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Short-long-term memory interaction with underlearned long term storage.

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SHORT- LONG-TERM MEMORY INTERACTION WITH UNDERLEARNED LONG TERM STORAGE

by

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INTRODUCTION

Many situations, both military and civilian, require S to compare immediately stored data with information contained in his long-term memory. For example, a reconnaissance pilot following a quick glimpse of terrain through cloud cover must compare what was seen with his prior knowledge of that terrain, its fortification, etc. In this type of situation, short-term memory is required to act as both a cue to recall data from long-term storage, and as a comparison with the data recalled.

Although a great deal of research has been invested in determining the factors which affect short- and long-term memories independently, almost nothing has been done to study their interdependence. Teichner (1963) has formulated an approach to the problem of studying the interaction of short- and long-term memory. Using slides containing normal alphabetic sequences, with some letters removed, causing gaps in the sequence, though not in the actual letter spacing, S was required to report the letters missing, following a brief exposure. It was found that as the number of gaps per slide, and the number of letters in these gaps increased, the percentage of correct reports decreased. Such results suggest that the effectiveness of extracting information from long-term memory may depend on short-term load.

In the Teichner (1963) study, the English alphabet represents overlearned long-term information. With such

information the experimental problem is not completely relevant to the kind of situation previously discussed, i.e., where S is briefed in advance or learns a code for a specific purpose, since in such cases, long-term memory is subject to loss, whereas overlearned information may suffer little memory loss. One purpose of this study therefore, was to reconsider Teichner's approach using less well learned information.

A second interest of the experiment concerned the payoff for correct reporting. Taub (1965) found that high reward symbols were more often recalled from short-term memory storage, than were symbols with low reward value. If this is the case, then reward value acting through short-term memory would affect recall when short-term memory cues long-term memory.

This experiment was an attempt to investigate the effect of reward upon the short- and long-term memory interaction when the long-term memory is not as highly learned as it has been in previous studies. The present study employed the Russian alphabet and systematically varied the ratio of reward for high- and low-valued symbols and the base rate at which these ratios were applied.

METHOD

Subjects: Twenty-four male and 24 female undergraduate students were used as Ss.

Apparatus: Slides containing white letters on a dark background were projected from behind S to a screen located 10 ft. in front of S. The total illuminated field was 30x46 in.; the projected characters were one in. high. Exposure times (shutter speed) and intertrial-intervals were controlled by Hunter interval timers.

The S sat in a chair with a writing arm and a small attached lamp. The lamp provided the only illumination in the room. During training, Ss responded by writing their reports on 8.5x11 in. paper. During the experimental session, Ss were supplied with 3x5 in. white unlined index cards on which to record their reports. The index cards had small holes punched in their upper left-hand corner and were mounted on a binder ring inserted in a 12x8 in. fiber board writing base. It was possible to turn the cards over on the ring one-at-a-time.

Training Procedure: Two to 6 Ss were seated on experimental chairs and the room made dark except for the chair lamps. Twenty-six slides, each containing one Russian character, were presented in random order for 15 sec. each. The Ss were instructed to write the symbols as they were presented. The 26 slides were then re-randomized and shown again for 5 sec. each. The Ss were then shown the complete sequence in its

proper order. Twenty slides, each containing 8-10 characters in their proper order were then presented for 20 sec. each. The Ss were then shown the entire sequence for a second time, instructed to write it out and study it carefully. The slide was then removed and the Ss were required to write the entire 26-symbol sequence correctly. The slide containing the entire sequence was flashed again and the Ss corrected their own paper. This procedure was repeated until all Ss had written the sequence twice correctly. Following training a 2 min. rest period was used to pass out experimental materials and change slides. During the entire training session, all timing was controlled manually.

Test Stimuli: The 144 slides serving as test stimuli contained the first 26 characters of the Russian alphabet. Each slide contained an alphabetic sequence of eight characters with gaps in the sequence caused by omitting letters. The 144 slides contained 12 slides from each of 12 categories depending on the total number of missing letters (3, 4, 5, or 6) and the total number of gaps in the sequence (1, 2, or 3). The slides were completely randomized and then divided into two sets of 72 slides each. Each set was put in a separate carousel. Slides were presented to all Ss in the same completely randomized order.

Experimental Design: A factorial design consisting of two payoff ratios (2:1, 4:1), and three base rate (5¢, 1¢, $5.00) prizes for best performance in group was employed. The payoff

ratio is defined as the relative value of a high-valued half of the 26 symbol sequence to a low-valued half. The base rate is defined as the unit of pay. For example, with a 2:1 ratio and a 1¢ base, a high-valued symbol was worth 2¢ and a low-valued symbol was worth 1¢. Each cell of the design contained 4 male and 4 female Ss. Gaps, Load, and Value were within-S variables. Rates, Base, and Sex were between S variables.

Test Session Procedure: Subjects sat in the same seats they used during training. Viewing angle and high-valued half of alphabet were balanced across sex and sessions. Instructions were read to Ss which described the task and method of responding. These instructions are presented in Appendix 3. Upon completion of instructions, S sat in the dark for 5 min. Each slide was then presented for one sec.. The slide presentation was followed by an 8.5 sec. period during which the chair lamps were automatically illuminated and S recorded his report of the missing letters. Following this, a warning buzzer was sounded; the lamps were automatically extinguished and S turned his card over on the ring and prepared to view the next slide 1.5 sec. later. The procedure was repeated until 72 slides were viewed. A 2 min. rest period followed during which the room was illuminated. Following this, Ss readapted to the dark for 5 min., and then a second, different series of 72 slides was presented.

Table 1.--Per Cent Correct as Related to Value, Sex, and Base Rate

	High Value			Low Value			
	$5	1¢	.5¢	$5	1¢	.5¢	$\bar{x}$
Male	24	27.7	29.5	22.5	16.5	15.5	22.8
	$\bar{x}_{\text{Male Hi}} = 27.6$			$\bar{x}_{\text{Male Lo}} = 18.2$			
Female	22.5	25.5	20.5	17.9	26.4	26.5	23.1
	$\bar{x}_{\text{Fem. Hi}} = 22.5$			$\bar{x}_{\text{Fem. Lo}} = 23.6$			
	$\bar{x}_{\text{Hi}} = 25.1$			$\bar{x}_{\text{Lo}} = 20.8$			

RESULTS

The data were analyzed with respect to the per cent of letters correctly identified as missing from the gaps. An analysis of variance of the arc sine transformation of these scores is provided in Table 1, Appendix 1.

None of the between-Ss variables was significant. The only significant effects indicated in Table 1, Appendix 1 were the main effects of Value ($p < .05$) and the Sex x Value interaction ($p < .05$). Table 1 which summarizes these effects and that of Base Rate, indicates that the high-valued symbols were reported with over four per cent greater accuracy than were the low-valued ones. The Sex x Value interaction may be seen by the finding that male Ss reported high-valued symbols with over nine percent great accuracy than they did low-valued ones whereas the accuracy of report of the female Ss was essentially unaffected by symbol value.

The Base Rate x Sex x Value interaction was also significant ($p < .05$). Inspection of Table 1 indicates that male Ss increased the correctness of their reports of high-valued symbols in the order of $5 prize, 1 cent per symbol payoff and .5 cent per symbol payoff. The order of correct reporting for male Ss was just the reverse for the low-valued symbols. The table also shows that the reports of female Ss tended to be most correct with 1-cent per symbol payoff; other than this females showed no trend.

Gaps and Load were also significant ($p < .01$) as was

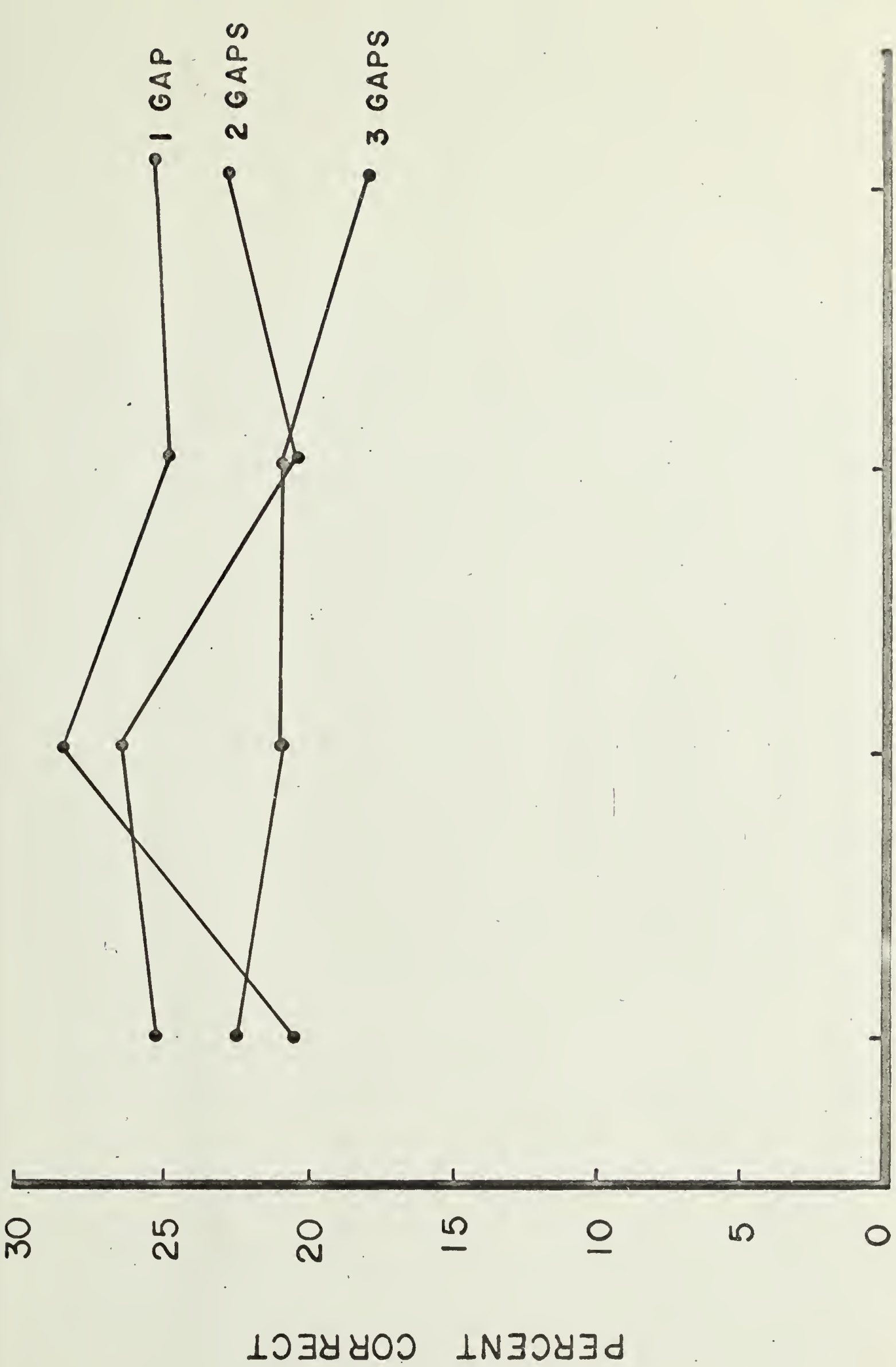

Fig. 1. Percent correct as a function of Gaps and Loads.

their interaction (p .01). These results are shown in Figure 1 which presents per cent correct as a function of gaps and of loads. The figure shows that the effects of load were very small and not entirely consistent although, in general, accuracy did tend to decrease as load increased. The figure also shows that excepting the first point of Gap 1 and the third point of Gap 2, per cent correct decreased as number of gaps increased.

The data were also analyzed with respect to two kinds of false alarm (FA). The first type, FA-on, consists of reports of letters which were on the slide but which were not among those in a gap. The second type, FA-off, are letters reported as missing from the gap, but which were actually outside of the entire sequence shown on the slide. Analyses of Variance were also done on these measures. For the analyses, the scores were transformed using a $f + 0.5$ transformation.

The results of the FA-on analysis is presented in Table 2, Appendix 1. None of the between-Ss variation was significant. There were significantly more FA-on reports with high-valued symbols than with low-valued symbols (p .05). The $\bar{x}$ of FA-on high-valued symbols was 1.89; for low-valued symbols it was 1.55.

The analysis of FA-on reports also showed that the effects of load were significant (p .01), and of Sex x Load (p .05). These effects are shown in Table 2, where it may be seen that Ss give fewer FA-on reports as load

Table 2.--Mean Number of FA-ons as Related to Sex and Load

	Load			
	3	4	5	6
Male	2.20	1.33	1.65	1.37
Female	2.01	2.01	2.00	1.57
$\bar{x}$	2.11	1.67	1.83	1.47

Table 3.--Mean Number of FA-ons as Related to Sex, Load, and Base

	Load				
	3	4	5	6	Base
Male	2.97	1.65	1.56	1.35	.5¢
Female	1.95	1.54	2.50	1.87	
Male	2.35	1.40	2.23	1.65	1¢
Female	2.65	2.55	2.50	1.58	
Male	1.76	1.28	1.55	1.38	$5
Female	2.36	2.17	1.96	1.50	
Mean Male	2.36	1.44	1.78	1.46	
Mean Female	2.32	2.09	2.32	1.65	
Mean-Male-Female	2.34	1.77	2.05	1.56	

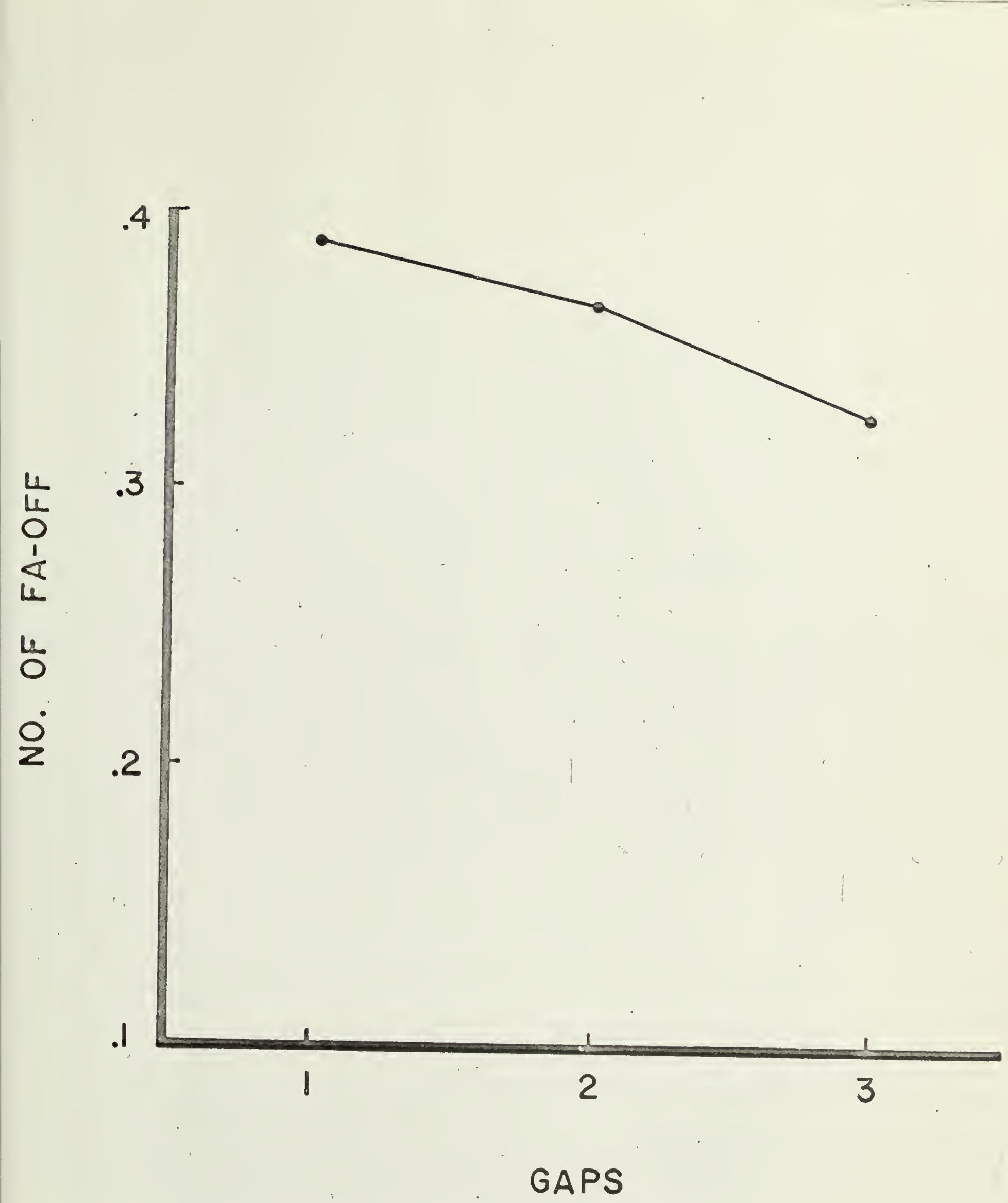

Fig. 2. Number of false-alarm-off reports as a function of Gaps. (Data plotted without omitted S. See Appendix 2 for his data.)

increases. Except at Load 3 females gave more FA-on reports than did males. Table 3 shows the interaction of Base x Sex x Load, although significant, exhibited no trend.

The final measure analyzed was of FA reports which were not on the slide. The analysis of variance of these data is shown in Table 3, Appendix 1. One S gave markedly more high-valued FA-off reports than the other Ss. These scores were included in the statistical analysis, but the figures were plotted without them. For data on the omitted scores (one S, high-valued FA-off reports) see Appendix 2.

As with the previous two measures, the analysis of FA-off reports showed no significant between-S effects. The analysis did show that the effects of Gaps were significant ($p < .01$), of Load ($p < .01$) and of Value x Gap x Load ($p < .01$). The effects of Gaps are shown in Figure 2 where it may be seen that there was a consistent decline in FA-off reports as the number of gaps increased. Inspection of figures with and without data from the omitted S show similarity in their shape. The effects of Load are shown in Figure 3 where it may be seen that as the number of letters missing increased, fewer FA-off reports were given. The trend with and without the omitted S is the same.

The analysis presented in Table 2, Appendix 1 showed Value x Gap x Load to be significant ($p < .01$). The effects of this interaction are presented in Figure 4. Inspection of this figure shows that at Gap 1 and 2, except for the smallest load, slightly more FA-off reports occurred with

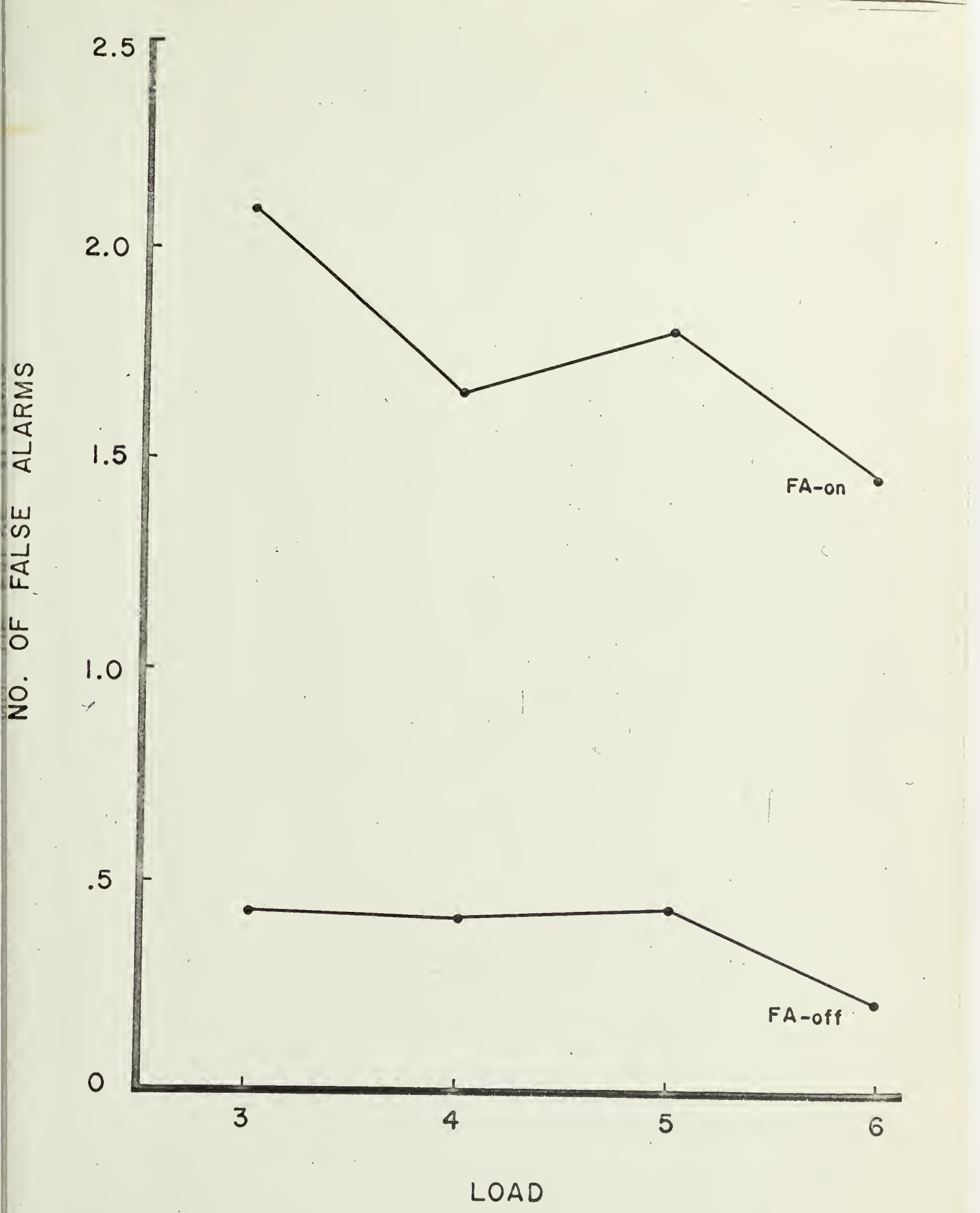

Fig. 3. Number of false-alarms plotted as a function of Loads.

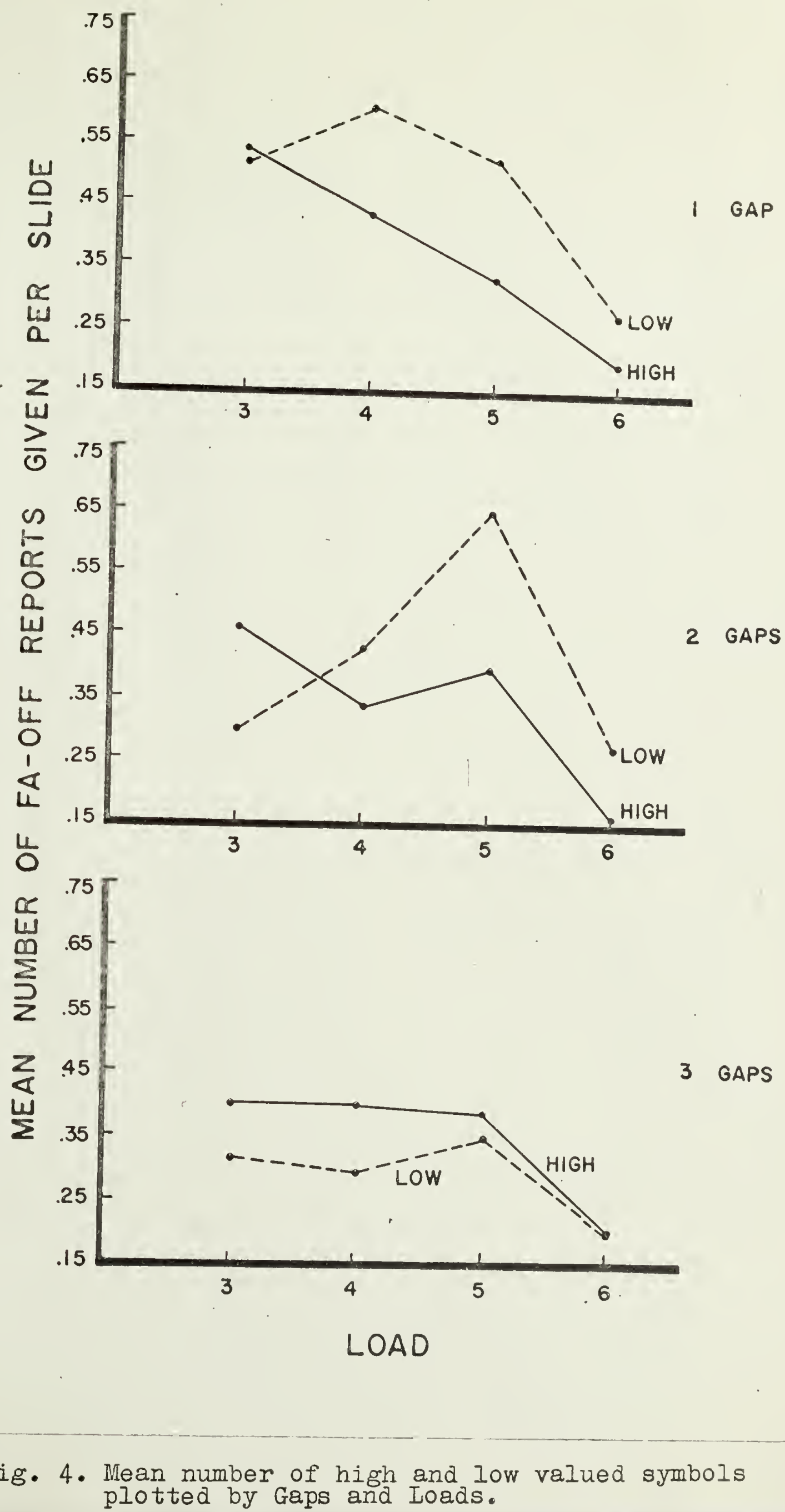

Fig. 4. Mean number of high and low valued symbols plotted by Gaps and Loads.

the low-valued symbols whereas the opposite effect was obtained for 3-Gap displays. As a result of the exception noted, FA-offs were always slightly greater at the smallest load for high-valued symbols. The figure also shows that, in general, the number of FA-offs decreased with increasing load. The greatest exception to this decrement is shown as the low-valued report for Gap 2 where, it may be seen, this report increased to Load 5 and then dropped sharply.

DISCUSSION

The results confirm those of Teichner (1963) in showing an inverse relationship between per cent of correctly-reported letters and number of gaps and between percentage correct and load. As with his study, these effects were small as compared with more conventional studies of load effects (Sperling, 1960). The data extend the previous work with gaps by showing that load also affects false alarms. This is in agreement with the results of Teichner, Reilly and Sadler (1961) which showed that errors of commission decreased as load increased. Thus, as far as the short- and long-term memory interaction is concerned, the results suggest that load, whether in terms of missing letters within gaps or in terms of number of gaps, introduces no effect not previously reported from studies of short-term memory.

No effect due to size of payoff or ratio was found. Such results are consistent with the findings of Christ (1965) in a more conventional study in that payoff and ratio had no effect upon overall number of correct reports. Christ also analyzed initial reports and found no effect due to ratio or payoff. The effect which ratio has upon the short-long- term memory cannot, however, be dismissed. Although ratio was significant in the Taub (1965) study, Taub found little difference between high- and low-valued symbol recall in comparing his 2:1 and 4:1 ratios. We actually found a larger effect over the same range. His significant overall

effect of ratio was, presumably, due to the still higher ratios which he employed (8:1 and 16:1). Our failure to get significance with the ratio or size of payoff variables was most likely due to the closeness of the ratios employed. Thus, although the results suggest that with a less highly learned long-term memory than used in previous studies, the value of a symbol is a factor influencing Ss report. The results are inconclusive as to whether the value is a function of ratio or not.

The interaction of Sex with the other variables employed suggests that women may be more highly motivated by the certainty of a reward than by the uncertainty associated with competing for a prize. On the same basis men would seem to be more highly motivated by competition. With respect to FAs, men appear to be more affected by Load than are women. The results also suggest the possibility that men become more selective as load increases and tend to make fewer errors than women since the number of male FA-on reports dropped quickly as load increased, while the female FA-on reports stayed at a higher level.

If S is in error in his recall of the position of a gap, he could make false reports even though his long-term memory were perfect. This seems like the simplest way to interpret FA-on reports, that is, as a miscuing of long-term memory. Conversely, FA-off reports can be interpreted as instances of correct cuing of the long-term memory, so that

the error must result from inadequate long-term storage. The results show that both kinds of error occur, but since the predominant one was of FA-on, the data suggest that short-term memory is the greater source of error for the task employed. This suggests that of the two factors which influence cuing, short-term memory may be more important to understand and control in situations which require that S compare briefly-seen data with long-term memory.

SUMMARY AND CONCLUSIONS

Twenty-four male and 24 female Ss were divided into six groups containing an equal number of each sex. The Ss were taught the first 26 characters of the Russian alphabet in their proper sequence. The Ss then reported the contents of a series of 144 briefly-exposed slides which contained letter sequences with gaps in alphabetic, but not physical sequence. The number of gaps per slide and the number of letters missing per slide were varied in the same way for each group. Each group was assigned to one cell of a 2x3 factorial design where the variables were base rate (.5¢, 1¢ or $5 prize for best performance) and ratio of high half to low half of the sequence (2:1 or 4:1). Consideration of the results suggest the following conclusions:

1. There is an inverse relationship between per cent of correctly reported letters and number of gaps and between percentage correct and load.

2. A decrease in FA reports is associated with an increase in number of missing letters.

3. Differential value of symbols affects the accuracy of S's report.

4. Women may be more highly motivated by certainty of reward, while men may be more highly motivated by competition.

5. The majority of errors come from short-term memory. Therefore to increase efficiency in reconnaissance and

related tasks, improvement of short-term memory will have a greater effect upon performance, than will improvement of long-term storage.

6. In general, the same results are found when a less highly learned long-term storage is involved as have been obtained from previous studies, which used more highly learned materials.

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APPENDIX 1

ANALYSES OF VARIANCE TABLES

Table 1.--Analysis of Variance Performed on Per Cent Correct Data

SV	df	MS	F
Between	47		
Ratio (R)	1	0.306	.181
Base (B)	2	0.290	.171
Sex (S)	1	0.001	.001
R x B	2	0.642	.379
R x S	1	0.179	.106
B x S	2	0.383	.226
R x B x S	2	0.087	.051
SS/GPS	36	1.694	
Within			
Value (V)	1	2.961	4.944*
R x V	1	.007	
B x V	2	.013	
S x V	1	2.913	4.863*
R x B x V	2	.046	
R x S x V	1	.383	
B x S x V	2	2.474	4.131*
R x B x S x V	2	1.187	1.982
V x SS/GPS	36	.599	
Caps (G)	2	.992	9.793**
R x G	2	.192	1.892
B x G	4	.099	
S x G	2	.112	1.104
R x B x G	4	.113	1.116
R x S x G	2	.113	1.116
B x S x G	4	.198	1.959
R x B x S x G	4	.078	
G x SS/GPS	72	.101	
Load (L)	3	.428	5.541**
R x L	3	.034	
B x L	6	.074	
S x L	3	.010	
R x B x L	6	.042	
R x S x L	3	.069	
B x S x L	6	.012	
R x B x S x L	6	.035	
L x SS/GPS	108	.077	
V x G	2	.233	1.460
R x V x G	2	.145	
B x V x G	4	.075	
S x V x G	2	.240	1.504
R x B x V x G	4	.0965	
R x S x V x G	2	.062	
B x S x V x G	4	.023	

*p .05.
**p .01.

Table 1.--Continued

SV	df	MS	F
R x B x S x V x G	4	.180	1.128
V x G x SS/GPS	72	.15954	
V x L	3	.063	
R x V x L	3	.066	
B x V x L	6	.101	1.509
S x V x L	3	.053	
R x B x V x L	6	.050	
R x S x V x L	3	.318	4.751**
B x S x V x L	6	.049	
R x B x S x V x L	6	.043	
V x L x SS/GPS	108	.06694	
G x L	6	.271	3.41869**
R x G x L	6	.071	
B x G x L	12	.030	
S x G x L	6	.030	
R x B x G x L	12	.059	
R x S x G x L	6	.038	
B x S x G x L	12	.024	
R x B x S x G x L	12	.090	1.13536
G x L x SS/GPS	216	.07927	
V x G x L	6	.0190	
R x V x G x L	6	.0488	
B x V x G x L	12	.06041	
S x V x G x L	6	.008	
R x B x V x G x L	12	.1085	1.6308
R x S x V x G x L	6	.025	
B x S x V x G x L	12	.0736	1.10626
R x B x S x V x G x L	12	.10725	1.61205
V x G x L x SS/GPS	216	.06653	

*p .05.
**p .01.

Table 2.--Results of Analysis of Variance Performed on FA-on Data

SV	df	MS	F
Between	47		
Ratio (R)	1	.360	
Base (B)	2	.940	
Sex (S)	1	2.666	
R x B	2	4.281	1.253
R x S	1	8.379	2.452
B x S	2	.535	
R x B x S	2	1.088	
SS/GPS	36	3.417	
Within			
Value (V)	1	7.344	4.246*
R x V	1	.040	
B x V	2	1.949	1.127
S x V	1	1.162	
R x B x V	2	1.938	1.121
R x S x V	1	1.585	
B x S x V	2	1.407	
R x B x S x V	2	.733	
V x SS/GPS	36	1.729	
Caps (C)	2	.435	1.825
R x C	2	.156	
B x C	4	.369	1.549
S x C	2	.067	
R x B x C	4	.131	
R x S x C	2	.095	
B x S x C	4	.156	
R x B x S x C	4	.805	3.377*
C x SS/GPS	72	.239	
Load (L)	3	3.027	13.163**
R x L	3	.256	1.114
B x L	6	.208	
S x L	3	.625	2.717*
R x B x L	6	.261	1.134
R x S x L	3	.062	
B x S x L	6	.879	3.824**
R x B x S x L	6	.187	
L x SS/GPS	108	.230	
V x C	2	.023	
R x V x C	2	.030	
B x V x C	4	.142	
S x V x C	2	.959	2.00
R x B x V x C	4	.502	1.05

*p .05.
**p .01.

Table 2.--Continued

SV	df	MS	F
R x S x V x G	2	.164	
B x S x V x G	4	.045	
R x B x S x V x G	4	.828	1.730
V x G x SS/GPS	72	.4785	
V x L	3	.102	
V x L x R	3	.639	2.439
B x V x L	6	.110	
S x V x L	3	.475	1.814
R x B x V x L	6	.112	
R x S x V x L	3	.085	
B x S x V x L	6	.665	2.539
R x B x S x V x L	6	.322	1.267
V x L x SS/GPS	108	.26194	
G x L	6	.376	1.843
R x G x L	6	.111	
B x G x L	12	.257	1.260
S x G x L	6	.214	1.05
R x B x G x L	12	.263	1.289
R x S x G x L	6	.236	1.157
B x S x G x L	12	.176	
R x B x S x G x L	12	.207	1.01
G x L x SS/GPS	216	.204	
V x G x L	6	.180	
R x V x G x L	6	.095	
B x V x G x L	12	.153	
S x V x G x L	6	.672	2.772*
R x B x V x G x L	12	.189	
R x S x V x G x L	6	.204	
B x S x V x G x L	12	.131	
R x B x S x V x G x L	12	.243	1.003
V x G x L x SS/GPS	216	.242	

* p .05.
** p .01.

Table 3.--Results of Analysis of Variance Performed on PA-off Data

SV	df	MS	F
Between	47		
Ratio (R)	1	2.336	
Base (B)	2	6.745	1.017
Sex (S)	1	11.480	1.731
R x B	2	7.717	1.164
R x S	1	.288	
B x S	2	9.500	1.433
R x B x S	2	5.511	
SS/GPS	36	6.631	
Within			
Value (V)	1	5.007	
R x V	1	6.038	
B x V	2	9.894	1.456
S x V	1	5.887	
R x B x V	2	7.213	1.061
R x S x V	1	9.923	1.460
B x S x V	2	9.475	1.394
R x B x S x V	2	4.302	
V x SS/GPS	36	6.795	
Gap (G)	2	.365	3.867
R x G	2	.045	
B x G	4	.041	
S x G	2	.229	2.426
R x B x G	4	.082	
R x S x G	2	.087	
B x S x G	4	.201	2.129
R x B x S x G	4	.031	
G x SS/GPS	72	.094	
Load (L)	3	.890	8.337**
R x L	3	.179	1.677
B x L	6	.025	
S x L	3	.014	
R x B x L	6	.051	
R x S x L	3	.009	
B x S x L	6	.055	
R x B x S x L	6	.101	
L x SS/GPS	108	.107	
V x G	2	.016	
R x V x G	2	.097	
B x V x G	4	.058	
C x V x G	2	.153	1.341
R x B x V x G	4	.149	1.306

* p .05.
**p .01.

Table 3.--Continued

SV	df	MS	F
R x S x V x G	2	.010	
B x S x V x G	4	.112	
R x B x S x V x G	4	.210	1.841
V x G x SS/GPS	72	.114	
V x L	3	.260	
R x V x L	3	.105	
B x V x L	6	.038	
S x V x L	3	.165	
R x B x V x L	6	.088	
R x S x V x L	3	.040	
B x S x V x L	6	.431	1.310
R x B x S x V x L	6	.096	
V x L x SS/GPS	108	.329	
G x L	6	.090	1.046
R x G x L	6	.128	1.487
B x G x L	12	.117	1.359
S x G x L	6	.061	
R x B x G x L	12	.086	
R x S x G x L	6	.240	2.788*
B x S x G x L	12	.065	
R x B x S x G x L	12	.083	
G x L x SS/GPS	216	.086	
V x G x L	6	.062	19.333**
R x V x G x L	6	.098	16.333**
B x V x G x L	12	.108	18.000**
S x V x G x L	6	.147	24.500**
R x B x V x G x L	12	.243	40.500**
R x S x V x G x L	6	.120	20.000**
B x S x V x G x L	12	.077	12.833**
R x B x S x V x G x L	12	.129	21.500**
V x G x L x SS/GPS	216	.006	

*p .05.
**p .01.

APPENDIX 2

DATA FOR OMITTED SUBJECT

Data for Omitted Subject

Table 4

	Gaps		
	1	2	3
Mean Number of High-Valued FA-off Reports	62	65.5	62.75

Table 5

	Loads			
	3	4	5	6
Mean Number of High-Valued FA-off Reports	61.67	65.00	65.67	61.33

APPENDIX 3

INSTRUCTIONS

"You are serving in an experiment which shall measure a person's ability to determine the symbols left out of a sequence, when the sequence is presented for a short period of time.

"You have all received training in the recognition of 26 symbols in a prescribed sequential order. You shall be presented with slides which will show sequences of these symbols in the same order that you have learned them. In all cases symbols shall be left out. You are to report which symbols are omitted by writing them on the index cards in front of you. There may be one or more symbols left out, and there may be one or more gaps.

"After you have finished writing, turn the card over on the ring, and be ready to view the next slide. Repeat the procedure for each slide. If you are not able to report anything put a big X on the card, turn to the next card and be ready to view the following slide.

"After the slide is presented, you will be allowed 8.5 seconds to write your report. At the end of this period, you will hear a buzzer to direct you to stop writing. You are then to attend to the screen, and prepare yourself for the next slide. For subjects 1, 3, and 5, the last thirteen symbols of the sequence shall be worth more than the first thirteen. For subjects 2, 4, and 6, the first thirteen shall be worth more. The symbols in the high payoff half of the sequence shall be worth (two times, four times) as much as symbols in the low payoff half.

"The base rate is (1¢, 1/2¢). This means that a low-valued symbol is worth (1/2, 1) cent, and a high-valued symbol is worth (two, four) times as much."*

*In place of this paragraph, the $5.00 bonus group was instructed:

"You are members of a group of eight subjects. The person in this group who amasses the highest number of points will receive a $5.00 bonus."

Approved: _____

_____

_____

_____

_____

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Date: _____