THE EFFECT OF MAGNITUDE OF REWARD AND INTERTRIAL INTERVAL ON THE ACQUISITION OF A DISCRETE TRIAL LEVER PRESS RESPONSE

A Dissertation

Presented to

the Faculty of the Department of Psychology

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

By

Donald T. Williams

May, 1969

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Abstract

This study examined the effect of regular patterns of reward and ITI on acquisition. 4 groups of 20 rat Ss were given 13 trials a day for 6 days. There were 2 schedules of reward (CRF and VRF), 2 lengths of ITI (15 and 60 sec.), and 2 values of reward (1 and 8 45 mg pellets). The rewards in the VRF groups and the ITI for all groups were presented in single alternation. A significant (alpha = .05) response decrement occurred on trials following a large reward and a short ITI. This decrement was present on the first and last days of training and did not appear to change over days and was independent of schedule of reward. It was concluded that the decrement was unconditioned and not the product of differential conditioning and therefore is a serious source of confoundment in pattern learning experiments.

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Introduction

A series of recent (unpublished) experiments in the Texas Research Institute of Mental Sciences (TRIMS) has examined pattern responding in rats using regular partial reinforcement and regular varied reinforcement in the discrete trial lever press conditioning situation. Schedules of partial and varied reinforcement both involve the presentation of different amounts of reward on different trials. Varied reinforcement (VRF), as introduced into the literature by Logan (Logan et al, 1955), means different but nonzero amounts of reward, whereas partial reinforcement (PRF) is the situation in which some trials are nonrewarded or receive zero amount. Continuous reinforcement (CRF) is defined as the same nonzero value of reward on all trials. A regular schedule is one in which some sequence is repeatedly presented. Examples of this would be single alternation of rewarded (R) and nonrewarded (N) trials (i. e., RNRNRNR...) or double alternation (i. e., RRNNRRNNR...) of reward schedule.

When partial reward is used in a single alternation schedule (SA), rat subjects (Ss) will learn to pattern respond. Pattern responding means that the S will respond rapidly on the rewarded trial and slowly on the nonrewarded trial. This also means that with the SA schedule the Ss will respond rapidly on trials following nonreward (TFN) and slowly on trials following reward (TFR). That is, a single alternation of fast and slow responding. (Capaldi, 1967)

The recent studies in the TRIMS laboratory have examined pattern responding as a function of partial and varied reward schedules in the discrete lever press apparatus. These studies extended the work reported by Gonzales, Bainbridge and Bitterman (1966) who found pattern responding in the discrete lever press situation using partial reward. Gonzales et al (1966) used one and zero pellet reward on an SA schedule in one experiment and six and zero pellets in another experiment and found evidence of pattern responding in both cases, but the patterning was not very clear in the experiment that used one and zero pellets. They concluded that when one pellet is used an alternating schedule produces very little patterning in acquisition, but when the number of pellets in increased to six patterning is accentuated.

In the first experiment of the series at the TRIMS laboratory two groups of rat Ss were given training in a retractable lever apparatus under either SA varied or SA partial reward. The partial reward group (5-0) received five 45 mg pellets for a lever press on every other trial, while the remaining trials were nonrewarded. The varied group (5-1) also received five pellets on alternate trials, but the remaining trials were rewarded with one pellet. In both groups only a lever press was rewarded: failure to respond was not rewarded. As training progressed all Ss began to pattern respond, showing a significant difference between response times on five and zero trials and five and one trials for the partial and varied groups respectively. There was also a significant difference between the response times on the

zero and one-pellet trials, with response times being slower on zero than on one-pellet trials. But there was no significant difference between the five-pellet trials.

At the end of acquisition training each group was divided into three matched subgroups: a control group maintained on the same schedule, an extinction group which did not receive any further reward, and a transfer group that was switched to the other group's schedule. The group transferred from 5-1 to 5-0 showed a gradual increase in response times (i. e., responded slower) on the nonrewarded trials, and the group transferred from 5-0 to 5-1 showed a gradual decrease in response times (i. e., responded faster) on one-pellet trials. Responding on five-pellet trials was unaffected by the transfer. Thus it was assumed that response level in SA pattern responding is a positive absolute function of the amount of reward on a particular trial.

A subsequent experiment was run in which group 8-1 received eight and one 45 mg Noyes pellets in an SA schedule, group 8-4 received eight and four pellets and group 4-1 received four and one pellets. All groups developed appropriate response patterning; and, as in the first experiment, patterning was more pronounced the larger the difference in the two reward values. Responding during the terminal sessions of acquisition on the one-pellet trials was slower in the 8-1 than in the 4-1 group. However, there was no difference in responding on eight-pellet trials in the 8-1 and 8-4 groups. An additional analysis including the four-pellet trials in the 4-1 group, eight-pellet trials in the 8-1 group, and eight-pellet trials in the 8-4 group also

showed no difference. Thus, the response on the small reward trial of the alternating pair of rewards was related to the amount on the large reward trial. A replication of these groups confirmed these results.

These findings prompted the reexamination of the results of another study which had followed the first experiment. This particular study had been terminated because of apparatus difficulties. The experiment had eight groups and only five Ss per group. The groups received the following SA schedules: 8-0, 4-0, 8-1, 8-4, 4-1, 8-8, 4-4, and 1-1 (in which the first digit indicates the number of pellets on the odd trials and the second digit indicates the number of pellets on the even trials). Although the partial and varied reward groups pattern responded, the level of responding on a given trial in the varied reward groups appeared to be related to the magnitude of reward on the prior trial. This conclusion was further supported by examination of the responding of the CRF groups. Both PRF groups had more pronounced pattern responding than any of the VRF groups.

It is noteworthy to mention that the pattern responding in the three subsequent studies did not appear to be as pronounced as that of the partial and varied groups in the first study, and patterning appeared to occur later in acquisition even though a larger magnitude of reward (eight pellets) was used in some groups. One important difference between the first study and the subsequent three was the intertrial intervals (ITIs) employed. In the first study two values of ITI, 15 and 45 sec., were randomly presented. That is, half of the TFR also followed

a 15 sec. ITI. In the three following studies the ITI was randomly varied between 20 and 40 sec. in steps of two sec. That is, 9% of the TFR also followed a 20 sec. ITI, 9% followed a 22 sec. ITI, 9% followed a 24 sec. ITI, etc. Thus, in all experiments there was an average ITI of 30 sec., although the individual ITI following a given reward varied considerably. It follows then that if the ITI affects responding on TFR this could explain the difference in pattern responding between these experiments.

Thus, part of the evidence from the studies at the TRIMS laboratory using the discrete trial lever press situation have indicated that responding on a given trial is influenced by the value of reward on the prior trial. Specifically, the larger the reward on the prior trial the greater the response decrement, that is, the slower the S responds. Further, this effect appears to be influenced by the ITI: the shorter the ITI the greater the decrement.

Wall and Goodrich (1964) reported that when rats are trained in a discrete lever press apparatus with regular schedules of reward, such as regular 33 1/3% reward, i. e., NNRNNR..., or regular 25% reward, i. e., NNNRNNNR..., that latencies were shorter on non-rewarded trials closer to the next rewarded trial and shortest on the rewarded trial. That is, latencies were longer on nonrewarded trials that immediately followed a rewarded trial than on later nonrewarded trials. Similarly, Collier and Siskel (1959), using lever press rate in the Skinner box as the indicant measure, varied interreinforcement interval (.5, 1, 2,

and 4 min.) and sucrose concentration (4, 8, 16 and 32%) and found that performance is an increasing function of sucrose concentration for the long intervals and a nonmonotonic function for short intervals. Specifically, there appeared to be a response decrement when large concentrations and short intervals were used. The Gonzales, Bainbridge and Bitterman (1966) study had two magnitudes of CRF (six and one pellets), one lever press as the response, and a 65 sec. ITI. They found no difference in responding on the six-pellet trials and on the one-pellet trials.

The present study examines these variables and their interaction more directly than has been done previously. That is, the previous studies examined either the effect of magnitude of reward or intertrial interval on a discrete trial lever press response, but not the combination of these factors within any one study. The only study that examined both the effect of magnitude of reward and intertrial interval was the Collier and Siskel (1959) study, but they used an interreinforcement interval and a lever press rate and not a discrete trial lever press response. In this experiment both large and small values of reward were used and both long and short ITIs were used. Further, the reward variable is varied both within and between Ss. Half of the Ss received a CRF schedule, with either large or small reward. The other half of the Ss received a VRF schedule of large and small reward. All of the Ss received half of their trials following a short ITI and half of their trials following a long ITI.

Half of the Ss on the VRF schedule were trained with the short ITI following the large reward and preceding the small reward. The other half of the VRF Ss were trained with the short ITI following the small reward and preceding the large reward. The following questions are answered by this experiment: Is response decrement a function of a large reward on the prior trial? Is there more response decrement when a briefer ITI is used? Do the ITI and magnitude of reward combine to produce even more response decrement?

Methods and Design

Subjects. The Ss were 80 90- to 120-day old experimentally naive, male albino rats obtained from the Berkeley Pacific Laboratories.

Apparatus. All training took place in two similar operant conditioning apparatuses (Scientific Prototype # A - 100 with retractable levers). Half of the Ss from each group were trained in each chamber. The apparatus was contained within a light-proof and sound-resistant chamber (Scientific Prototype # 150) which was cooled by a baffeled blower which also provided a background masking noise. Foringer electromechanical equipment was used to make the entire experimental procedure fully automated, and all control equipment was maintained on a rack outside the chambers.

Design. The design, shown in Table 1, included two schedules of reward, CRF (groups R and r) and SA VRF (groups VRF - I and VRF - II): two values of reward, eight and one 45 mg Noyes pellets: and two values of ITI, a short 15 sec. interval and a long 60 sec. interval which were also presented in SA. Thus, there were four groups: group R, an eight-pellet group with both long and short ITIs; group r, which was a one-pellet group with both long and short ITIs; group VRF - I, a VRF group which had the short ITI following the eight-pellet trials and the long ITI following the one-pellet trials; and group VRF - II, a VRF group which had the long ITI following

the eight-pellet trials and the short ITI following the one-pellet trials. Half of the Ss in the CRF groups had the short ITI between trials one and two and the remaining half of the Ss had the long ITI between trials one and two. Trial one for the VRF groups always had the largest reward available on the given schedule.

Procedure. The Ss were placed on a 23 hr. food deprivation schedule two weeks prior to training and handled the last three of these days. Water was available at all times. There were four days of pretraining. The first day of pretraining the Ss were allowed to explore an empty Skinner box, without the lever, for five min. The second and third days the food cup was baited with the appropriate number of pellets (eight for group R, one for group r, and one on one day and eight on the other day for groups VRF - I and VRF - II) and the Ss were allowed in the box for ten min. During this ten min. period on days two and three the Ss were awarded six presentations of reinforcements without the lever being in the cage (again with the appropriate values, at irregular intervals). On day four the Ss were put in the Skinner box and the lever was extended into the chamber. The lever remained in the chamber until the S emitted ten lever presses, each of which was rewarded with the appropriate number of pellets.

Following the pretraining the Ss were given 13 trials a day for six days of acquisition training. Each trial was discrete in that the lever was extended into and retracted from

the cage on each trial. Any attempt by the S to depress the lever as it was extended into the cage had no effect as the apparatus was set to activate only when the lever was fully extended into the cage. The timing also began as soon as the lever was fully extended into the cage. The indicant measure was latency of the lever press response in tenths of a second. Either a response or 60 sec. elapsing without a response constituted a trial. At the end of a trial the lever was retracted out of the cage. The ITI began with the termination of a trial.

Table 1

Group	Ss	Acquisition															
		Trials	1	ITI	2	ITI	3	ITI	4	ITI	//	ITI	11	ITI	12	ITI	13
R (CRF)	10		8	15	8	60	8	15	8	60	...	60	8	15	8	60	8
	10		8	60	8	15	8	60	8	15	...	15	8	60	8	15	8
r (CRF)	10		1	15	1	60	1	15	1	60	...	60	1	15	1	60	1
	10		1	60	1	15	1	60	1	15	...	15	1	60	1	15	1
VRF - I	20		8	15	1	60	8	15	1	60	...	60	8	15	1	60	8
VRF - II	20		8	60	1	15	8	60	1	15	...	15	8	60	1	15	8

Summary of the experimental design. The digits in the trials columns indicates the number of 45 mg pellets reward available on that trial. The digits in the ITI columns indicates the number of seconds between trials.

Results

All of the scores, the response latencies, were transformed to logarithms: log (10 X). Because the major interest of this study is examining responding on trials following a specified reward and following a specified ITI, the first trial of the day, which has no immediate preceding condition, has been excluded from the analysis. Thus, the analysis involves trials two through 13 on each day.

The course of acquisition is shown in Figure 1. Responding appears to become progressively more rapid for the small reward CRF group, group r, and for the VRF - II group, which were the groups that had the short ITI following the small reward. Groups R and VRF - I, which were the groups that had the short ITI following a large reward, show little, if any, decrease in response latency during training. Figure 2 shows the responding of these four groups on the trials following the short ITIs separately from the trials following the long ITIs. Thus, each plot shows responding following a specific reward and ITI combination.

The two groups, r and VRF - II, that showed a progressive decrease in response latency for overall responding in acquisition, shown in Figure 1, do not appear to respond differentially on trials following short ITIs (TFS) and trials following long ITIs (TFL). However the other two groups, R and VRF - I, evidenced longer latency responding on TFS than on TFL. To test for differences between these four groups and for differences in responding on TFS and TFL, a 2 X 4 analysis of variance was

performed on the data (Winer, 1962) and is shown in Table 2a. Alpha was set at .05 for all analyses. The groups did differ from each other, responding was slower on TFS than TFL, and there was a significant interaction between groups and ITI. It would appear from Figure 2 that this interaction reflected a response decrement on TFS that is confined to groups R and VRF - I. To test this conjecture about the nature of this interaction, three subsequent analyses were performed and these are shown in Tables 2b, 2c, and 2d.

A 2 X 2 analysis of variance, Table 2b, comparing amount of reward and ITI within the CRF schedule was performed. That is, group R versus group r and TFS versus TFL. Responding was slower on trials following large reward (TFR) than on trials following small reward (TFr) and was slower following short than long ITIs and responding was slowest following both short ITI and a large reward (TFS/TFR). The nature of this interaction is depicted in Figure 3. It is clear from Figure 3 that the decrement on TFS is confined to group R.

Because there is an order effect that would confound a 2 X 2 factorial analysis of the VRF groups, it was decided to run two separate analyses which would test the sequences of (TFS/TFR) versus (TFL/TFr) for group VRF - I, Table 2c, and (TFS/TFr) versus (TFL/TFR) for group VRF - II, Table 2d. Only in the varied group (VRF - I) where trials followed both a short ITI and a large reward did differential responding occur. The varied reward group (VRF - II) that had large reward trials

followed by a long ITI showed no decrement on these trials relative to responding on trials following small reward and a short ITI. The VRF - II group evidenced no pattern responding. These three analyses confirm the conjecture that the significant Group X ITI interaction in the overall analysis reflected response decrement on TFS that was confined to groups R and VRF - I.

The results are quite straightforward: response decrement occurred on trials following the combination of a large reward on the prior trial and a short ITI. And further, that this decrement is independent of the amount of reward to be received on the trial in question. That is, this decrement occurs both in the continuous and varied schedules. In both groups R and VRF - I the combination of TFS/TFR was presented in single alternation with another combination (TFL/TFR and TFL/TFr respectively) and the response decrement following TFS/TFR resulted in pattern responding for both groups R and VRF - I. Pattern responding is defined simply as a single alternation of fast and slow responding.

The response differential between TFS and TFL is plotted for each of the four groups in Figure 4. This difference in mean log latency score is obtained by subtracting the latencies on TFL from the latencies on TFS. A zero score indicates no differential responding. Response decrement on TFS relative to TFL, and consequently pattern responding, is shown by positive difference scores. It can be seen from Figure 4 that there is little or no indication of differential response decrement for group r or group VRF - II. However, the other two groups, R

and VRF - I, have high difference scores. The difference scores of these two groups do not appear to differ from each other: the curves cross each other almost as many times as there are days and the levels of the difference scores do not appear to show any systematic change over days. This would indicate that the response decrement was present throughout training. With this consideration in mind it was decided to examine the first and last days of acquisition to determine whether the response decrement following TFS and TFR was evident at the beginning and at the end of acquisition. The same sets of analyses were performed on the first and last days of acquisition as were performed on the total acquisition data.

The analyses for day one are summarized in Tables 3a, 3b, 3c, and 3d. The response latencies for day 1, plotted separately for TFS and TFL, are shown in Figure 5. It will be noted that the data are plotted across six trials. For each S on each day there were only six trials which were TFS (the odd trials for half the Ss and the even trials for the remaining half of the Ss) and six trials which were TFL. Thus the data for TFS and TFL are plotted along the same abcissa points. If the response latencies for day one, depicted in Figure 5, are compared with the responding throughout acquisition, shown in Figure 2, it is clear that the groups are similarly aligned but there seems to be more variability on the first day. The overall analysis, the CRF schedule analysis, which compared amount of reward and ITI, and the separate VRF - I and VRF - II analyses show this to be

true. The interaction of magnitude and ITI for the CRF group is shown in Figure 6. Thus, on day one of acquisition the interaction of short ITI and large reward on the prior trial produced response decrement on the current trial in the CRF schedule. Similarly, with the VRF groups only the group which had TFS combined with TFR on the same trials showed response decrement. Figure 7 shows the within groups difference scores for day one. Again, if this is compared with the total acquisition data, shown in Figure 4, the comparability is clear.

The analysis of the last day of acquisition yields essentially the same results as the analysis of total acquisition. These results are summarized in Tables 4a, 4b, 4c, and 4d. The responding of the four groups on TFS and TFL is depicted in Figure 8. The interaction of magnitude of reward and ITI for the CRF groups is shown in Figure 9. The differential responding for the four groups on day six is shown in Figure 10. The results then, are that the immediate response decrement following a large reward trial occurred at the beginning as well as at the end of acquisition.

To summarize the results: response decrement occurred following a large reward trial and a short ITI. This decrement was diminished on trials following a large reward and a long ITI. It was also absent on trials following a small reward with either a long or short ITI. And the reward value, large or small, on the current trial did not systematically effect this decrement so that the decrement occurred in both CRF and VRF schedules

when there were trials that followed the combination of large reward and a short ITI. Finally, the immediate response decrement was present throughout acquisition—from the initial to the terminal session.

Table 2a

The Analysis of Variance of the Acquisition Data for all Groups

Source	df	MS	F
Between Subjects	79	8.339	14.725 *
A (Groups)	3	0.566	
Subjects	76		
Within Subjects	880	3.040	24.393 *
B (ITI)	1	0.701	5.625 *
AB	3	0.124	
B X Subjects	76		
C	5	2.133	14.716 *
AC	15	0.896	6.185 *
C X Subjects	380	0.144	
BC	5	0.045	0.673
ABC	15	0.143	2.116 *
BC X Subjects	380	0.067	

* Significant

Table 2b

The Analysis of Variance of the Acquisition Data for the CRF Groups

Source	df	MS	F
Between Subjects	39		
A (Reward Magnitude)	1	21.243	28.983 *
Subjects	38	0.732	
Within Subjects	440		
B (ITI)	1	0.325	6.388 *
AB	1	1.221	23.969 *
B X Subjects	38	0.050	
C (Days)	5	1.662	14.858 *
AC	5	1.989	17.781 *
C X Subjects	190	0.111	
BC	5	0.054	0.999
ABC	5	0.087	1.604
BC X Subjects	190	0.054	

* Significant

Table 2c

The Analysis of Variance of the Acquisition Data for Group VRF - I

Source	df	MS	F
A (ITI-Reward Sequence)	1	48.450	33.258 *
A X Subjects	19	1.457	
B (Days)	5	1.329	1.991
B X Subjects	95	0.667	
AB	5	0.331	1.106
AB X Subjects	95	0.299	

* Significant

Table 2d

The Analysis of Variance of the Acquisition Data for group VRF - II

Source	df	MS	F
A (ITI-Reward Sequence)	1	0.642	0.235
A X Subjects	19	0.274	
B (Days)	5	7.850	10.734 *
B X Subjects	95	0.731	
AB	5	0.562	1.751
AB X Subjects	95	0.321	

* Significant

Table 3a

The Analysis of Variance for All Groups on Day One

Source	df	MS	F
Between Subjects	79		
A (Groups)	3	1.369	0.790
Subjects	76	1.732	
Within Subjects	880		
B(ITI)	1	5.625	21.560 *
AB	3	4.083	15.651 *
B X Subjects	76	0.260	
C (Trials)	5	2.042	7.954 *
AC	15	0.438	1.707
C X Subjects	380	0.256	
BC	5	0.107	0.581
ABC	15	0.312	1.687
BC X Subjects	380	0.185	

* Significant

Table 3b

The Analysis of Variance for the CRF Groups on Day One

Source	df	MS	F
Between Subjects	39		
A (Reward Magnitude)	1	0.162	0.096
Subjects	38	1.683	
Within Subjects	440		
B (ITI)	1	2.848	11.545 *
AB	1	7.267	29.456 *
B X Subjects	38	0.246	
C (Trials)	5	1.131	5.048 *
AC	5	0.430	1.921
C X Subjects	190	0.224	
BC	5	0.236	1.444
ABC	5	0.532	3.255 *
BC X Subjects	190	0.163	

* Significant

Table 3c

The Analysis of Variance for Group VRF - I on Day One

Source	df	MS	F
A (ITI-Reward Sequence)	1	7.601	8.187 *
A X Subjects	19	0.928	
B (Trials)	5	0.752	3.517
B X Subjects	95	0.213	
AB	5	0.087	0.422
AB X Subjects	95	0.204	

* Significant

Table 3d

The Analysis of Variance for Group VRF - II on Day One

Source	df	MS	F
A (ITI-Reward Sequence)	1	0.160	0.142
A X Subjects	19	1.128	
B (Trials)	5	1.044	3.688 *
B X Subjects	95	0.283	
AB	5	0.190	0.985
AB X Subjects	95	0.193	

* Significant

Table 4a

The Analysis of Variance for All Groups on Day Six

Source	df	MS	F
Between Subjects	79		
A (Groups)	3	21.623	19.748 *
Subjects	76	1.094	
Within Subjects	880		
B (ITI)	1	11.116	28.589 *
AB	3	2.905	7.473 *
B X Subjects	76	0.388	
C (Trials)	5	0.106	0.319
AC	15	0.614	1.849
C X Subjects	380	0.332	
BC	5	0.241	0.809
ABC	15	0.134	0.449
BC X Subjects	380	0.299	

* Significant

Table 4b

The Analysis of Variance for the CRF Groups on Day Six

Source	df	MS	F
Between Subjects	39		
A (Reward Magnitude)	1	47.655	44.048 *
Subjects	38	1.081	
Within Subjects	440		
B (ITI)	1	5.093	25.824 *
AB	1	6.682	33.877 *
B X Subjects	38	0.197	
C (Trials)	5	0.442	1.645
AC	5	0.956	3.552 *
C X Subjects	190	0.269	
BC	5	0.106	0.364
ABC	5	0.223	0.765
BC X Subjects	190	0.291	

* Significant

Table 4c

The Analysis of Variance for Group VRF - I on Day Six

Source	df	MS	F
A (ITI-Reward Sequence)	1	7.518	11.762 *
A X Subjects	19	0.639	
B (Trials)	5	0.258	0.774
B X Subjects	95	0.334	
AB	5	0.274	0.913
AB X Subjects	95	0.300	

* Significant

Table 4d

The Analysis of Variance for Group VRF - II on Day Six

Source	df	MS	F
A (ITI-Reward Sequence)	1	0.539	0.519
A X Subjects	19	1.049	
B (Trials)	5	0.292	0.793
B X Subjects	95	0.367	
AB	5	0.041	0.354
AB X Subjects	95	0.116	

* Significant

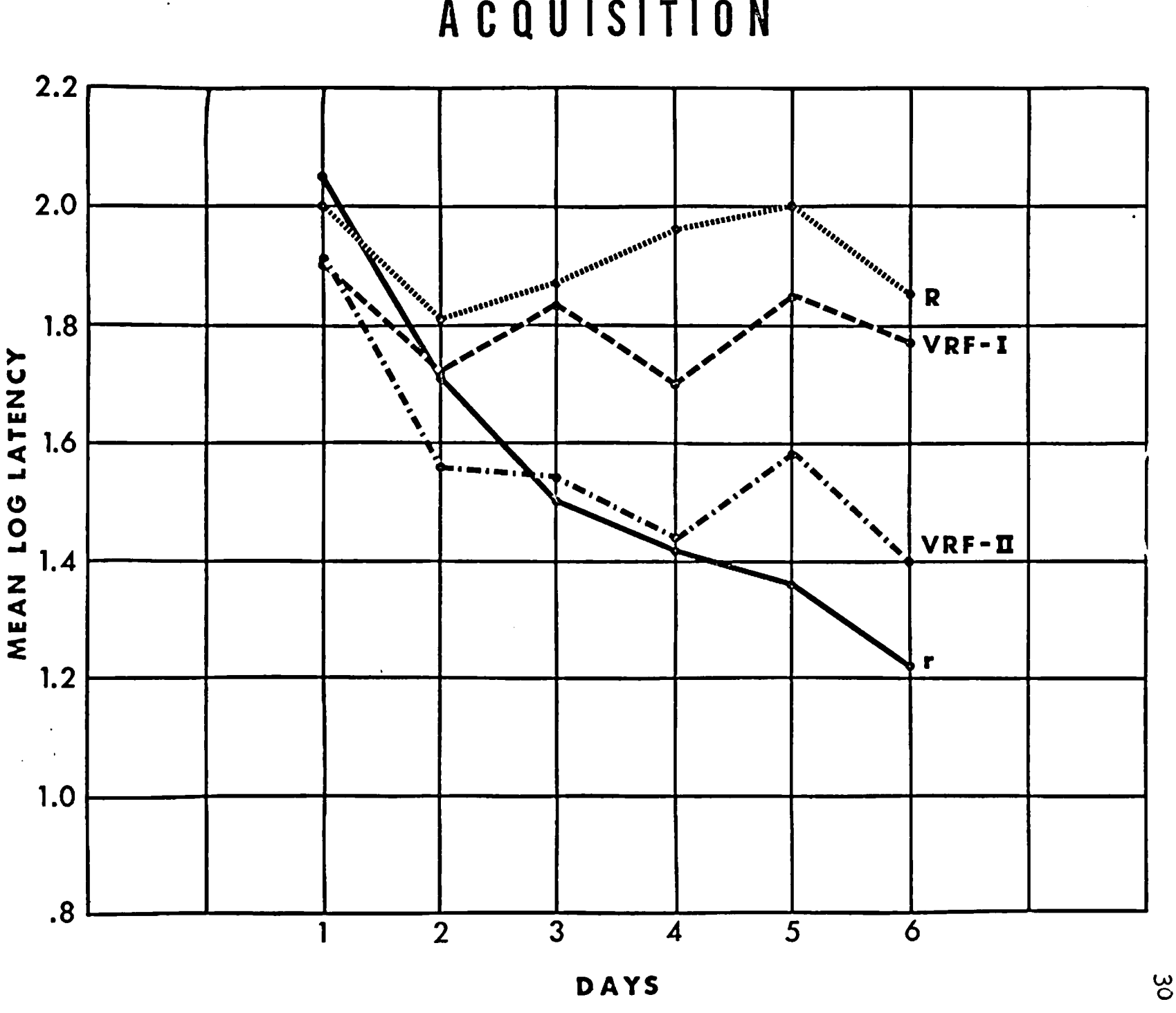

Figure 1. Mean log latency to each group across days

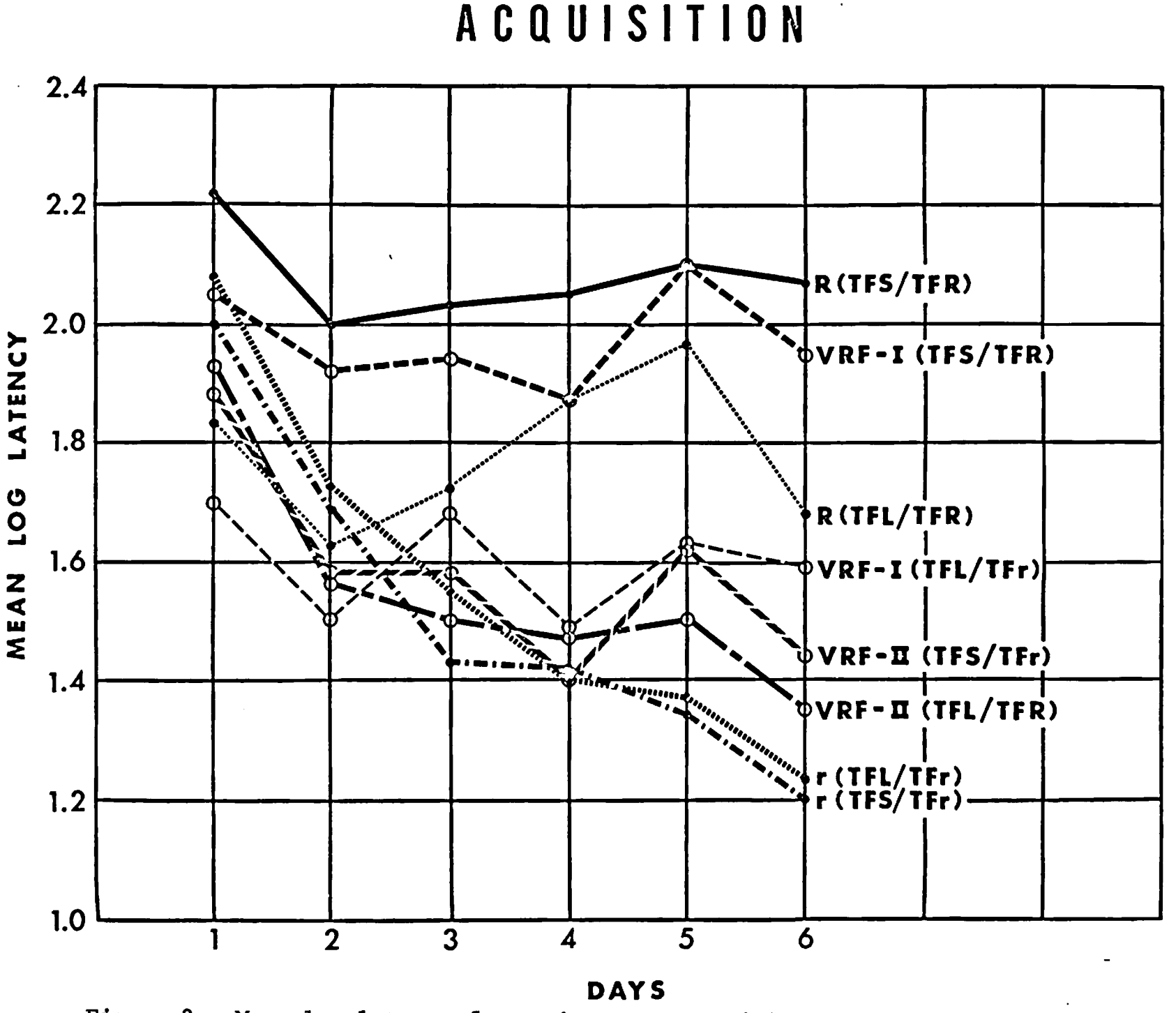

Figure 2. Mean log latency for each group on trials following long ITI (TFL) and trials following short ITI (TFS) across days. For more detailed explanation

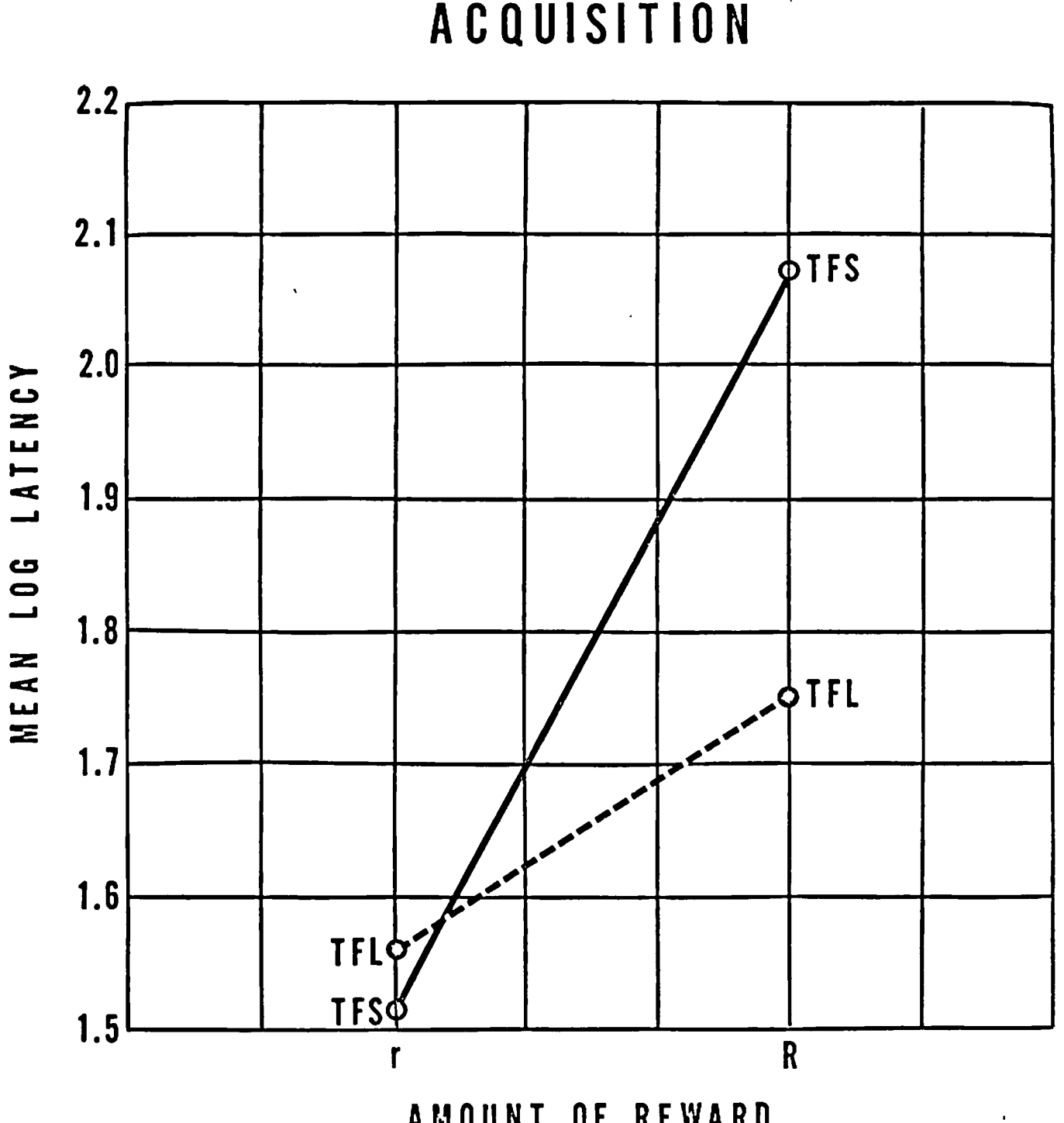

Figure 3. mean log latency on trials following long ITI and short ITI for

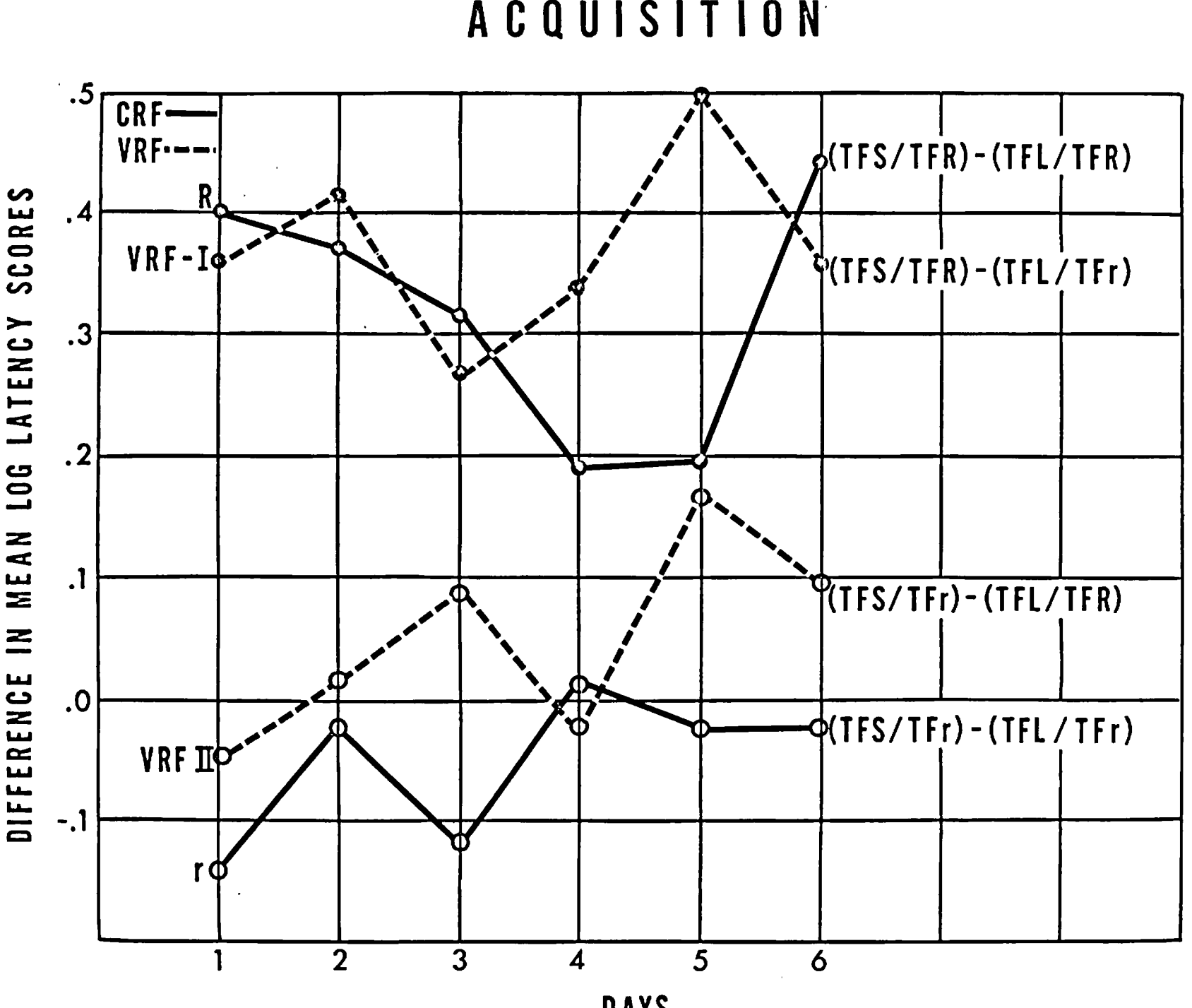

Figure 4. Difference in mean log latency scores for the four groups across days. These scores were obtained by subtracting the mean log latency on TFL

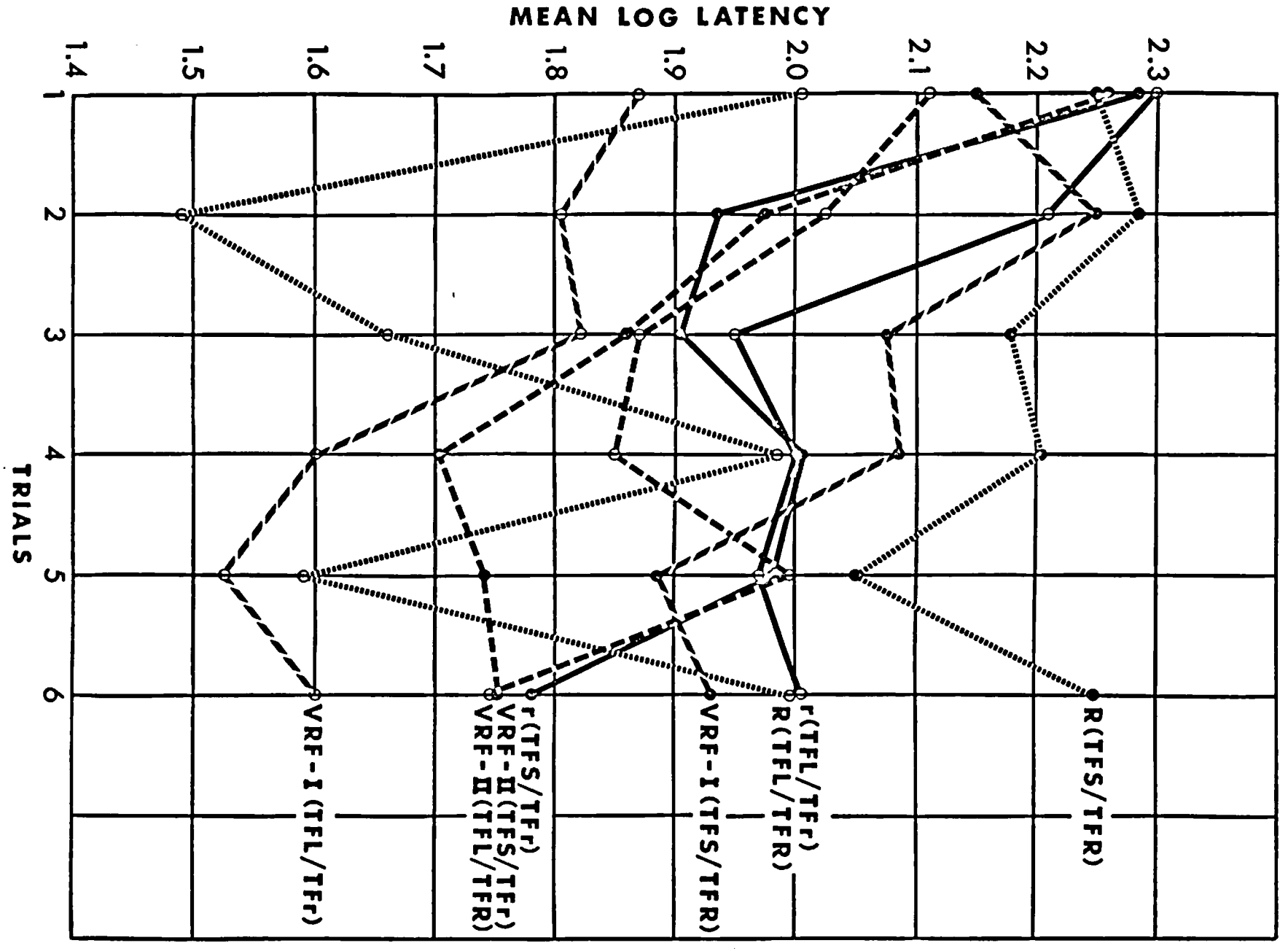

Figure 5. Mean log latency across trials for each group on TFL and TFS on day 1. See text for more detailed explanation.

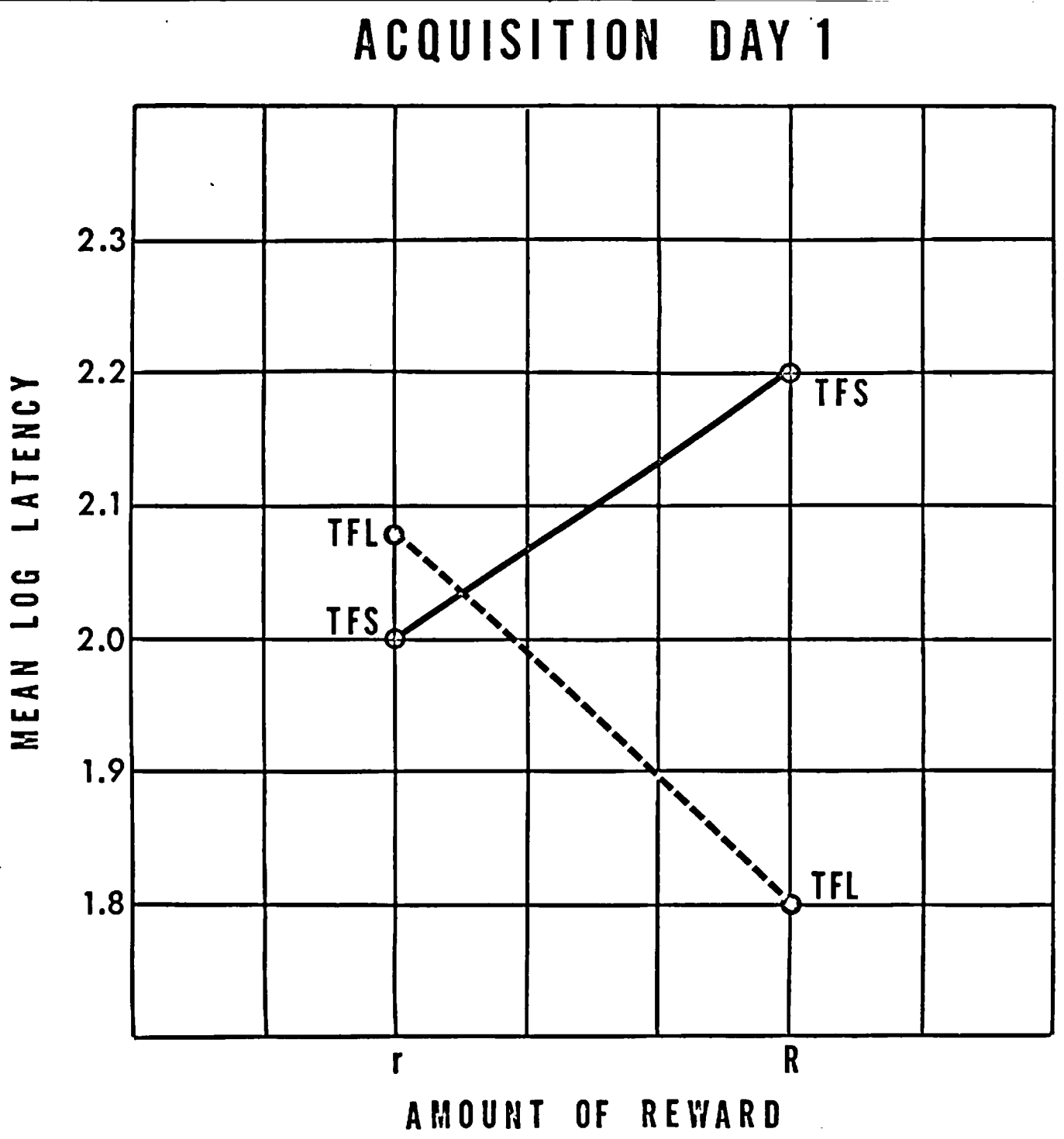

Figure 6. Mean log latency on TFL and TFS for the CRF groups on day 1.

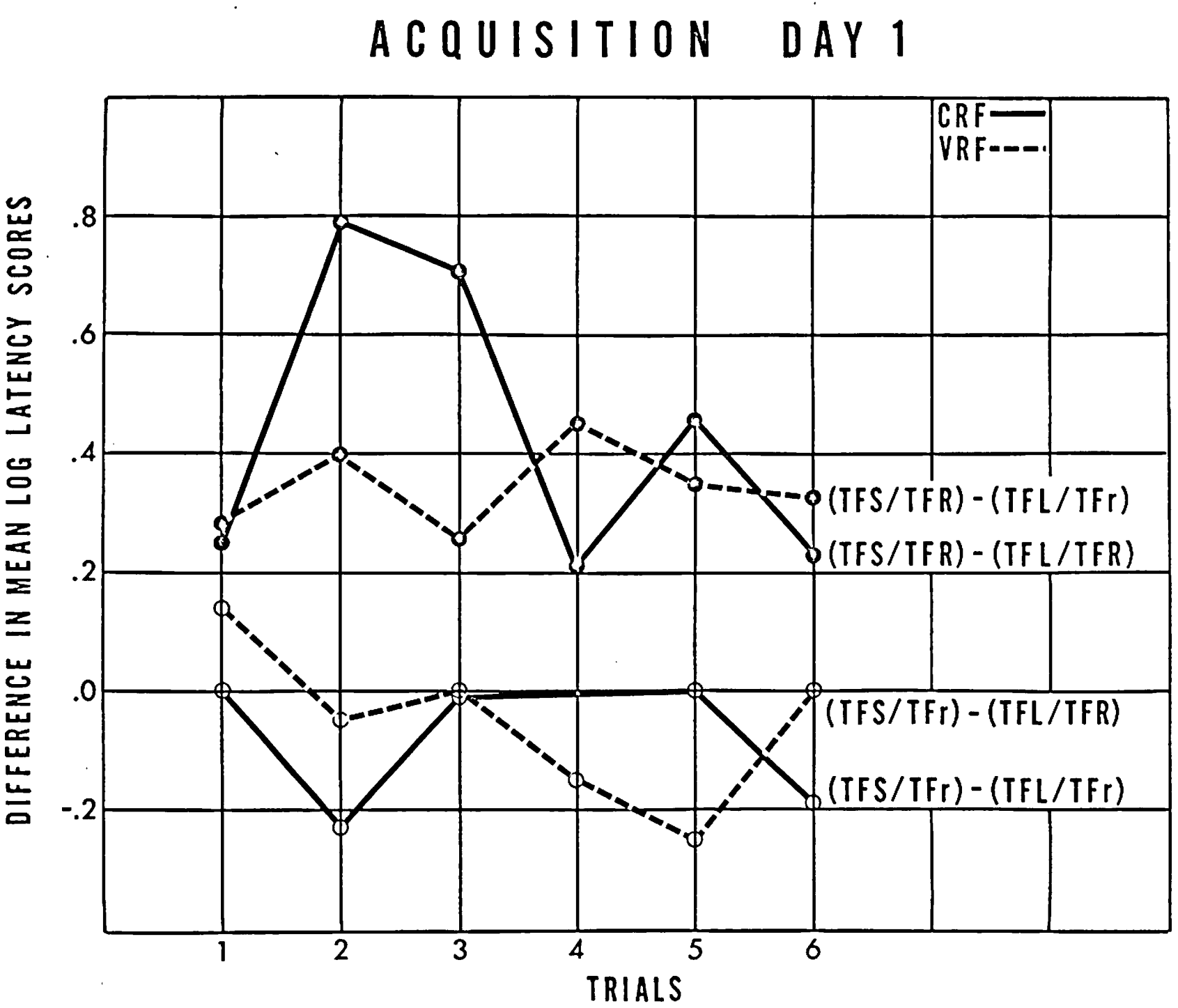

Figure 7. Difference in mean log latency scores across trials for the four groups on day 1. See text for more detailed explanation.

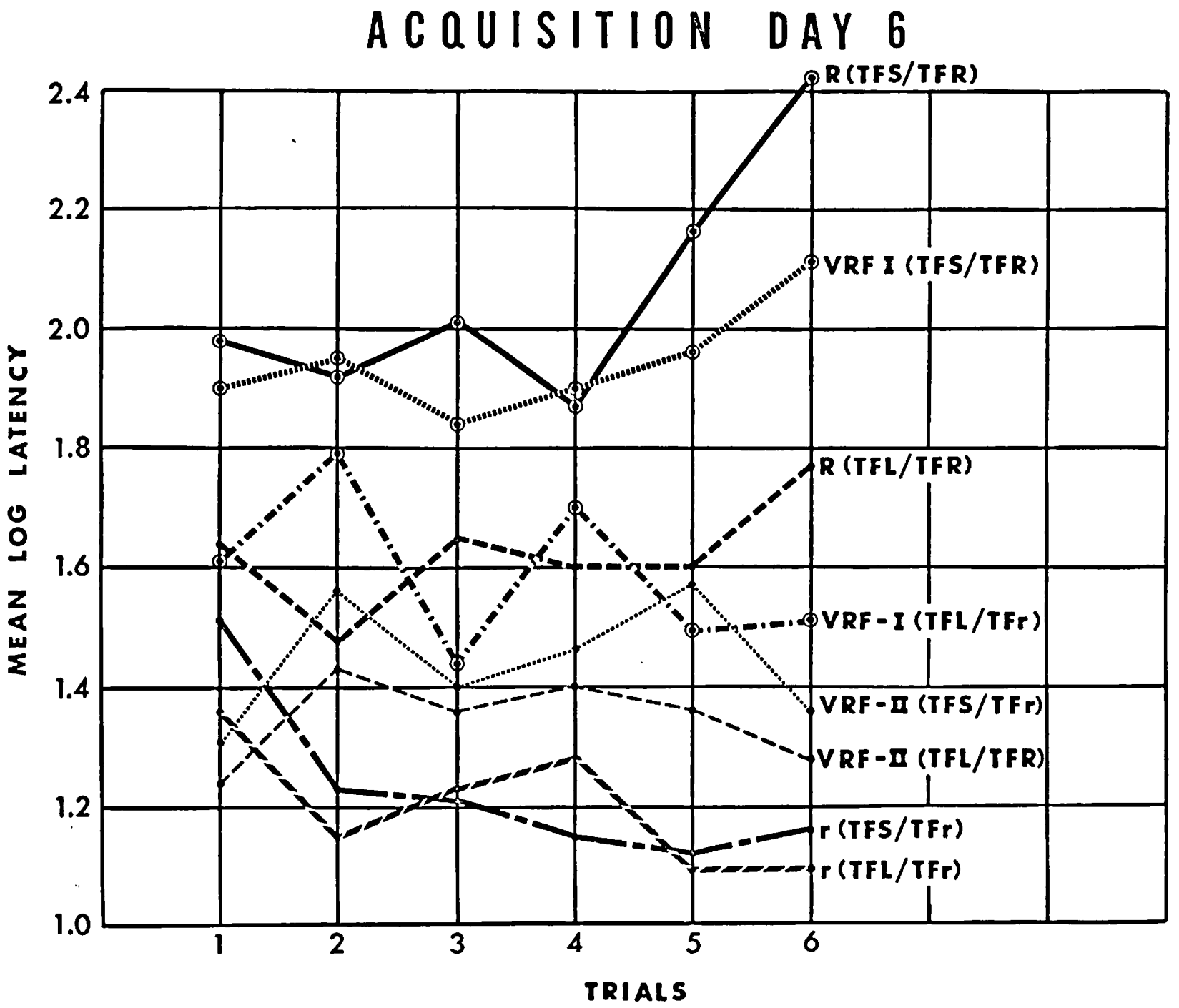

Figure 8.- Mean log latency across trials for each group on TFL and TFS on day 6.

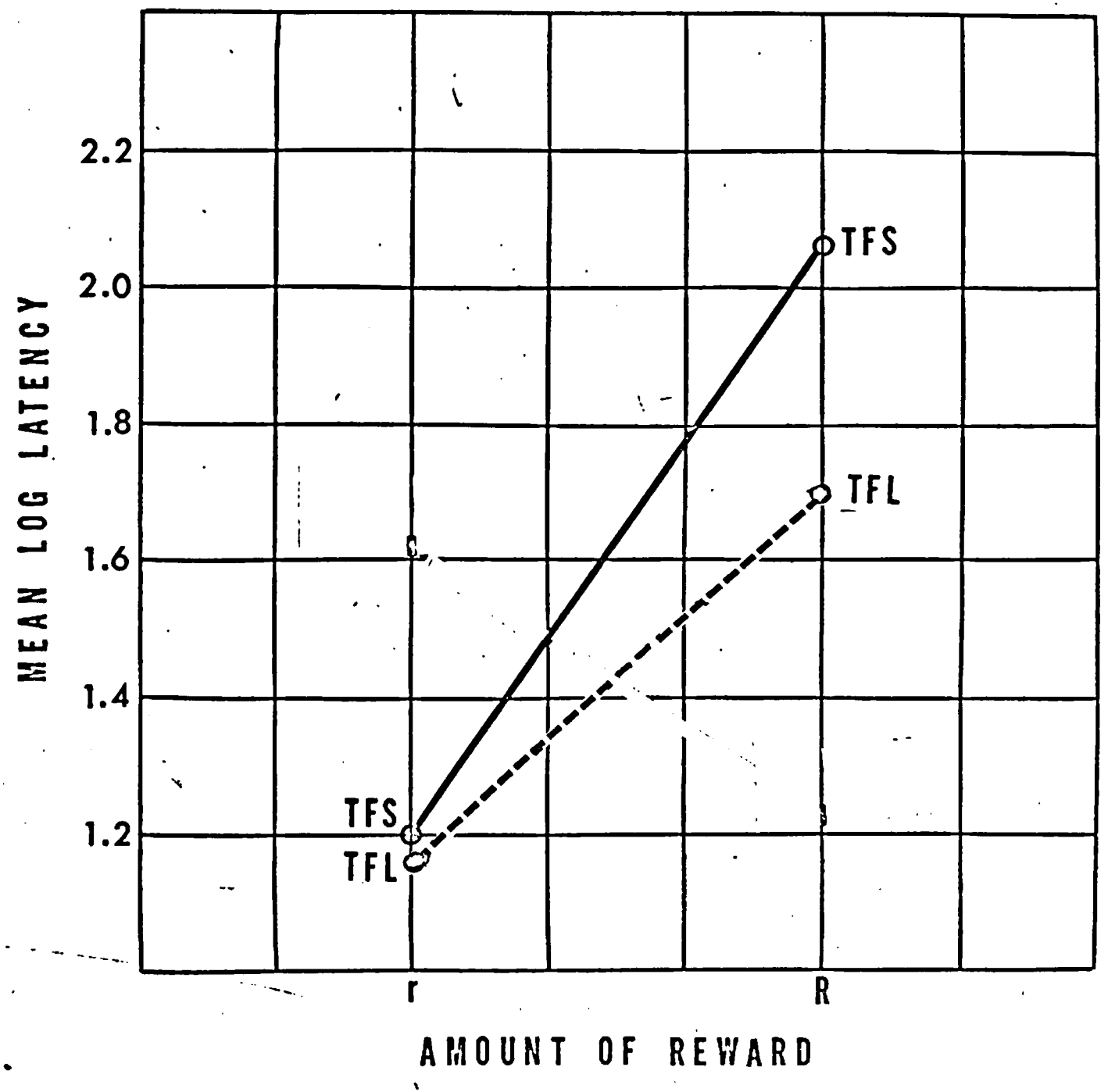

Figure 9. Mean log latency on TFL and TFS for the CRF groups on day 6.

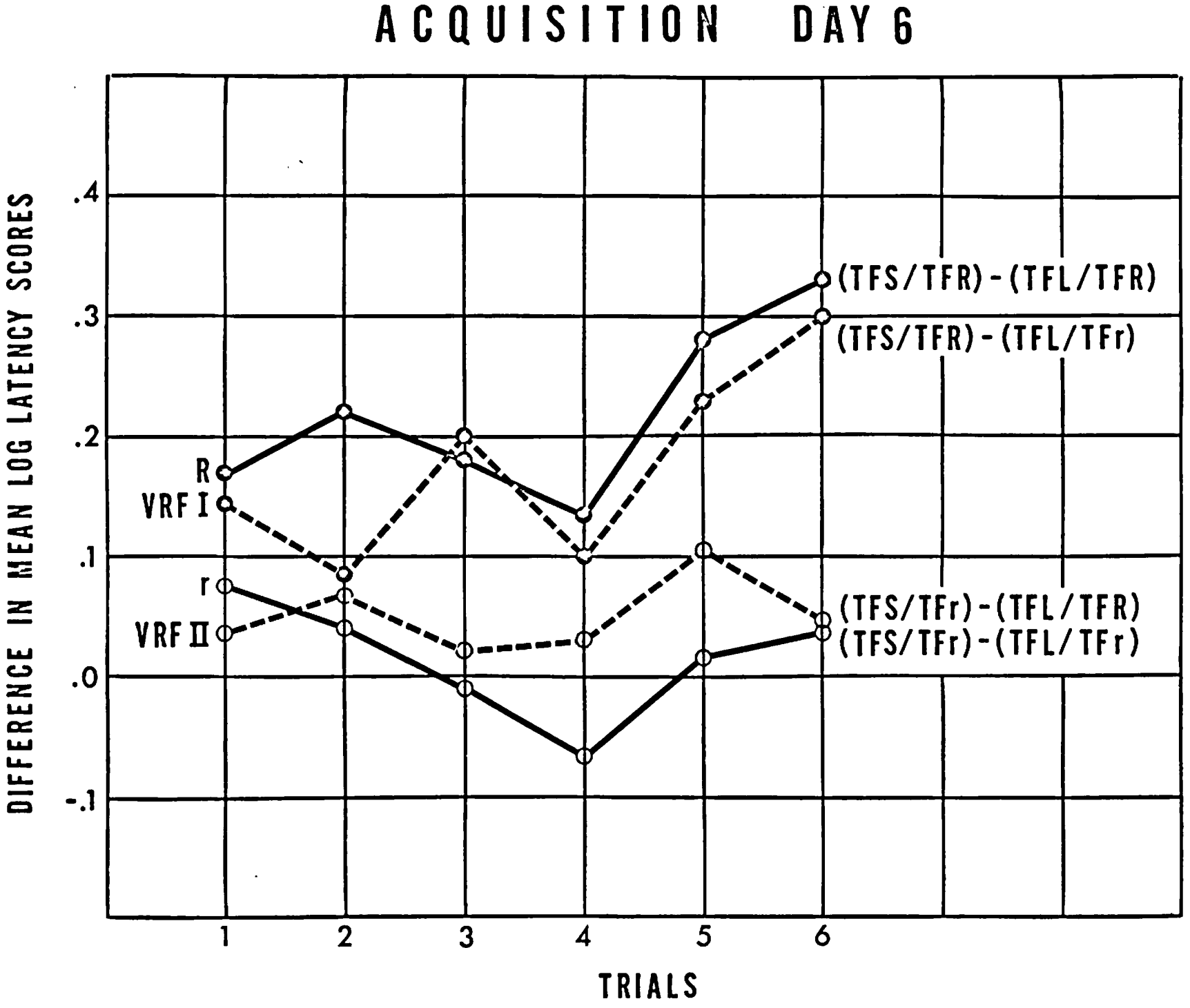

Figure 10. Difference in mean log latency scores across trials for the four groups on day 6. See text for more detailed explanation.

Discussion

The questions, is response decrement a function of a large reward on the prior trial? and, is there more response decrement when a briefer ITI is used? are answered by this experiment. It is evident that in the acquisition of a discrete lever press response a response decrement occurs as a function of large reward on the prior trial and a short ITI and appears to be unconditioned. The conclusion that the decrement is unconditioned is supported by the fact that it occurs on day one of training. An examination of the trial-by-trial responding on day one (shown in Figure 5) indicates that the decrement occurred on the early trials of the day. This response decrement occurred whether the response on the current trial was rewarded with a large or small reward. Therefore, it must be concluded that the response decrement following a large reward and a short ITI is independent of schedule of reward.

The question, do the ITI and magnitude of reward combine to produce even more response decrement? was also answered by this experiment. The response decrement is specific to the situation in which a trial followed a large reward and a short ITI. When a trial followed a large reward and a long ITI the response decrement was greatly diminished. Similarly, when a trial followed a small reward there was no decrement on trials following a short ITI as compared with a long ITI as is shown by the responding of the CRF group r. This is shown in Figure 2.

It has been shown in this experiment that in the situation in which there is a CRF schedule of large magnitude reward and an alternation of short and long ITIs, that response decrement occurred on the trials following the short ITI and pattern responding was the result. Also, where there was an alternation of large and small reward, and an alternation of long and short ITIs, response decrement occurred only on trials following a large reward and a short ITI. Pattern responding occurred in only one VRF group (VRF - I), and that was the group in which the large reward trials were followed by a short ITI. Pattern responding did not occur in the other group (VRF - II), which was the one in which the large reward trials were followed by a long ITI. It is quite clear that in this experiment pattern responding was not an associative process built up via differential conditioning.

In a single alternation differential reward situation it might be expected that the S would learn to respond slowly on the trials that are to receive the smaller amount of reward and thus pattern respond (Capaldi, 1967; Gonzales et al, 1966). The implication of these results for pattern learning experiments in the discrete lever press situation is that pattern responding can occur in the absence of differentially conditioned responses. Because the direction of the differential responding as a function of immediate response decrement (i. e., slower following large reward and faster following small reward) is in the same direction as would be expected if differential conditioning did occur, it follows then that this immediate response decrement is a serious

source of confoundment for such pattern learning experiments.

It is not possible, from this experiment, to completely assess the amount of patterning due to the immediate response decrement. However, the differential responding of the varied reward group was not greater than that of the continuous reward group. This would seem to indicate that, in this experiment, the immediate response decrement was the major variable influencing pattern responding.

That large magnitude of reward combined with a short ITI can produce response decrement on the subsequent trial as an empirical construct is helpful in clarifying some of the results of earlier experiments using the discrete lever press situation. The studies in the TRIMS laboratory which found pattern responding with SA VRF schedules have indicated that absolute level of responding appeared to be related to magnitude of reward on the prior trial. Further, looking across experiments, the pattern responding appeared to be of greater magnitude and occurred earlier in the experiment which used the shortest ITI. In the first experiment there were two ITIs, 15 and 45 sec., randomly presented. In the following studies the ITI was a random value between 20 and 40 sec. in steps of two sec. Thus, in the first study a 15 sec. ITI was used for half of the trials that followed large reward, whereas in the following studies an ITI of 20 sec. followed a large reward trial 9% of the time, a 22 sec. ITI followed a large reward 9% of the time, and so on up to a 40 sec. ITI which followed a large reward 9% of the

time. If, as this experiment has found, large reward and short ITI lead to response decrement on the subsequent trial, then the superior patterning of the first experiment would be in agreement with this construct. It was noted, although statistical tests were not run, in two experiments in which eight and four pellets were used in the same SA schedule that mean response latency was longer following eight pellets from the beginning of acquisition. It seems quite feasible then, that at least some of the patterning found in these earlier studies could be attributed to the immediate response decrement found in this experiment.

In one of the experiments run at TRIMS there were three VRF groups: 8-1, 8-4 and 4-1. The absolute level of responding was slowest on trials following eight pellets, for both the 8-1 and 8-4 groups. Absolute responding was faster on trials following four pellets, for both the 8-4 and 4-1 groups. And absolute responding was faster on trials following one pellet, for both the 8-1 and 4-1 groups. Thus, although pattern responding did occur, the absolute level of responding appeared to be related to the magnitude of reward on the prior trial.

Gonzales, Bainbridge and Bitterman (1966) found pattern responding using SA PRF schedules and also indicated that patterning was more pronounced with a large magnitude partial reward schedule than with a small magnitude reward schedule. A six-pellet group was run in one experiment and a one-pellet group was run in another experiment. Thus, their comparison was between groups and between experiments. The pattern responding in their

study reflected a response decrement following the rewarded member of the pair of goal stimuli, and there appeared to be more response decrement following the six-pellet goal stimulus than following the one-pellet goal stimulus. The previous experiments in the TRIMS laboratory using within-experiment comparisons of amount of reward in SA schedules have confirmed the Gonzales et al (1966) indication that the larger the reward on the large member of the pair the greater the patterning. However, as has been previously noted, the patterning is always due to response decrement following the larger member of the pair. In the present experiment pattern responding occurred in the large reward CRF group, group R, and there was no differential goal stimuli.

It must be remembered that an unusually small number of trials, 78, were used in this experiment relative to the prior experiments (Gonzales et al, 1966; Collier & Siskel, 1959; Wall & Goodrich, 1964; and the experiments in the TRIMS laboratory) which used considerably larger numbers of trials. In these prior experiments patterning increased over trials. It was assumed that this increased pattern responding reflected differential conditioning. Another interesting point is the differential responding of group VRF - II, which is shown in Figure 4. There is a suggestion (not borne out by the statistical tests) of improved pattern responding as acquisition progresses. This might indicate that in initial training the amount of reward on the prior trial is affecting responding while later in training

it is the ITI which is affecting responding. Further, it should be noted that this experiment used only CRF and VRF schedules and the results may not be applicable to experiments using PRF.

In the first experiment done in the TRIMS laboratory two groups were run with the same large magnitude of reward (5-0 and 5-1) and pattern responding occurred. That is, response decrement occurred on the trials that received zero or one pellet. Moreover, the responding was slower on the zero-pellet trials than on the one-pellet trials. This clearly indicates that response decrement in the experimental situation is not confined to the amount of reward on the prior trial and the ITI but is also affected by the reward on the trial in question. In the experiment using 5-0 and 5-1 the zero and one-pellet trials were trials following five pellets in both cases and yet differential responding occurred. It is clear that the immediate response decrement found in the present experiment which occurs as a function of reward magnitude on the prior trial and ITI is not the sole factor involved in pattern responding in the discrete lever press situation, but it will bring about the same pattern responding as differential conditioning and therefore constitutes a serious source of confoundment in the patterning experiment.

Having considered some of the variables that are possibly operating in this experimental situation, there appears to be some direction indicated for subsequent research. There is little need to be excessively speculative as to which of the variables accounts for differential responding in the pattern

learning experiment. The immediate response decrement in the discrete operant apparatus and those variables most likely to influence it are readily available to experimental investigation and can be dealt with in the laboratory.

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