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The role of information in choice behavior.

Patricia Ann Butler
University of Massachusetts Amherst

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THE ROLE OF INFORMATION IN CHOICE BEHAVIOR

A Dissertation

By

Patricia A. Butler

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Patricia A. Butler

Approved as to style and content by:

(Chairman of Committee)

(Head of Department)

(Member)

(Member)

(Member)

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INTRODUCTION

Until relatively recently, theoretical accounts of binary prediction behavior were dominated by models which were originally formulated to describe so-called simple associative or S-R learning (e.g., the linear model of Bush and Mosteller, 1955; the stimulus sampling model of Estes and Burke, 1953). Such models, whether linear or Markov, typically conceptualized reinforcement in terms of single trial outcomes. More specifically, models of this class assumed that the presentation of some event, E_i, on trial _n_ increased the probability of the occurrence of its corresponding response, A_i, on the following trial. Two obvious implications of this treatment are that (1) the proportion of repetition responses or predictions of the immediately preceding event, $P(A_{i,n+1}/E_{i,n})$ should exceed the proportion of alternation responses, $P(A_{j,n+1}/E_{i,n})$ and (2) conditional response data should show evidence of positive recency, an increase in $P(A_i)$ as the number of successive occurrences of E_i increases.

While the predicted rank ordering of $P(A_{i,n+1}/E_{i,n})$ and $P(A_{j,n+1}/E_{i,n})$ has often been observed (e.g., Anderson, 1960; Estes & Straughan, 1954; Feldman, 1959), the applicability of this notion of reinforcement appears questionable in view of the finding that event contingencies exert an effect on conditional response probabilities which is, in great part, independent of the effects of marginal or overall event probabilities (Anderson, 1960; Engler, 1958; Hake & Hyman, 1953; Witte, 1964). Moreover, the data of Engler (1958) indicated some tendency for event contingencies to influence marginal response probabilities, particularly for groups exposed to sequences in which the two events occurred equally often. As Anderson (1964) has pointed out with reference to the stimulus sampling theory framework, the inability of simple S-R models to account for differential effects of event dependencies reflects the inadequacy of the implicit assumption of no memory for past events, which is fundamental to these models. Although some theorists, notably Bush and Estes (1957), have developed models which incorporate a minimal amount of memory which is sufficient to permit prediction of first-order event contingency effects, the ability of these models to deal with more complex aspects of the data has not been impressive (see, for example, Witte, 1964).

An equally serious indictment of the single event view of reinforcement is provided by the frequent finding of negative recency, a decline in repetition response proportions with increases in the number of adjacent identical events (Anderson, 1960; Jarvik, 1951; Nicks, 1959). Although several investigations have demonstrated the predicted positive recency late in training (Anderson & Whalen, 1960; Edwards, 1961; Derks, 1963), the predominance of negative recency over a sizeable number of earlier trials in these experiments is inconsistent with the characterization of reinforcement as set forth in simple S-R models.

A more adequate conceptualization of reinforcement did not occur until the early sixties. However, the research which laid the foundation for the development of a new class of choice models began with the work of Hake and Hyman (1953), who redefined the functional stimulus in probability learning. In order to account for the ability of Ss to predict event repetitions approximately as often as they occurred, Hake and Hyman postulated that the S's choice on each trial is based on short, discriminable sequences of events which precede that trial. They pointed out, moreover, that because of greater discriminability, certain patterns such as runs, that is successive occurrences of the same event, exert a greater determining effect on the response emitted on a given trial. Thus, according to their analysis, the functional stimuli in probability learning are not the binary events comprising the sequence, but temporal patterns formed by these events over a series of trials.

Goodnow (1955), following this line of reasoning, hypothesized that whether positive or negative recency will occur in a given situation depends on the nature of run structure. Manipulations of the distribution of run lengths have yielded support for this view (Derks, 1963; Goodnow & Pettigrew, 1955; Goodnow, Rubenstein, & Lubin, 1960; Nicks, 1959), as have replications of the conditions under which negative recency was originally observed (Feldman, 1959). The results of these experiments are quite nicely summarized by Nicks' statement (1959) that the "... prediction of a given event may increase or decrease following the occurrence of that event, depending upon whether the occurrence was at the beginning of a run or not."

Subsequent to much of this experimental work, Restle (1961) proposed a schemata model of binary choice which assumes that the critical cue for response is the length of a run in progress, and which views reinforcement in terms of the continuation and breaking off of runs. Essentially, the model holds that the S remembers all events since the last event alternation, and predicts the continuation of a current run in proportion to the number of times that runs of that length continued on earlier occurrences. In order to account for the finding that Ss tend to overshoot objective probabilities of run continuation (Anderson, 1960; Engler, 1958), Restle assumes a bias toward predicting long runs, and represents this bias mathematically by a weight which is equal to the number of events in the run in question. According to this model, the probability of a repetition response following a run of length m, $P(A_i/mE_is)$, is obtained as follows:

$$P(A_i/mE_is) = \frac{(m+1)W_{m+1}+(m+2)W_{m+2}+\ldots.}{mW_m+(m+1)W_{m+1}+\ldots..}$$

where W_j is the number of runs of length j that have been presented over previous trials.

Tests of the schemata model have yielded results which have not been entirely supportive. Witte (1964) pitted the model against data obtained using sequences in which the two events occurred equally often and in which event repetition probabilities were varied. The model not only over-predicted the total proportion of repetition responses, but failed to adequately describe repetition responses as a function of the length of the current run. Deviations of predicted from observed run statistics were smaller for the schemata model, however, than for the Burke-Estes (1957) trace conditioning stimulus sampling model.

Perhaps the most critical tests of the run or schemata model involved the use of sequences in which run length information greatly reduced stimulus uncertainty and could be easily extracted. Typically, these sequences have been partially learnable in the sense that the number of lengths in which runs could occur was restricted by the experimenter. Such sequences can be characterized as having two types of trials: determinate trials, on which E_1 occurs with certainty, and indeterminate trials, on which E_1 occurs with some probability greater than zero but less than unity. In a sequence involving runs of length 2 and 5 which are equally probable, the outcome on trials following exactly 1, 3, 4, or 5 consecutive E_1s are completely determined. Following 2 E_1s, however, the outcome is indeterminate; here an additional E_1 occurs with probability .50.

For cases in which such sequences are used, the schemata model makes a very strong prediction; namely, that repetition response probabilities should conform completely to event repetition probabilities. This prediction has been consistently contradicted by the finding of anticipatory and perseverative errors (Butler, Myers, & Myers, 1969; Gambino & Myers, 1966; Myers, Butler, & Olson, 1969; Restle, 1966; Rose & Vitz, 1966). Returning to the example of a 2-5 sequence, anticipatory errors, or failures to predict the continuation of a run when it will continue with probability 1.0 can occur following runs of lengths 1, 3 and 4. Perseverative errors, failures to predict a break in the run given the longest possible run in the sequence, can occur following runs of length 5.

A very stringent test of the schemata model was conducted by Rose and Vitz (1966), who attempted to determine the extent to which information concerning current run length is used to the exclusion of other stimulus information. On half of the trials in this series of experiments, the two events occurred randomly and with equal probability, while on the other half of the trials, rules dictated event patterns. Rules were formulated in such a way that two types of determinate trials occurred. For trials of the first type, knowledge of current run length was sufficient for generating a correct response.

For the second type, both current run length and the preceding k events determined the trial outcome. In one sequence, for example, trials following runs of length 1 were indeterminate with respect to current run length. However, on all occassions on which an E_i run of length 1 was the last member of the 4-tuple $E_iE_iE_jE_i$ ($i \neq j$), rules dictated an event alternation.

Although the schemata model predicts perfect learning of points determined by current run length, it cannot predict learning of points which are jointly determined by current run length and the pattern of events preceding this run. Analysis of the data indicated that points of the latter type were learned to some extent. Alternation responses occurred more frequently following the 4-tuple $E_iE_iE_jE_i$, for example, than following trials on which the last two events of this pattern were preceded by non-rule combinations of events. However, error rates were much higher for rule trials of this type than for those requiring only knowledge of the current run length. Thus, at the very least the results did indicate that current run length information is processed more accurately than other information. The fact that perseverative and anticipatory errors occurred even at late stages of practice was inconsistent with predictions of the model.

The results of research conducted with partially learnable sequences has two-fold implications for the run model. First of all, the well replicated finding that repetition response probabilities tend to covary with run continuation probabilities suggests that the model does provide an adequate representation of the critical aspect of the stimulus situation, and of the nature of the reinforcing event. On the other hand, the persistence of errors over the course of hundreds of trials suggests that the processing of critical stimulus information is less perfect than is implied by the model. It appears that some form of interference either distorts the perception of run length, or prevents completely efficient usage of correctly perceived run information.

The study reported in this paper attempted to examine three possible sources of this interference: generalization, miscounting, and inefficient information utilization. The major proponents of the generalization position are Gambino and Myers (1967). Their view is that errors at determinate points occur because of imperfect discriminations among run lengths. Accordingly, each trial outcome is assumed to affect the S's expectancy about the continuation of runs of the sampled length and of every other length occurring in the sequence. Although Gambino and Myers are unclear as to the exact locus of this generalization, the mathematical statement of the model implies that the initial perception of run length is correct, but that either the storage of this information or its translation into an overt response is affected by the similarity of a given run length to other run lengths, where the similarity dimension is defined in terms of the number of events comprising any given run.

Like Restle, Gambino and Myers assume that run length is the critical cue in the binary choice situation, and that reinforcement is constituted by the continuation and breaking off of runs. Expectancies or subjective probabilities of run continuations are represented in the model by a vector containing repetition response probabilities associated with each run length. If the prediction on trial n is preceded by a run of length m and that run continues, $P_n(m)$, the associated repetition response probability, is increased to form the corresponding entry, $P_{n+1}(m)$, of the vector for trial n+1. If the run breaks off, $P_n(m)$ is decreased. $P_n(j)$, the expectancy for any other run length, j, is also affected by whether the run of length m breaks off. The magnitude of this generalized effect is determined by the distance between this run length and the sampled run length, m. The transformation of the typical vector entry, $P_n(j)$, over trials is given in the model as

$$P_{n+1}(j)=P_n(j)\left[1-\theta\gamma^{|j-m|}\right]+\lambda\theta\gamma^{|j-m|}, \qquad (2)$$

where θ is the learning rate, γ the generalization parameter, and λ is set at one if the run of length m continues and zero if it does not. Note that when j is equal to m, the magnitude of the change in repetition probability is completely determined by the learning rate parameter, which reflects the effectiveness of direct reinforcement. As the distance between j and m increases, the amount of generalized change decreases.

The data of three experiments (Gambino & Myers, 1966;

Myers, Butler, & Olson, 1969; Restle, 1966) have been used to evaluate the model. Although fits were rather poor in instances in which event alternation occurred on a large percentage of the trials, quantitative and qualitative descriptions of the data were quite good for the most part. For example, the model was able to predict differences in error proportions as a function of the variability of run lengths, and as a function of both the relative frequency of long runs, and the distance between the two run lengths comprising the sequence. The model also provided a fairly accurate picture of variations in run curves over trials, and of run curves conditionalized on the length of the run preceding the run in progress.

Despite the rather impressive support that can be amassed for the generalization view, other factors can not be ruled out as alternative, or at least additional, sources of errors. The most definitive evidence for the Gambino-Myers model rests on its ability to deal with systematic differences in repetition response probabilities as a function of the relationship between current run length and over-all run structure. To illustrate, in the Myers et. al. experiment (1969), Ss were exposed to sequences composed of runs of lengths 4 and 5 or 1 and 5. Because runs of length 5 never continued, and because they occurred with equal probability in the two sequences, the Gambino-Myers model would hold that any differences in perseverative errors are attributable to differences in the length of the shorter run. Due to the fact that reinforcement from the breaking off of this run would have to generalize over a greater distance in a 1-5 than in a 4-5 sequence, greater decrements would accrue to $P_n(5)$ in 4-5 groups. Therefore, fewer perseverative errors would be predicted for these groups than for 1-5 groups. This prediction was upheld.

As has been pointed out by Myers et. al., certain types of miscounting models would make an identical prediction. Consider a model which treats the effective stimulus and the reinforcing event as the Gambino-Myers model does. In this case, however, the model assumes (1) that errors are the result of misperceptions of run length, (2) that only the repetition probability associated with the perceived run length is affected by any trial outcome, and (3) that the probability that the S's count is off by k events is a decreasing function of k, where k is bounded by 1 and the maximum run length occurring in the sequence. In this context, differences in error rates can be accounted for in terms of the likelihood of mistaking the longer run for the shorter run. Because of the similarity of the basic assumptions and the similarity of the generalization and the miscounting gradients, the two models would yield very similar predictions despite major theoretical differences in conceptualizing the nature of the interference process.

Even though the generalization and miscounting models appear equivalent in some very important respects, they would make different predictions in instances in which the S perceives run length accurately. In this circumstance, assuming that the S has learned the lengths in which runs can occur, the miscounting model presented above would predict no errors. The generalization model, on the other hand, would make no deterministic prediction. Within this framework, generalized response tendencies could result in errors even if the S has correctly identified current run length. Unfortunately, since errors are never completely eliminated, it is not safe to rule out the possibility that Ss have failed to learn the run lengths due to frequent counting errors. For this reason, the present experiment included a condition in which Ss were provided with a count on every trial, and were told the run lengths prior to the start of the experiment.

If one accepts the possibility that miscounting can prevent the S from learning event contingencies at determinate points, a rather perplexing problem is introduced. Research with perfectly learnable sequences has shown that Ss generally master fairly complex tasks after fewer than 10 exposures to the basic pattern (e.g., Derks & House, 1965, 1967). In some instances, these sequences were composed of as many as 10 runs. It seems clear, therefore, that Ss are certainly capable of learning two run lengths after several hundred trials. The possibility that they do not--or what is at least as likely, that they err in spite of having learned the run lengths--suggests that something more than simple miscounting or mis-perceptions of run length is involved.

A very likely candidate for this "something more than" is hypothesis complexity, the third source of errors examined in this study. Because the basic difference between perfectly and partially learnable sequences is that the latter contain an uncertainty point, it is quite possible that the performance differences noted in situations involving the two types of sequences are related to this factor. The plausibility of this assumption is supported by the finding that with completely predictable sequences, errors are eliminated more slowly at points which are determined by optional rules (Restle, 1967). For example, if the pattern AA-BB-AAA-BB forms the basic unit of a recursive sequence, errors would occur more frequently following the second A in a series. At all other points, rules are mandatory: after a single A, another A occurs; after a single B, another B occurs; after 2 Bs, an A occurs. After 2 As, however, either a B or an additional A can occur depending on whether the most recent run of As was of length 2 or length 3.

In order to perform without error on a sequence of this type, the S must not only learn the lengths in which runs can occur, but must also learn the order in which these run lengths occur. In view of the fact that Ss exposed to partially learnable sequences can learn to respond differentially to a given run length depending on the events preceding this run length (Butler, Myers, & Myers, 1969; Rose & Vitz, 1966), it appears that even in this situation, Ss concern themselves with order or pattern information.

When faced with a sequence in which runs form no predictable pattern over trials, the most efficient approach would involve concentrating on current run length and on the proportion of runs of each length occurring in the sequence. However, because instructions generally emphasize maximizing the number of correct predictions, Ss may be encouraged to seek solutions which include rules for generating correct responses even at uncertainty points. To the extent that this is the case, the S is forced to assemble information spanning a large number of trials and, what may be even more important (see Derks and House, 1965, 1967), a large number of event runs.

Attempts to solve the prediction problem would clearly tax the S's information processing ability. Processing limitations imposed by factors such as the discriminability of patterns of runs, immediate memory span, short-term memory capacity, and the amount of time available for encoding could easily prevent the S from extracting all of the information required by his approach. Moreover, unless the S discovers a very ingenious method for organizing and storing information which is successfully extracted, he would undoubtedly have trouble retaining it over trials.

Placing heavy demands on memory could have several consequences which would interfere with performance at determinate points. First of all, the S might devote so much attention to rehearsing pattern information in order to retain it, that he could simply lose track of current run length. This loss, in turn, could result in subsequent counting errors which could not be corrected until a new run started. Memory overloads could also produce interference which results in the S temporarily forgetting which response is appropriate to a particular run length. Furthermore, if the S uses the same encoding scheme for remembering information relevant to determinate and indeterminate points, he could easily become confused as to the level on which a rule applies. For example, he could forget whether a rule such as "alternate after 3 in a row" refers to like events or to like run lengths. Whatever the specific consequences of memory overloads are, if the use of complex hypotheses does interfere with performance, it should be possible to influence error rates by varying the degree of emphasis placed on the optimal set of information.

The present experiment attempted to determine the relative importance of generalization, miscounting and hypothesis complexity by providing Ss with (a) one of three types of displays: the correct event for the current trial (Standard condition), all events comprising a run in progress (Run condition, or all events which occurred within the 12 most recent trials (History condition); (b) instructions which were neutral or which specified the lengths in which runs could occur; and (c) sequences composed of runs of lengths 2 and 6 or lengths 5 and 6.

On the assumption that Ss provided with information concerning current run length will use this information and will generally perceive it accurately, a comparison of error proportions of the Standard groups with those of other groups should provide some indication of the influence of simple miscounting. If errors are a reflection of the S's inability to keep track of temporally constituted patterns, as Garner (1962) has suggested, error rates of the Standard condition should be highest, and those of the two multiple display conditions should not differ markedly from each other.

If errors are appreciably affected by the extent to which current run length is emphasized, the performance of Run groups should always be superior; the method of event presentation in these groups not only provides Ss with a counting aid, but defines the optimal set of information so precisely that it could stress its importance. The relationship of History and Standard groups is somewhat more complicated. While History Ss would have the advantage of counting information on all trials, this advantage might well be counteracted by the development of overly complex hypotheses based on the additional information displayed.

Comparisons of Informed and Uninformed groups could also aid in determining the relative influence of hypothesis complexity. However, the exact effect of providing detailed instructions cannot be predicted in advance. Although such instructions could emphasize the importance of current run length and, as a result, could reduce the tendency to form complex hypotheses, Ss could also interpret instructions as implying that their task is to predict patterns of long and short runs. If this is the case, at the later stages of practice, Uninformed groups should have fewer errors. On the other hand, if detailed instructions discourage complexity, the opposite relationship would be expected. If these instructions merely make it unnecessary for Ss to learn the run lengths, Informed and Uninformed groups should be similar.

Besides making it possible to determine whether instructions can influence hypothesis behavior, the inclusion of an Informed condition has an additional advantage. As was pointed out earlier, the generalization and miscounting models make different predictions under conditions in which current run length has been perceived accurately. Because the miscounting position holds that errors are attributable to counting failures, it predicts no errors in this situation. However, because there is no way to guarantee that the S perceives current run length correctly on every trial, it is possible that the S may know the current run length but may not have learned the appropriate response because frequent miscounting on earlier trials has distorted his perception of event contingencies. The presence of an Informed condition controls for this possibility.

Assuming that Ss in the Informed R condition will identify current run length correctly on most trials, the miscounting model would predict very low error rates. In addition, because the model accounts for sequence effects by postulating a miscounting gradient, it would predict no differences in errors as a function of current run length. To the extent that multiple event displays greatly reduce miscounting in general, this prediction should hold for H and R groups under both levels of instruction. Furthermore, an all-or-none model should describe the learning of determinate points about as well as such models describe the learning of mandatory points in periodic sequences (see Restle, 1967; Vitz and Todd, 1967). On the other hand if generalization is a relatively potent variable, and if it operates along a similarity dimension such as that defined in the Gambino-Myers model, repetition response probabilities should conform approximately to the predictions of this model and, therefore, should differ for 2-6 and 5-6 groups.

In summary, the effects of miscounting will be examined by comparing the performance of Ss provided with a counting aid with the performance of Ss who must track a run in progress over trials. The effects of hypothesis complexity will be evaluated by comparing groups whose displays involve varied degrees of emphasis on current run length, and by comparing Informed and Uninformed groups. Finally, the effects of generalization will be inferred from comparisons of repetition response proportions for 2-6 and 5-6 groups under conditions in which miscounting and failures to focus on the critical stimulus should be relatively rare.

METHOD

Subjects -- The Ss were 240 students at the University of Massachusetts who served for $1.50 or for one experimental credit toward fulfillment of a course requirement.

Apparatus -- Events were presented using a 37 1/2" x 8 1/2" display panel which was mounted at a height of 8' at the front of the experimental room. The display was divided into two rows of 12 compartments each. A 6 watt, 120 volt light bulb was mounted in each of the 24 compartments. The display case was covered with a sheet of frosted glass which prevented unilluminated bulbs from being visible. Sequences of lights were presented by means of Tally and Western Union tape readers.

Each S was seated at a partially separated booth beside a response console containing two momentary toggle switches which were separated by a vertical distance of 3". Responses were entered by deflecting these switches and were registered by an Esterline-Angus operations recorder.

Design -- Twenty Ss were assigned to each of 12 groups which differed with respect to instructions, type of event display, and run length combinations occurring in the sequence. All groups were exposed to an identical pattern of long and short runs (see Appendix A). In one condition these runs were of lengths 2 and 6, and in the other condition, of lengths 5 and 6. In both conditions long and short runs were equally probable. In the 2-6 condition, sequences consisted of 384 trials, and in the 5-6 condition, of 528 trials. Subjects received either neutral instructions, or a detailed explanation of the lengths in which runs could occur. Events were presented according to one of three schemes: the display indicated only the correct event for the current trial (Standard condition), the correct event for the current trial and all other events in the run in progress (Run condition), or the correct event for the current trial and the outcomes of the preceding 11 trials (History condition).

Procedure -- The Ss in each group were run four to eight at a time. Upon entering the room, they were given written instructions explaining the method of event presentation and the operation of response consoles. At the start of the session, Ss were permitted to make inquiries about points which may not have been clear. After answering questions, the experimenter read either neutral or detailed instructions and responded to additional questions. Instructions given to Ss in each condition are presented in Appendix B. During the task, Ss were required to operate the top switch to predict a light in the top row of the display, or the bottom switch to predict a light in the bottom row. Display exposure times were set at 1, 3 and 4 sec. for Standard, Run and History groups, respectively. The response interval was held at 2 sec. for all groups, and event lights remained off throughout this period.

RESULTS

Only those aspects of the data that are particularly relevant to error sources and models discussed in the Introduction will be considered in detail. Other results will be summarized briefly and appear in more detail in the Appendix section. The Appendix also contains summaries of the analyses of variance conducted on anticipatory errors, perseverative errors, and repetition responses at the uncertainty point. Therefore, F-ratios and levels of significance are not reported in the text.

Anticipatory errors -- Anticipatory error proportions for each of the 12 groups are plotted in Fig. 1. Comparisons of errors as a function of display type supported the hypothesis that the presence of a counting aid facilitates performances. Run (R) groups were superior to History (H) groups which, in turn, were superior to Standard (S) groups. There error rates, pooled over instruction and run length (RL) combination conditions were .024 for the R group, .039 for the H group, and .048 for the S group. The fact that error rates for the H and R group differed suggests that the degree of facilitation may depend on the context in which counting information is presented.

As Fig. 1 shows, however, if comparisons of display types are limited to the Uninformed condition, it is clear that H and R groups were nearly identical within each RL condition. Moreover, in the 5-6 condition, where errors were somewhat infrequent in general, performance of the S group was roughly

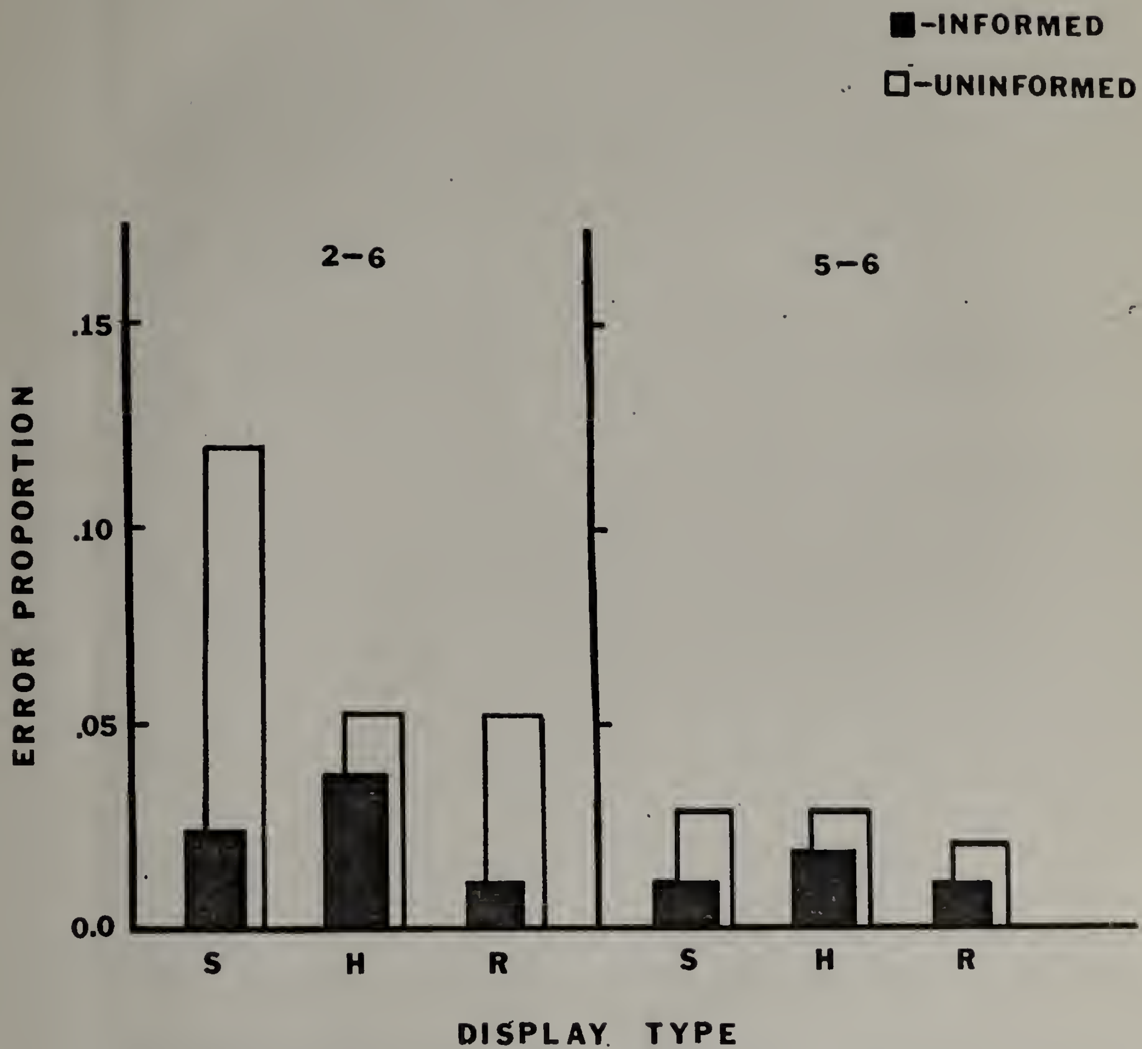

Fig. 1. Anticipatory error proportions for Standard (S), History (H), and Run (R) groups in each Instruction x Run Length condition.

equivalent to that of other display groups. Comparisons of Informed groups provided a somewhat different picture of display relations. In this case, S and R groups were more similar, while H groups had slightly higher error rates. Due to these differences, the interaction of display type and instructions, and the interaction of RL combination with these two variables were significant.

As the results reported above would suggest, the overall effect of RL combination was significant, with 5-6 groups having lower error rates than 2-6 groups. It should be noted, however, that when groups are equated for the number of exposures to long and short runs, 2-6 groups would have less experience with three of the four anticipatory points (runs of lengths 3, 4 and 5) than 5-6 groups would have on comparable points. On the other hand, additional considerations suggest that practice is not the only factor involved. Comparisons of terminal error proportions for 2-6 groups with block 3 proportions for 5-6 groups were indicative of superior performance in 5-6 groups for the most part. Moreover, in Uninformed conditions, 5-6 Ss generally required fewer exposures to each comparable anticipatory position to reach a criterion of 10 successive correct responses. Although sequence structure effects did vary over display conditions and over dependent measures, with the exception of overall error proportions for Informed R groups, trends were generally in the direction favoring 5-6 groups.

As was expected, Informed groups were superior to Uninformed groups. The effects of instructions, however, appeared to be most powerful in groups in which errors occurred most frequently. In the 2-6 condition, Informed instructions led to a .065 reduction in error rate relative to the Uninformed instruction group. As a consequence, the interaction of instructions and RL combination was significant. As noted above, the interaction of instructions with display type was also significant, reflecting the fact that detailed instructions produced larger decrements in error rate in the S condition.

The proportion of anticipatory errors, pooled over groups, declined monotonically over the six trial blocks. Error proportions for each group are presented as a function of blocks in Table 1. Although errors did decline from the initial level in every group, the rate at which they decreased varied over experimental conditions. The 2-6 groups, for example, generally showed larger net reductions in error rate than 5-6 groups. Furthermore, although the most appreciable decrements generally occurred from the first to the second block of trials in both conditions, these decrements tended to be greater in 2-6 groups. The Trials x RL interaction, therefore, was significant.

The interaction of trials and instructions was also primarily attributable to differences in the magnitude of the block 1 to block 2 reduction. Pooled over groups, in the Uninformed condition, this reduction was approximately four

Table 1

Group Anticipatory Error Proportions as a

Function of a Trial Block

Trial Block

Group	1	2	3	4	5	6
2-6SI	.054	.041	.018	.015	.018	.018
2-6SU	.255	.088	.106	.105	.100	.088
2-6HI	.161	.015	.026	.021	.022	.015
2-6HU	.236	.046	.022	.024	.026	.014
2-6RI	.039	.004	.002	.001	.004	.014
2-6RU	.198	.025	.038	.035	.039	.025
5-6SI	.024	.025	.006	.008	.003	.007
5-6SU	.095	.025	.018	.024	.006	.009
5-6HI	.086	.006	.003	.001	.001	.001
5-6HU	.152	.005	.016	.019	.007	.009
5-6RI	.022	.002	.003	.000*	.009	.008
5-6RU	.078	.007	.007	.003	.004	.003

*Zero proportion did not result from rounding.

times as great as in the Informed condition. As Fig. 2 shows, the interaction of display type with trials had a more complicated source. It appeared to reflect the fact that H groups had the highest initial error rate, the lowest terminal error rate, and the greatest decline in error rate from the first to the second block of trials. Because those groups with the highest initial error rates generally changed most markedly over trials, only the error rate of the Uninformed 2-6 S group exceeded .02 by the end of the session.

The results described so far were based on errors pooled over the four anticipatory points. Because other research indicates that errors are not generally uniform over these points, run curves (repetition responses as a function of current run length) were computed and are shown in Appendix D. Although few clear-cut trends were evident in these data, there was some tendency for the fifth point to have a higher error rate than other points in the 2-6 groups; in 5-6 groups, the fourth point had this distinction. It should be noted, however, that these trends occurred primarily in S groups. It should also be noted that the rank order of errors for the four positions was fairly constant over blocks only in S and in Uninformed groups. These results suggest that the typical finding that anticipatory errors cluster around run break-off points may only be characteristic of situations in which errors are relatively frequent, or alternatively, situations in which Ss are forced to track run length temporally.

Perseverative errors -- Perseverative error proportions

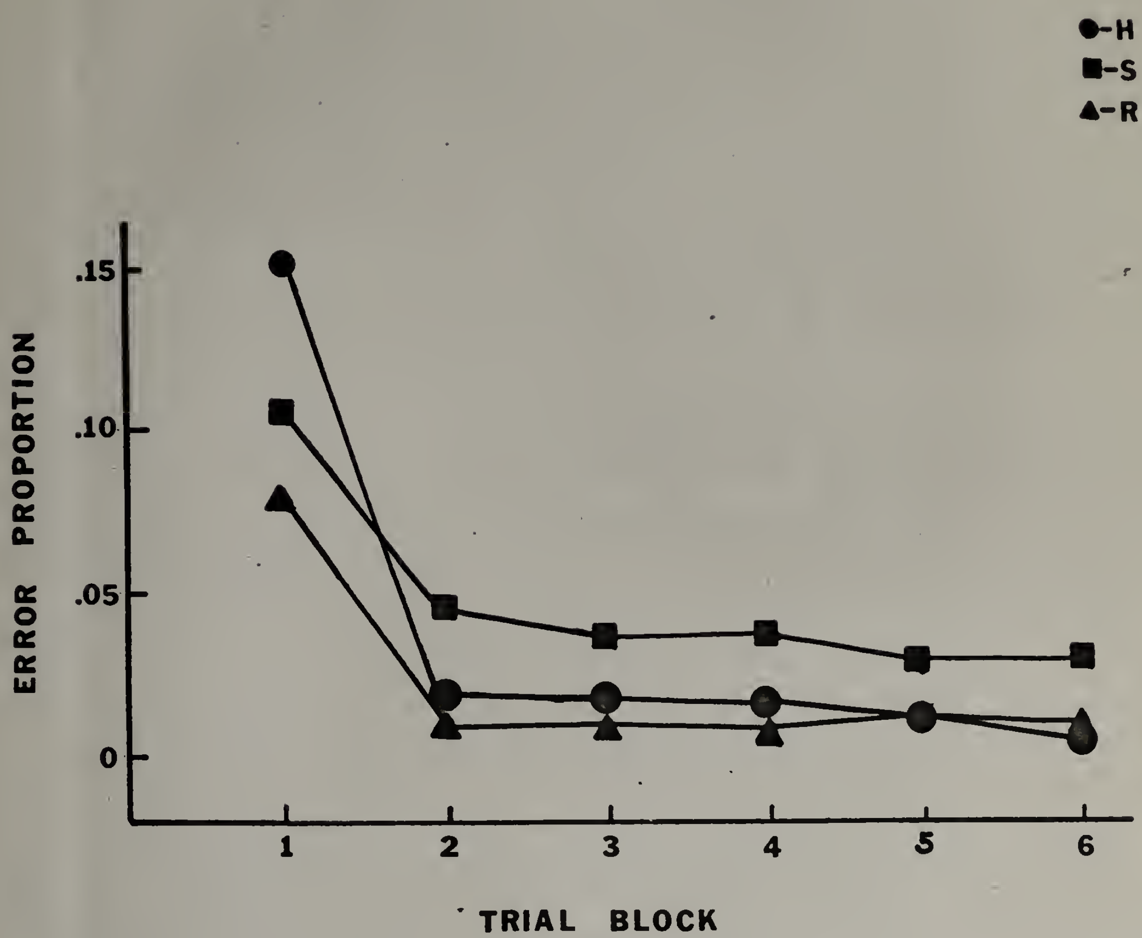

Fig. 2. Anticipatory error proportions as a function of trial blocks for Standard (S), History (H), and Run (R) groups pooled over levels of instruction and run length combination conditions.

for each group are presented in Fig. 3. As this figure indicates, perseverative errors displayed the same overall trends as anticipatory errors. R groups erred last often (.057), S most often (.248), and H groups at an intermediate level (.121). The error rate of 2-6 groups (.182) exceeded that of 5-6 groups (.121), and Informed groups (.096) were superior to Uninformed groups (.187). Furthermore, differences between 2-6 and 5-6 groups were most dramatic in the S condition. In this case, however, differences were sufficiently large for the interaction of display type and RL combination to be significant.

The two error measures showed additional differences in the pattern of interactions. First of all, neither differences between RL conditions nor differences among display types varied significantly as a function of instructions. In addition, instructions apparently had no effect on the relationship between 2-6 and 5-6 groups as a function of display type. This was not the case on anticipatory errors. Thus, it seems that the advantage provided by detailed instructions is relatively independent of overall error rate here. Perseverative errors may be such a stable phenomenon that certain manipulations can reduce their absolute level, but not in a manner which would alter characteristic relationships among groups.

Like anticipatory errors, perseverative errors, pooled over groups, decreased at each trial block. Due to the complexity of group differences in the pattern of decline,

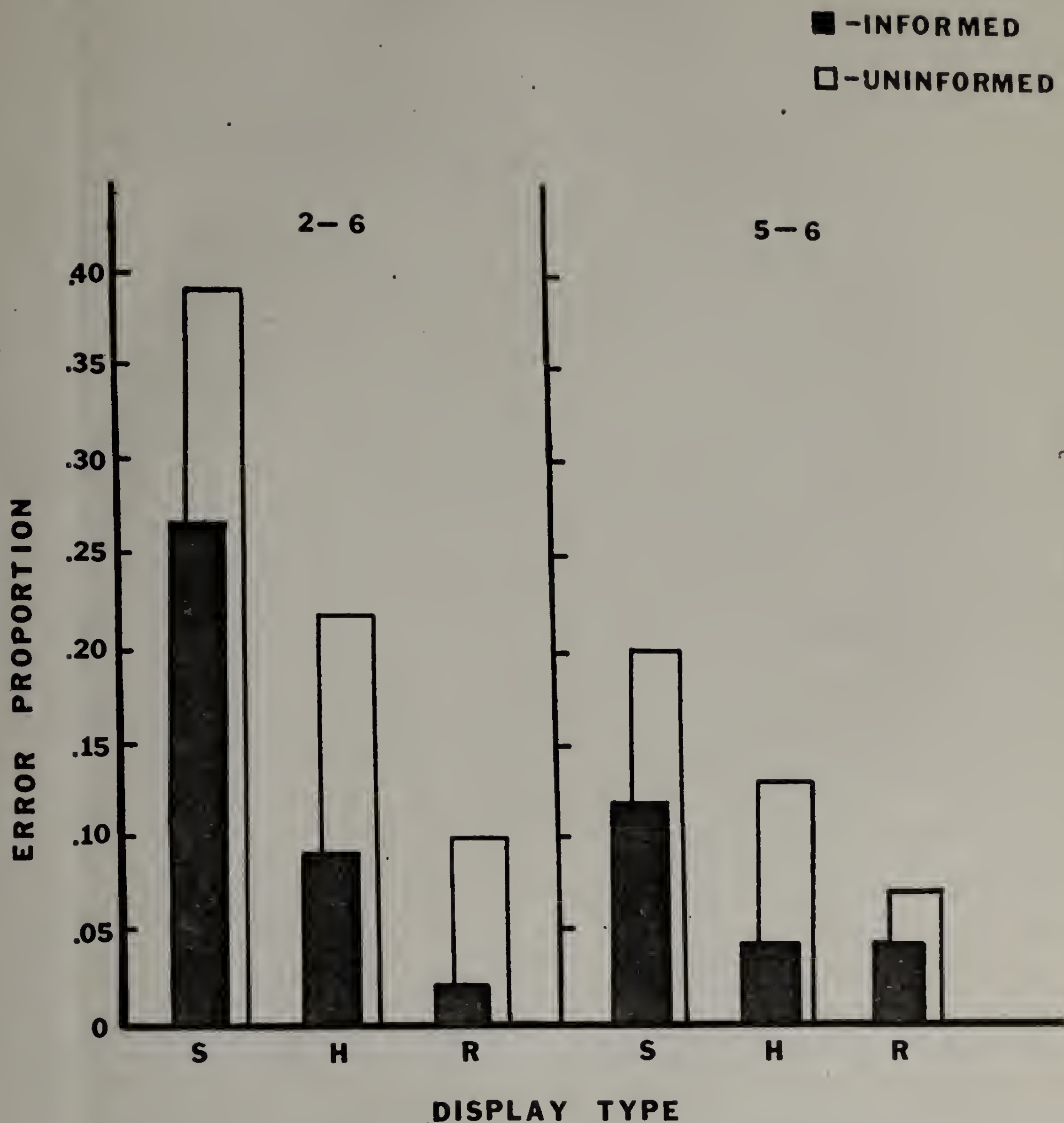

Fig. 3. Perseverative error proportions for Standard (S), History (H), and Run (R) groups in each Instruction x Run Length condition.

only first-order interactions involving trials will be described. A more complete picture of performance can be obtained by referring to Table 2. Because 2-6 error proportions declined at every trial block, while 5-6 proportions exhibited an upturn in the last half of the session, the interaction of trials and RL combination was significant. The interaction of trials and instructions also reflected difference in the continuity and direction of change. In Uninformed groups, error rates dropped at each successive block, while in Informed groups, error rates tended to fluctuate.

Repetition responses at the uncertainty point.-- Because a probabilistic rule governs outcomes at the uncertainty point, the dependent measure of interest here is the deviation of repetition response proportions from the objective probability of a run continuation, .50 in this experiment. Figure 4 contains repetition probabilities for each group. Unlike the measures considered above, repetition proportions, P(R), revealed no effect of RL combination. A significant display effect, however, was observed. H groups most closely approximated matching with P(R) equal to .575, followed by R groups at .608, and S groups at .661. As is apparent in Fig. 4, this effect was primarily the result of differences in the 2-6 condition. Due to the fact that P(R) was much less variable in the 5-6 condition, the interaction of display type and RL combination was significant. The instruction effect was also significant. In Informed groups, P(R) was .595, and in Uninformed groups, .634.

Table 2

Group Perseverative Error Proportions Over Trial Blocks

Trial Block

Group	1	2	3	4	5	6
2-6SI	.481	.225	.306	.212	.150	.225
2-6SU	.494	.488	.412	.331	.350	.300
2-6HI	.150	.081	.094	.056	.081	.056
2-6HU	.388	.219	.200	.181	.181	.156
2-6RI	.025	.025	.006	.019	.006	.012
2-6RU	.269	.144	.081	.062	.044	.031
5-6SI	.156	.144	.056	.109	.156	.131
5-6SU	.356	.256	.162	.181	.150	.112
5-6HI	.169	.019	.019	.019	.019	.031
5-6SU	.281	.106	.119	.100	.106	.069
5-6RI	.119	.031	.006	.012	.044	.019
5-6RU	.188	.069	.019	.056	.019	.056

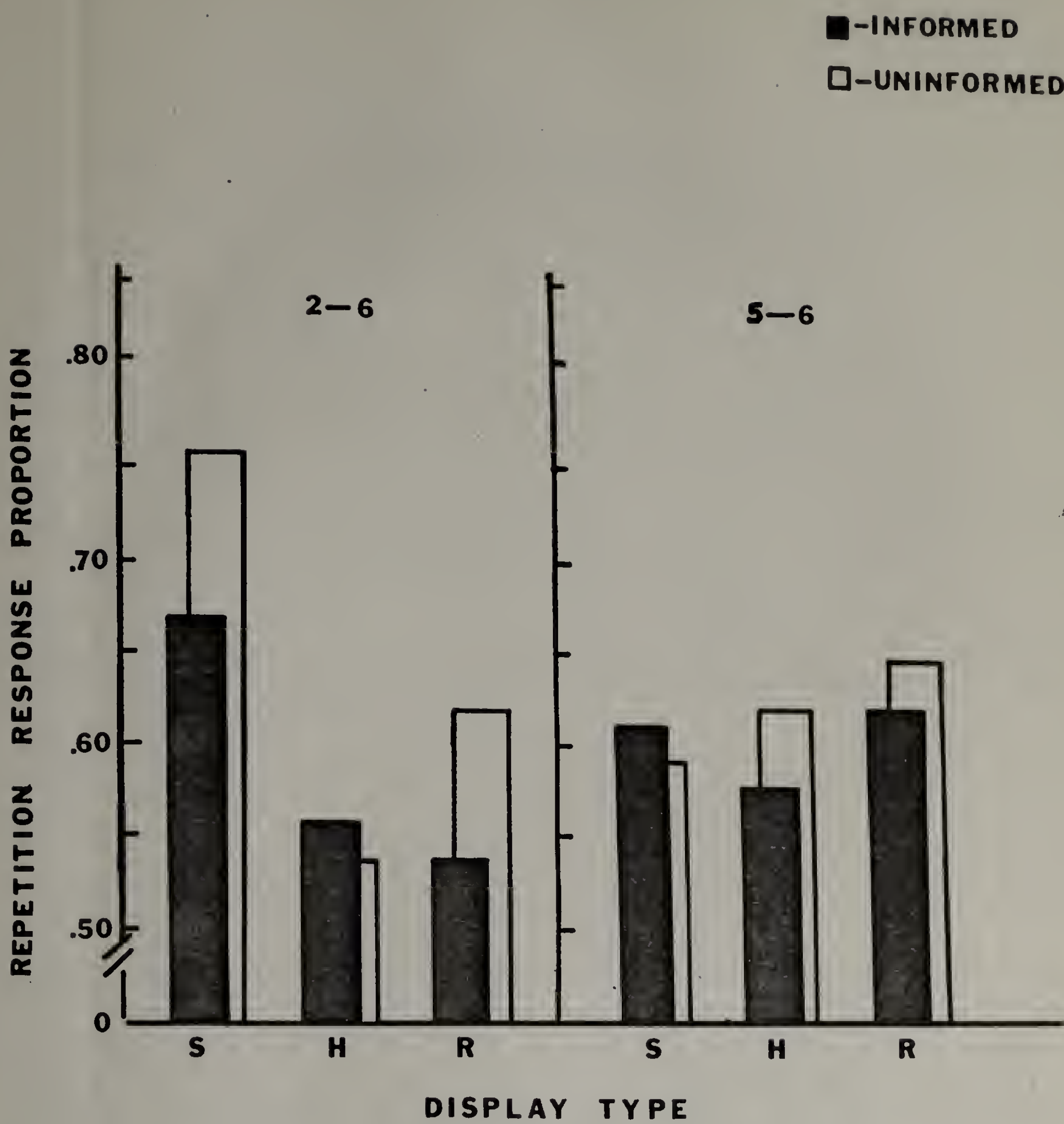

Fig. 4. Repetition response proportions at the uncertainty point for Standard (S), History (H), and Run (R) groups in each Instruction x Run Length condition.

From the first to the second block of trials, P(R), pooled over groups, increased by .10, an exact reversal of the directional trend noted on both error measures. After the second block, P(R) declined, reaching a terminal level of .588, which was quite close to its initial value, .594. Although block 2 increases in overshooting occurred in all except the Informed 2-6 S group, changes over trials were highly dependent on group. For example, the initial increase in P(R) was somewhat smaller in S groups, and the variability of P(R) over blocks was less marked in H groups. The trials main effect and all except first- and second-order interactions involving instructions were significant. The changes in P(R) which produced these effects are reported in Table 3.

<u>Conditional response data</u> -- Appendix C contains conditional run curves for each of the 12 groups. The first set of statistics for each group are repetition response proportions at each point in an event run, given that the preceding run was short. The second set are corresponding proportions, given that the preceding run was long. Myers, Butler, and Olson (1969) noted that for 1-5 groups in their experiment, repetition response probabilities at early points in a run were higher following long than following short runs. With increases in the length of the current run, the advantage associated with the long run decreased, and by the perseverative point, probabilities associated with the short preceding run were higher.

Table 3

Group Repetition Response Proportions Over Trial Blocks

Trial Block

Group	1	2	3	4	5	6
2-6SI	.844	.822	.653	.609	.569	.531
2-6SU	.675	.856	.791	.753	.715	.759
2-6HI	.481	.584	.578	.553	.581	.556
2-6HU	.475	.625	.544	.581	.516	.528
2-6RI	.550	.622	.519	.509	.522	.491
2-6RU	.712	.838	.619	.569	.544	.469
5-6SI	.625	.638	.628	.588	.624	.569
5-6SU	.622	.678	.597	.569	.594	.562
5-6HI	.459	.572	.591	.603	.616	.619
5-6HU	.594	.669	.600	.622	.581	.666
5-6RI	.525	.656	.594	.653	.640	.647
5-6RU	.572	.725	.634	.678	.650	.656

In this experiment, the 2-6 groups are most comparable to those in which Myers et. al. observed this long-short effect, as the phenomenon has been termed. In order to simplify the task of comparing the two sets of curves for the 2-6 groups, probabilities corresponding to a short run (hereafter referred to as short probabilities) have been subtracted from those corresponding to a long run (long probabilities) and are presented in Table 4.

As Table 4 indicates, with the exception of R groups, long probabilities tended to be greater than short probabilities for at least the first two positions in a run. By the sixth position, short probabilities were generally greater. However, several differences from the expected pattern of results were evident. First of all, even when differences were in the predicted direction, very often they were smaller at anticipatory points than was the case in the Myers et. al. 1-5 groups. Secondly, and perhaps as a consequence of the small differences noted in this experiment, the magnitude of the effect did not change systematically over anticipatory points. Finally, the effect did not seem to diminish over trial blocks in an orderly fashion.

In an attempt to better understand the source of the long-short effect, an additional analysis was performed on perseverative errors. This analysis was motivated by the finding that despite the occurrence of perseverative errors, Ss in memory probe experiments rarely reported runs longer

Table 4

Differences Between Long and Short Probabilities for 2-6 Groups[1]

Group	Trial Block	Current Run Length 1	2	3	4	5	6
	1	.010	-.030	.050	.042	.004	-.183
	2	.006	-.031	.088	.000	-.125	-.088
2-6SI	3	.006	.138	.000	-.012	.012	.000
	4	-.006	.081	.000	.000	-.038	-.127
	5	.000	-.025	.038	.000	-.038	.012
	6	-.006	.044	.038	-.012	.025	-.045
	1	.017	.127	.150	.117	.083	-.067
	2	.019	.062	.038	.050	.000	.000
2-6SU	3	.031	.006	-.012	.000	-.088	-.088
	4	.067	.081	.062	-.038	-.112	-.033
	5	.094	.031	.088	.050	-.025	-.088
	6	.035	.019	.088	-.038	.012	-.078
	1	.120	.042	.038	.058	.054	-.067
	2	.006	.006	.025	.000	.012	-.062
2-6HI	3	.050	.181	.000	.000	.012	-.012
	4	.000	.094	.000	.025	.038	-.083
	5	.025	.025	.012	.000	-.012	-.125
	6	.071	.138	.012	.012	.000	-.102

[1]Positive entries indicate that long probabilities are greater than short probabilities

Table 4 (cont.)

Group	Trial Block	Current Run Length 1	2	3	4	5	6
	1	.194	.269	.050	.059	-.021	-.417
	2	.031	.212	.012	.062	-.025	-.112
2-6HU	3	.031	.125	.000	-.012	-.025	-.125
	4	.000	.038	.012	.000	-.025	-.060
	5	.019	.044	.012	.000	-.012	-.075
	6	-.004	.095	-.038	-.038	.000	-.012
	1	.050	-.162	.048	.012	.009	-.017
	2	.012	-.069	-.012	.000	.000	.025
2-6RI	3	.006	-.050	.012	.000	.000	.012
	4	.006	.019	.000	.000	.000	-.030
	5	-.006	-.094	.012	.000	.012	-.012
	6	.000	-.007	.025	-.012	-.025	-.002
	1	.179	.142	.142	.125	.104	.017
	2	.031	-.050	-.025	.000	.012	-.050
2-6RU	3	-.031	.000	.012	.000	.000	-.062
	4	-.012	.025	-.075	-.012	-.012	.007
	5	-.006	.012	.000	.000	.000	.025
	6	-.018	.096	.025	.000	.000	.002

than those in the sequence (Ellis and Myers, manuscript in preparation). Vitz and Hazan (1969), using completely randomized event sequences, observed a similar result. In their experiment, subjective estimates of the proportion of runs longer than length 9 were obtained from memory probe data and from prediction data. While the memory data showed .02 undershooting of the objective proportion, prediction data showed .04 overshooting.

In view of these results, it appeared plausible to assume that perseverative errors are attributable to <u>S</u>s losing a count when tracking current run length. It was also assumed that count losses are indicative of disruption, and that disruption occurs primarily following errors. Yellot (1969) has provided evidence which is consistent with the notion that errors produce some type of interference. An additional but non-essential assumption underlying this analysis was that the disruptive effect of an error does not depend on the point at which the error occurs. Because errors are more probable at run transition points, particularly when the outcome at such points is indeterminate, it follows that the disruption which results in perseverative errors should occur more often when a preceding run was short.

Table 5 presents perseverative error proportions conditionalized on the length of the preceding run and on the response which occurred at the break-off point of that run. To summarize these data, errors were typically more frequent

Table 5

Conditional Perseverative Error Proportions for 2-6 Groups

GROUP	TRIAL BLOCK	PRECEDING RUN LENGTH	P(E/E)	F_1	P(E/C)	F_2
Informed 2-6 Standard	1	SHORT	0.5161	62	0.2778	18
		LONG	0.4828	29	0.2903	31
	2	SHORT	0.2941	68	0.1667	12
		LONG	0.1875	16	0.1563	64
	3	SHORT	0.2857	49	0.3548	31
		LONG	0.6250	24	0.1607	56
	4	SHORT	0.3043	46	0.1765	34
		LONG	0.3158	19	0.1148	61
	5	SHORT	0.1522	46	0.2059	34
		LONG	0.3077	13	0.1194	67
	6	SHORT	0.2857	35	0.1778	45
		LONG	0.5294	17	0.1111	65
Uninformed 2-6 Standard	1	SHORT	0.5472	53	0.5556	27
		LONG	0.6875	32	0.2143	28
	2	SHORT	0.4848	66	0.2857	14
		LONG	0.6750	40	0.2500	40
	3	SHORT	0.5000	68	0.1667	12
		LONG	0.6750	40	0.2500	40
	4	SHORT	0.4138	58	0.1364	22
		LONG	0.5862	29	0.2353	51
	5	SHORT	0.4828	58	0.2727	22
		LONG	0.5714	28	0.1731	53
	6	SHORT	0.4107	56	0.1667	24
		LONG	0.5714	23	0.0962	52

[1]P(E/E) is the probability of a perseverative error given an error at the preceding break-off point. P(E/C) is the corresponding probability given a correct response. F_1 is the frequency of errors at the preceding break-off point. F_2 is the frequency of correct responses at the preceding break-off point.

Table 5 (cont.)

GROUP	TRIAL BLOCK	PRECEDING RUN LENGTH	P(E/E)	F_1	P(E/C)	F_2
INFORMED 2-6 HISTORY	1	SHORT	0.2444	45	0.1143	35
		LONG	0.4000	10	0.1000	50
	2	SHORT	0.1154	52	0.1071	28
		LONG	0.1111	9	0.0423	71
	3	SHORT	0.1200	50	0.0667	30
		LONG	0.3750	8	0.0556	72
	4	SHORT	0.1282	39	0.0732	41
		LONG	0.0000	6	0.0135	74
	5	SHORT	0.2083	48	0.0313	32
		LONG	0.1667	6	0.0135	74
	6	SHORT	0.1860	43	0.0270	37
		LONG	0.0000	3	0.0000	77
UNINFORMED 2-6 HISTORY	1	SHORT	0.7568	37	0.4651	43
		LONG	0.3462	26	0.1471	34
	2	SHORT	0.2222	54	0.3077	26
		LONG	0.5833	24	0.0179	56
	3	SHORT	0.3590	39	0.1707	41
		LONG	0.4762	21	0.0169	59
	4	SHORT	0.2500	48	0.1250	32
		LONG	0.5333	15	0.0769	65
	5	SHORT	0.3500	40	0.1000	40
		LONG	0.5385	13	0.0597	67
	6	SHORT	0.3143	35	0.0444	45
		LONG	0.6667	12	0.0588	68

Table 5 (cont.)

GROUP	TRIAL BLOCK	PRECEDING RUN LENGTH	P(E/E)	F_1	P(E/C)	F_2
INFORMED 2-6 RUN	1	SHORT	0.0227	44	0.0000	36
		LONG	0.0000	0	0.0000	60
	2	SHORT	0.0000	55	0.0400	25
		LONG	0.0000	2	0.0385	78
	3	SHORT	0.0000	37	0.0000	42
		LONG	0.0000	1	0.0250	80
	4	SHORT	0.0227	44	0.0270	37
		LONG	0.0000	2	0.0000	76
	5	SHORT	0.0217	46	0.0303	33
		LONG	0.0000	1	0.0000	81
	6	SHORT	0.0400	25	0.0000	55
		LONG	0.0000	1	0.0127	79
UNINFORMED 2-6 RUN	1	SHORT	0.2778	54	0.1154	26
		LONG	0.6364	11	0.1224	49
	2	SHORT	0.1692	65	0.0000	15
		LONG	0.6000	15	0.0462	65
	3	SHORT	0.1500	40	0.0750	40
		LONG	0.3333	9	0.0141	71
	4	SHORT	0.0667	45	0.0571	35
		LONG	0.1429	7	0.0548	73
	5	SHORT	0.0286	35	0.0222	45
		LONG	0.6667	3	0.0390	77
	6	SHORT	0.0741	27	0.0189	53
		LONG	0.0000	4	0.0263	76

following errors than following correct responses. However, it is quite clear that the disruptive effect of an error depended on whether that error occurred at a determinate or an indeterminate point. As Table 5 shows, in most instances involving non-zero probabilities, errors followed errors more often when the preceding run was long. Although these results indicate that simple frequency notions cannot account for the long-short effect, the basic point of view implied by this analysis was supported. Count losses could result in perseverative errors, and errors apparently do lead to further interference.

Analysis of pre-criterion data -- In the Introduction, it was maintained that if miscounting is the primary source of errors, the learning of determinate points should be adequately described by an all-or-none model. The all-or-none position requires that two basic conditions be met: error probabilities should be independent of responses occurring on earlier trials, and should be constant over trials which precede the error which marks the beginning of the criterion run of correct responses. The conditional perseverative error data presented earlier indicate that this first condition was not satisfied. Although the perseverative error analysis was based on all trials, this conclusion appears valid in view of the fact that this relationship was evident at those trial blocks which constituted the pre-criterion phase for most Ss in each group.

In order to test the remaining condition, a criterion of 10 successive correct responses was established. A cycles to criterion measure was computed for each S at each of the 5 determinate points. Here a cycle corresponds to a single occurrence of a particular position. For example, if a S reached criterion on the third position after having been exposed to one long and one short run, his cycles to criterion score would be 1 if he is in a 2-6 group; he would have seen a run length of 3 only once. In a 5-6 group, his score would be 2; runs of length 3 are embedded in both the long and the short run in 5-6 sequences.

For each position, cycles prior to the last error before criterion were divided into four segments for every S-position pair. The group error proportions for each position are tabulated in Appendix F. Informed groups were not included in this analysis because so few exposures were needed to reach criterion that the data could not be easily divided into four segments. The results of the X^2 tests of stationarity appear in Table 6. In the 2-6 R group, only position 6 had non-stationary error probabilities, and in the 5-6 R group, only position 3. In both cases, the lack of stationarity appeared related to the large decrease in errors at the second quarter. In the latter case, however, the data for the third position were based on only two Ss and on only two cycles per quarter for each. Prior to the last error, only two errors occurred

Table 6

Chi-square Statistics for Tests of Stationarity[1]

Group	Position Number (Current Run Length) 1	2	3	4	5	6
2-6SU	4.21	-----	10.76*	3.49	3.14	4.35
2-6RU	1.41	-----	5.25	4.00	1.03	15.62**
s-6HU	19.91***	-----	14.60**	9.89*	6.40	5.36
5-6SU	8.21*	4.00	1.67	13.16**	----	1.45
5-6RU	1.55	4.31	7.85*	5.02	----	2.77
5-6HU	5.86	12.13**	7.64	5.14	----	3.06

[1] X^2 based on 3 df.

* p. < .05

** p. < .01

*** p. < .001

at this position and both occurred during the first quarter. Therefore, the error proportion dropped from .50 to zero.

In the H groups, a different pattern of results caused departures from stationarity. For the 5-6 H group, a .73 increase in errors at the second quarter as well as a sizeable decrease at the third quarter seemed to be responsible. For the 2-6 H group, positions 1, 3 and 4 were non-stationary. At the first position, error proportions declined continuously, while at the third and fourth positions, large declines at the second quarter appeared to be the source of the significant X^2.

Although the miscounting notion outlined in this paper would not predict all-or-none learning in S groups, stationarity was found at all points except position 3 in the 2-6 S group, and positions 1 and 4 in the 5-6 S group. Error proportions underwent continuous decline in only one of these cases. In the remaining instances, reductions at the second quarter appeared to result in lack of stationarity.

<u>Data fits of the generalization model</u> -- Predictions of the generalization model were generated by reading group event sequences into a CDC 3600 computer. Trial 1 entries for the vector of repetition response probabilities were initialized at .50. On each trial, a new entry was obtained by operating on the existing value with the expression designated Equation 2 in the Introduction. The selection of parameter estimates was based on a variance minimization criterion, and was accomplished using search routine STEPIT,

developed by Chandler (1965). The variance criterion involved weighting the squared deviation for each position in a run by the relative frequency with which that position occurred in the event sequence. Table 7 presents parameter estimates and variance statistics for each group.

As Table 7 indicates, both the estimates of the learning rate parameter, $\hat{\theta}$, and the generalization parameter, $\hat{\gamma}$, varied widely over groups. If one eliminates the Informed R groups, however, the range for $\hat{\theta}$ narrows substantially and is comparable to that observed in the Myers et. al. (1969) experiment. The fact that $\hat{\theta}$ was consistently higher in R, 5-6, and Informed groups suggests that this parameter variability is not random, but is systematically related to task difficulty. The variability of $\hat{\gamma}$ seems to have a similar source. Generalization was evidently greatest in S groups and least in R groups, greater in Uninformed than in Informed groups, and with two exceptions, greater in 2-6 than in 5-6 groups.

Predicted and observed repetition response probabilities are presented as a function of current run length and trial block in Appendix G. As comparisons of these statistics indicate, the model generally described the more gross characteristics of the data. In addition, parameter estimates and variance statistics for the Uninformed S groups were quite similar to those of groups receiving comparable treatment in other experiments (e.g., Gambino & Myers, 1967; Myers, Butler, & Olson, 1969).

Table 7

Parameter Estimates and Variance Statistics

for Data Fits of the Generalization Model

Group	$\hat{\theta}$	$\hat{\gamma}$	Variance
2-6SI	.455	.160	.0107
2-6SU	.160	.360	.0051
2-6HI	.395	.055	.0010
2-6HU	.175	.088	.0021
2-6RI	.997	.014	.0011
2-6RU	.240	.092	.0052
5-6SI	.620	.118	.0022
5-6SU	.265	.175	.0015
5-6HI	.434	.038	.0016
5-6HU	.195	.125	.0022
5-6RI	1.000	.023	.0028
5-6RU	.361	.084	.0041

One surprising finding was that the model did not provide better fits for R groups than for other groups. The generalization model, it will be recalled, assumes that the S focuses on current run length and perceives it accurately. It further assumes that the response on every trial is determined only by the reinforcement history of the current run length. Certainly these assumptions are most realistic for R groups. As the sum of squares entries in Table 7 show, within each RL x Instruction condition, fits of the R data were generally equivalent to or worse than those of H and S groups; they were rarely better.

DISCUSSION

Before attempting to discuss the implications of the results, it would be worthwhile to summarize the major trends apparent in the data. According to both error measures and the cycles to criterion measure, performance was better in Informed than in Uninformed groups, and was best in R groups and poorest in S groups. Sequence structure effects, however, were somewhat more complicated. In all conditions, perseverative errors exceeded anticipatory errors, and in most cases, 5-6 groups were somewhat better than 2-6 groups. The advantage of 5-6 groups was typically smaller under Informed instructions and in the R display condition. At the uncertainty point, overshooting was most pronounced in S and Uninformed groups, and least pronounced in H and Informed groups. However, the complex pattern of group relationships noted at the uncertainty point suggests that overall trends may have been an artifact of pooling over conditions.

The error data suggest several characteristics of the interference which operates in the learning of run sequences. The magnitude of this interference appears to depend on both the amount of information provided, and the context in which this information is presented. Furthermore, this interference appears sensitive to run structure, but to an extent which depends on the method of event presentation. Although it would be desirable to specify the effects of interference on performance at indeterminate points, the data of this experiment were not particularly helpful in this respect.

The finding that repetition response proportions varied with current run length even in the Informed R condition is consistent with the assumption that generalized response tendencies are a source of interference. However, the specific treatment of generalization given in the Gambino-Myers model was contradicted by the finding that differences in overall error rates for 2-6 and 5-6 groups were not only negligible, but were indicative of slightly better performance in 2-6 groups. In addition, despite the fact that the model's assumptions are most tenable for R groups, and that the H display would seemingly encourage behavior which is inconsistent with the model's assumption that Ss process only current run length, on the average, fits of the H data were generally better than those of other groups.

The Gambino-Myers conceptualization provides an unsatisfactory account of the interference process for still another reason. Although there is no a priori reason for expecting the magnitude of generalization to depend on the lengths of the two runs occurring in a sequence, $\hat{\gamma}$ generally varies over groups. Furthermore, the model inevitably yields higher values of $\hat{\gamma}$ for conditions in which the two run lengths should be most discriminable. Surely if the model must predict differences in the amount of generalization, these differences should be in the opposite direction.

The miscounting conception of interference was supported by the fact that counting aids facilitated performance and that differences between 2-6 and 5-6 groups were considerably reduced in the R condition. However, this conception could not easily encompass the finding that even in Informed R groups, error rates varied with current run length. While this result implies that very simple interpretations of miscounting may be inappropriate, the better performance of H and R groups suggests that counting failures do contribute to errors in the usual experimental situation.

Recent evidence suggests that if counting failures are involved, these failures are probably indicative of interference processes which affect memory. Ellis and Myers (manuscript in preparation) have found that low error groups (2-3 and 4-5 in their experiment) could better recall the current run length and the four preceding runs than could groups with intermediate error rates (2-5 and 4-7). The latter groups, in turn, had more accurate recall than did high error groups (2-3-4-5 and 4-5-6-7).

Although it is not possible to specify the reasons for this covariation of sequence structure and retention, an experiment conducted by Colker and Myers (manuscript in preparation) suggests one possibility. After several hundred trials, Ss in their experiment were switched to non-contingent reinforcement schedules in which every response was designated correct. Prior to this change, as would be expected, error rates were higher for 2-5 than for 4-5 groups. During the second stage of the experiment, Ss in 2-5 groups displayed more complex response patterns than did those in 4-5 groups. Moreover, Ss within both groups who exhibited periodic "solutions" (e.g., $2E_1s-5E_2s-2E_1s-5E_2s\ldots$) fell below the group median on both the anticipatory and perseverative error measures computed for the acquisition phase of the experiment. Although Ss who emitted more complex solutions fell below group medians in some cases, the average error rates and the variability of error rates for this sub-group were always greater than for sub-groups composed of Ss giving simpler solutions.

These findings suggest that the relationship between sequence structure and error rates may reflect differences in the extent to which certain patterns of events induce complex hypothesis behavior on the part of Ss. As the complexity of such hypotheses increases, the demands placed on memory would increase, thereby reducing both retention and prediction accuracy. The contention that performance is adversely affected by increasing memory lead is supported by the finding that error rates increase with the number of run lengths occurring in a partially learnable sequence (Gambino and Myers, 1966) and the finding that cycles to solution increase with the number of structural units forming the basic pattern of a recursive sequence (Derks and House, 1965; 1967).

Under circumstances in which the number of runs in various sequences is held constant, differences in memory requirements would seemingly be attributable to differences in the relationship of the long and short run. In sequences in which the two run lengths are separated by a minimal distance, it would be difficult for Ss to discriminate between the long and short run. Therefore, it would be quite difficult for Ss to detect temporal patterns formed by the two run lengths over a series of trials. As the distance between run lengths is increased, discriminability would also increase, and Ss would find it less difficult to compile the type of information necessary for formulating hypotheses regarding patterns of runs. As the task of compiling this information becomes more feasible, Ss should be able to detect increasing degrees of complexity in the event sequence.

The notions sketched out above suggest a theoretical framework for interpreting the results observed in this experiment. First of all, the results summarized above suggest that Ss attempt to generate hypotheses which include rules for predicting outcomes at indeterminate points. Secondly, they suggest that hypothesis complexity is determined by the discriminability of the run lengths which comprise the sequence. Finally, these results suggest that as hypothesis complexity increases, processing ability and/or memory load approach their limits. As a consequence, performance at determinate points deteriorates.

In this context, differences between 2-6 and 5-6 groups would be expected due to the fact that 2-6 sequences would tend to encourage more complex hypothesis behavior and as a result, would lead to more interference at learnable points. Differences among display conditions can also be accounted for by differences in memory load. In the H condition, the display would not only facilitate the detection of run patterns, but could conceivably alter demand characteristics of the situation in such a way that Ss feel compelled to use all of the information presented. The R display could either emphasize the importance of current run length, thereby discouraging complexity, or reduce the demands placed on memory to such a degree that complex hypotheses appear feasible. In the former case, Ss in S groups might be expected to entertain more complex hypotheses than Ss in R groups; in the latter case, the reverse might be true.

Due to differences in hypothesis load, performance should be better in R groups than in H groups. Due to the fact that Ss in the S condition must remember current run length without visual aids, performance in the H groups should be better than in S groups. Although overall trends supported this prediction, initial error rates indicated that the advantage of a counting aid in H groups may have been outweighed by interference effects during the earliest stage of practice. In the Informed condition, with only one exception, perseverative and anticipatory errors occurred more frequently in these groups than in S groups.

The effects of instruction can also be interpreted in this framework. To the extent that detailed instructions emphasized current run length at the expense of pattern information, Informed groups should perform better than Uninformed groups. In the S condition, an additional factor could contribute to differences in the two instruction conditions. In the absence of a counting aid, some proportion of the Uninformed Ss could very well fail to learn the run lengths during the course of the experiment. However, as noted in the Introduction, these failures can probably be attributed to the interfering effects of overly complex strategies. Therefore, even failures to learn can be treated as indications that the demands placed on memory exceed processing limitations.

Although only 2-6 S groups showed sizeable differences in anticipatory error rates by the end of the session, initial and terminal error rates were generally somewhat higher in Uninformed groups. In addition, although differences between Informed and Uninformed groups did not vary markedly with display type, in the 2-5 condition, where interference would be greater, perseverative error rates at most trial blocks suggested that detailed instructions were most beneficial in H groups and least beneficial in R groups. This relationship is consistent with the assumption that hypothesis complexity is jointly determined by the emphasis placed on current run length and the discriminability of temporal patterns formed by runs.

Although the interpretations offerred for the results of this experiment suggest that information processing conceptions of prediction behavior may be fruitful, the foregoing remarks do not dictate exact lines that such models should follow. Perhaps the most critical choice point in developing a formal model involves the representation of the basic learning process. It could be assumed that learning is an incremental process. In this case, the learning of certainty points could be described using a system which is similar to the direct reinforcement assumptions of the generalization model. To describe the hypothesis structure developed by Ss, the model could incorporate a parallel set of assumptions which treat expectancies about run repetitions in a manner which is analogous to the treatment of expectancies about event repetitions at determinate points.

Alternatively, learning could be conceived of as a discrete process, and the S could be viewed as in a guessing state for each run length until some trial on which reinforcement becomes effective. If the run of length j continued on that trial, a repetition response would be conditioned to that run length; if the run broke off, an alternation response would be conditioned. To account for performance at indeterminate points, the model could assume that with some probability the conditioning process leads the S to expect either a short or a long run to follow a particular pattern of long and short runs.

Discrete conceptions of the learning process may be preferable for several reasons. First of all, they could more easily cope with the stationarity of error probabilities observed in this experiment and in experiments involving perfectly learnable sequences. Secondly, assumptions regarding memory and hypothesis behavior may actually be more compatible with discrete analyses of learning. This possibility is suggested by the fact that most recent models which have incorporated information processing assumptions have been cast in such a framework. Furthermore, as Rumelhart's (1967) review of memory models of paired associate learning and Chumbley's (1967) review of the concept identification literature will substantiate, much of the impetus for the investigation of the cognitive processes involved in learning has been provided by theories which view the learning process as composed of stages which correspond to the operation of different psychological and behavioral processes.

Another choice point in developing a formal model involves deciding whether interference effects should be independent of responses and sequence constraints. The finding that perseverative error rates in this experiment were higher when an error occurred at the preceding break-off point suggests that it may be profitable to assume that interference occurs primarily when the information used to generate a response is invalidated by the trial outcome. In order to account for differences noted as a function of preceding run length, it could also be assumed that disruption is more probable when the hypothesis that is disconfirmed has been supported on most previous occassions. Due to the complete predictability of outcomes at determinate points, this assumption would lead one to expect more frequent disruption when an error occurs at a certainty point.

It would also be necessary for a formal model to make some statement regarding the consequences of interference. If the model either implicitly or explicitly assumes that the S is aware of disruption when it occurs, it follows that the contents of memory would be unaffected by the trial outcome. On the other hand, if the model holds that disruption goes unnoticed, then it follows that stored information would be changed in a manner which is consistent with the trial outcome and with the faculty information upon which the response was based. The latter assumption, however, implies that Ss never become familiar enough with run structure to be able to detect counting failures. In so doing, it not only implies that most Ss fail to learn event contingencies at determinate points, but it also suggests that the hypothesis structure of Ss exposed to 2-5 sequences would be almost as complex as that of Ss exposed to 2-3-4-5 sequences. In view of the Colker and Myers (manuscript in preparation) finding that Ss rarely use incorrect run lengths in generating solutions when all responses are reinforced, and in view of the differences in retention and error rate reported by Ellis and Myers (manuscript in preparation), both of these possibilities seem unlikely.

In addition to having to specify how disruption would affect memory, a formal model would also have to specify how the response selection process is affected. When disrupted, the S could simply guess at random, could base his response on an estimate of overall event repetition probabilities, or could base his response on the last run length he remembers seeing. The latter alternative seems particularly well suited to information processing notions in that it is compatible with recency assumptions generally incorporated in theories of forgetting (see, for example, Melton, 1963). Furthermore, it is consistent with two of the major findings of the Ellis and Myers experiment: that Ss rarely report runs longer than the current run length when memory is probed, and that the proportion of Ss reporting the current run as being of length j decreases with the distance of j from true run length. Both of these results imply that when the S loses track, he is most likely to retrieve the run length for which memory should be most accurate--the one which was most recently experienced.

It is no doubt evident that the status of the miscounting position has been left rather vague. While the results of this experiment strongly suggest that no simple interpretation of counting failures would be adequate, these results are compatible with the assumption that the processing of complex information may cause attentional fluctuations and/or memory overloads which make it difficult for the S to keep track of current run length. Thus, it can be concluded that the results of this experiment are consistent with the following assumptions: (1) interference may be caused by the S's attempts to generate hypotheses that contain information regarding outcomes at both determinate and indeterminate points; (2) the complexity of these hypotheses may be determined by the discriminability of the run lengths which occur in the sequence; (3) interference may increase with the complexity of the hypotheses developed, and (4) interference may be manifested by the S losing track of current run length.

Although these assumptions can provide guide lines for formulating models of the learning situation, they do not greatly restrict the range of additional assumptions which could be entertained. Several alternatives are available in deciding on how to view the learning process, whether the likelihood of disruption depends on the response occurring on a particular trial and on the series of events preceding that trial, how disruption would alter the contents of memory, and how it would affect the response selection process.

SUMMARY

Twelve groups of 20 Ss were exposed to partially learnable sequences composed of runs of lengths 2 and 6 or 5 and 6. The Ss were given either neutral instructions or instructions which specified the lengths in which runs could occur. Either a single event, all events comprising the run in progress, or all events occurring within the 12 most recent trials were displayed after each prediction. The major results were that differences among the two run length conditions depended on levels of the other independent variables, and that providing information either through instructions or via the event display improved performance. Results were discussed with reference to information processing conceptions of binary choice behavior.

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APPENDIX A

Pattern of Long (L) and Short (S) Runs for All Group Sequences.

Trial Block:	1	2	3	4	5	6
	L	L	L	S	S	S
	S	L	S	L	S	S
	S	L	L	S	L	L
	S	S	L	S	L	L
	L	S	S	L	L	S
	S	L	S	L	L	L
	S	S	L	L	S	S
	L	L	L	S	L	S
	L	L	S	S	S	L
	S	S	S	S	S	S
	S	L	S	L	S	S
	L	S	L	L	S	L
	L	S	L	S	L	L
	L	S	S	S	S	L
	S	S	S	L	L	L
	L	L	L	L	L	S

APPENDIX B

Instructions

General Instructions for All Groups

In this experiment you will be presented with a series of lights. On each trial, you are to predict whether a light will come on in the top row or in the bottom row of the display panel at the front of the room.

How to make predictions. Next to you, there is a console containing two switches. To record your prediction, you are to flip one of the switches downward. If you think a light in the top row will come on, flip the top switch. If you think a light in the bottom row will come on, flip the bottom switch. It is important that you move only one switch on each trial.

When to make a prediction. Between trials, the lights on the display will go off and will remain off for 2 seconds. You are to make your prediction in this 2 second interval. After 2 seconds have gone by, the display will show the correct prediction for that trial. There will be no warning signal to tell you when to respond or when to check the display for the correct prediction. So make your predictions rapidly. Remember, as soon as the lights go out, make your prediction, look up immediately, and wait for the correct prediction to appear on the display.

APPENDIX B (cont.)

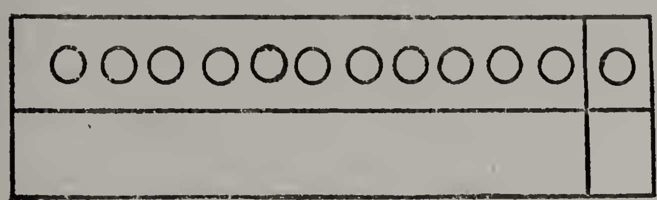
Instructions for Standard Groups

Only the lights for the leftmost position will be used, so be sure to look at the appropriate area of the display. Either a light in the top row or in the bottom row will come on after you have made your prediction. We will start with one light on. As soon as it goes off, make your first prediction.

APPENDIX B (cont.)

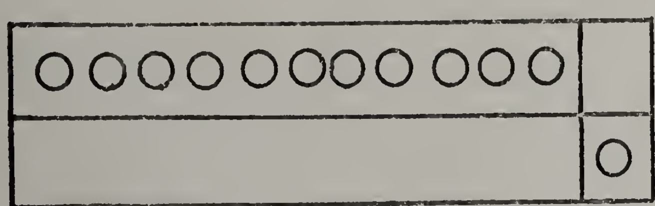
Instructions for History Groups

On every trial, several lights will appear on the display. The correct prediction for the present trial will appear in the rightmost position to the right of the black line. The correct prediction for the preceding trial will occur in the next position, and so on. In other words, you will be able to see the correct prediction for the present trial and for each of several preceding trials, ordered from right to left in terms of the most recent to the least recent. For example, suppose we start off with all of the lights in the first row on. The display would look like this.



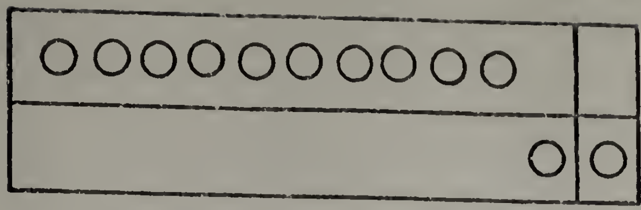
Trial 1

When these lights went off you would make your first prediction. If a light in the second row is now correct, the display would look like this after your prediction.



Trial 2

If a light in the second row is also correct on the next trial, after your second response, the display would look like this.



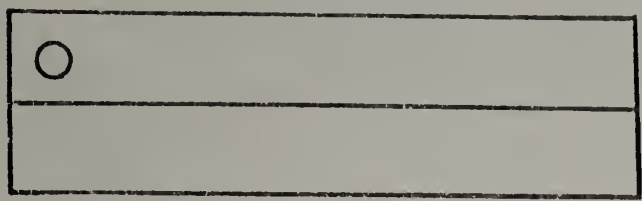
Trial 3

Event for Trial 1
Event for Trial 2
Event for Trial 3

Notice that after each response interval, the lights move over one position to the left in order to make room for the new event. Notice also that the same number of lights will be on for every trial, so that the leftmost light will move off the display when a new event is added. We will start with the display lighted. As soon as the lights go off, make your first prediction.

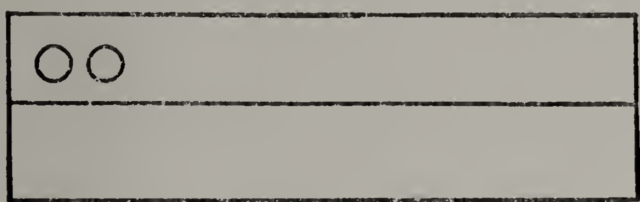
Instructions for Run Groups

Whenever a light in a particular row is followed by a light in the same row, these lights will be shown together. For example, suppose that we start off with a light on in the first row. The display would look like this.



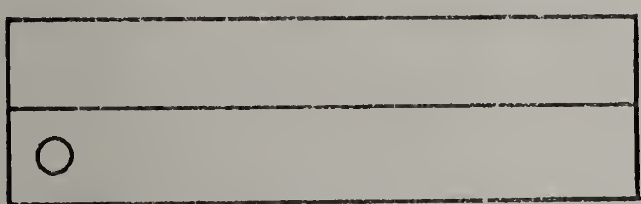
Trial 1

After your first prediction, if the top row is correct, the display would look like this.



Trial 2

If the bottom row is correct next, after your prediction, the display would look like this.



Trial 3

We will start off with a single light on. As soon as it goes off, make your first prediction.

APPENDIX B (cont.)

Special Instructions: Uninformed 2-6 and 5-6 Groups

Are there any questions? (E responds by paraphrasing written instructions.) I would like to point out that it is not possible to be correct on every trial, but it is possible to be correct most of the time. Remember, you must make one and only one response on every trial and you must make that response during the lights off period. We will begin now.

APPENDIX B (cont.)

Special Instructions: Informed 2-6 Groups

Are there any questions? (E responds by paraphrasing written instructions.)

This group will be given special information that other groups will have to learn. Exactly two or exactly six lights in the same row will be correct on successive trials. When you see the first light come on in a particular row, there will always be a second one in that same row on the next trial. After 2 lights in the same row, there will sometimes be a third one in that row, and at other times, the lights in the alternate row will begin to come on. Whenever you have seen 3 lights in the same row, there will always be a fourth, a fifth and a sixth light in that row on the following trials. In other words, there will never be fewer than 2 or more than 6 lights in the same row occurring on successive trials. When you have seen 1, 3, 4 or 5 lights in a particular row, there will always be another one in that row on the next trial. When you have seen exactly 2, there may or may not be a third. When you have seen six, the lights in the other row will begin to be correct next. The sign at the front of the room will remind you of these rules. I would also like to point out that it is not possible to be correct on every trial, but it is possible to be correct most of the time. Remember, you must make one and only one response on every trial and you must make that response during the lights off period. We will begin now if you have no questions.

Special Instructions: Informed 5-6 Groups

Are there any questions? (E responds by paraphrasing written instructions.)

This group will be given special information that other groups will have to learn. Exactly five or exactly six lights in the same row will be correct on successive trials. When you see the first light come on in a particular row, there will always be a second, a third, a fourth and a fifth light in the same row on the following trials. After 5 trials in the same row, there will sometimes be a sixth one in that row, and at other times, lights in the alternate row will begin to come on. In other words, there will never be fewer than 5 or more than 6 lights occurring in the same row on successive trials. When you have seen 1, 2, 3 or 4 lights in a particular row, there will always be another one in that row on the next trial. When you have seen exactly 5, there may or may not be a sixth. When you have seen 6, the lights in the other row will begin to be correct next. The sign at the front of the room will remind you of these rules. I would also like to point out that it is not possible to be correct on every trial, but it is possible to be correct most of the time. Remember, you must make one and only one response on every trial, and you must make that response during the lights off period. We will begin now if you have no questions.

APPENDIX C

Summaries of Analyses of Variance
Anticipatory Errors

Source of Variance	df	ss	ms	f
Between				
Run Length Comb. (RL)	1	.4384	.4384	31.54***
Display (D)	2	.1463	.0732	5.27**
Instructions (I)	1	.4367	.4367	31.42***
RL x D	2	.0702	.0351	2.52
RL x I	1	.1400	.1400	10.07**
D x I	2	.0962	.0481	3.46*
RL x D x I	2	.0952	.0476	3.42*
S/(RL)DI	228	3.1708	.0139	-----
Within				
Trials (T)	5	1.8341	.3668	244.53***
RL x T	5	.1555	.0311	20.73***
D x T	10	.2401	.0241	16.07***
I x T	5	.3556	.0711	47.40***
RL x D x T	10	.0064	.0006	1.00
RL x I x T	5	.0322	.0064	4.27**
D x I x T	10	.0209	.0021	1.40
RL x D x I x T	10	.0218	.0022	1.47
S/(RL)DIT	1140	1.7623	.0015	-----

* $p < .05$
** $p < .01$
*** $p < .001$

APPENDIX C (cont.)

Perseverative Errors

Source of Variance	df	ss	ms	f
Between				
RL	1	2.3017	2.3017	17.00***
D	2	9.0714	4.5357	33.50***
I	1	2.9631	2.9631	21.88***
RL x D	2	1.5667	.7834	5.78**
RL x I	1	.2621	.2621	1.94
D x I	2	.1790	.0895	<1.00
RL x D x I	2	.0019	.0010	<1.00
S/(RL)DI	228	30.8820	.1354	-----
Within				
T	5	4.1404	.8281	52.74***
RL x T	5	.1917	.0383	2.44*
D x T	10	.2190	.0219	1.39
I x T	5	.4476	.0895	5.70***
RL x D x T	10	.2446	.0245	1.56
RL x I x T	5	.0756	.0151	<1.00
D x I x T	10	.2159	.0216	1.38
RL x D x I x T	10	.5637	.0564	3.59***
S/(RL)DIT	1140	17.9060	.0157	-----

APPENDIX C (cont.)

Repitition Responses at the Uncertainty Point

Source of Variance	df	ss	ms	f
Between				
RL	1	.0002	.0002	<1.00
D	2	1.8319	.9159	11.34 **
I	1	.5571	.5571	6.89 **
RL x D	2	2.0333	1.0166	12.58 ***
RL x I	1	.0907	.0907	1.12
D x I	2	.1180	.0590	<1.00
RL x D x I	2	.3715	.1858	2.30
S/(RL)DI	228	18.4204	.0808	-----
Within				
T	5	1.7444	.3489	19.71 ***
RL x T	5	.8674	.1735	9.80 ***
D x T	10	1.0042	.1004	5.67 ***
I x T	5	.1814	.0363	2.05
RL x D x T	10	.4625	.0462	2.61 **
RL x I x T	5	.1789	.0358	2.02
D x I x T	10	.7729	.0773	4.37 ***
RL x D x I x T	10	.5659	.0566	3.21 **
S/(RL)DIT	1140	20.1583	.0177	-----

APPENDIX D

Repetition Responses as a Function of Current Run Length

Trial Block

Group	Current Run Length	1	2	3	4	5	6
Informed 2 - 6 Standard	1	0.9625	0.9906	0.9969	0.9906	0.9937	0.9969
	2	0.8250	0.8094	0.6375	0.6156	0.5687	0.5250
	3	0.9625	0.9438	0.9750	1.0000	0.9812	0.9812
	4	0.9438	0.9875	0.9937	1.0000	1.0000	0.9937
	5	0.9250	0.9000	0.9563	0.9438	0.9438	0.9375
	6	0.4938	0.2188	0.3063	0.2062	0.1625	0.2125
Uninformed 2-6 Standard	1	0.8219	0.9469	0.9656	0.9531	0.9406	0.9625
	2	0.6750	0.8562	0.7906	0.7531	0.7156	0.7594
	3	0.7250	0.9187	0.9187	0.9187	0.9312	0.9063
	4	0.7250	0.9125	0.8750	0.8562	0.8750	0.8813
	5	0.6312	0.8375	0.7437	0.7937	0.8125	0.8438
	6	0.5188	0.4563	0.3937	0.3500	0.3688	0.3000
Informed 2 - 6 Standard	1	0.9489	0.9937	0.9969	0.9969	0.9969	1.0000
	2	0.5500	0.6219	0.5188	0.5094	0.5219	0.4906
	3	0.9359	0.9937	0.9937	1.0000	0.9937	0.9625
	4	0.9875	1.0000	1.0000	1.0000	1.0000	0.9812
	5	0.9811	1.0000	1.0000	1.0000	0.9937	0.9875
	6	0.0250	0.0250	0.0063	0.0187	0.0063	0.0125
Uninformed 2-6 Standard	1	0.8344	0.9656	0.9469	0.9688	0.9656	0.9688
	2	0.7125	0.8375	0.6187	0.5687	0.5437	0.4688
	3	0.7250	0.9500	0.9812	0.9625	0.9625	0.9875
	4	0.8000	1.0000	1.0000	0.9688	0.9625	1.0000
	5	0.8188	0.9937	0.9375	0.9563	0.9500	0.9500
	6	0.2687	0.1437	0.0812	0.0625	0.0437	0.0313

APPENDIX D (cont.)

Trial Block

Group	Current Run Length	1	2	3	4	5	6
Informed 2 - 6 History	1	0.8438	0.9719	0.9563	0.9750	0.9688	0.9688
	2	0.4812	0.5844	0.5781	0.5531	0.5813	0.5562
	3	0.8562	0.9875	0.9875	1.0000	0.9688	0.9937
	4	0.8313	1.0000	0.9875	0.9750	0.9875	0.9937
	5	0.8188	0.9937	0.9812	0.9688	0.9937	1.0000
	6	0.1500	0.0812	0.0938	0.0562	0.0812	0.0562
Uninformed 2-6 History	1	0.7937	0.9406	0.9719	0.9812	0.9719	0.9906
	2	0.4750	0.6250	0.5437	0.5813	0.5156	0.5281
	3	0.7188	0.9563	0.9750	0.9812	0.9812	0.9812
	4	0.7437	0.9563	0.9812	0.9625	0.9750	0.9688
	5	0.7688	0.9750	0.9875	0.9750	0.9688	1.0000
	6	0.3875	0.2188	0.2000	0.1812	0.1812	0.1563
Informed 5 - 6 Standard	1	0.9750	0.9750	0.9969	1.0000	1.0000	0.9937
	2	0.9875	0.9812	0.9969	1.0000	1.0000	1.0000
	3	0.9812	0.9812	0.9969	1.0000	1.0000	1.0000
	4	0.9594	0.9625	0.9844	0.9686	0.9875	0.9781
	5	0.6250	0.6375	0.6281	0.5881	0.6238	0.5687
	6	0.1563	0.1437	0.0562	0.1069	0.1563	0.1312
Uninformed 5-6 Standard	1	0.9028	0.9719	0.9750	0.9781	1.0000	0.9906
	2	0.9250	0.9844	0.9937	0.9937	0.9969	0.9969
	3	0.9250	0.9844	0.9937	0.9812	1.0000	0.9937
	4	0.8687	0.9594	0.9656	0.9500	0.9781	0.9812
	5	0.6219	0.6781	0.5969	0.5687	0.5938	0.5625
	6	0.3562	0.2562	0.1625	0.1812	0.1500	0.1125

APPENDIX D (cont.)

Group	Current Run Length	Trial Block 1	2	3	4	5	6
Informed 5 - 6 Run	1	0.9625	0.9969	0.9969	1.0000	0.9906	0.9875
	2	0.9781	0.9969	0.9969	1.0000	0.9875	0.9875
	3	0.9844	0.9969	0.9969	1.0000	0.9906	0.9969
	4	0.9875	1.0000	0.9969	1.0000	0.9969	0.9969
	5	0.5250	0.6563	0.5938	0.6531	0.6395	0.6469
	6	0.1187	0.0313	0.0063	0.0125	0.0435	0.0187
Uninformed 5-6 Run	1	0.9125	0.9906	0.9906	0.9906	0.9937	0.9969
	2	0.9344	1.0000	0.9937	1.0000	0.9969	0.9969
	3	0.9531	0.9969	0.9937	1.0000	0.9969	0.9969
	4	0.8875	0.9844	0.9937	0.9969	0.9969	0.9969
	5	0.5719	0.7250	0.6344	0.6781	0.6500	0.6563
	6	0.1875	0.0688	0.0187	0.0562	0.0187	0.0562
Informed 5 - 6 History	1	0.9031	0.9906	0.9906	1.0000	0.9969	1.0000
	2	0.9156	0.9937	0.9969	1.0000	1.0000	0.9969
	3	0.9219	0.9969	1.0000	1.0000	1.0000	1.0000
	4	0.9156	0.9937	1.0000	0.9969	1.0000	1.0000
	5	0.4594	0.5719	0.5906	0.6031	0.6156	0.6187
	6	0.1688	0.0187	0.0187	0.0187	0.0187	0.0313
Uninformed 5-6 History	1	0.8344	0.9875	0.9875	0.9844	0.9906	0.9844
	2	0.8531	1.0000	0.9906	0.9937	0.9969	1.0000
	3	0.8750	1.0000	0.9844	0.9969	1.0000	1.0000
	4	0.8313	0.9937	0.9750	0.9500	0.9844	0.9781
	5	0.5938	0.6687	0.6000	0.6219	0.5813	0.6656
	6	0.2813	0.1063	0.1187	0.1000	0.1063	0.0688

APPENDIX E

Repetition Responce Proportions as a Function of the Preceding and Current Run Length

Group	Preceding Run	Current Run Length	1	2	3	4	5	6
Informed 2-6 Standard	<u>Short</u>	1	0.9688	0.9875	0.9937	0.9937	0.9937	1.0000
		2	0.8375	0.8250	0.5687	0.5750	0.5813	0.5000
		3	0.9500	0.9000	0.9750	1.0000	0.9625	0.9625
		4	0.9250	0.9875	1.0000	1.0000	1.0000	1.0000
		5	0.9125	0.9625	0.9500	0.9625	0.9625	0.9250
		6	0.5667	0.2500	0.3000	0.2600	0.1750	0.2250
	<u>Long</u>	1	0.9786	0.9937	1.0000	0.9875	0.9937	0.9944
		2	0.8071	0.7937	0.7063	0.6563	0.5562	0.5437
		3	1.0000	0.9875	0.9750	1.0000	1.0000	1.0000
		4	0.9667	0.9875	0.9875	1.0000	1.0000	0.9875
		5	0.9167	0.8375	0.9625	0.9250	0.9250	0.9500
		6	0.4844	0.1625	0.3000	0.1333	0.1875	0.1800
Uninformed 2-6 Standard	<u>Short</u>	1	0.8188	0.9375	0.9500	0.9187	0.8938	0.9429
		2	0.6375	0.8250	0.7875	0.7125	0.7000	0.7500
		3	0.7000	0.9000	0.9250	0.8875	0.8875	0.8625
		4	0.7000	0.8875	0.8750	0.8750	0.8500	0.9000
		5	0.6000	0.8375	0.7875	0.8500	0.8250	0.8375
		6	0.5333	0.4625	0.4250	0.4000	0.4250	0.3375
	<u>Long</u>	1	0.8357	0.9563	0.9812	0.9875	0.9875	0.9778
		2	0.7643	0.8875	0.7937	0.7937	0.7312	0.7688
		3	0.8500	0.9375	0.9125	0.9500	0.9750	0.9500
		4	0.8167	0.9375	0.8750	0.8375	0.9000	0.8625
		5	0.6833	0.8375	0.7000	0.7375	0.8000	0.8500
		6	0.4667	0.4625	0.3375	0.3667	0.3375	0.2600

APPENDIX E (cont.)

Trial Block

Group	Preceding Run	Current Run Length	1	2	3	4	5	6
Informed 2-6 History	Short	1	0.8438	0.9688	0.9312	0.9750	0.9563	0.9286
		2	0.4938	0.5813	0.4875	0.5062	0.5687	0.5000
		3	0.9625	0.9750	0.9875	1.0000	0.9625	0.9875
		4	0.9250	1.0000	0.9875	0.9625	0.9875	0.9875
		5	0.9125	0.9875	0.9750	0.9500	1.0000	1.0000
		6	0.2167	0.1125	0.1000	0.1000	0.1375	0.1125
	Long	1	0.9643	0.9750	0.9812	0.9750	0.9812	1.0000
		2	0.5357	0.5875	0.6687	0.6000	0.5938	0.6375
		3	1.0000	1.0000	0.9875	1.0000	0.9750	1.0000
		4	0.9833	1.0000	0.9875	0.9875	0.9875	1.0000
		5	0.9667	1.0000	0.9875	0.9875	0.9875	1.0000
		6	0.1500	0.0500	0.0875	0.0167	0.0125	0.0100
Uninformed 2-6 History	Short	1	0.7562	0.9250	0.9563	0.9812	0.9625	0.9929
		2	0.3812	0.5188	0.4812	0.5625	0.4938	0.4929
		3	0.8000	0.9500	0.9750	0.9750	0.9750	1.0000
		4	0.8250	0.9250	0.9875	0.9625	0.9750	0.9500
		5	0.8875	0.9875	1.0000	0.9875	0.9750	1.0000
		6	0.6500	0.3000	0.2625	0.2100	0.2250	0.1625
	Long	1	0.9500	0.9563	0.9875	0.9812	0.9812	0.9889
		2	0.6500	0.7312	0.6062	0.6000	0.5375	0.5875
		3	0.8500	0.9625	0.9750	0.9875	0.9875	0.9625
		4	0.8833	0.9875	0.9750	0.9625	0.9750	0.9875
		5	0.8667	0.9625	0.9750	0.9625	0.9625	1.0000
		6	0.2333	0.1875	0.1375	0.1500	0.1500	0.1500

APPENDIX E (cont.)

Trial Block

Group	Preceding Run	Current Run Length	1	2	3	4	5	6
Informed 2-6 Run	Short	1	0.9355	0.9875	0.9937	0.9937	1.0000	1.0000
		2	0.6187	0.6563	0.5437	0.5000	0.5687	0.5071
		3	0.9351	1.0000	0.9875	1.0000	0.9875	0.9500
		4	0.9875	1.0000	1.0000	1.0000	1.0000	0.9875
		5	0.9747	1.0000	1.0000	1.0000	0.9875	1.0000
		6	0.0167	0.0125	0.0000	0.0300	0.0125	0.0125
	Long	1	0.9855	1.0000	1.0000	1.0000	0.9937	1.0000
		2	0.4571	0.5875	0.4938	0.5188	0.4750	0.5000
		3	0.9831	0.9875	1.0000	1.0000	1.0000	0.9750
		4	1.0000	1.0000	1.0000	1.0000	1.0000	0.9750
		5	0.9833	1.0000	1.0000	1.0000	1.0000	0.9750
		6	0.0000	0.0375	0.0125	0.0000	0.0000	0.0100
Uninformed 2-6 Run	Short	1	0.7500	0.9500	0.9625	0.9750	0.9688	0.9786
		2	0.6438	0.8625	0.6187	0.5562	0.5375	0.4286
		3	0.7250	0.9625	0.9750	1.0000	0.9625	0.9750
		4	0.8250	1.0000	1.0000	0.9750	0.9625	1.0000
		5	0.8125	0.9875	0.9375	0.9625	0.9500	0.9500
		6	0.2000	0.2000	0.1125	0.0600	0.0250	0.0375
	Long	1	0.9286	0.9812	0.9312	0.9625	0.9625	0.9611
		2	0.7857	0.8125	0.6187	0.5813	0.5500	0.5250
		3	0.8667	0.9375	0.9875	0.9250	0.9625	1.0000
		4	0.9500	1.0000	1.0000	0.9625	0.9625	1.0000
		5	0.9167	1.0000	0.9375	0.9500	0.9500	0.9500
		6	0.2167	0.1500	0.0500	0.0667	0.0500	0.0400

APPENDIX E (cont.)

Trial Block

Group	Preceding Run	Current Run Length	1	2	3	4	5	6
Informed 5-6 Standard	Short	1	1.0000	0.9625	1.0000	1.0000	1.0000	0.9857
		2	1.0000	0.9688	1.0000	1.0000	1.0000	1.0000
		3	0.9937	0.9688	1.0000	1.0000	1.0000	1.0000
		4	0.9563	0.9438	0.9875	0.9686	0.9937	0.9786
		5	0.6250	0.5562	0.5750	0.5813	0.6250	0.5429
		6	0.2000	0.1375	0.0750	0.1100	0.1750	0.1250
	Long	1	0.9929	0.9875	0.9937	1.0000	1.0000	1.0000
		2	1.0000	0.9937	0.9937	1.0000	1.0000	1.0000
		3	0.9857	0.9937	0.9937	1.0000	1.0000	1.0000
		4	0.9643	0.9812	0.9812	0.9686	0.9811	0.9778
		5	0.5929	0.7188	0.6812	0.5949	0.6226	0.5750
		6	0.0167	0.1375	0.0625	0.1000	0.1013	0.1500
Uninformed 5-6 Standard	Short	1	0.8931	0.9563	0.9812	0.9750	1.0000	0.9857
		2	0.9563	0.9688	0.9937	1.0000	0.9937	1.0000
		3	0.9438	0.9688	1.0000	0.9625	1.0000	0.9929
		4	0.8750	0.9563	0.9563	0.9250	0.9937	0.9857
		5	0.5250	0.6312	0.5500	0.4812	0.6125	0.5786
		6	0.3000	0.2250	0.1875	0.1100	0.1125	0.1000
	Long	1	0.9786	0.9875	0.9688	0.9812	1.0000	0.9944
		2	0.9500	1.0000	0.9937	0.9875	1.0000	0.9944
		3	0.9500	1.0000	0.9875	1.0000	1.0000	0.9944
		4	0.8929	0.9625	0.9750	0.9750	0.9625	0.9778
		5	0.7143	0.7250	0.6438	0.6563	0.5750	0.5375
		6	0.3333	0.2625	0.1875	0.2833	0.2000	0.1200

APPENDIX E (cont.)

Group	Preceding Run	Current Run Length	Trial Block 1	2	3	4	5	6
Informed 5-6 History	Short	1	0.9500	0.9937	0.9812	1.0000	0.9937	1.0000
		2	0.9688	0.9937	0.9937	1.0000	1.0000	1.0000
		3	0.9750	1.0000	1.0000	1.0000	1.0000	1.0000
		4	0.9688	0.9937	1.0000	1.0000	1.0000	1.0000
		5	0.5313	0.5687	0.5875	0.6125	0.6687	0.7000
		6	0.0833	0.0125	0.0000	0.0100	0.0125	0.0500
	Long	1	0.8357	0.9875	1.0000	1.0000	1.0000	1.0000
		2	0.8429	0.9937	1.0000	1.0000	1.0000	0.9944
		3	0.8500	0.9937	1.0000	1.0000	1.0000	1.0000
		4	0.8429	0.9937	1.0000	0.9937	1.0000	1.0000
		5	0.3000	0.5750	0.5938	0.5938	0.5625	0.5687
		6	0.0333	0.0250	0.0250	0.0333	0.0375	0.0100
Uninformed 5-6 History	Short	1	0.8625	0.9812	0.9937	0.9778	0.9937	0.9786
		2	0.8625	1.0000	0.9937	0.9944	1.0000	1.0000
		3	0.8875	1.0000	0.9812	1.0000	1.0000	1.0000
		4	0.8188	1.0000	0.9750	0.9889	1.0000	1.0000
		5	0.5875	0.6563	0.5687	0.6833	0.6250	0.7643
		6	0.2333	0.2000	0.2125	0.1500	0.2000	0.1000
	Long	1	0.7786	0.9937	0.9812	0.9929	0.9375	0.9889
		2	0.8214	1.0000	0.9875	0.9929	0.9937	1.0000
		3	0.8429	1.0000	0.9875	0.9929	1.0000	1.0000
		4	0.8214	0.9875	0.9750	0.9000	0.9688	0.9611
		5	0.5429	0.6812	0.6312	0.5429	0.5375	0.6000
		6	0.1333	0.0125	0.0250	0.0500	0.0125	0.0300

APPENDIX E (cont.)

Trial Block

Group	Preceding Run	Current Run Length	1	2	3	4	5	6
Informed 5-6 Run	Short	1	0.9875	0.9937	0.9937	1.0000	0.9811	0.9786
		2	0.9937	0.9937	0.9937	1.0000	0.9811	0.9714
		3	1.0000	1.0000	0.9937	1.0000	0.9811	0.9929
		4	1.0000	1.0000	0.9937	1.0000	0.9937	0.9929
		5	0.5437	0.6875	0.5938	0.6312	0.6604	0.6786
		6	0.1167	0.0375	0.0000	0.0100	0.0625	0.0000
	Long	1	0.9929	1.0000	1.0000	1.0000	1.0000	0.9944
		2	0.9929	1.0000	1.0000	1.0000	0.9938	1.0000
		3	0.9929	0.9937	1.0000	1.0000	1.0000	1.0000
		4	0.9929	1.0000	1.0000	1.0000	1.0000	1.0000
		5	0.4643	0.6250	0.5938	0.6750	0.6187	0.6125
		6	0.0167	0.0250	0.0125	0.0167	0.0123	0.0400
Uninformed 5-6 Run	Short	1	0.9563	0.9937	0.9875	1.0000	1.0000	1.0000
		2	0.9875	1.0000	0.9875	1.0000	1.0000	1.0000
		3	0.9937	0.9937	0.9875	1.0000	1.0000	1.0000
		4	0.8938	0.9688	0.9875	0.9937	1.0000	1.0000
		5	0.4437	0.6187	0.6187	0.6500	0.6250	0.6571
		6	0.1500	0.1125	0.0125	0.0600	0.0250	0.0500
	Long	1	0.9357	0.9875	0.9937	0.9812	0.9875	0.9944
		2	0.9500	1.0000	1.0000	1.0000	0.9937	0.9944
		3	0.9643	1.0000	1.0000	1.0000	0.9937	0.9944
		4	0.9500	1.0000	1.0000	1.0000	0.9937	0.9944
		5	0.7071	0.8313	0.6500	0.7063	0.6750	0.6667
		6	0.1167	0.0750	0.0125	0.0667	0.0250	0.0500

APPENDIX F

Pre-criterion Error Frequencies and Proportions for Uninformed Groups[1]

UNINFORMED 2-6 STANDARD

Quarter	Position	No. of Errors	Position Occurrences	Error Proportion
1	1	11	27	.407
	2	160	303	.528
	3	19	41	.463
	4	24	53	.453
	5	33	64	.516
	6	65	109	.596
2	1	13	27	.481
	2	146	303	.482
	3	12	41	.293
	4	23	53	.434
	5	26	64	.406
	6	67	109	.615
3	1	11	27	.407
	2	154	303	.508
	3	8	41	.195
	4	16	53	.302
	5	34	64	.531
	6	60	109	.550
4	1	6	27	.222
	2	141	303	.465
	3	7	41	.171
	4	24	53	.453
	5	27	64	.422
	6	53	109	.486

1 Figures in the Position Occurrences column refer to the total number of cycles per quarter summed over Ss.

APPENDIX F

UNINFORMED 2-6 HISTORY

Quarter	Position	No. of Errors	Position Occurrences	Error Proportion
1	1	24	40	.600
	2	168	320	.525
	3	17	23	.789
	4	15	31	.484
	5	9	16	.562
	6	28	59	.474
2	1	15	40	.375
	2	190	320	.594
	3	7	23	.304
	4	5	31	.161
	5	3	16	.188
	6	40	59	.678
3	1	18	40	.450
	2	152	320	.475
	3	6	23	.261
	4	6	31	.194
	5	4	16	.250
	6	33	59	.559
4	1	5	40	.125
	2	154	320	.481
	3	7	23	.304
	4	8	31	.258
	5	4	16	.250
	6	31	59	.525

APPENDIX F

UNINFORMED 2-6 RUN

Quarter	Position	No. of Errors	Position Occurrences	Error Proportion
1	1	11	28	.393
	2	153	309	.495
	3	9	14	.643
	4	2	2	1.000
	5	2	3	.667
	6	16	36	.444
2	1	10	28	.357
	2	160	309	.518
	3	6	14	.428
	4	1	2	.500
	5	2	3	.667
	6	119	36	.528
3	1	7	28	.250
	2	129	309	.417
	3	3	14	.214
	4	1	2	.500
	5	2	3	.667
	6	6	36	.444
4	1	9	28	.321
	2	147	309	.476
	3	6	14	.428
	4	0	2	.000
	5	1	3	.333
	6	4	36	.111

APPENDIX F

UNINFORMED 5-6 STANDARD

Quarter	Position	No. of Errors	Position Occurrences	Error Proportion
1	1	7	13	.538
	2	1	1	1.000
	3	3	5	.600
	4	12	23	.522
	5	177	320	.553
	6	30	61	.492
2	1	4	13	.308
	2	0	1	0.000
	3	2	5	.400
	4	9	23	.391
	5	171	320	.534
	6	29	61	.475
3	1	2	13	.154
	2	0	1	.000
	3	2	5	.400
	4	4	23	.174
	5	181	320	.566
	6	24	61	.393
4	1	1	13	.077
	2	1	1	1.000
	3	1	5	.200
	4	2	23	.087
	5	168	320	.525
	6	29	61	.475

APPENDIX F

UNINFORMED 5-6 HISTORY

Quarter	Position	No. of Errors	Position Occurrences	Error Proportion
1	1	6	19	.316
	2	1	11	.091
	3	1	6	.167
	4	5	15	.333
	5	153	318	.481
	6	23	61	.377
2	1	10	19	.526
	2	9	11	.818
	3	5	6	.833
	4	10	15	.667
	5	182	318	.572
	6	17	61	.279
3	1	7	19	.368
	2	4	11	.364
	3	5	6	.833
	4	5	15	.333
	5	161	318	.506
	6	15	61	.246
4	1	3	19	.158
	2	5	11	.454
	3	4	6	.667
	4	5	15	.333
	5	159	318	.500
	6	21	61	.344

APPENDIX F

UNINFORMED 5-6 RUN

Quarter	Position	No. of Errors	Position Occurrences	Error Proportion
1	1	3	11	.273
	2	2	5	.400
	3	2	4	.500
	4	4	10	.400
	5	167	312	.535
	6	8	20	.400
2	1	3	11	.273
	2	1	5	.200
	3	0	4	.000
	4	0	10	.000
	5	164	312	.526
	6	10	20	.500
3	1	3	11	.273
	2	0	5	.000
	3	0	4	.000
	4	2	10	.200
	5	162	312	.519
	6	7	20	.350
4	1	1	11	.091
	2	0	5	.000
	3	0	4	.000
	4	3	10	.300
	5	149	312	.478
	6	5	20	.250

APPENDIX G

Data Fits of the Generalization Model: Observed (O) and Predicted (P) Repetition Response Proportions

Group	Current Run Length		Trial Block 1	2	3	4	5	6
Informed 2-6 Standard	1	O	.962	.991	.997	.991	.994	.997
		P	.869	.930	.925	.923	.926	.933
	2	O	.825	.809	.638	.616	.569	.525
		P	.563	.611	.587	.573	.590	.609
	3	O	.962	.944	.975	1.000	.981	.981
		P	.804	.906	.875	.877	.890	.893
	4	O	.944	.988	.994	1.000	1.000	.994
		P	.865	.965	.959	.960	.962	.963
	5	O	.925	.900	.956	.944	.944	.938
		P	.797	.874	.873	.873	.873	.874
	6	O	.494	.219	.306	.206	.162	.212
		P	.276	.172	.171	.171	.171	.171
Uninformed 2-6 Standard	1	O	.822	.947	.966	.953	.941	.962
		P	.754	.884	.861	.859	.869	.869
	2	O	.675	.856	.791	.753	.716	.759
		P	.619	.729	.671	.666	.689	.682
	3	O	.725	.919	.919	.918	.931	.906
		P	.719	.862	.816	.816	.835	.830
	4	O	.725	.912	.875	.856	.875	.881
		P	.747	.887	.873	.873	.881	.879
	5	O	.631	.838	.744	.794	.812	.844
		P	.689	.790	.791	.791	.793	.792
	6	O	.519	.456	.394	.350	.369	.300
		P	.460	.386	.375	.373	.373	.373

APPENDIX G (cont.)

Group	Current Run Length		TRIAL BLOCK 1	2	3	4	5	6
Informed 2-6 History	1	O	.844	.972	.956	.975	.969	.969
		P	.899	.975	.972	.972	.973	.975
	2	O	.481	.584	.578	.553	.581	.556
		P	.502	.570	.522	.510	.534	.544
	3	O	.856	.988	.988	1.000	.969	.994
		P	.822	.961	.945	.956	.952	.952
	4	O	.831	1.000	.988	.975	.988	.994
		P	.853	.993	.994	.994	.994	.994
	5	O	.819	.994	.981	.969	.994	1.000
		P	.821	.948	.949	.949	.949	.949
	6	O	.150	.081	.094	.056	.081	.056
		P	.212	.060	.057	.057	.057	.057
Uninformed 2-6 History	1	O	.794	.941	.972	.981	.972	.991
		P	.809	.960	.957	.956	.960	.959
	2	O	.475	.625	.544	.581	.516	.528
		P	.506	.620	.535	.528	.564	.544
	3	O	.719	.956	.975	.981	.981	.981
		P	.715	.916	.920	.920	.931	.927
	4	O	.744	.956	.981	.962	.975	.969
		P	.740	.949	.980	.985	.987	.987
	5	O	.769	.975	.988	.975	.969	1.000
		P	.709	.889	.918	.923	.924	.924
	6	O	.388	.219	.200	.181	.181	.156
		P	.333	.142	.099	.091	.090	.090

APPENDIX G (cont.)

Group	Current Run Length		TRIAL BLOCK 1	2	3	4	5	6
Informed 2-6 Run	1	O	.949	.994	.997	1.000	1.000	1.000
		P	.962	.993	.993	.993	.993	.994
	2	O	.550	.622	.519	.509	.522	.491
		P	.476	.507	.507	.507	.507	.540
	3	O	.936	.994	.994	1.000	.994	.962
		P	.924	.986	.986	.986	.986	.988
	4	O	.988	1.000	1.000	1.000	1.000	.981
		P	.938	1.000	1.000	1.000	1.000	1.000
	5	O	.981	1.000	1.000	1.000	.994	.988
		P	.926	.986	.986	.986	.986	.986
	6	O	.025	.025	.006	.019	.006	.012
		P	.085	.015	.015	.015	.015	.015
Uninformed 2-6 Run	1	O	.834	.966	.947	.969	.966	.969
		P	.844	.962	.955	.954	.958	.958
	2	O	.712	.838	.619	.569	.544	.469
		P	.514	.613	.538	.531	.562	.553
	3	O	.725	.950	.981	.962	.962	.988
		P	.756	.935	.918	.918	.929	.925
	4	O	.800	1.000	1.000	.969	.962	1.000
		P	.789	.973	.984	.985	.986	.986
	5	O	.819	.994	.938	.956	.950	.950
		P	.750	.908	.920	.921	.921	.921
	6	O	.269	.144	.081	.062	.044	.031
		P	.296	.116	.010	.094	.094	.094

APPENDIX G (cont.)

Group	Current Run Length		TRIAL BLOCK 1	2	3	4	5	6
Informed 5-6 Standard	1	O	.975	.975	.997	1.000	1.000	.994
		P	.952	1.000	1.000	1.000	1.000	1.000
	2	O	.988	.981	.997	1.000	1.000	1.000
		P	.956	.999	.999	.999	.999	.999
	3	O	.981	.981	.997	1.000	1.000	1.000
		P	.952	.994	.994	.993	.994	.994
	4	O	.959	.962	.984	.969	.988	.978
		P	.905	.946	.945	.943	.945	.950
	5	O	.625	.638	.628	.589	.624	.569
		P	.504	.529	.520	.508	.520	.542
	6	O	.156	.144	.056	.107	.156	.131
		P	.215	.130	.134	.134	.132	.132
Uninformed 5-6 Standard	1	O	.903	.972	.975	.978	1.000	.991
		P	.898	.999	1.000	1.000	1.000	1.000
	2	O	.925	.984	.994	.994	.997	.997
		P	.910	.998	.998	.998	.998	.998
	3	O	.925	.984	.994	.981	1.000	.994
		P	.902	.988	.986	.986	.987	.987
	4	O	.869	.959	.966	.950	.978	.981
		P	.848	.930	.922	.921	.925	.927
	5	O	.622	.678	.597	.569	.594	.562
		P	.517	.579	.531	.525	.545	.545
	6	O	.356	.256	.162	.181	.150	.112
		P	.312	.192	.188	.188	.189	.187

APPENDIX G (cont.)

Group	Current Run Length		TRIAL BLOCK 1	2	3	4	5	6
Informed 5-6 History	1	O	.903	.991	.991	1.000	.997	1.000
		P	.930	1.000	1.000	1.000	1.000	1.000
	2	O	.916	.994	.997	1.000	1.000	.997
		P	.932	1.000	1.000	1.000	1.000	1.000
	3	O	.922	.997	1.000	1.000	1.000	1.000
		P	.932	.999	.999	.999	.999	.999
	4	O	.916	.994	1.000	.997	1.000	1.000
		P	.915	.982	.981	.981	.982	.983
	5	O	.459	.572	.591	.603	.616	.619
		P	.479	.536	.495	.482	.504	.518
	6	O	.169	.019	.019	.019	.019	.031
		P	.182	.040	.039	.038	.038	.038
Uninformed 5-6 History	1	O	.834	.988	.988	.984	.991	.984
		P	.859	.997	1.000	1.000	1.000	1.000
	2	O	.853	1.000	.991	.994	.997	1.000
		P	.872	.998	.999	.999	.999	.999
	3	O	.875	1.000	.984	.997	1.000	1.000
		P	.869	.992	.993	.993	.993	.993
	4	O	.831	.994	.975	.950	.984	.978
		P	.829	.948	.942	.941	.944	.944
	5	O	.594	.669	.600	.622	.581	.666
		P	.496	.581	.512	.506	.535	.522
	6	O	.281	.106	.119	.100	.106	.069
		P	.317	.156	.133	.130	.130	.130

APPENDIX G (cont.)

Group	Current Run Length		Trial Block 1	2	3	4	5	6
Informed 5-6 Run	1	O	.963	.997	.997	1.000	.991	.988
		P	.969	1.000	1.000	1.000	1.000	1.000
	2	O	.978	.997	.997	1.000	.987	.988
		P	.970	1.000	1.000	1.000	1.000	1.000
	3	O	.984	.997	.997	1.000	.991	.997
		P	.969	1.000	1.000	1.000	1.000	1.000
	4	O	.988	1.000	.997	1.000	.997	.997
		P	.958	.988	.988	.988	.988	.990
	5	O	.525	.656	.594	.653	.640	.647
		P	.472	.501	.501	.501	.501	.532
	6	O	.119	.031	.006	.012	.044	.019
		P	.094	.024	.024	.024	.024	.024
Uninformed 5-6 Run	1	O	.912	.991	.991	.991	.994	.997
		P	.918	1.000	1.000	1.000	1.000	1.000
	2	O	.934	1.000	.994	1.000	.997	.997
		P	.924	1.000	1.000	1.000	1.000	1.000
	3	O	.953	.997	.994	1.000	.997	.997
		P	.922	.997	.997	.997	1.000	.997
	4	O	.888	.984	.994	.997	.997	.997
		P	.889	.963	.960	.959	.960	.963
	5	O	.572	.725	.634	.678	.650	.656
		P	.491	.551	.505	.494	.516	.523
	6	O	.188	.069	.019	.056	.019	.056
		P	.230	.091	.089	.089	.089	.089