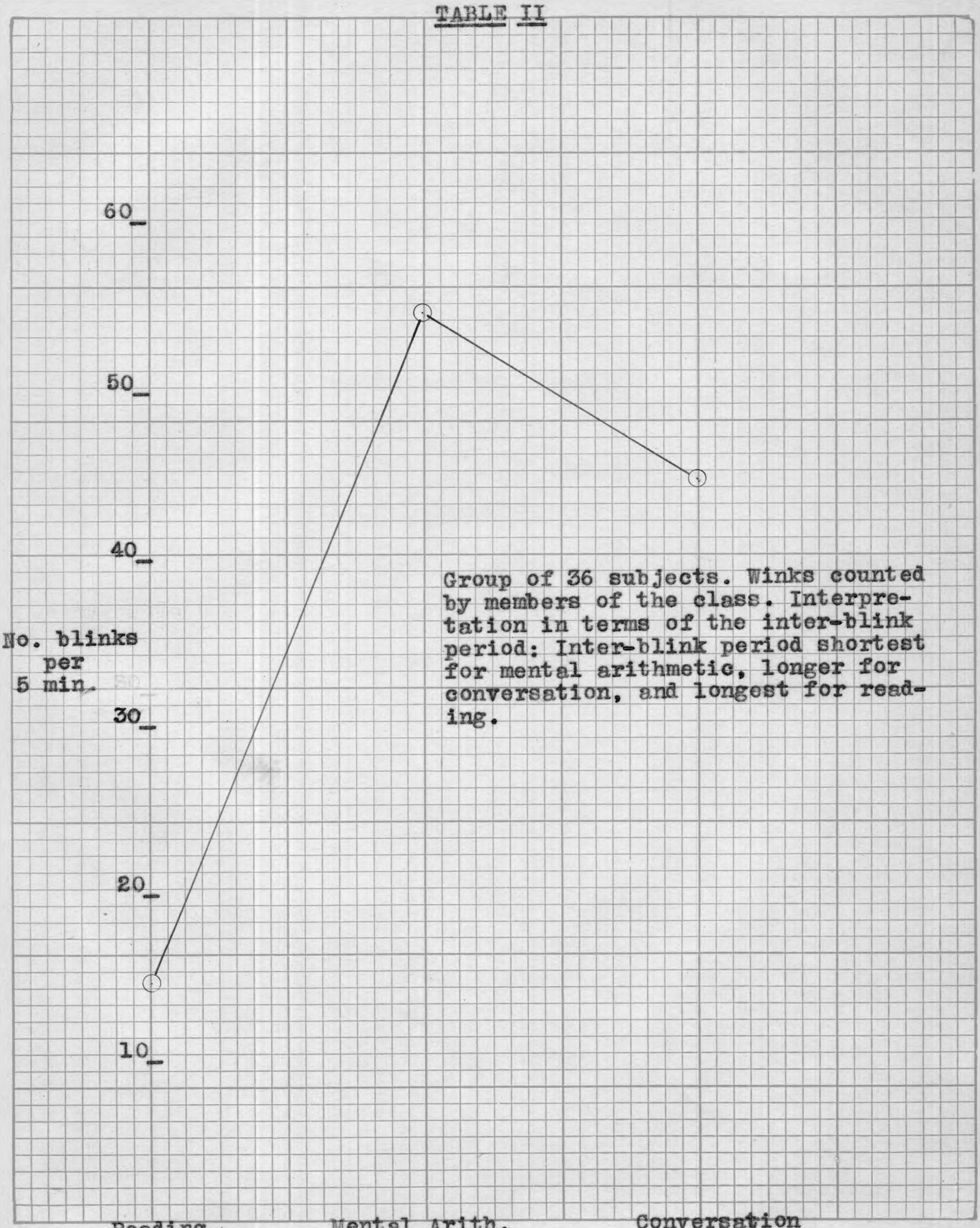
M is the mean number of winks per 5 Min. interval.
N is the number of subjects used in the experiment.

The results of this experiment corroborate the findings in three of the four cases in table I. This indicates that if

more subjects were subjected to the experimental conditions followed in table I , most of them would give data to substantiate the data from B, C, and D. The results in table II are given in terms of blinks per 5 min. instead of inter-blink periods as in table I . In order to compare tables I and II it is necessary to compare the short inter-blink period of table I with the large number of blinks in table II .

The graph of the means for table II are on the next page.

TABLE II



Group of 36 subjects. Winks counted by members of the class. Interpretation in terms of the inter-blink period: Inter-blink period shortest for mental arithmetic, longer for conversation, and longest for reading.

WINK AS REFLEX

APPARATUS AND PROCEDURE.

In the study of the reflex the apparatus consisted of a head rest with a heavy plate glass, eight inches square, fastened to the front; one rubber tipped wooden hammer that hinged from above the headrest, and the recording device. The plate glass was approximately three cm. in front of the subjects eyes. The small wooden hammer, 25 cm. long and fastened 2 1/2 cm. from the end was regulated by hand. When released, it descended through an arc of 90 degrees and struck the glass on the level with the subjects eyes. This caused the subject to wink. The recording device was as follows; a small copper wire (size 22) about 12 cm. long, was fastened to the subjects left eye by means of a small piece of adhesive tape. The wire was then thrust through a loop of wire about 6 cm. from the subjects eye. This made a perfectly balanced lever that was almost free from friction. The end of the wire opposite the eye was placed in a slotted celluloid strip attached to a second lever. This second lever was connected in series with the secondary winding of an induction coil, the coil being in circuit with a kymograph. Thus the eye-wink was recorded on the blacked surface of the kymograph paper by the jump spark from the induction coil. The levers were so well balanced that the subject was not conscious of the transmitted movement of the eye-wink to the levers. The hammer was placed in a circuit with a recording armature, and this produced a record of the stimuli directly below the record of the eye-

wink. This arrangement of the two records made it possible to distinguish the normal winks from the reflex winks. The subject fixed his eyes on an object placed in the field of vision, so as to maintain a constant postion of the eyes, and this made it possible to secure a fairly straight base-line in the record.

SAMPLE OF RECORD

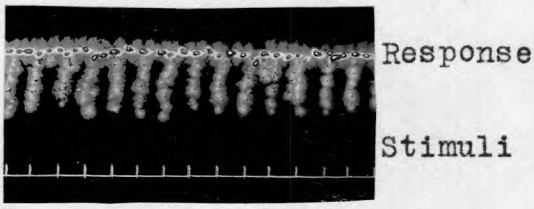


Table III gives the results from reflex winking. The subjects were instructed to remain perfectly passive, trying neither to inhibit nor facilitate the response.

The stimuli were given at five different time intervals, being 1/2, 1, 2, 4, and 6 sec. respectively. The subject was comfortably seated before the apparatus, his head placed in the head-rest, the recording device fastened to his eyelid, and instructed to keep his eyes fixed on an object placed directly in the frontline of vision.

TABLE III

Subjects	A			B			C			D		
Interval in sec. ↓	M	σ	N	M	σ	N	M	σ	N	M	σ	N
1/2	5.25	1.88	141	1.36	3.97	187	2.55	3.43	235	1.63	4.48	113
1	5.99	1.93	176	6.16	2.41	137	2.76	6.40	222	1.47	1.94	116
2	5.21	4.36	172	0.56	1.29	232	5.77	2.59	127	1.95	1.99	116
4	7.52	1.99	114	6.83	1.66	129	4.92	2.13	98	4.03	2.64	102
6	7.63	1.56	101	3.84	1.81	151	1.30	1.47	84	3.86	5.42	99

N is no. responses M is mean amplitude in mm.

RELIABILITY-DIFFERENCES

Compared —	A			B			C			D		
	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma Diff.}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma Diff.}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma Diff.}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma Diff.}$
1/2 ~~1~~ ↓	0.74	.212	3.49	2.19	.356	06.1	0.21	.487	0.43	0.16	.46	0.35
1 ~~2~~	0.78	.362	2.18	5.60	.222	25.2	3.01	.490	6.12	0.47	.26	1.88
2 ~~4~~	2.30	.380	6.06	6.27	.169	37.1	0.86	.313	2.76	2.08	.32	6.46
4 ~~6~~	0.12	.242	0.48	5.09	.202	24.4	3.62	.269	13.4	0.17	.59	0.29

DISCUSSION.

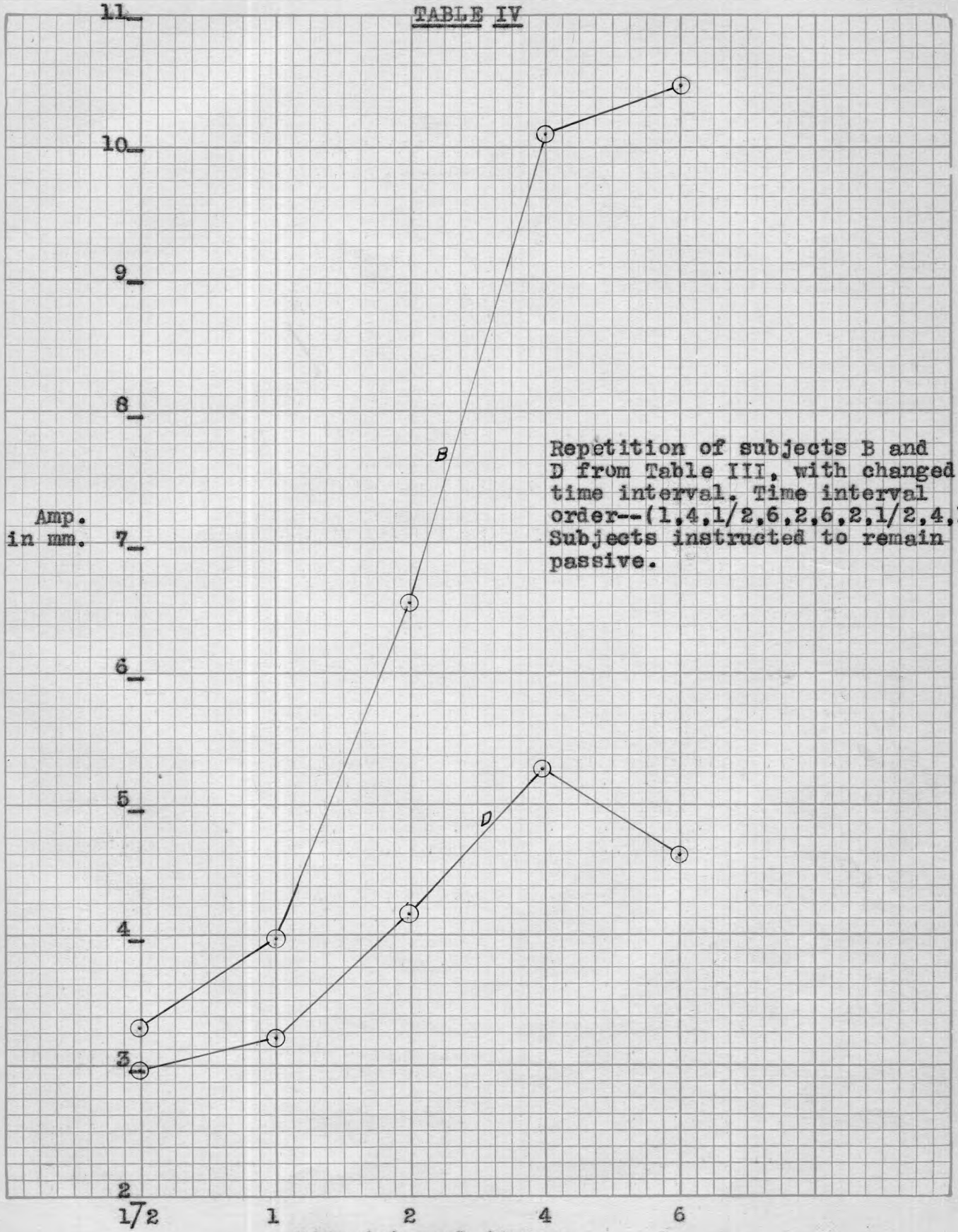
The results taken individually are too variable to be of any significance but the pooled results suggest that the mean amplitudes of the winks at the different intervals are due largely to practice effects. For this reason individuals B and D, who showed the most pronounced differences, were selected to act as subjects for the second time. The results were so variable that the graph of the means resulted in an unintelligible mass and have purposely been left out.

Table IV includes those two individuals from table III who showed the greatest variability. In this study the time intervals, instead of being given in the order 1, 4, 1/2, 6, and 2 sec., were given in the order 1, 4, 1/2, 6, 2, 6, 2, 1/2, 4, and 1 sec. In this way the 1 sec.(taking the 1 sec. merely as an example) occurs first for one half of the responses and last in order for the second half of the responses. In this manner the effect of practice should be eliminated.

TABLE IV

Subjects.	D			B		
Intervals in sec.	M	σ	N	M	σ	N
1/2	2.90	1.97	150	3.26	2.96	194
1	3.16	2.81	248	3.95	3.14	168
2	4.10	2.03	202	6.49	2.10	174
4	5.25	2.09	139	10.08	2.85	116
6	4.68	1.68	107	10.39	2.01	104

TABLE IV



Repetition of subjects B and D from Table III, with changed time interval. Time interval order--(1,4,1/2,6,2,6,2,1/2,4,1) Subjects instructed to remain passive.

RELIABILITY-DIFFERENCES

Subjects	D			B		
Compared	Diff	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$	Diff	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$
1/2+1	0.26	.239	1.07	0.69	.322	2.13
1+2	0.95	.239	3.94	2.55	.296	8.63
2+4	1.15	.236	4.87	3.59	.224	16.0
4+6	0.57	.238	2.40	.691	.257	2.69

Graph of means on next page.

The inconsistencies have been eliminated by the changing of the interval orders. The results show a consistent decrease in the refractory period up to the 6 sec. interval. This indicates that the state of decreased excitability has passed, or in other words that the refractory period is no longer present. These results are now consistent with the findings of Telford and Andersen (1931).

Table V gives the results from new subjects under the same experimental conditions as those in table IV. The same order of time intervals are used, the purpose being to find out whether or not the results of table IV were valid or whether the results obtained were influenced by the previous practice of individuals B and D during the experiment previous.

TABLE V

Sub. Int. sec.	A			B			C			D			E		
	M	σ	N	M	σ	N	M	σ	N	M	σ	N	M	σ	N
½	2.8	5.1	155	3.5	4.8	156	1.0	2.2	163	1.4	1.9	172	2.8	2.1	172
1	5.3	6.4	172	5.1	4.8	211	1.6	3.1	210	1.7	2.0	173	4.3	1.6	155
2	5.2	4.0	165	6.4	3.3	136	3.1	3.1	156	2.2	1.8	134	2.8	1.7	155
4	8.4	2.4	183	7.5	2.6	101	5.3	2.8	121	4.9	1.9	105	4.5	1.8	117
6	9.6	2.5	103	8.4	2.0	92	7.2	1.2	100	4.7	1.7	98	5.1	1.9	102

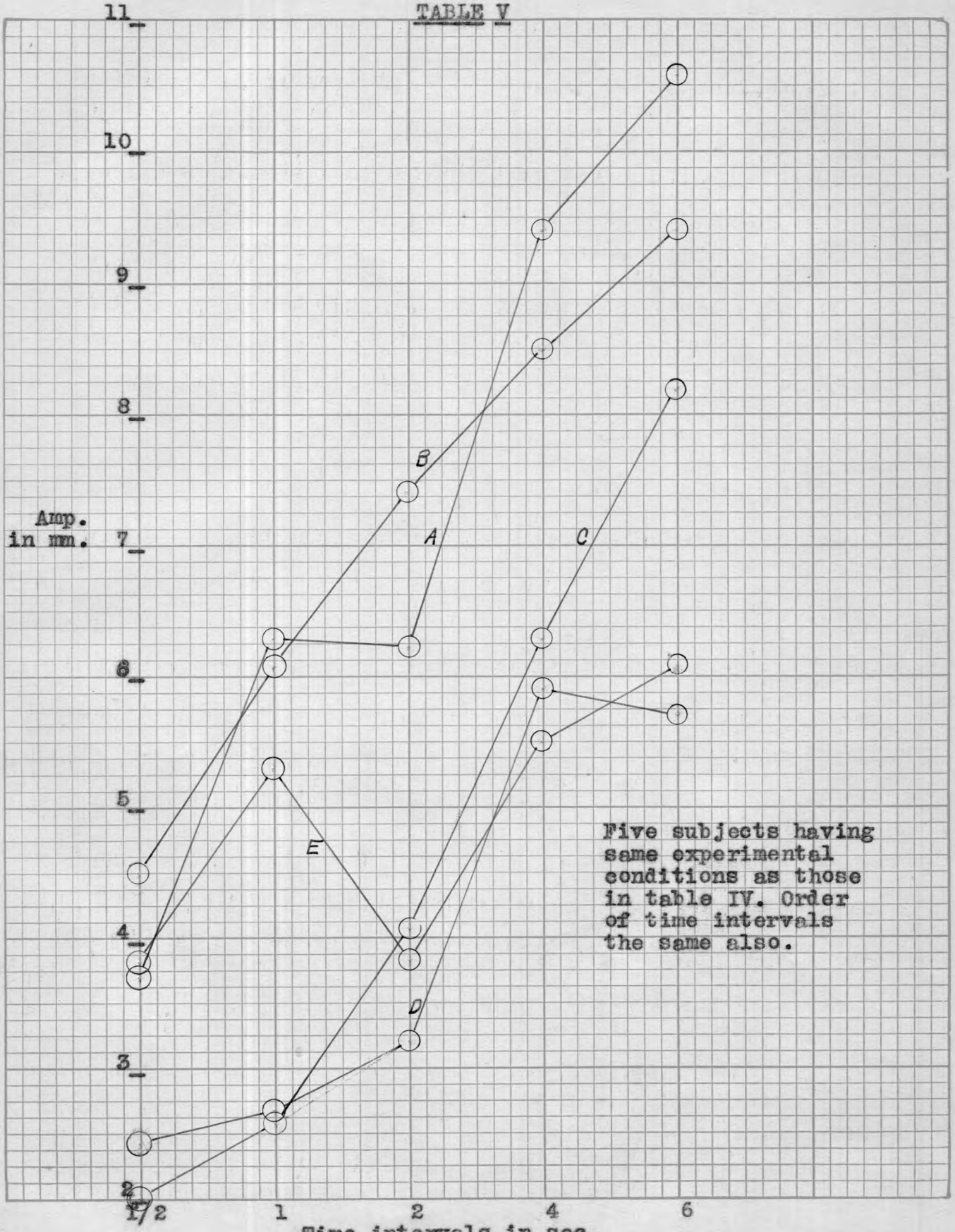
Chart of means on next page.
M is mean amplitude in mm.
N is number of responses.

RELIABILITY-DIFFERENCE

Sub. Com. 1	A			B			C			D			E		
	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff}}$	Diff.	σ_{Diff}	$\frac{Diff.}{\sigma_{Diff}}$	Diff.	σ_{Diff}	$\frac{Diff.}{\sigma_{Diff}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff}}$
2-1	2.4	.62	3.8	1.6	.50	3.3	.6	.27	2.1	.2	.21	1.1	1.6	.21	7.5
1-2	.1	.58	.1	1.2	.43	2.9	1.5	.33	4.6	.5	.22	2.2	1.5	.19	7.9
2-3	3.1	.58	5.5	1.1	.38	3.0	2.2	.36	6.2	2.7	.24	1.1	1.6	.21	7.9
3-4	1.3	.80	1.6	.9	.33	2.9	1.9	.28	6.9	.2	.25	..7	.6	.24	2.6

These results are consistent with those of table IV with the exception of the 6 sec. interval. Instead of remaining on a level with the 4 sec. interval the amplitude went up, indicating that the refractory phase was still present. However the results from table IV and V prove definately that the results in table III were due to practice effects and since the results

TABLE V


11
10
9
8
7
6
5
4
3
2
Amp. in mm.
A
B
C
D
E
1/2
1
2
4
6
Time intervals in sec.
Five subjects having same experimental conditions as those in table IV. Order of time intervals the same also.

of IV and V were consistent, the carry over of practice after a certain amount has been had, can be considered negligible.

WINK AS VOLUNTARY REINFORCED RESPONSE

On the highest "level", the eye-wink operates as a positive voluntary response. In this study the subjects were instructed to wink every time the stimulus was given. The apparatus used was the same as that used for the reflex so the eye-wink is in reality a voluntarily reinforced response because the subject responds voluntarily to an external stimulus.

Telford and Andersen (1931) reported; "a shortening of the refractory period in the voluntarily inhibited and reinforced responses, as well as a second increase in the average amplitude of response following the decline after the supernormal period".

The same order of time intervals is used in table VI as in tables IV and V. The subjects are given the same instructions as in the former study with the exception: instead of remaining passive the subject is requested to wink every time the stimulus is given.

TABLE VI

Subjects	A			B			C		
Int. Sec.	M	σ	N	M	σ	N	M	σ	N
1/2	10.33	1.23	140	18.51	1.15	135	13.06	1.15	128
1	9.02	2.11	108	17.54	1.61	115	10.36	1.95	146
2	8.64	1.45	100	18.69	1.23	127	11.70	1.95	180
4	8.93	1.68	103	18.34	1.17	108	9.00	2.85	140
6	8.47	1.10	99	19.73	1.94	94	11.51	1.68	98

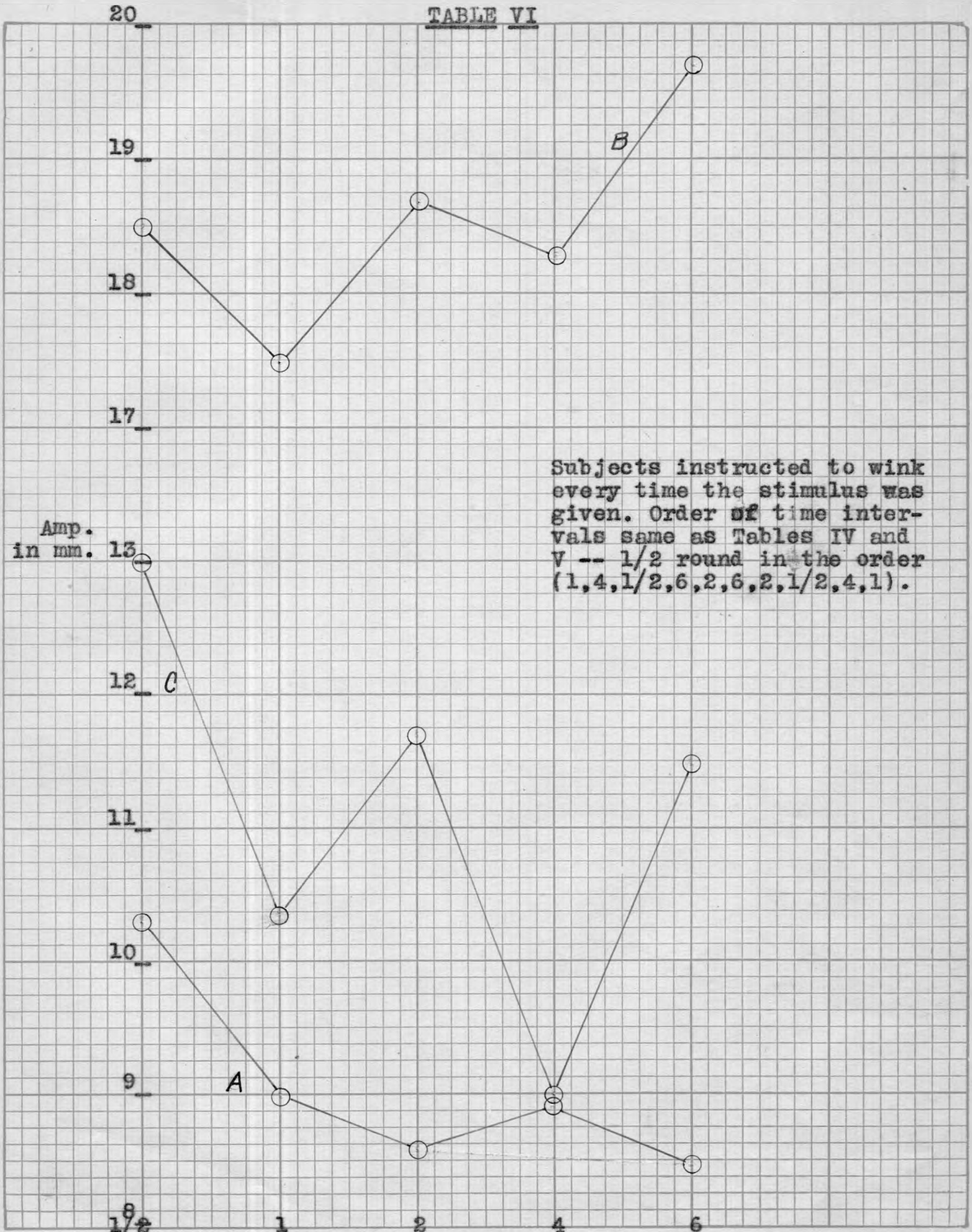
N is no. stimuli (responses) M is mean amp. in mm.

RELIABILITY-DIFFERENCE

Subjects	A			B			C		
Compared	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$
1/2-1	.23	1.30	5.75	.34	.98	2.88	2.71	.191	14.18
1-2	.28	.39	1.38	.18	1.15	6.42	1.35	.217	6.20
2-3	.22	.29	1.33	.16	.37	2.36	2.71	.270	10.00
3-4	.20	.46	2.31	.17	1.40	8.20	2.51	.294	8.550

The pooled results of table VI show the greatest mean amplitude at the 1/2 sec. interval and the next largest at the 6 sec. interval. This suggests that the response is least effected by refractory phase at these time intervals. It is possible that the subject accustoms himself to the rhythm and that such and order of the time intervals is undesir-

TABLE VI



Subjects instructed to wink every time the stimulus was given. Order of time intervals same as Tables IV and V -- 1/2 round in the order (1,4,1/2,6,2,6,2,1/2,4,1).

able. However, when we consider that the 1 sec. interval was first and the 4 sec. next etc. we can see the effect of practice. Therefore it seemed desirable to take a new series of readings with new subjects and the order of the time intervals changed, to determine the effect of eliminating practice effects on the voluntary-reinforced winks. The effect of rhythm is not eliminated by the changed order of intervals.

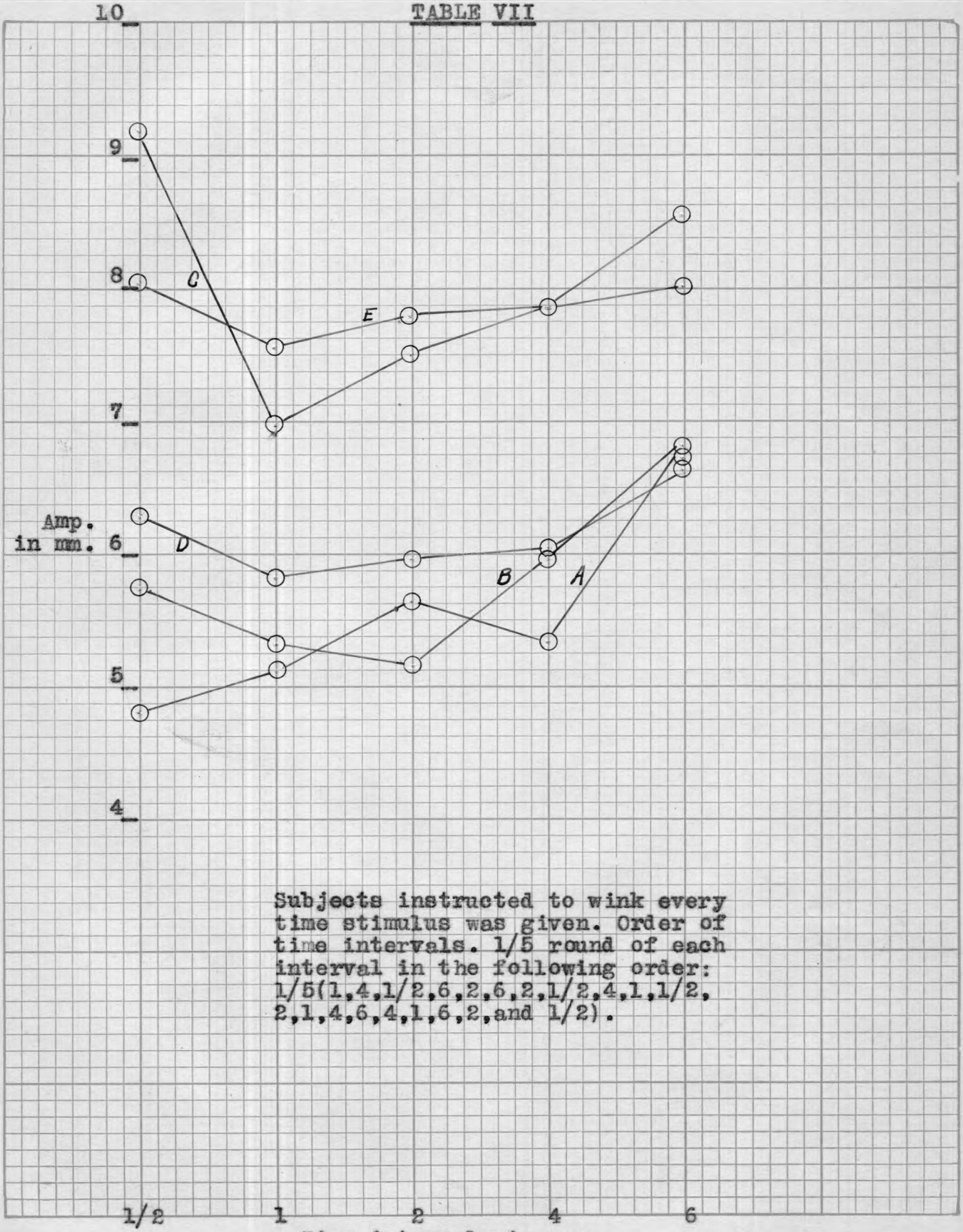
Table VII gives the results of the voluntary-reinforced responses under the same experimental conditions as table VI with the exception of the time intervals. Each round of the recording sheet was divided up into five sections and each section was used for recording a different time interval. Thus the time interval became 1/5(1, 4, 1/2, 6, 2), 1/5(6, 2, 1/2, 4, 1), 1/5(1/2, 2, 1, 4, 6), 1/5(4, 1, 6, 2, 1/2), and 1/5(2, 6, 1/2, 1, 4).

TABLE VII

Sub.	A			B			C			D			E		
Int. Sec.	M	σ	N	M	σ	N	M	σ	N	M	σ	N	M	σ	N
1/2	4.80	2.2	143	5.72	2.6	143	9.18	2.76	211	6.26	1.12	159	8.01	.9	164
1	5.09	1.9	148	5.30	1.7	132	6.95	1.79	209	5.80	1.13	179	7.53	.9	189
2	5.62	2.0	112	5.14	2.1	97	7.47	2.58	189	5.93	1.13	130	7.78	.8	133
4	5.29	2.1	143	5.94	1.7	115	7.81	2.15	159	6.01	1.10	153	7.8L	.8	144
6	6.58	2.1	100	6.76	1.9	94	8.51	2.65	120	6.63	1.13	123	7.99	.9	125

M is mean amp. in mm. N is no. stimuli.
Graph of means on next page.

TABLE VII



Subjects instructed to wink every time stimulus was given. Order of time intervals. 1/5 round of each interval in the following order: 1/5(1,4,1/2,6,2,6,2,1/2,4,1,1/2, 2,1,4,6,4,1,6,2,and 1/2).

RELIABILITY-DIFFERENCES

Sub.	A			B			C			D			E		
Com.	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$	Diff.	$\sigma_{Diff.}$	$\frac{Diff.}{\sigma_{Diff.}}$
1&1/2	.29	.2	1.2	.41	.3	1.54	2.22	.14	15.4	.5	.12	3.82	.48	.10	4.68
1&2	.53	.2	2.2	.17	.3	.65	.51	.22	2.3	.1	.12	1.03	.25	.10	2.47
2&4	.33	.2	1.3	.80	.3	3.03	.34	.28	1.20	.1	.13	.64	.03	.10	.32
4&6	1.29	.2	4.9	.82	.3	3.27	.71	.32	2.19	.6	.14	4.60	.18	.11	1.67

A graph of the data now gives nearly a straight line but with a slightly higher mean for the 1/2 and the 6 sec. intervals. The height of the 1/2 sec. is still suggestive of the rhythmical procedure in giving the stimuli. The reason mention is made of the 1/2 sec. and not the others is that in all the studies of the reflex the 1/2 sec. has been the smallest response. Also in the study by Telford and Andersen the 1/2 sec. was the smallest in the reflex and also in the voluntary-reinforced responses. It seems that the only way to remove this undesirable effect, when using the voluntary-reinforced response to study refractory phase etc., is to use paired stimuli as used by Telford and Andersen (1931).

EFFECT OF BREATHING ON THE EYE-WINK

The apparatus used in this study was the same as that used in the reflex and voluntary response study. However, instead of giving the stimuli at specified intervals, the stimuli were given; first, when the subject had completely exhaled; second, when the subject had completely inhaled; third, when the subject 1/2 exhaled; fourth, when the subject had 1/2 inhaled. A pneumograph was used in order to enable the operator to give the stimulus at the proper time.

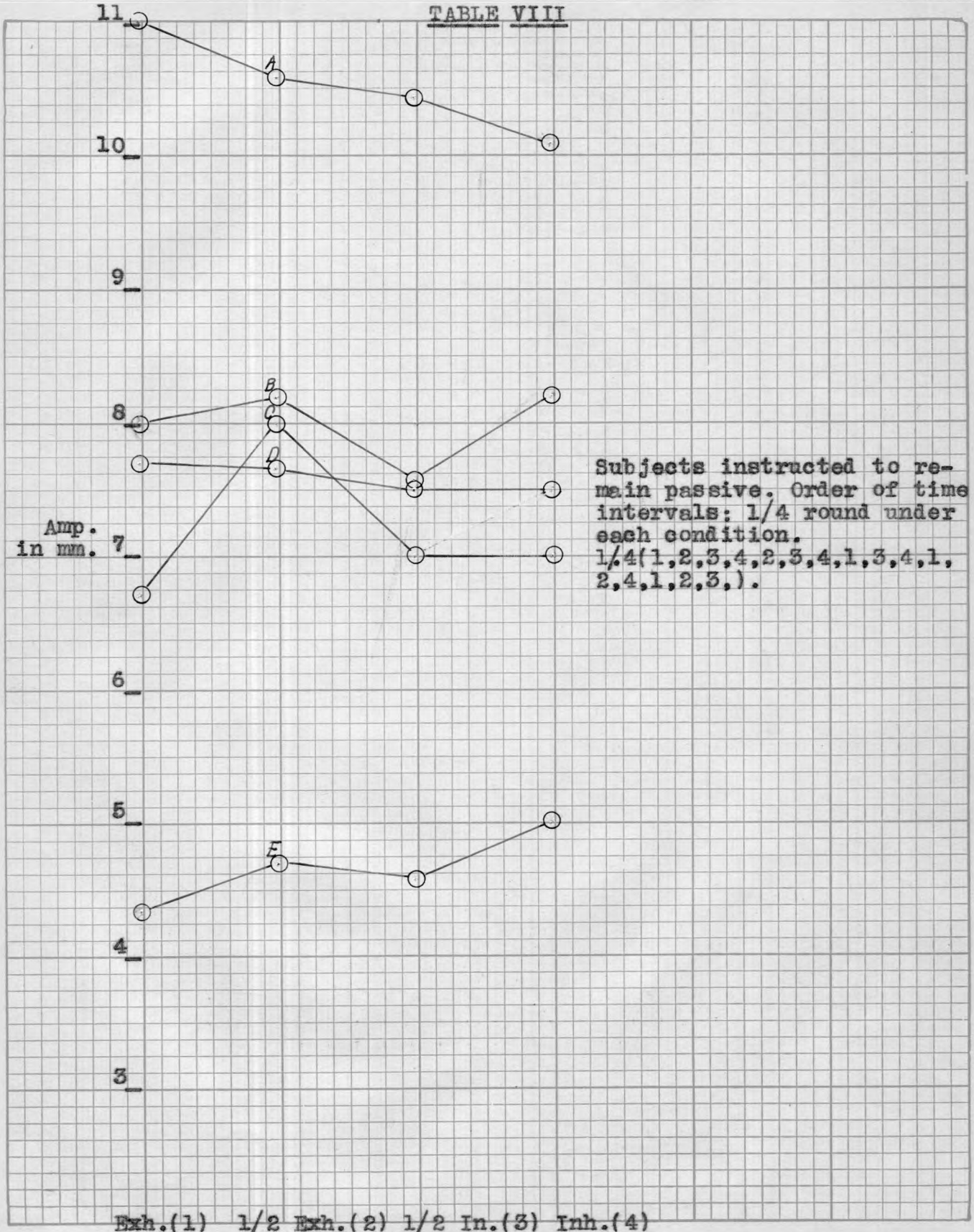
Table VIII gives the results obtained for the effect of breathing.

TABLE VIII

Sub.	A			B			C			D			E		
	M		N	M		N	M		N	M		N	M		N
Exh.	11.0	1.9	110	8.0	.9	114	6.7	2.0	159	7.7	2.1	125	4.35	1.9	117
1/2 Ex.	10.6	1.4	113	8.2	.9	130	8.0	2.3	136	7.6	2.2	101	4.72	2.2	93
1/2 In.	10.4	2.0	111	7.6	1.1	133	7.0	1.9	100	7.5	2.3	130	4.66	2.2	125
Inh.	10.1	1.9	112	8.2	1.6	133	7.0	1.9	150	7.5	2.6	127	5.01	2.1	117

M is the mean amp. in mm. N is the total no. stimuli.
Graph of means on next page.

TABLE VIII



Subjects instructed to remain passive. Order of time intervals: 1/4 round under each condition.
1/4(1,2,3,4,2,3,4,1,3,4,1,2,4,1,2,3,).

Exh.(1) 1/2 Exh.(2) 1/2 In.(3) Inh.(4)
Conditions subjected to.

RELIABILITY-DIFFERENCES

Subjects	A	B	C	D	E
Compared	Diff. / Diff.	Diff. / Diff.	Diff. / Diff.	Diff. / Diff.	Diff. / Diff.
Inh+Exh	2.84	1.445	2.060	.920	2.60
Ex+1/2In	1.80	1.925	5.450	.825	1.34
1/2In+In	.89	3.970	4.320	.328	.20
Ex+1/2Ex	1.29	3.670	.326	.032	1.29

The pooled results from table VIII show no effect of breathing on the eye-wink and from the data available it seems that the effect of breathing can be considered negligible for all practical purposes when dealing with eye-wink reactions.

EFFECT OF FIXATION OF VISION AND CONTRACTING MUSCLES

It is an accepted fact that there are portions of the eye that are better adapted to see moving objects than others. It is also known that fixation on distant objects results in a longer inter-blink period than fixation on an object near the eyes. Petersen and Allison (1931). The apparatus used in this study is the same as that used in the former studies on the reflex and voluntary-reinforced responses. The subject was instructed to remain passive, trying neither to inhibit nor facilitate the response. The stimuli were given at 1 sec. intervals. First the object of fixation was placed in front and three feet from the individual. Then the object was moved 45 degrees to the right and three feet distant. After considerable responses under these conditions the object was placed 4 inches from the subjects eyes. Last of all the responses were recorded when the subject was clinching his fist. During all of these changes the subject's head remained in the same position; the shift being made by the eyes.

The study cannot be considered conclusive because only one subject was used. The study is merely suggestive.

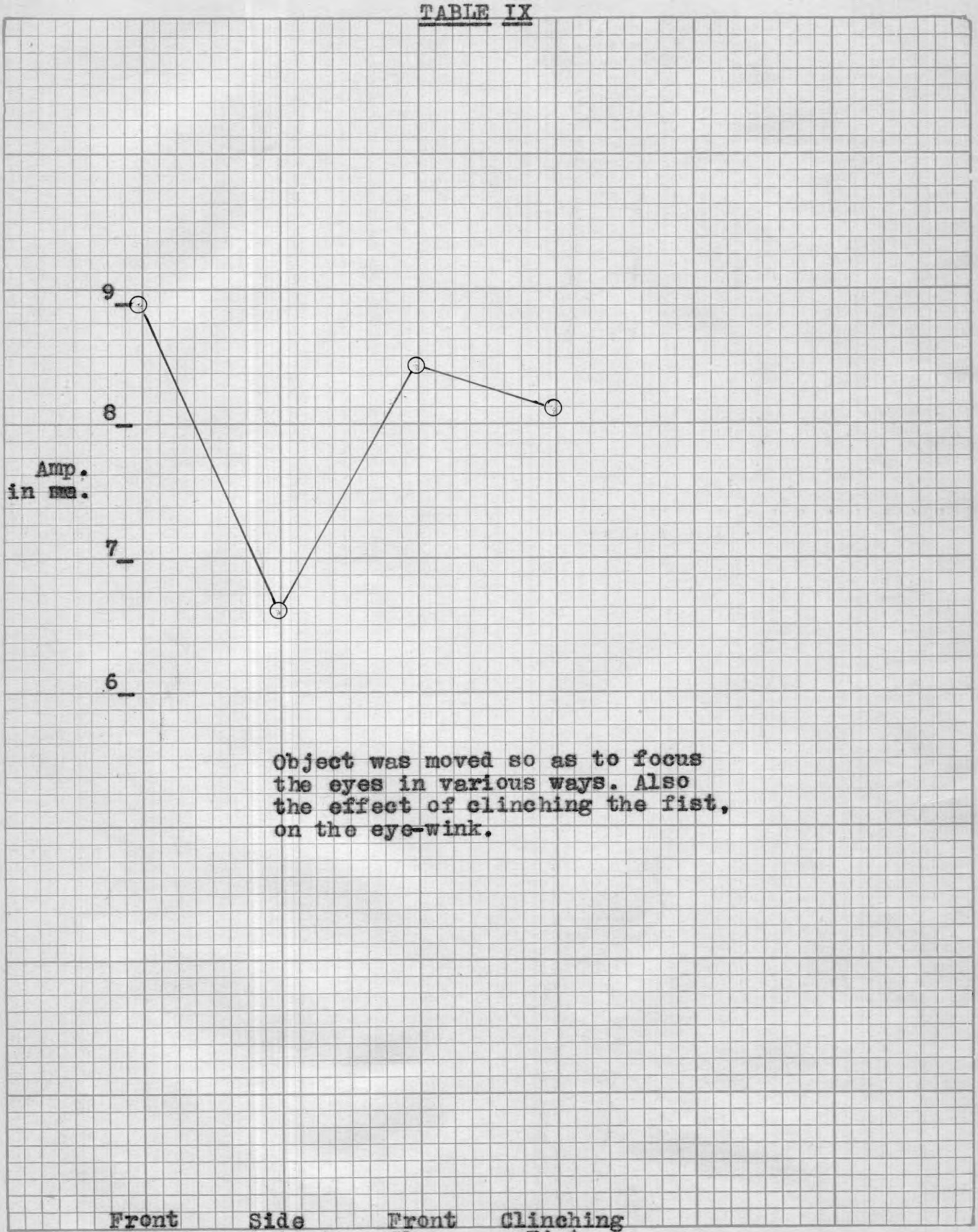
Table IX consists of one individual under the above experimental conditions.

TABLE IX

Subject	A			A	
	M	σ	N	Compared	Diff. / Diff
Front Dist	8.8	1.2	185	Fr.D.-Side	9.6
Side Dist	6.6	2.1	94	Sid.-Clo.	7.8
Close Front	8.4	.9	109	Clo.-Clin.	1.4
Cl. Fist	8.1	1.9	96	Fr. D.-Clo	3.5

It was found that there was a great difference in the mean amplitudes for the front distant and the side distant fixation. There is also a great difference between the front close and the side distant. This indicates that there are portions of the eye that are more responsive to stimulation than others. Mention has already been made that Petersen and Allison (1931) found a difference in the inter-blink period when a subject is focusing distant and when focusing close. In this study it is seen that the amplitude of the wink is also affected. Fixation to the front, close to the eye, is not much different from front close while clinching the fist. The result is not statistically reliable so it cannot be definately said whether or not the difference is due to the clinching of the fist. As has been suggested before, there is an opportunity for further study on the effect of the emotions,etc., on the eye-wink and this last effect could well be studied in connection with the emotions.

TABLE IX


9
8
7
6
Amp. in ma.
Object was moved so as to focus the eyes in various ways. Also the effect of clinching the fist, on the eye-wink.
Front Distant
Side Distant
Front Close
Clinching Fist
Conditions subjected to.

SUMMARY

Studying the eye-wink of humans on the three "levels" (Intra-organic, Reflex, and Voluntary) it has been found:

1. Mental-arithmetic facilitates blinking while reading retards blinking.

2. The order of the time intervals is a factor that determines the results from the reflex wink. When practice effects are equated the results from the reflex substantiate the findings, on refractory phase, by Telford and Andersen (1931)

3. The voluntary-reinforced response is affected not only by the order of the time intervals but also by the rhythm of the stimulation. Rhythm operates to eliminate refractory phase in voluntary-reinforced responses.

4. There is no measurable effect, of breathing, on the eye-wink.

5. Fixation of the eyes to an object, placed in a different relative position to the eyes, gives a different magnitude of response.

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