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LOCUS OF THE STIMULUS PROBABILITY EFFECT IN ITEM RECOGNITION

By

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ABSTRACT

Part 1 of the present investigation was designed to examine Sternberg's model of information retrieval. In particular, Experiments 1 through 3 focused on the confounding between frequency of occurrence, P, and positive set size, s. These experiments were designed to examine the possibility that the increase in RT with increases in s is, in whole or in part, an effect of variations in the frequency of occurrence of individual positive items. In short, each experiment examined the memory scanning stage of the linear additive model.

In Experiment 1, the two variables, s and P, were unconfounded for some trials by holding constant the frequency of occurrence for one item in each set size. Here, it was found that when P was unconfounded by s, there remained a small but significant effect of s, supporting the conclusion that increases in mean RTs are largely accounted for by the associated decreases in P.

To determine whether or not the variable P has additive or interacting effects on the scanning stage, the additive-factors method was employed in the subsequent experiments. Mean RTs were obtained where at least two positive items within each memory set were assigned different P values and these particular values of P were found in all set sizes. In Experiment 2, it was found that P had additive effects when values of P were held constant across s at .25 and .15. In contrast, in Experiment 3 when P was held constant across s at .25 and .05, it was found that P had interacting effects on the scanning stage, strongly suggesting that the serial and exhaustive scanning model, as

proposed by Sternberg, is unable to handle the effects of P.

In an attempt to explain some of the features of the data, Stanovich and Pachella's temporal overlap model, Theios et al.'s self-terminating model, and Atkinson and Juola's familiarity model were examined separately. The general features of the data reconciled best with the familiarity model where it is hypothesized that subjects do not always serially and exhaustively scan the memorized list on every trial. The supposition is that repetitions of an item as a probe will result in an increase in its familiarity value, and thereby increase the likelihood of a fast positive response.

Working within the basic concepts underlying the familiarity model, Part 2 of this Thesis describes an experiment which examined aspects of repetition that affect the memory scanning stage of the item recognition process. In general, the data revealed that repetition is an important variable since scanning of the memory list seems to be influenced by how often a positive item is probed and by the number of intervening items occurring between consecutive tests of a positive item (lag length).

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INTRODUCTION

During the past decade, there has been a tremendous amount of research aimed at isolating and measuring the basic perceptual and cognitive processes underlying speeded mental tasks. More precisely, there has been a general revival in the use of reaction time methods to infer what happens to information between its presentation and its recall. Such methods have been successfully applied to a wide variety of tasks, including memory search (Sternberg, 1966), visual search (Neisser, 1963), mental rotation (Shepard & Metzler, 1971), mental arithmetic (Groen & Parkman, 1972) and simple verification tasks (Clark & Chase, 1972), to name a few. The questions addressed by such reaction time studies have focused on mechanisms of memory retrieval for information in both short term memory and long term memory and issues such as what information is stored, how it is coded and organized (see e.g. Landauer & Meyer, 1972).

This current desire to analyse the processing of information into its functional components has not only led to various reaction time methods but also to the interest in the temporal structure of processing. A very traditional idea is that the time between the presentation of a stimulus and its recognition (or recall) is occupied by a series of processing stages, or successive operations, so arranged that one operation does not begin until the preceding one has ended (e.g. Donders, 1868; Sternberg, 1967; Taylor, 1976). Plausible stages which have been proposed to account [illegible] the time it takes to recognize an item include: (1) the registration of a stimulus (i.e. encoding stage); (2) identification of a stimulus among the set of alternative stimuli (i.e. identification stage); (3) selection of one of the response alternatives (i.e. response selection stage); and (4) the organization and execution of a response (i.e. response execution stage) (e.g. Sternberg, 1966, 1967, 1975). Four assumptions characterized by the 'traditional' definition of a reaction process (referred to as the stage theory) are: (1) reaction time (RT) is a sum composed of the durations of the stages in the series; (2) each stage has a finite processing capacity; (3) the distributions which describe the stage times are independent of one another, in the sense that a change in the distribution for one stage does not affect the distribution for the other stages (i.e. stage independence); and (4) the times required by the various stages on a given observation are independent of one another (i.e. stochastic independence) (Taylor, 1976).

Despite a plethora of experimental literature based on an acceptance of the traditional information-processing model of memory, it has its critics. Smith (1968), Stanovich and Pachella (1977) and McClelland (1979), for example, have expressed concern over the possibility that successive stages might overlap in time, violating the assumption of seriality. Others have maintained that the predictors of a serial stage model are indistinguishable from those of a model where processing stages operate in parallel (e.g. Townsend, 1974). Townsend (1971) has argued against the evidence for finite capacity. Sternberg (1969a) has questioned the assumption of stochastic independence and both Taylor (1976) and Townsend (1974) have challenged the assumption of stage independence.

A further problem raised against a traditional serial stage model is its neglect to consider several potentially important aspects of the stimulus situation. Consider an item recognition task wherein subjects are given a series of items (i.e. letters or digits) which they commit to memory. Retrieval is then usually tested by presenting a series of probe items and the subject must indicate whether or not each probe was among the memorized series. As many as one hundred and sixty probes may be used in an item recognition experiment where the basic measure is the length of time it takes for a subject to decide whether the probe is a member of the memorized set. The probe presented on the first trial is assumed to play the same role in the recognition process as that presented on the last trial. The serial stage theory, then, ignores the possible significant influences repetition of probed items has on processing; nor does it deal with other aspects of memory experiments such as whether a memory item is frequently or infrequently probed or the subject's expectancies as to which probed item will be presented. Such factors or experimental variables may also affect performance. Some investigators have taken factors such as frequency of a test item's occurrence, expectancy effects, and repetition effects into consideration (e.g. Theios, Smith, Haviland, Traupmann & Moy, 1973; Shiffrin & Schneider, 1974; Atkinson & Juola, 1974).

Although much can be gained by considering human memory as analogous to an information-processing system, the properties of existing information-processing models of memory are hypothetical and may require revision in the face of future experimental findings. Some current findings indicate that a greater emphasis needs to be placed on the information provided over the course of an experimental session. Any effective model of a cognitive task must be able to account for changes in the subjects' processing strategies over time: man's behavior and the decision making processes at play in probabilistic situations need to be accounted for.

While the model of memory to be presented hails from the traditional information-processing ideas, the present investigation focuses on several potentially significant factors which may play an important role in item recognition. Specifically, this thesis attempts to present a systematic analysis of the variable stimulus frequency of occurrence and its effect in item recognition tasks, and to formulate a hypothesis concerning its main determinant. Other variables, which are directly altered with changes in stimulus frequency presentation, will also be examined (i.e. a test item's familiarity and repetition pattern). Although the serial stage theory's assumptions have been, in many cases, rightfully criticized, it will be shown that it is a relevant theoretical framework for research investigating the role of stimulus frequency of occurrence in item recognition.

1.1.1 Donders' subtraction method and reaction time in the study of item recognition

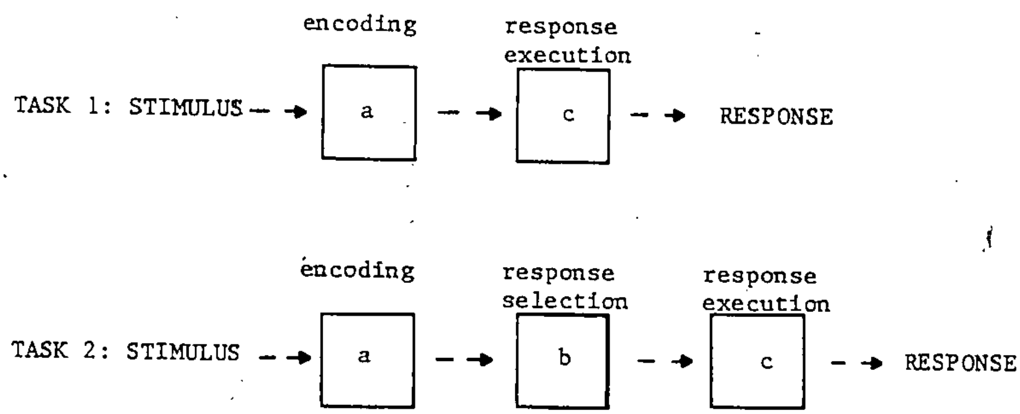
As early as 1868, C.F. Donders, a Dutch scientist best known for his work in ophthalmology, recognized that the time between the presentation of a stimulus and its response reflects the duration of intervening mental processes and he emphasized the importance in measuring a particular sensation's duration.

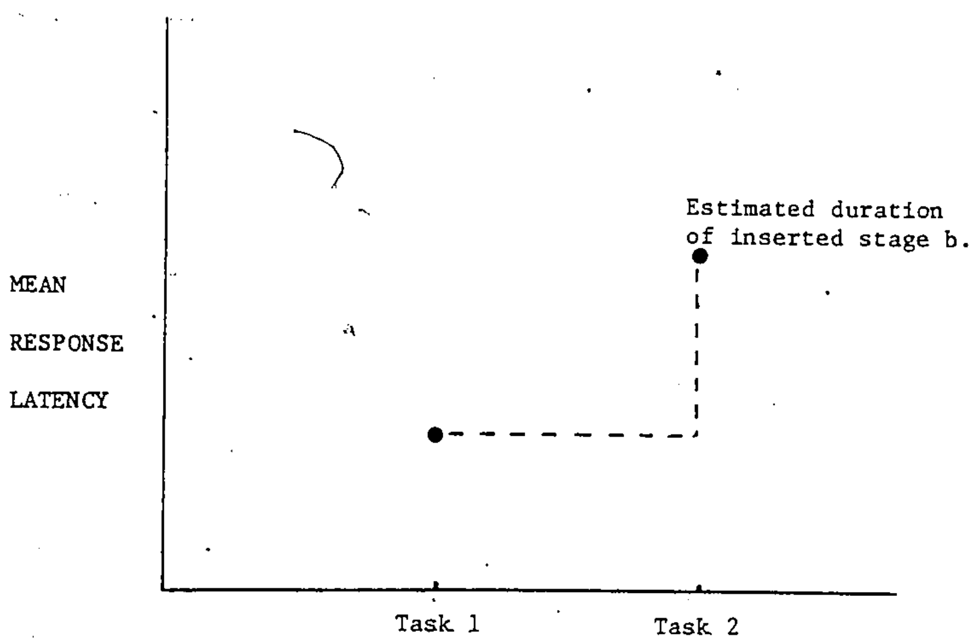
> An important factor seemed to be susceptible to measurement; I refer to the time required for simple mental processes... Whether we may assume that there is an absolute correspondence between diverse functions in the brain and the diversity in each particular sensation, each private mental picture, each expression of the will - it seems that the determination of that duration of time is not without importance.
> (Donders, 1868; in Koster, 1969, p. 413-414)

Based on the idea that the time between the stimulus and the response is occupied by a train of successive and independent processes or stages, Donders proposed a way to measure the durations of some of these stages. His method, the 'subtraction method', consisted of measuring reaction time under two different conditions (or tasks). In one series of experiments, for example, Donders would ask subjects to watch for the appearance of one of two stimulus lights. The experiments were executed in two ways: (1) In the first task, subjects were asked to press a response key when light A appeared; no response was required for light B; (2) In the second task, when either stimulus light A or B appeared, the subject had to press one of two alternative buttons. Donders found that more time was required when the subject must decide which key to press. He argued that the second task required all the mental operations of the first task, plus an additional stage, shown in Figure 1 as the response selection stage. An estimate of the duration of the inserted stage (i.e. response selection) could be obtained by taking the difference between the mean response latencies in the two tasks.

Donders' Subtraction Method

Figure 1: A schematic illustration of the mental processes Donders thought to be required for tasks not requiring a response selection (or decision) stage, task 1 and for those tasks which did, task 2. The graph showing task 1 and task 2 plotted against response latency illustrates the method by which Donders estimated the duration of the inserted stage.





RT(Task 2) = RT(Task 1) + RT(Inserted Stage B)

Interpretation of Donders' data depends not only on the validity of the traditional stage theory but also what Sternberg (1971) terms the "assumption of pure insertion"; that when a second task is created from the first by adding an element such as response selection, one merely inserts a new processing stage without altering the other stages. However, the assumptions underlying Donders' method have been subjected to a series of criticisms (e.g. Woodworth, 1938; Boring, 1963; Smith, 1968). Critics argue that the other stages might be altered; that in adding the response choice, Donders produced a task no longer comparable to the first.

1.2.1 Sternberg's additive-factors method

Sternberg (1969a) revived Donders' subtraction logic by developing a simple method of testing for linear additive reaction time components from which inferences could be made about the organization of mental operations from reaction time data. Rather than comparing tasks where stages have been added or deleted, Sternberg employed experimental variables (i.e. factors) which affected the duration of one or more processing stages. Like Donders' method, Sternberg's 'additive-factors method' was developed to establish the existence and properties of stages.

Sternberg (1969a, 1971) describes a stage as one of a series of successive processes that operates on an input to produce an output, and contributes an additive component to the reaction time. The concept of 'additivity' is used here to imply that the individual mean stage durations are independent; that the mean duration of a stage depends on (a) the nature of the input, and (b) the levels of experimental factors that influence it. The concept of additivity further implies that a stage's duration is <u>not</u> influenced directly by the mean durations of other stages. It is further assumed that the processing functions carried out in stages are fixed: while experimental factors may influence the duration of the processing in a stage, the output is invariant. The function of the encoding stage, for example, may be to identify the name of a stimulus. Although degrading a stimulus may increase the processing time of that stage, the output is unchanged; the stimulus' name is identified. The additional assumption of selective influence implies that experimental factors selectively affect the processing duration of one stage.

Suppose, for example, there are three stages, a, b, and c, between the stimulus presentation and the response, with durations of Ta, Tb, and Tc, as shown in Figure 2a. The reaction time, as assumed by stage theory, is the sum of these three durations:

$$\text{Reaction Time (RT)} = Ta + Tb + Tc$$

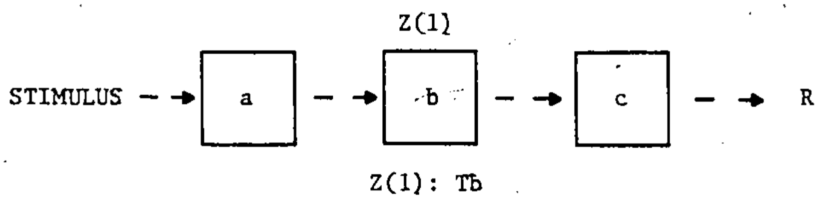
Now suppose (Figure 2b), there is an experimental factor, Z, that influences the duration of stage b only, and has no effect on the other stages. When factor Z is at level 1, its duration is Tb msec. but when factor Z is at level 2, its duration is increased by U msec. producing a duration of Tb + U msec. Because stage durations are additive and independent, the increase is reflected directly in the total reaction time. Increasing the duration of a stage by U msec. increases the total reaction time by U msec. where:

$$RT = Ta + Tb + Tc + U$$

Influence of Factor Z on Reaction Time

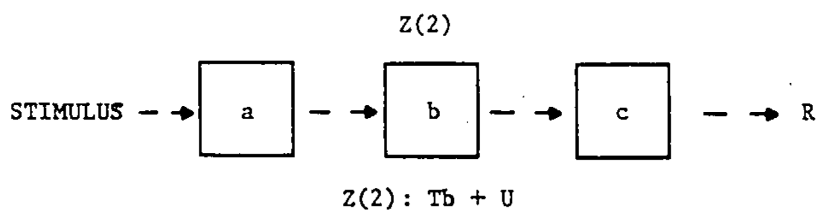
Figure 2: An illustration of (a) the effect Factor Z, at level 1 has on reaction time and (b) the effect Factor Z, at level 2 has on reaction time.

(a)



Factor Z(1): Reaction Time = Ta + Tb + Tc

(b)



Factor Z(2): Reaction Time = Ta + Tb + Tc + U

In this example, altering the level of factor Z is not assumed to insert a new stage in the process but instead is assumed to selectively influence one stage of the reaction time process without altering the other stages. According to Sternberg (1971), factor Z satisfies an assumption of selective influence.

In the additive-factors method (Sternberg, 1969a), however, one searches for pairs of factors that have additive effects. The basic idea is that if two factors influence different stages, they will have additive influences on reaction time because the stage times are added to compute reaction time. Whenever such additive factors are discovered it is believed, by Sternberg (1971, 1975), "that there exist a corresponding pair of stages, a and b, between the presentation of the stimulus and its response." (1971, p.18) On the other hand, if two factors influence one or more stages in common, then they would interact with each other. These factors would then be assigned to a common stage.

For the additive-factors method, it is critical to determine whether pairs of factors have effects on reaction time that are additive or that interact. The patterns of factor effects are central in making inferences about the processing mechanisms.

Figure 3 schematically illustrates the definition of additive and interacting factors. Here, reaction time is shown plotted as a function of the level of factor Z for each of the two levels of factor X. Figure 3a shows that the two factors, Z and X, are additive. The fact that mean reaction time for level 1 of factor X and level 2 of factor X increases by the same amount and in parallel with levels of factor Z, reflects the additivity of the two factors. In contrast, Additive and Interacting Factors

Figure 3: A schematic illustration of (a) an additive relationship between factors X and Z and (b) an interactive relationship between factors X and Z, where reaction time is shown plotted as a function of the levels of factor Z for each of the two levels of factor X.

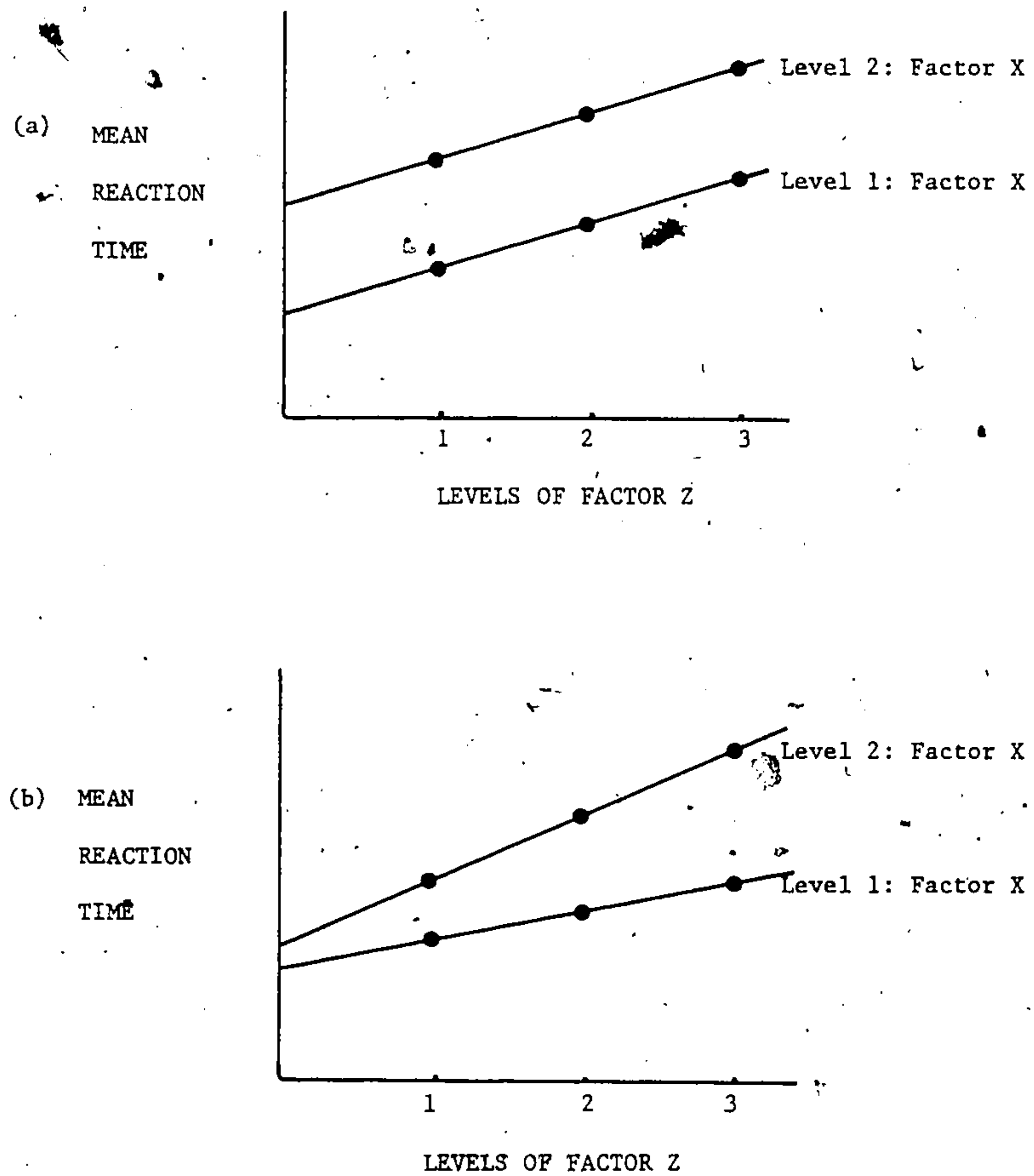


Figure 3b shows mean reaction time for factor X at level 1 and factor X at level 2 does not increase by the same amount and in parallel with levels of factor Z indicating that the effects of factor X and Z interact.

Factors that influence different stages are interpreted as having additive effects on mean reaction time, whereas factors that influence stages in common are interpreted as having an interactive effect. Although Sternberg's method is based on the acceptance of the null hypothesis, that finding additive relationships between factor pairs implies that there exist a corresponding pair of stages, patterns of interactions between factors may also be useful (Sternberg, 1969a). Interactions, even though they lead to the rejection of the null hypothesis, may provide information concerning the operations performed by a particular stage and possibly its location in a series of stages.

1.2.2 The binary classification task (the item recognition paradigm).

Sternberg (1966, 1967, 1969b) and others have studied the effects of a large number of experimental factors on performance in the item recognition paradigm. In a binary classification task, the subject is given a set of items to memorize and is then shown an item to which he/she must respond 'yes' or 'no' to indicate whether or not the item shown is a member of the memorized set. The subjects are instructed to respond quickly but to maintain accuracy. Time from the presentation of the test item until the subject's response is measured.

While the focus of most attention (in order to allow inferences about the scanning process) has been on the effect of varying the number of items memorized (i.e. the size of the positive set), while keeping constant the relative frequency with which positive (yes) and negative (no) responses are required, factors other than positive set size and response type have been varied. Additional factors which have been considered in the item recognition paradigm include: (1) stimulus quality (e.g. Sternberg, 1969a, 1971; Biederman & Kaplan, 1970; Miller & Pachella, 1973; Shwartz, Pomerantz & Egeth, 1977; Miller, 1979; Hardzinski & Pachella, 1980; Miller & Hardzinski, 1981); (2) relative frequency of response type (e.g. Sternberg, 1969a, 1971; Blackman, 1972a & b; Briggs & Johnsen, 1972; Corballis & Miller, 1973); and (3) frequency of stimulus presentation (e.g. Theios et al.,1973; Shiffrin & Schneider, 1974; Raeburn, 1974; Miller, 1979; Hardzinski & Pachella, 1980; Miller & Hardzinski, 1981).

1.2.3 Application of the additive-factors method to the binary classification task

Sternberg (1969a, 1971) has applied his additive-factors method to test his four stage model of memory recognition. The hypothesis states that if any two selected pairs of experimental variables have consistently additive effects, functionally independent processing stages may be inferred. Although Sternberg (1971) has stated that if two factors are found to influence different stages, their additivity must hold up whatever the level of a third factor, only two experimental factors are examined at one time.

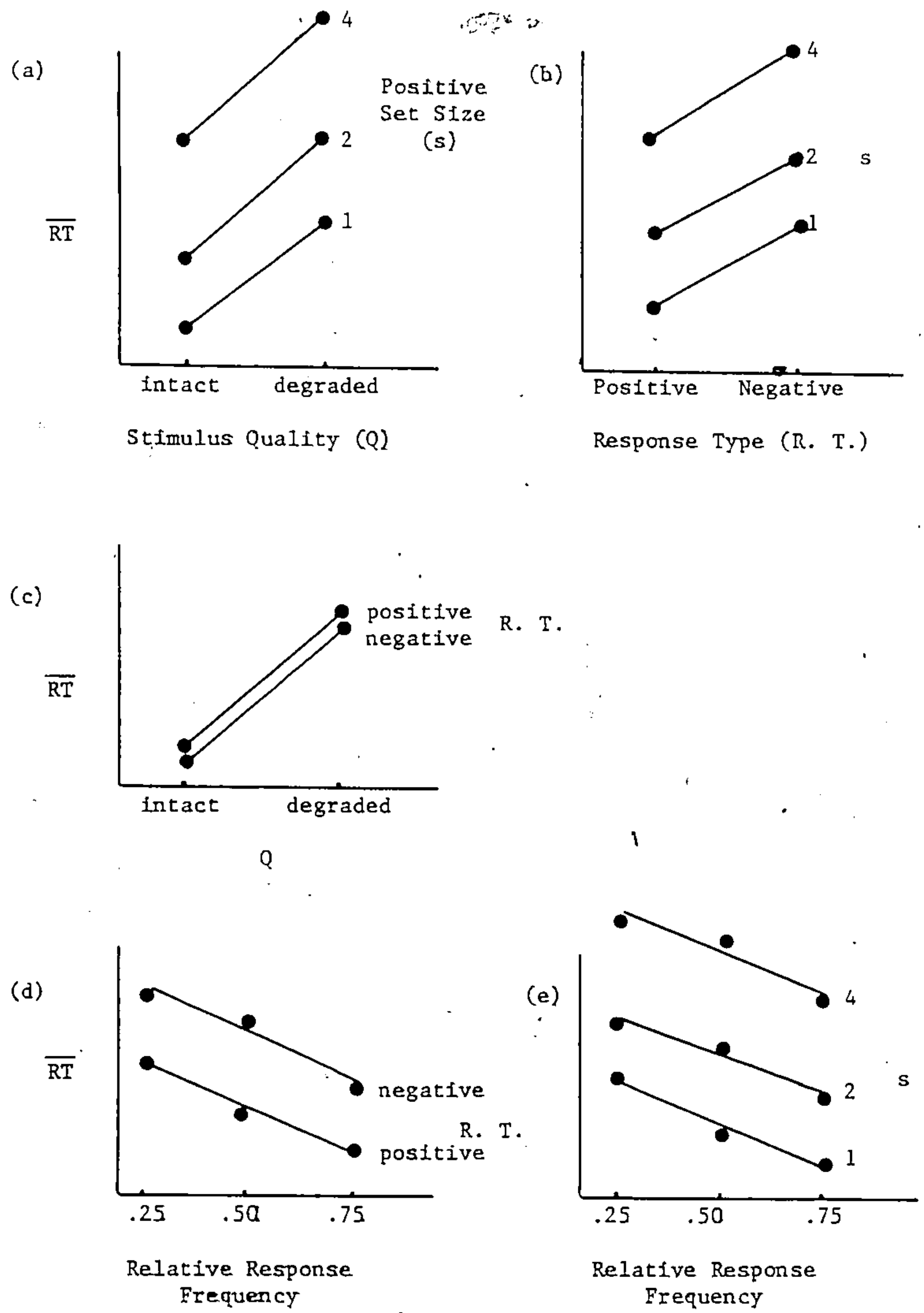
In a series of experiments with the item recognition task, Sternberg (1969a, 1971) varied four different pairs of factors to evaluate their additivity. The four factors varied were: (1) number of digits in the memorized list; (2) quality of the test stimulus (i.e. stimuli were shown intact or degraded); (3) relative response frequency of the positive and negative responses; and (4) response type. These four factors produce six different pairs of factors whose additivity can be evaluated. In this series of studies, five of the six possible pairings of these factors were examined: (1) positive set size and stimulus quality; (2) stimulus quality and response type; (3) response frequency and response type; (4) response type and positive set size; and (5) response frequency and positive set size.

In each instance, the factor pairs were additive. As shown in Figure 4, it was found: (a) degrading the stimulus had virtually the same effect for list lengths 1, 2 and 4; (b) when positive/negative responses were equally frequent, negative responses were slower than positive responses by the same amount regardless of list length, (c) degraded stimuli slowed positive and negative responses equally, (d) increasing the relative frequency of a response had the same effect on positive responses as on negative responses, and (e) responses to items from larger list lengths were slower than responses to smaller list lengths by the same amount regardless of the relative response frequency. In all these cases, then, the data are fitted remarkably well by an additive model.

1.2.4 Interpretation: Four stages in binary classification

Having found additive relations between the five factor pairs

Figure 4: Application of the additive-factors method to the binary classification task is shown. Best fitting additive relations between factor pairs have been drawn where the effects on response latencies were examined for the factor pairs (a) stimulus quality and positive set size, (b) response type and positive set size, (c) stimulus quality and response type, (d) relative response frequency and response type, and (e) relative response frequency and positive set size.



Sternberg, 1969a, p. 290.

studied, this suggests there exist a number of corresponding stages. Figure 5 shows an interpretation that uses these findings and goes somewhat beyond them. The instances of additivity found in these experiments are, according to Sternberg, sufficient to identify four separate stages. The argument Sternberg (1969a) gives to postulating four stages follows like this:

> The stage influenced by stimulus quality is most simply interpreted as an encoding stage that prepares a stimulus representation to be compared to the items in the memorized list. Hence it must precede the comparison stage. The purpose of the comparison stage must be to provide information for response selection. Hence any stage that depends on the response must follow the comparison stage. This must include the stages influenced by factor 3 and 4. Since factor 1 influences a stage that precedes the comparison, and factor 4 influences a stage that follows it, these two factors must influence separate stages... This discussion should also give you a feel for the kinds of considerations used to order the stages that are implied, but not ordered, by the additivity of factor effects. (p. 35-36)

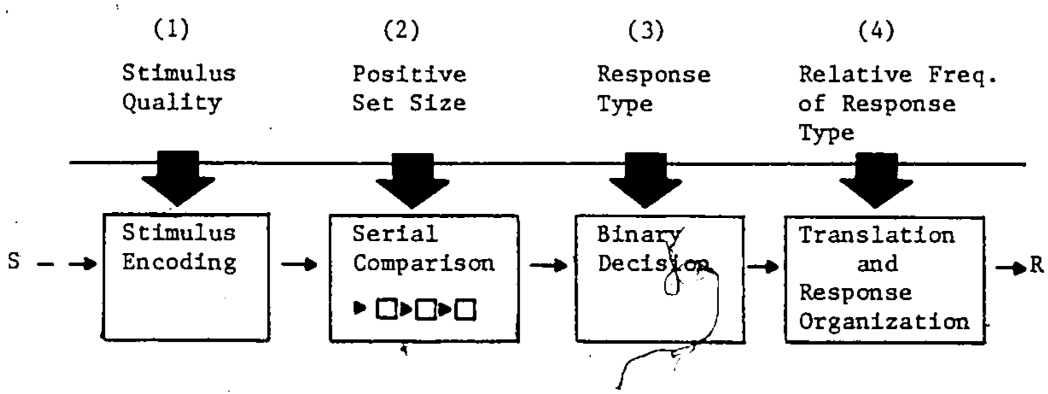
Describing the flow chart below the horizontal line in Figure 5, Sternberg's four stage model of memory begins the process of memory retrieval with the encoding of the test stimulus (stage 1). Here the visual signal is translated into an internal representation of unspecified form, and is then transmitted as the input into the serial comparison stage (stage 2). In the serial comparison stage, the internal representation of the test item is compared to the internal representation of the previously presented memory set items. The output of the serial comparison stage or the information concerning the existence of a match is then input into the binary decision stage (stage 3), where a 'yes' or 'no' response is selected and transmitted to the response execution stage (stage 4). Here, motor organization and response execution are accomplished. Sternberg (1967, 1969b, 1975) assumes that reaction time is composed of these 4 stages and that the stages are ordered in time and are independent of each other. Further, he assumes one must go through all these stages on every given trial.

Inferred from the additive relations between the factor pairs studied (and also intuition), Sternberg assigned, in a one-to-one relationship, a factor to the stage it influences. The assignment of factors to stages is shown above the horizontal line in Figure 5. Other factors, not shown in the figure, may also influence these same stages, of course. Sternberg (1971) emphasizes "that any decomposition into stages that is produced by the additive-factors method must be tentative. Each stage is defined by the set of factors that influence it. As new instances of interaction are observed, our ideas about what occurs in the affected stage will change. And as new instances of additivity are discovered, additional stages have to be postulated." (p. 53).

Finally, statements about interacting and additive effects depend on which measure is used. Here, the measure of performance is physical time, and the quantity examined is the (arithmetic) mean of the measure. One feature of the additive-factors method, then, is that it specifies the appropriate scale of measurement; many common data transformations (i.e. geometric mean) would destroy the instances of additivity.

A Serial Stage Model of Item Recognition

Figure 5: An illustration of the assignment of factors (above the horizontal line) that influence each stage (below the horizontal line).



Sternberg, 1969a, p. 432.

1.2.5 Limitations of the additive-factors method

The additive-factors method was developed to test hypotheses about stages with specified functions and to test subsidiary hypotheses about the relations between the factors studied and the hypothesized stages. While Sternberg's method has been widely accepted since its introduction (e.g. Biederman & Kaplan, 1970; Briggs & Swanson, 1970; Clark & Chase, 1972; Klatzky & Smith, 1972; Biederman & Stacy, 1974; Shwartz, et al., 1977; Ogden & Alluisi, 1980), there are limitations to this method.

For example, the additive-factors method does not determine the duration of the individual stages nor their temporal order (Taylor, 1976). Further, the basic rule Sternberg applied for assigning factors to stages is that factors which produce additive effects should be assigned to different stages of the process. Such an arrangement of factor and processing stages is illustrated in Figure 6a. It is further contended, however, that a default rule should be used: if all the stages but one have factors assigned to them and another factor fails to interact with any of these factors, then the factor in question would be assigned to the one remaining stage, despite the credibility of such assignment (Taylor, 1976). The factor, stimulus luminance, for example, could be assigned to the response initiation stage by default.

While interactions play a minor role in this scheme, Sternberg argues that initial factor-stage mappings can be used in the interpretation of factor interactions: "as new instances of interactions are found the function of the stages identified become better known and the labels in the boxes get changed." (Sternberg, 1971, p.23). If the effects of stimulus degradation were found to interact with those of stimulus luminance (which is thought to have its effects at the encoding stage), for example, then the effects of degradation would also be assigned to the encoding stage. Of course, if these factors have been assigned to stages incorrectly then further assignments based on interactions will also be in error.

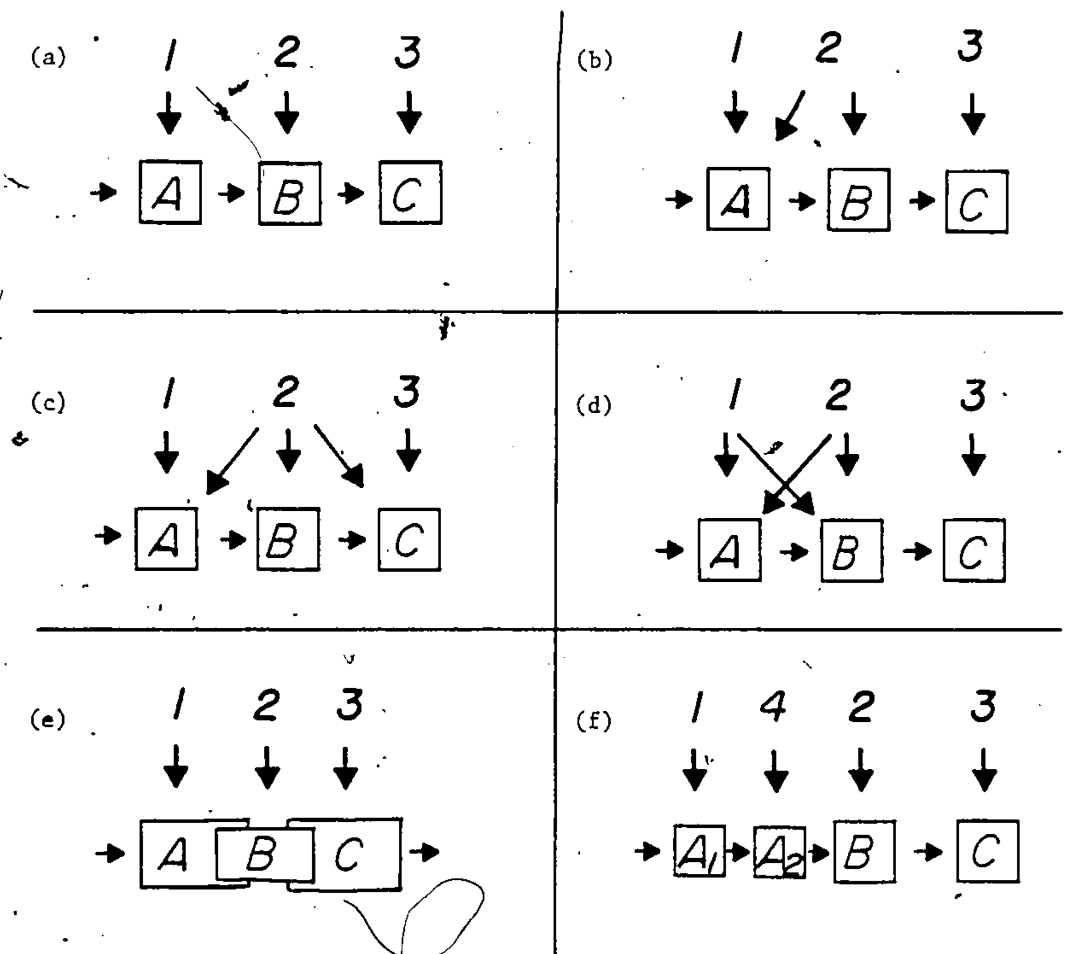
Besides depending on the validity of the first three assumptions inherent in the traditional stage theory, Taylor (1976) has pointed out that the most serious problem with the method is that it is based on the acceptance of the null hypothesis: that finding additive relationships between factor pairs implies that there exist a corresponding pair of stages. Sternberg argues that the proof of additivity of processing stages lies in the failure to obtain significant interactions among pairs of experimental factors. While significant interactions would indicate that factors under study influence one or more stages in common, the converse of this statement is <u>not</u> necessarily true. It has been argued (e.g. Taylor, 1976; Stanovich & Pachella, 1977) that failure to observe interactions does not necessarily imply that these factors affect different stages. Taylor (1976), for example, notes that it is possible for an interaction to be masked by overlapping or dependent stages as shown in Figure 6e. In addition, there is the possibility that the factors influence one or more stages in common and in an additive way as illustrated in Figures 6b to 6d. Finally, the finding that two factors fail to interact may also be interpreted as indicating that an assigned unitary stage actually involves two or more stages. It has been questioned, for example, whether the encoding stage can be adequately described by a single unitary stage (e.g. Stanovich & Pachella, 1977; Miller, 1979). Here, two or more stages may be required to summarize all the activities usually referred to as sensation and perception, together with certain aspects of pattern recognition and association (see Figure 6f).

In light of this problem with the method (i.e. the fact that if two factors fail to interact does not mean that they do not influence any stages in common), a more productive research strategy, according to Taylor (1976), would be to study sets of factors which are expected to interact. A finding of a significant interaction between two factors, then, would provide strong evidence for the conclusion that the factors under study influence one or more stages in common.

Finally, there are findings which may be at variance with this principle of additivity: that factors which influence different stages should have additive effects on mean reaction time. Egeth, Marcus and Bevan (1972), for example, varied the number of items in the positive set and also the response set size (i.e. yes only condition vs yes/no condition) in the binary classification task. Assuming the serial comparison stage and the response selection stages are independent, one would expect memory set size and response set variations to have additive effects on reaction time; yet these investigators showed that they interact. Here, mean reaction time was found to be significantly faster for the yes-only condition than for the yes/no condition for each of the positive set sizes studied, but not by a constant amount. Although Egeth et al. interpret the interaction between positive set size and response set size as evidence for the nonindependence of processing stages, this interpretation depends on the implicit assumption that these two factors influence different stages: that variations in positive set size influence the serial comparison stage and variations in response set size influence the response selection stage. However, an alternative interpretation which is still consistent with the idea of independent stages is that the two factors influence a stage in common (c.f. Sternberg, 1969a).

Possible Arrangements of Factors and Stages in an Information Processing Model of Item Recognition

Figure 6: An illustration of the possible arrangements factors and processing stages can possess when describing potential models of the item recognition process. The arrangements of factors and stages shown here, illustrate (a) factors that produce additive effects, (b,c and d) factors that influence one or more stages in common and in an additive way, (e) factors that influence more than one stage but their interaction is masked by overlapping or dependent stages, and (f) two factors that influence a stage in common but fail to interact when an assigned unitary stage involves two or more stages.



The differential influences of variations in response set size on reaction time with changes in positive set size do, however, create a serious problem for Sternberg's theory of a serial and exhaustive comparison search discussed in the next section.

1.2.6 The theory of a serial and exhaustive comparison process

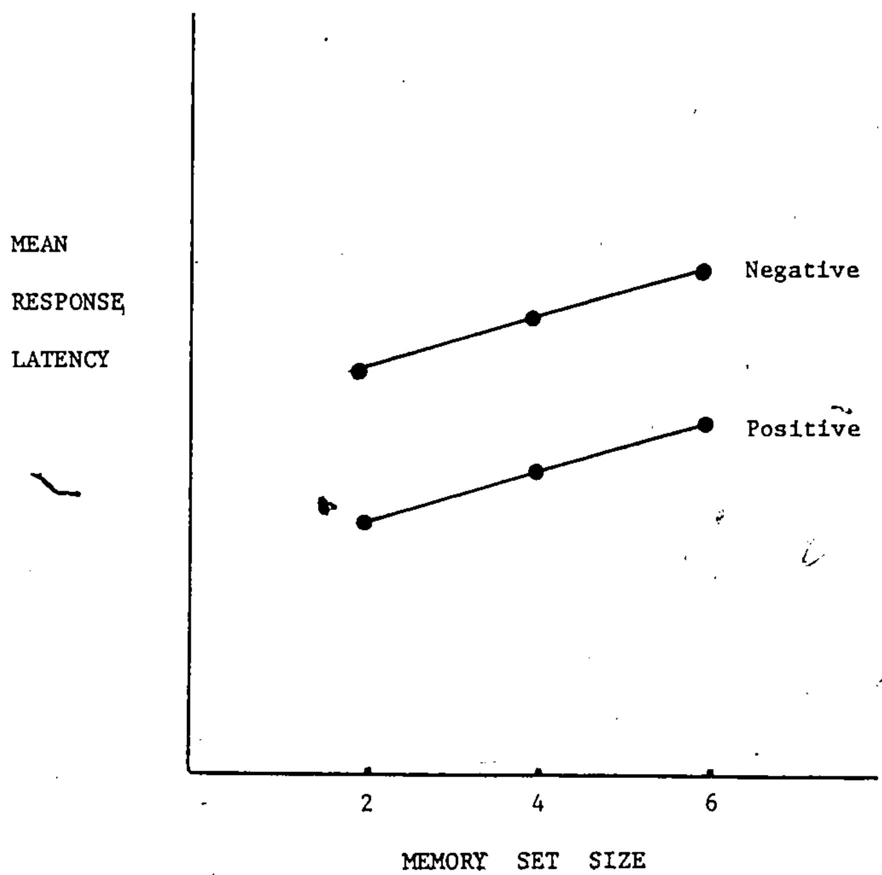
While Sternberg has placed considerable emphasis on the additive effects on mean reaction time of different experimental factors from which he inferred reaction time can be broken down into serial additive stages, primary attention has been focused on the form of the function that relates mean reaction time to the size of the memorized list. When the size of the memory set is varied in the binary classification task and functions relating mean reaction times and positive set size are determined for trials requiring positive and negative responses separately, this task has consistently yielded the following empirical findings: (1) mean reaction times of both positive and negative responses increase linearly with the number of characters in the memorized set; (2) the mean increase in reaction time per item is approximately the same for positive responses as for negative responses; and (3) this rate of increase is usually about 30 to 40 msecs. for each item in the positive set. Another way of saying this is that the addition of one item to the positive set has the same effect, regardless of the size of the set which it is added to. Such findings are illustrated in Figure 7 where mean reaction time is shown plotted as a function of positive set size for positive and negative responses, separately. The phenomenon seems to be the same whether the same positive set is fixed and used for a long series of trials (i.e. here, each trial consists of a warning signal, test (or probe) stimulus, and a response), or is varied from trial to trial. In the varied set procedure, on each trial a new memory set is drawn at random from the total ensemble and is composed of 1-s items. Here then, a trial consists of the visual presentation of the positive set (where generally the positive items are shown one at a time) and is followed, after a brief retention interval, by a probe.

It was on the basis of such findings that Sternberg (1966, 1969b) proposed that memory search is a very rapid serial and exhaustive comparison process. Once a test stimulus is encoded and its internal representation is translated as input into the comparison stage (stage 2 of Figure 5), Sternberg suggests there is a search through the positive set where the test item is compared serially to each of the memorized items and each comparison results in either a match or mismatch. This comparison is said to proceed serially and exhaustively, where the test item representation is compared to each memory item in turn until all possible comparisons are completed. The comparison is thought to proceed through the entire memory set whether or not a match is found (i.e. there is an exhaustive search).

A most compelling feature of the data which supports Sternberg's interpretation of the comparison process is the fact that positive and negative functions are parallel (i.e. have equal slopes). This implies that the search is exhaustive: even when a match has occurred, scanning continues through the entire positive set. If the scanning process is terminated when a match occurs (i.e. a self-terminating

Mean Response Latency: Typical Findings

Figure 7: Mean response latency shown plotted as a function of memory set size: An illustration of the typical findings.



search), the increase in mean response latency for positive items would be half that of the negative (Sternberg, 1975).

The finding that positive and negative mean response latencies increase <u>linearly</u> as a function of the number of items in the positive set is interpreted to mean that reaction time is increased by a <u>constant</u> amount for each additional item added to the positive set. This kind of additivity suggests that the comparison stage is composed of <u>sub-</u> stages such that each item in the positive set corresponds to a sub-stage. The durations of these sub-stages represent additive components with equal means. The slope, m, of the linear item recognition function, RT = m(s) + b, reflects the mean duration of a sub-stage. It represents then, the constant amount by which reaction time is increased for each additional item added to the positive set. The number of sub-stages in the comparison stage can be varied without influencing the other stages simply by varying the number of items in the positive set.

While the slope of this function represents the time required to scan one item, its zero-intercept, b, reflects the time required to carry out all other stages of processing (i.e. encoding, decision time, and response execution time). The high zero-intercept value obtained in item recognition studies indicates that a large fraction of the reaction time duration is due to processing at stages other than the scanning stage (i.e., stage 2). Factors which selectively influence stages other than the comparison stage will then be reflected by changes at the intercept.

1.2.7 Problems with Sternberg's theory

Sternberg (1975) maintains that the comparisons are serial and exhaustive with respect to both matches and nonmatches. Although this conclusion is still widely accepted (e.g. Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977; Hunt, 1978), there are a number of difficulties with the concept of exhaustiveness.

The primary difficulty with exhaustiveness is that it strikes one as inefficient. Instead many investigators feel a self-terminating system provides a more rational explanation of the comparison stage's function. They feel that it is not clear why subjects should seem to waste time by continuing to scan a list even after they have found a match. Sternberg, however, argues that scanning is generally exhaustive rather than self-terminating because subjects do not evaluate the outcomes of the comparison until after the scan is completed, and they are thus able to scan more quickly. For the exhaustive system, then, Sternberg proposes that there is a separate match testing operation which determines whether a match has occurred. If the search were self-terminating, the scanning process would have to be interrupted after each comparison. Hence, it would be faster, according to Sternberg (1975), to store information that a match had occurred in a location that was examined only after all comparisons had been completed. Here, the response would depend only on whether there was a match, not on which item produced it.

There is support for the idea that it is the exhaustiveness of the process that makes its high speed possible. Some studies have shown evidence of a self-terminating search (i.e. positive slopes half the size of negative slopes), and also the slopes of the positive and negative item recognition functions are very large (i.e. 50 to 120 msec./item) (Clifton & Birenbaum, 1970; Klatzky & Atkinson, 1970; Swinney & Taylor, 1971; Pachella, 1975; Corballis & Miller, 1973).

It is further possible that Sternberg's task is something of an exception (see McCormack, 1972; Baddeley, 1976; Ogden & Alluisi, 1980). Baddeley (1976), for example, has remarked, "It is not easy to see what function an exhaustive recognition scan could have outside the limits of Sternberg's task." (p. 150). Several features of the 'standard' paradigm should be taken into account in any comparison with other binary classification tasks, such as: (1) the number of positive items assigned to the different positive set sizes is small; (2) there is no overlap between the items composing each positive set (i.e. non-nested sets); (3) a given item sometimes requires a positive and sometimes a negative response (i.e. response inconsistency); (4) relatively little practice is provided; (5) high accuracy is required; and (6) until the response to one stimulus is completed, the next stimulus cannot be viewed. Other versions of the item recognition paradigm, however, are known to quantitatively and qualitatively affect item recognition performance. Some procedures, for example, consistently produce nonlinear set size functions (e.g. Briggs & Swanson, 1970;

Briggs & Johnsen, 1973; Kristofferson, 1972a, 1977; Ross, 1970; Simpson, 1972; Swanson, 1974). Here the assignment of responses to stimuli is the same (or consistent) over all trials or even sessions. Since departures from the 'standard' item recognition task produce findings that are often different from those typically obtained, Sternberg (1975) feels they should be used to suggest limitations in the scope or generality of the model (p. 12).

Perhaps a more serious difficulty with Sternberg's theory is that it predicts that the time taken to make 'yes' decisions should be independent of the serial position of the critical item in the set, since the subject is supposed always to search, at a constant rate, the entire memory set. Yet many investigators, using the standard paradigm, have reported marked serial position effects (e.g. Burrows & Okada, 1971; Morin, DeRosa & Stultz, 1967; Corballis, 1967; Kennedy & Hamilton, 1969; Kirsner & Craik, 1971; Corballis, Kirby & Miller, 1972; Forrin & Cunningham, 1973). Scanning processes lead very easily to predictions of serial position effects if they are self-terminating: that is, if a positive response is initiated as soon as a match occurs.

Further, the scanning model, as it stands, cannot account for the unusually short reaction times obtained on trials where the same positive probe is repeated over consecutive trials (e.g. Theios et al., 1973; Theios, 1973; Theios & Walters, 1974). Nor can it account for the faster responses to positive items which are probed frequently. A few experimenters have unbalanced the frequency of occurrence with which the different members of the positive set are presented as test stimuli (e.g. Klatzky & Smith, 1972; Miller & Pachella, 1973; Theios et al., 1973; Biederman & Stacy, 1974; Hardzinski & Pachella, 1980; Miller & Hardzinski, 1981). They found that responses to frequently occurring items in the positive set are faster than responses to positive items occurring infrequently in the same set. If search were self-terminating, and frequency of item occurrence (i.e. stimulus probability) influenced the order of search, such effects of stimulus probability could be readily explained. But in an exhaustive process, an explanation of the stimulus probability effect is missing.

Other interpretations of the effect of the positive set size on reaction time have also been proposed (e.g. Theios et al., 1973; Theios, 1973; Atkinson, Holmgren & Juola, 1969; Stanovich & Pachella, 1977; Miller, 1979; Corballis, 1979). In short, the memory mechanisms proposed in these alternative models attempt to take into account the effects the above factors can have on item recognition performance. Such models will be presented in the following chapters.

Sternberg (1975) has argued that an explanation of serial position effects, repetition effects, and stimulus probability effects need not be the burden of the serial comparison process. An alternate strategy would be to preserve the second stage - the serial comparison stage - and explain these effects in terms of changes in the duration of other processing stages. One way to test this alternative strategy, and which relies on the additive-factors methodology developed by Sternberg (1969a), is to show that any factor likely to affect comparison time does not interact with set size in its effect on reaction time. This is the intent of the present investigation.

1.2.8 Advantages of a serial stage model and the additive-factor method

Despite the weaknesses inherent in Sternberg's method and his theory of a serial and exhaustive memory search, the model does have several strengths which make it a convenient starting point for researchers interested in the short term memory recognition phenomenon: the functions performed by each processing stage are well defined; the stages appear credible; the ordering of these stages, although based on intuition, corresponds to that in many information-processing models of memory (e.g. Broadbent, 1958); and the memory retrieval task which this model seeks to explain is well defined with respect to both what constitutes the immediate stimulus and the response. Most important, the experimental findings have been reproduced by different workers using a wide variety of stimulus materials. Linear reaction time functions have been widely documented using digits (e.g. Sternberg, 1966, 1969b; Clifton & Birenbaum, 1970), letters (Cavanagh & Chase, 1971; Ellis & Chase, 1971), words (e.g. Burrows & Okada, 1973), nonsense forms and pictures of faces (e.g. Sternberg, 1969b) as stimuli. Sternberg's task has also consistently yielded similar empirical findings for both limited (e.g. Sternberg, 1966, 1967; Burrows & Okada, 1973; Clifton & Tash, 1973) and prolonged practice (e.g. Kristofferson, 1972b; Corballis, Roldan & Zbrodoff, 1974), for positive set sizes up to 15 letters (Corballis & Miller, 1973) and for both visual and auditory presentation (Chase & Calfee, 1969). Finally, the underlying assumptions are retained by a number of investigators who have used Sternberg's model (e.g. Biederman & Stacy, 1974; Shiffrin & Schneider, 1977; Schneider & Shiffrin, 1977; Hunt, 1978; Ogden &

Alluisi, 1980).

In short, Sternberg's model is a convenient starting point for the present research.

1.3.1 The aims of the present investigation

The experiments which follow were designed to examine Sternberg's model (1971) of information retrieval in greater detail. In particular, the present investigation focuses on the confounding between frequency of occurrence (better known as stimulus probability or P) and positive set size. It has been noted by several investigators (e.g. Kornblum, 1967; Sternberg, 1969b, 1975; Theios et al., 1973; Miller & Pachella, 1973, 1976; Theios & Walters, 1974; Miller & Hardzinski, 1981) that as positive set size (s) increases, the frequency of occurrence (or probability of occurrence, P) of the individual positive items within each set size decreases. This is so because typically within each memory set size all positive items occur with equal probability. As illustrated in Figure 8, when the relative frequencies of the 'yes' and 'no' responses are equal, and every member of the positive (and negative) stimulus set has an equal probability of appearing as the probe, the frequency in which individual items are probed in the item recognition task depends on the size of the positive or negative set. Thus, if there are two items in the positive set, each will have a probability of .50 of appearing as the probe on any positive trial. Since positive trials have a probability of .50, each item in the positive set has a probability of occurrence of .50 x .50 according to the rules of probability theory. If there are four items in the positive set, each item in the positive set has a probability of occurrence of .25 X .50. It can be seen, then, that stimulus probability effects create a special problem in the memory item recognition paradigm since stimulus probability must co-vary with the factor memory set size (s). It leaves open the possibility that the effect which has been attributed to s is, in whole or in part, an effect of variations in the frequency of occurrence (P)[1].

It is well known that mean response latencies increase as item presentation frequency decreases. Such an effect of P has been documented in experiments where two or more items required the same response but frequency of occurrence of the items was varied within the experiment (e.g. La Berge & Tweedy, 1964; Bertelson & Tisseyre, 1966; Hawkins & Hosking, 1969; Krueger, 1970; Blackman, 1972a, 1972b). Krueger (1970), for example, had subjects commit four digits to memory. On each experimental trial, the subject's task was to determine whether the probed digit was or was not a member of the previously memorized set of digits. Unknown to the subject, Krueger also varied the frequency of occurrence of the individual memory items (i.e. P=.25, P=.175, P=.0625 and P=.0625 for the four positive digits). His

1 While stimulus probability decreases for the individual positive items as positive set size increases, the converse is true for negative items. As illustrated in Figure 8, stimulus probability slightly increases for the individual negative items with set size increases. But, since the size difference between the number of positive and negative items in each set is quite substantial (i.e. the number of negative items tested is much greater), the negative set, according to Sternberg, would never be a reasonable object of memory scanning.

Probability of Occurrence Values for Individual Items in the Standard Item Recognition Task

Figure 8: Shown are the positive and negative probability of occurrence values for individual items within each set size for the standard item recognition task where positive and negative items are probed equally often.

Memory Set Size	Probability of Occurrence Values for Individual Items (i.e. digits 0-9) Positive Items	Negative Items
2	.25 .25	remaining 8 digits, P=.06
3	.17 .17 .17	remaining 7 digits, P=.07
4	.125 .125 .125 .125	remaining 6 digits, P=.08

findings showed RT was significantly shorter for the more frequently tested items.

Several investigators have attempted to unconfound the two variables, s and P, and have examined the effects of P when it is held constant for a given item within each memory set size (Theios et al., 1973; Okada & Burrows, 1974; Shiffrin & Schneider, 1974; Raeburn, 1974). The findings from these studies showed, for items where P was the same, the increase in mean RT with set size remained significant but was smaller than that typically reported from experiments where s and P were confounded. The paradigms used in these studies, however, deviated in important ways from the 'standard' design as developed by Sternberg. It was pointed out formerly that the empirical findings from the task depend heavily on procedural and design details (e.g. Ross, 1970; Briggs & Swanson, 1970; Simpson, 1972; Briggs & Johnsen, 1973; Swanson, 1974; Kristofferson, 1972a, 1977). Certain variables have been identified which, when combined in specified ways, reliably yield two very different sets of empirical relationships. These variables include: (1) the way items are assigned to the positive set sizes (i.e. non-nested vs nested sets); (2) the consistency of the stimulus item and response category pairings (i.e. response inconsistency vs response consistency); and (3) the number of items assigned to the positive and negative sets (i.e. positive sets smaller in size than negative sets vs equal positive and negative sets or other variations). The 'standard' item recognition task is characterized by: (1) non-nested sets; (2) response inconsistency; and (3) positive sets smaller in size than negative sets. A condition of 'non-nested' sets is said to exist when there is no overlap between the items composing each positive set and a condition of 'response inconsistency' is said to exist if the same item sometimes requires a positive and sometimes a negative response. These characteristics are illustrated in Figure 9a. In the studies addressing the confounding of s by P, however, the procedural methods differed markedly from the standard paradigm, and in ways which Sternberg (1975) has singled out as producing findings that are consistently different from those he typically obtains (i.e. negatively accelerated item recognition functions). Sternberg (1975) has concluded that the findings from versions of the item recognition task should be "used to suggest limits in the scope or generality of the model, rather than ways in which it ought to be elaborated." (p. 12). To be more specific, the investigations of the confounding of s by P were characterized by: (1) 'nested sets', where all items in the smaller sets were included in the larger sets (Theios et al., 1973; Shiffrin & Schneider, 1974; Raeburn, 1974[2]); (2) 'response consistency', where a given item always requires only a positive or only a negative response (Theios et al., 1973; Okada & Burrows, 1974; Shiffrin & Schneider, 1974; Raeburn, 1974[2]); and/or (3) stimuli partitioned into equal positive and negative sets (Theios et al., 1973; Shiffrin & Schneider, 1974). These characteristics are illustrated in Figure 9b. Finally, in all of these studies, P was varied in the negative sets (also see Theios & Walters, 1974) and this resulted

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2 The detail in which Raeburn presented her design was inadequate to clearly determine how the variables response consistency/inconsistency or nested/non-nested sets were treated.

in the frequency of occurrence of negative items equalling or exceeding that of some of the positive items. This could result in the subject treating high probability negative items as though they were positive items. In the 'standard' task, the frequency with which individual negative items occur is always much smaller that the frequency with which individual positive items occur, so this is not likely to happen.

In light of this problem, Experiment 1 attempts to unconfound the two variables, s and P, deviating as little as possible from a 'standard' item recognition task. This is done by holding P constant at .15 for one positive item in each memory set size. The experiment also examines performance over a period of prolonged practice.

An Example of Non-Nested Sets and Response Inconsistency

Figure 9: Shown are (a) non-nested sets and a condition of response inconsistency as characterized by the 'standard' item recognition task, and (b) nested sets and a condition of response consistency.

(a) MEMORY SET SIZE	ITEMS IN THE POSITIVE SET	ITEMS IN THE NEGATIVE SET
1	6	0, 1, 2, 3, 4, 5, 7, 8, 9
2	2, 4	0, 1, 3, 5, 6, 7, 8, 9
3	0, 3, 8	1, 2, 4, 5, 6, 7, 9
4	5, 7, 9, 1	0, 2, 3, 4, 6, 8

An Example of Nested Positive Sets and Response Consistency

(b) MEMORY SET SIZE	ITEMS IN THE POSITIVE SET	ITEMS IN THE NEGATIVE SET
1	6	0, 2, 3, 5, 7, 9
2	6, 4	0, 2, 3, 5, 7, 9
3	6, 4, 8	0, 2, 3, 5, 7, 9
4	6, 4, 8, 1	0, 2, 3, 5, 7, 9

EXPERIMENT 1

METHOD

2.1.1 Subjects

Six paid student volunteers, who were naive to reaction time experiments, served as subjects. Each subject was run individually on 24 consecutive daily sessions excluding weekends.

2.1.2 Design

There were three blocks of trials in each session, one for each of the memory set sizes: s=2, s=3, s=4. Each of the six possible orders of the three set sizes was counterbalanced between and across the six subjects over each of four successive six-day periods. A four-minute break occurred between blocks.

In all 24 sessions, before each block, the subject was given a card showing the digits comprising the current memory set. The subject was instructed to commit these digits to memory and to keep the card showing the digits so they would be available for reference. The instructions read to each subject on day one of the experiment are shown in Appendix 1. On each trial the subject's task was to determine whether a visually displayed digit was or was not a member of a previously memorized set of digits, and to indicate his/her decision by pressing one of two telegraph keys. The subject was instructed to respond to positive set digits with his/her preferred hand and to all other digits with his/her non-preferred hand.

Shown in Table 1 are the approximate probability values and the presentation frequency values for the individual items within each set size. Note that one positive item occurs with a probability of .15 within each memory set size.

Mean response latencies and mean percent errors over all set sizes were calculated and posted daily for the subjects to see. The subjects were verbally encouraged to decrease their response latencies while maintaining their error level under 2%. Subjects were not given any information about the frequency of occurrence of items.

2.1.3 Apparatus and test stimuli

A Scientific Prototype 3-Field Tachistoscope was used for stimulus presentation and control of trial events. The test items were the digits 0 - 9, (Black Letraset, Grotesque 9) centered on individual 12.5 cm. x 17.5 cm. white cards. The average height of the digits was 2.5 cm; the visual angle subtended was approximately 1.25 degrees. The subject was seated, and positioned the index finger of each hand on telegraph keys placed at table height and slightly to the left and right of the tachistoscope's viewing hood.

2.1.4 Trial events

The sequence of events for each trial was as follows. A white card with a centered black dot, which served both as a warning signal and a fixation aid, was displayed for 1.25 sec. It was immediately replaced by a digit, which was displayed for 44 msec. A blank white card was then displayed for the remainder of the approximately 7 sec. intertrial interval. The time from the onset of the test item to the

Probability of Occurrence and Presentation Frequency Values of the Individual Items in Experiment 1

Table 1: Shown are the positive and negative presentation frequency values (and the approximate probability of occurrence values) which were assigned to the individual items within each set size in Experiment 1.*

Probability of Occurrence and Presentation Frequency Values of Individual Items

Memory Set Size	Positive Items	Negative Items
2	22 (.35) 10 (.15)	the remaining 8 digits each occur 4 times (P=.0625)
3	19 (.30) 10 (.15) 3 (.05)	the remaining 7 digits each occur 4 or 5 times (P=.071)
4	13 (.20) 10 (.15) 6 (.10) 3 (.05)	the remaining 6 digits each occur 5 or 6 times (P=.083)

* In order to maintain a constant presentation frequency value for the P=.15 items and for the remaining probed items in Experiment 1 across blocks and days, presentation frequency assumed a value rounded to the nearest integer. For example, an item having a P value of .15 should be presented 9.6 times in a block of trials. Since it is impossible to probe an item 9.6 times, it was probed 10 times instead. This manipulation, however, slightly altered the intended probability of occurrence values which are shown above. Thus, these values represent approximations of P. It should be further noted that for the proceeding experiments of this thesis, presentation frequency was manipulated in this way also.

subject's response was recorded. Auditory feedback was used to inform the subject about the correctness of his/her response.

2.1.5 Assignment of digits to the positive and negative sets

Separately for each session and for each subject, non-intersecting sets of digits were assigned to the three positive set size conditions. Each day, from the 10 stimuli, a new assignment of digits to positive sets was made randomly without replacement and with the further restriction that over the course of the experiment each digit was assigned to each of the presentation frequency values within each set size an equal number of times. Order of the individual items on the subject's memory card was varied systematically to eliminate the possibility of the subject correctly inferring P values (or order of P values) associated with any items.[3]

2.1.6 Test stimulus sequence

In each session, there were 64 trials preceded by 9 practice trials for each of the three set sizes. The presentation frequency of individual items (Table 1) was determined for the practice and experimental trials separately. For every session and every set size condition, items requiring a positive response were presented on 50% of the trials. The order of positive and negative trials was random.

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3 Appendix 2 reports the findings obtained for an additional group of 5 subjects In this preliminary study, the order of the individual items on subjects' memory cards was not varied systematically.

RESULTS

2.2.1 Memory set size effect confounded by probability

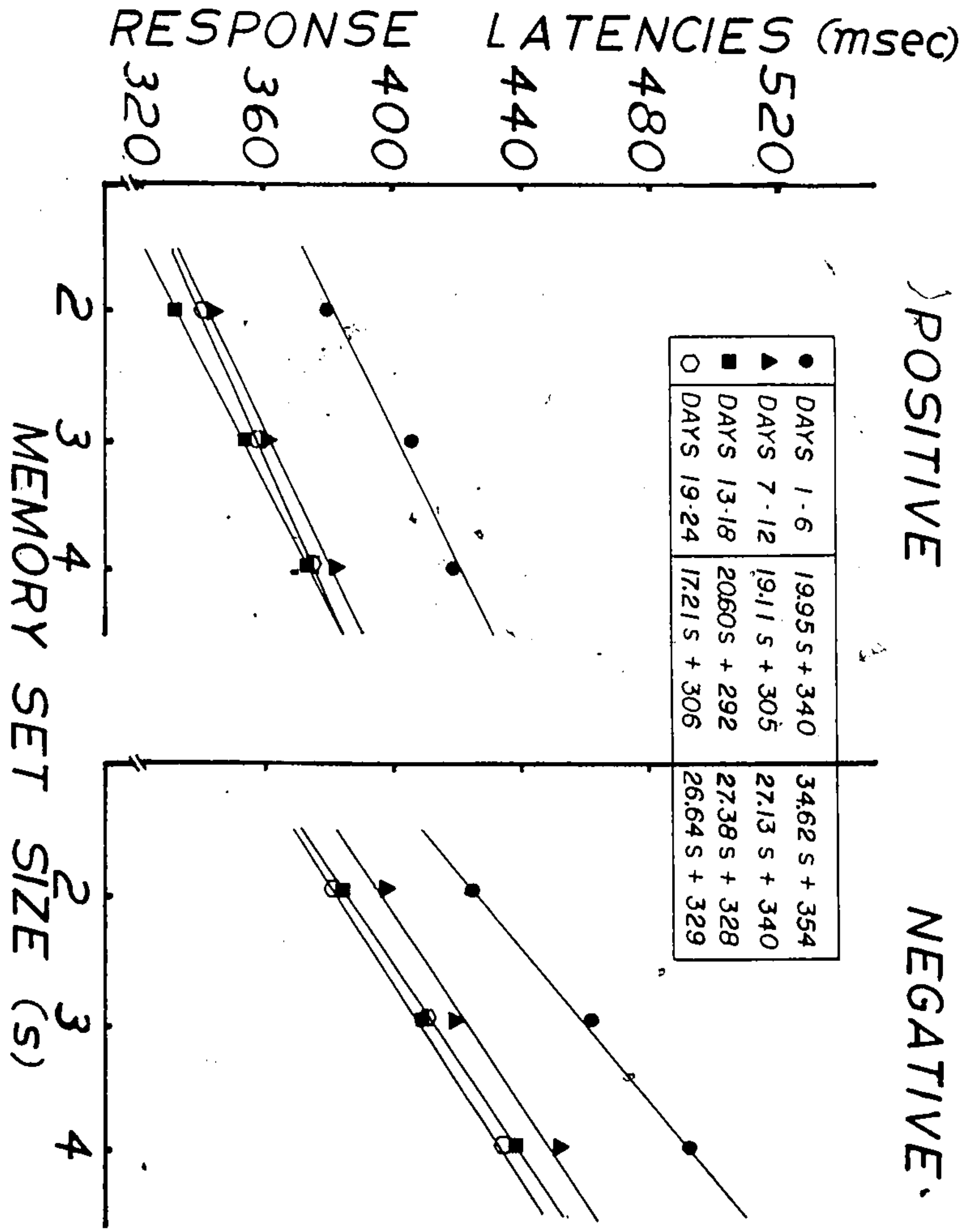
All correct responses, excepting practice trials, were used for calculating positive and negative mean response latencies separately each day for each subject. In Figure 10, mean response latencies are plotted against positive set size for each successive six-day period, for negative and positive responses separately over all six subjects.

Also in Figure 10, least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented. The relationships between response latency and set size were well described by linear functions. Linear regression accounted for between 95.8% and 99.9% of the variance, and did not show any systematic trend over blocks of days.

These same data are shown summarized for each subject in Table 2a and b.

An analysis of variance was performed on the mean response latency values obtained from positive and from negative trials, over the four successive 6–day periods, and for set sizes 2, 3, and 4. All main effects were significant: response latencies to negative trials were significantly greater than to positive trials [$F(1,5)=112.85$, $p=.0005$] ; response latencies decreased over practice [$F(3,15)=11.25$, $p=.0006$] ; and as set sizes increased, response latencies increased significantly [$F(2,10)=152.01$, $p=.0001$] . Interactions found to be significant were: positive–negative X set size [$F(2,10)=34.09$, $p=.001$] ; 6–day periods X set size [$F(6,30)=2.57$, $p=.0395$] ; and positive–negative X set size X 6–day periods [$F(6,30)=2.683$, $p=.0328$] .

Figure 10: Mean response latencies are plotted against positive set size for each successive 6-day period, for negative and positive responses separately over all six subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.


RESPONSE LATENCIES (msec)
320
360
400
440
480
520
POSITIVE
NEGATIVE
DAYS 1-6 19.95 s + 340 34.62 s + 354
DAYS 7-12 19.11 s + 305 27.13 s + 340
DAYS 13-18 20.60 s + 292 27.38 s + 328
DAYS 19-24 17.21 s + 306 26.64 s + 329
2
3
4
MEMORY SET SIZE (s)

Positive Mean RTs

Table 2a: Individual subjects' mean response latencies for positive responses are shown summarized over successive 6-day blocks for each set size separately in Experiment 1. Also shown are the corresponding slopes and coefficients of determination for each set of data.

Days 1-6 subject #	s=2	s=3	s=4	linear slope	r^2
1	383.01	410.19	407.68	12.34	.6744
2	387.39	409.72	434.44	23.53	.9991
3	344.19	375.74	392.79	24.30	.9712
4	369.59	396.44	405.09	17.76	.9194
5	344.75	375.75	388.79	22.03	.9475
6	438.56	462.47	478.06	19.75	.9854
x	377.92	405.05	417.81	19.95	.9585
Days 7-12					
1	304.17	311.10	324.21	10.03	.9693
2	343.17	364.82	382.29	19.56	.9962
3	321.42	337.60	357.97	18.28	.9956
4	357.50	378.44	399.37	20.94	1.0000
5	318.93	340.97	361.51	21.29	.9996
6	419.56	424.72	468.66	24.55	.8279
x	344.13	359.61	382.34	19.11	.9881
Days 13-18					
1	302.38	304.93	316.88	7.26	.8771
2	318.09	345.54	371.35	26.63	.9997
3	326.87	351.88	380.28	26.71	.9987
4	349.09	361.28	373.10	12.01	.9999
5	294.72	324.01	337.95	21.62	.9597
6	400.91	442.24	459.62	29.36	.9474
x	332.01	354.98	373.20	20.60	.9956
Days 19-24					
1	300.44	307.25	311.54	5.56	.9831
2	327.60	353.91	374.32	23.36	.9947
3	349.73	356.12	383.38	16.83	.8864
4	327.54	343.00	361.17	16.82	.9978
5	328.95	356.75	361.99	16.53	.8655
6	411.68	429.70	460.07	24.20	.9787
x	340.99	357.79	375.41	17.21	.9998

Negative Mean RTs

Table 2b: Individual subjects' mean response latencies for negative responses are shown summarized over successive 6-day blocks for each set size separately in Experiment 1. Also shown are the corresponding slopes and coefficients of determination for each set of data.

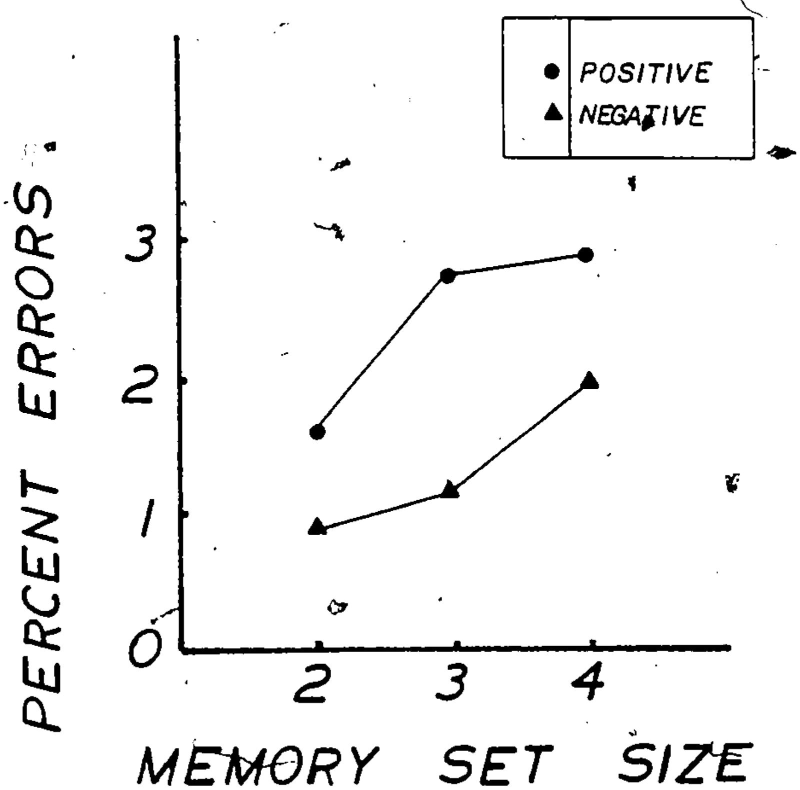
Days 1-6 subject #	s=2	s=3	s=4	linear slope	r^2
1	423.73	464.16	492.45	34.37	.9897
2	423.01	471.41	513.28	45.14	.9983
3	386.23	428.43	460.21	36.99	.9934
4	401.73	440.26	468.43	33.35	.9920
5	395.20	426.16	460.88	32.84	.9989
6	502.52	533.49	552.51	25.00	.9813
x	422.07	460.65	491.29	34.62	.9956
Days 7-12					
1	364.88	371.06	397.10	16.11	.8876
2	411.64	435.47	455.31	21.84	.9972
3	375.11	397.72	437.15	31.02	.9761
4	388.03	416.86	454.62	33.34	.9940
5	355.13	376.82	413.04	28.96	.9794
6	486.00	506.26	549.05	31.53	.9592
x	396.80	417.37	451.05	27.13	.9809
Days 13-18					
1	341.14	353.77	375.07	16.97	.9787
2	409.38	428.87	472.34	31.48	.9539
3	379.66	403.20	449.09	34.72	.9666
4	365.15	389.28	412.17	23.51	.9998
5	338.89	371.07	398.48	29.80	.9979
6	468.10	502.82	523.65	27.78	.9796
x	383.72	408.17	438.47	27.38	.9962
Days 19-24					
1	320.59	336.91	356.73	18.07	.9969
2	393.73	429.34	462.05	34.16	.9994
3	380.73	405.23	423.95	21.61	.9941
4	361.04	391.58	417.65	28.31	.9979
5	365.28	387.89	421.95	28.34	.9866
6	469.01	500.99	527.71	29.35	.9973
x	381.73	408.66	435.01	26.64	1.0000

These same variables result in significant interactions when slope values are analyzed. The nature of these interactions is dealt with more fully below.

An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variables were positive-negative trials and successive 6-day periods (see Figure 10 for slope values). Negative slopes were found to be significantly greater than positive slopes [$F(1,5)=55.93$, $p=.0013$] . The interaction between positive-negative slopes X 6-day periods was significant [$F(3,15)=4.22$, $p=.0235$] . A Duncan's Multiple Range test ($p=.05$) revealed that: (1) over the course of practice, negative slope values were significantly greater than positive slope values and (2) positive slopes did not change significantly over the course of practice, while negative slopes were significantly higher for the first 6-day period and then showed no further changes over the remainder of the course of practice.

Errors were maintained at a low level and no subject made errors on more than 2.4% of the total trials. The group error rates were 1.24%, 1.94% and 2.44% for the memory set sizes 2, 3 and 4 respectively. In Figure 11, mean percent errors are shown plotted against positive set sizes over days 1 to 24, for negative and positive trials separately over all six subjects. The individual subjects' error data for each successive 6-day period are given in Table 3. An analysis of variance was performed on percent errors where the within variables were positive-negative, successive 6-day periods and set size. Percent errors were significantly greater for positive than for negative

Figure 11: Mean percent errors are plotted against positive set size over days 1 to 24, for positive and negative trials separately over all six subjects.



Positive and Negative Percent Errors

Table 3: Individual subjects' percent errors for positive and negative responses are shown summarized over successive 6-day blocks for each set size separately in Experiment 1.

	POSITIVE % ERRORS			NEGATIVE % ERRORS		
subject #	s=2	s=3	s=4	s=2	s=3	s=4
Days 1-6						
1	3.65	5.21	7.81	.52	1.56	3.65
2	1.56	4.69	3.65	.52	1.04	4.69
3	2.60	1.56	.52	.00	.52	1.04
4	.00	3.65	1.04	.00	.52	2.08
5	.52	2.08	1.04	.00	1.56	.52
6	.00	.52	.00	1.04	.52	.52
x	1.39	2.95	2.34	.35	.95	2.08
Days 7-12						
1	3.13	3.65	5.73	2.08	4.69	4.17
2	1.56	1.04	2.60	.00	.52	1.56
3	1.56	2.60	.52	.00	.00	1.04
4	2.08	2.08	1.04	.52	1.56	2.60
5	2.08	4.17	3.13	.52	1.56	2.08
6	.52	.52	2.60	1.04	.00	.00
x	1.82	2.34	2.60	.69	1.39	1.91
Days 13-18						
1	5.21	6.77	8.33	3.65	2.60	2.60
2	2.08	.52	2.60	1.04	1.04	2.08
3	1.56	2.08	3.13	.52	.52	.00
4	1.04	3.13	2.60	.52	.52	2.08
5	3.13	1.56	2.60	1.56	1.56	1.56
6	.00	1.04	1.04	.00	.00	1.04
x	2.17	2.52	3.38	1.22	1.04	1.56
Days 19-24						
1	3.65	7.29	[illegible]	1.56	2.60	4.17
2	1.04	2.60	[illegible]	3.13	1.56	2.60
3	.52	2.08	[illegible]	1.04	.52	1.56
4	.52	3.65	[illegible]	.52	1.56	3.13
5	.52	2.60	2.08	.52	1.04	2.08
6	.00	.52	.00	.52	.00	.52
x	1.04	3.12	3.30	1.22	1.21	2.34

trials [$F(1,5)=6.34$, $p=.0526$] ; and the errors increased significantly as set size increased [$F(2,10)=7.62$, $p=.0099$] .

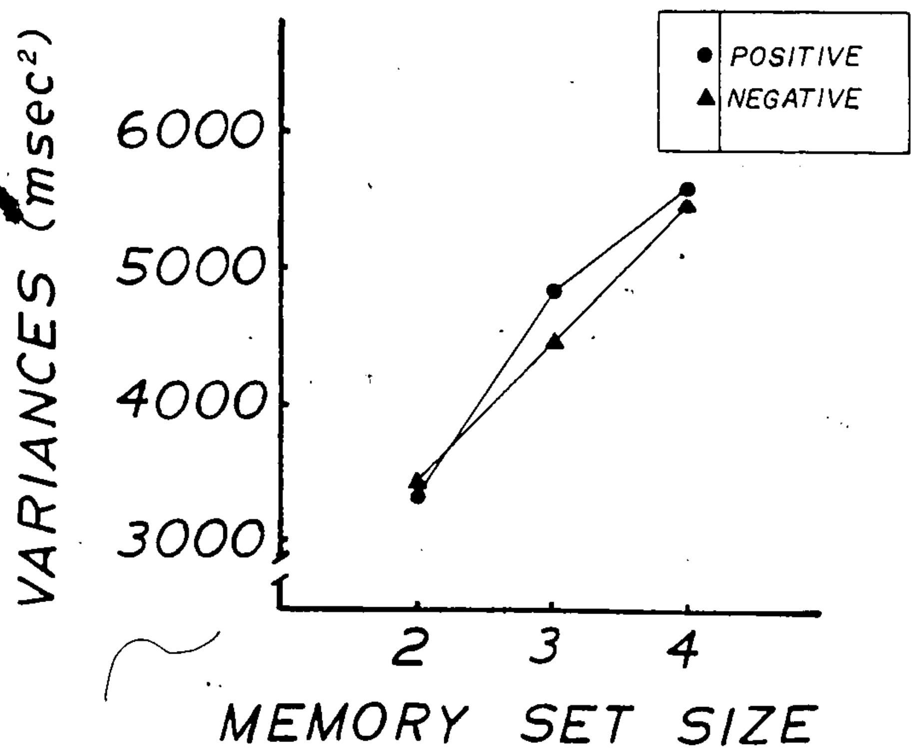
Variances were obtained from positive and from negative trials for each memory set size and were calculated day by day for each subject and averaged over successive 6-day periods. These data are shown in Table 4 and are shown plotted against positive set size over the 24 days, for positive and negative responses separately over all six subjects in Figure 12. An analysis of variance was performed where the within variables were positive-negative, successive 6-day periods and set size. The only significant effect was the main effect of set size: throughout the course of practice, both positive and negative response variances increased as set size increased [$F(2,10)=25.72$, $p=.0003$] .

2.2.2 Memory set size effect unconfounded by P (P = .15 data only)

The following analyses relate directly to the effects of memory set size with the confounding of probability removed. Only trials where items occurred with a probability of .15 in all set sizes were considered. In Figure 13, the means of the correct RTs are plotted against positive set size for each successive 6-day period. The data for the individual subjects are provided in Table 5.

Also in Figure 13, least squares best fitting straight lines are drawn through each set of data. The relationships between response latency and set size were not as well described by linear functions as when all positive trials were used in the calculations. Percent variance accounted for by linear regression ranged from 81.3% to 99.3%

Figure 12: Mean response variances are plotted against positive set size for positive and negative responses separately for all six subjects over all 24 days.



Positive and Negative Variances

Table 4: Individual subjects' positive and negative response variances are shown summarized over successive 6-day blocks for each set size separately in Experiment 1.

	POSITIVE VARIANCES			NEGATIVE VARIANCES		
subject #	s=2	s=3	s=4	s=2	s=3	s=4
Days 1-6						
1	4627.97	8107.92	10550.08	4161.33	6752.65	9056.06
2	5925.67	8240.03	12487.10	5306.09	9205.21	10223.20
3	3756.25	6663.83	6157.44	4439.94	6704.62	6155.33
4	2874.20	2832.67	4578.26	2340.21	2756.96	3444.58
5	2421.78	4707.21	3049.56	2849.70	2949.73	4450.81
6	2795.61	5662.07	5795.92	6654.05	4821.83	6420.79
x	3733.58	6035.62	7103.06	4291.89	5531.83	6625.13
Days 7-12						
1	1717.19	2485.02	3639.10	2169.91	2430.23	3691.68
2	4863.00	4778.78	6806.84	4835.27	5451.12	6193.78
3	2068.26	3311.71	4000.88	4052.04	4473.02	4490.61
4	2586.12	2900.35	3973.54	1412.26	2342.81	3386.52
5	1827.71	3605.68	6829.83	2562.64	3484.28	3662.73
6	6145.62	5095.74	5078.63	4307.30	4901.05	6617.63
x	3201.32	3696.21	5054.80	3223.24	3847.09	4673.83
Days 13-18						
1	2012.19	3382.34	2077.63	1933.17	2895.16	2426.36
2	3861.93	5928.56	10000.73	5479.91	5393.22	8419.01
3	1871.68	4939.36	6335.37	4037.12	4699.01	5177.88
4	2595.85	2723.06	3339.26	1600.84	2216.68	2569.27
5	2069.59	6121.81	3818.09	1675.39	2974.51	3140.68
6	3449.10	7536.43	6557.64	3295.62	5493.48	8041.79
x	2643.39	5105.26	5354.79	3003.68	3945.34	4962.50
Days 19-24						
1	3928.95	1667.35	2863.32	1580.36	1948.26	2397.94
2	4291.92	5634.53	6556.10	5377.03	5569.82	8297.76
3	5261.11	5111.01	7288.17	4838.06	5707.81	5525.99
4	2308.06	3223.37	3510.18	1371.87	2239.27	4321.30
5	2843.84	6193.79	2803.71	2509.96	3967.58	3801.31
6	2838.05	4254.43	6266.25	3095.56	7342.74	9412.28
x	3578.66	4347.41	4881.29	3128.81	4462.58	5626.10

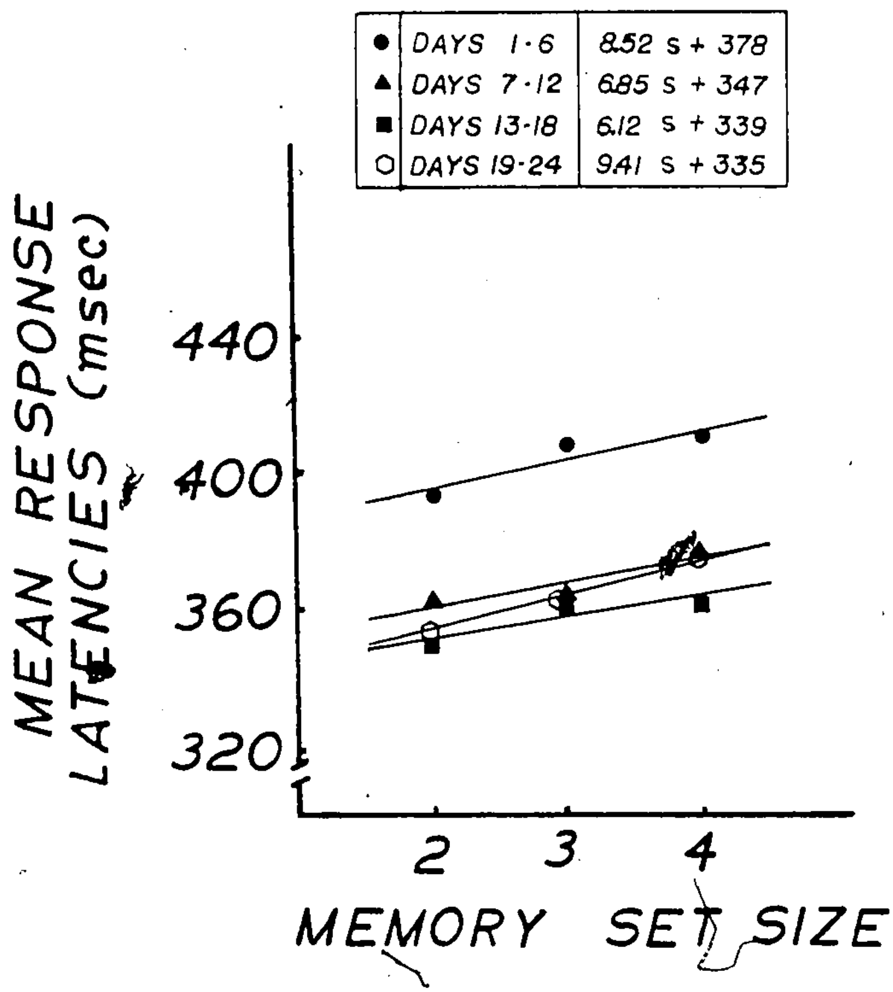
and did not show any systematic trend over blocks of days. In view of the small number of reaction times contributing to each 6-day period, it is important to note that over the 24 days, the variance accounted for was 99.4%.

An analysis of variance performed on the response latency values revealed that both main effects were significant and the interaction was not. Mean RTs decreased over practice [$F(3,15)=7.60$, $p=.0026$], and mean RTs increased significantly with set size increases [$F(2,10)=9.54$, $p=.0051$].

An analysis of variance of slopes over 6-day periods showed that the slopes did not change significantly over the course of practice. The slope values obtained from the .15 positive responses are given in Table 5 for the individual subjects. The average slope value for the positive trials where P = .15 over the 24 days was 7.73 msec./item. For all positive trials (including those trials where P = .15) the analogous slope value was 19.22 msec./item. An analysis of variance was performed on slope values where the within variables were: (1) slopes determined from all positive trials and from positive trials where P = .15, and (2) successive 6-day periods. The only significant finding was that over all 6-day periods slope values from all positive trials were significantly greater than slope values determined from P = .15 positive trials only [$F(1,5)=293.88$, $p=.0002$]. These slope values as well as those for negative trials are shown plotted against successive 6-day periods in Figure 14.

Percent errors made on positive .15 test trials were calculated day by day across all 6 subjects, and are shown summarized in Table 6

Figure 13: Mean response latencies are plotted against positive set size for each successive 6-day period, for .15 positive responses for all six subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.

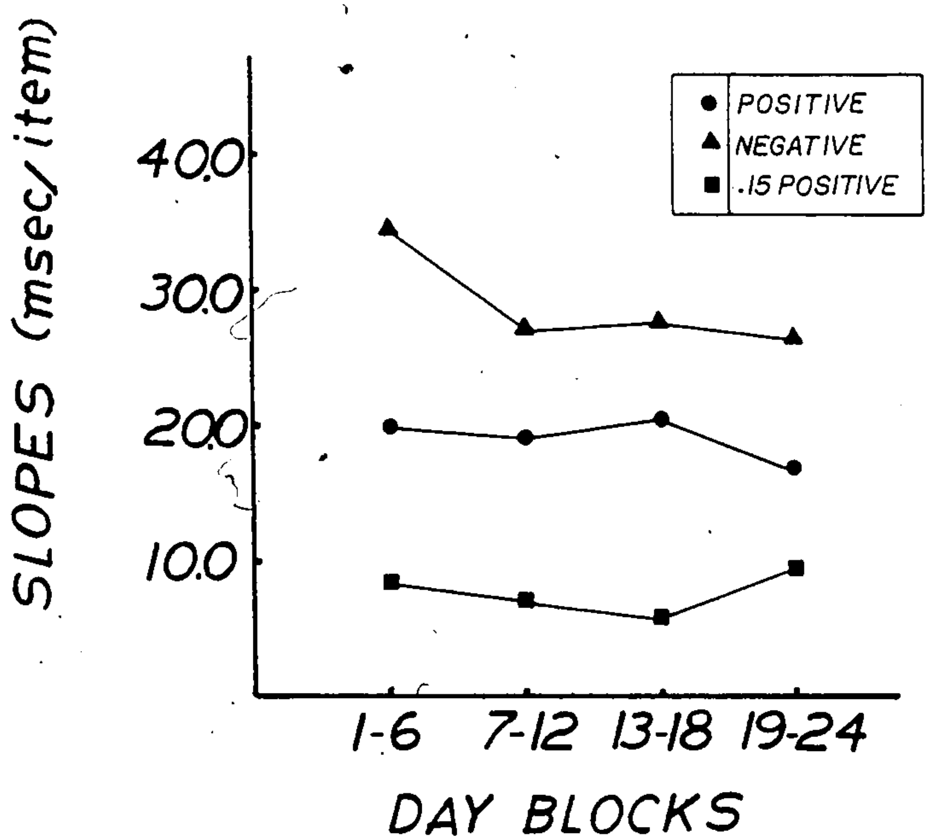


Positive .15 Mean RTs

Table 5: Individual Subjects' mean response latencies for positive .15 responses are shown summarized over successive 6-day blocks for each set size separately in Experiment 1. Also shown are the corresponding slopes and coefficients of determination for each set of data.

subject #	s=2	s=3	s=4	linear slope	r^2
Days 1-6					
1	405.43	422.20	410.05	2.31	.0711
2	398.90	403.75	415.80	8.45	.9430
3	359.46	380.85	396.13	18.34	.9908
4	384.40	383.79	383.35	-.53	.9916
5	365.02	389.25	381.55	8.27	.4457
6	447.25	462.41	475.85	14.30	.9988
x	393.41	407.04	410.46	8.52	.8932
Days 7-12					
1	322.41	313.36	317.74	-2.34	.2662
2	353.26	358.55	384.24	15.49	.8737
3	330.97	350.61	363.03	16.03	.9834
4	375.53	378.14	383.72	4.10	.9580
5	333.81	338.63	343.88	5.04	.9994
6	456.12	445.48	461.70	2.79	.1146
x	362.02	364.13	375.72	6.85	.8624
Days 13-18					
1	321.93	314.11	305.82	-8.06	.9997
2	343.65	323.92	351.73	4.04	.0798
3	341.90	368.80	372.60	15.35	.8412
4	356.23	371.15	364.98	4.38	.3405
5	316.12	335.15	328.69	6.29	.4218
6	415.25	449.12	444.67	14.71	.6388
x	349.18	360.38	361.42	6.12	.8132
Days 19-24					
1	303.04	307.48	303.00	-.02	.0001
2	336.59	370.52	372.52	17.97	.7916
3	379.95	356.02	383.64	1.85	.0151
4	341.83	355.99	365.60	11.89	.9879
5	335.59	350.59	360.90	12.66	.9887
6	429.78	434.63	454.03	12.13	.8929
x	354.46	362.54	373.28	9.41	.9934

Figure 14: Slope values for positive, negative and .15 positive trials are plotted against successive 6-day blocks.



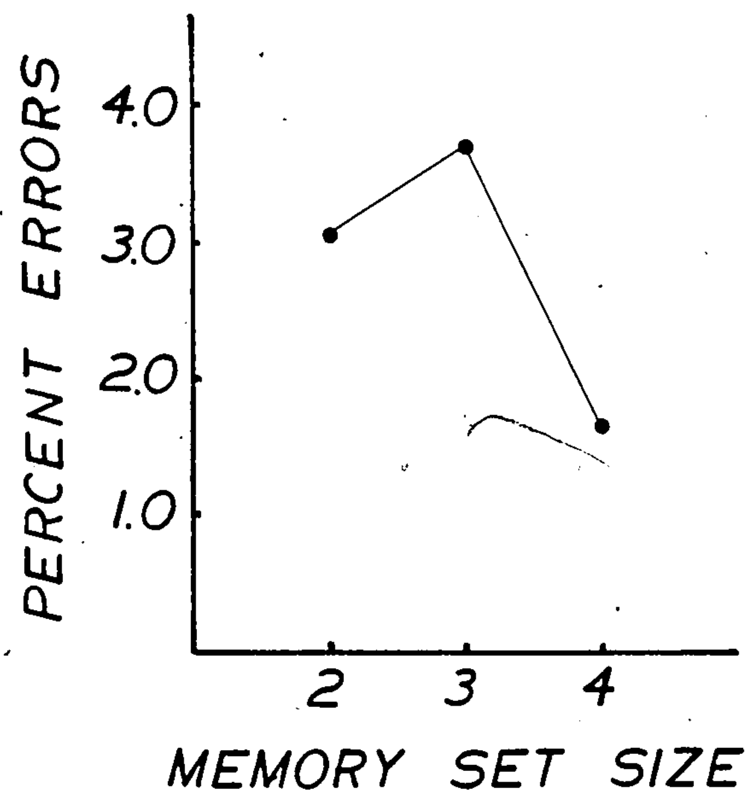
for each individual subject and for each of the successive 6-day periods. In Figure 15, percent errors are shown plotted against positive set size as calculated over all 24 days of the experiment and over all six subjects.

An analysis of variance was performed on percent errors for positive items where $P = .15$, and the within variables were memory set size and successive 6-day periods. Percent errors differed significantly for the three positive set sizes [$F(2,10)=4.61$, $p=.0376$] but errors did not show a systematic change with set size (3.06%, 3.68% and 1.67% respectively).

Variances were obtained from trials where item frequency was held constant across the three set sizes and were calculated day by day for each subject. An analysis of variance where the within variables were successive 6-day periods and memory set indicated that there were no significant main effects or interactions (i.e. variances did not differ significantly across set sizes). The variances obtained for each set size are provided in Figure 16 as calculated over all 24 days of the experiment, and are summarized in Table 7 for the individual subjects and for each successive 6-day period.

For one item in each of the two set sizes, $s=3$ and $s=4$, the frequency of presentation was .05. It was originally thought an analysis of this data might be useful. However, the very small number of responses obtained for this P value coupled with the very large variances within each subject's data led the writer to conclude that such an analysis would not be informative.

Figure 15: Percent errors are plotted against positive set size as averaged over all 24 days of the experiment and over all six subjects, for .15 positive responses.

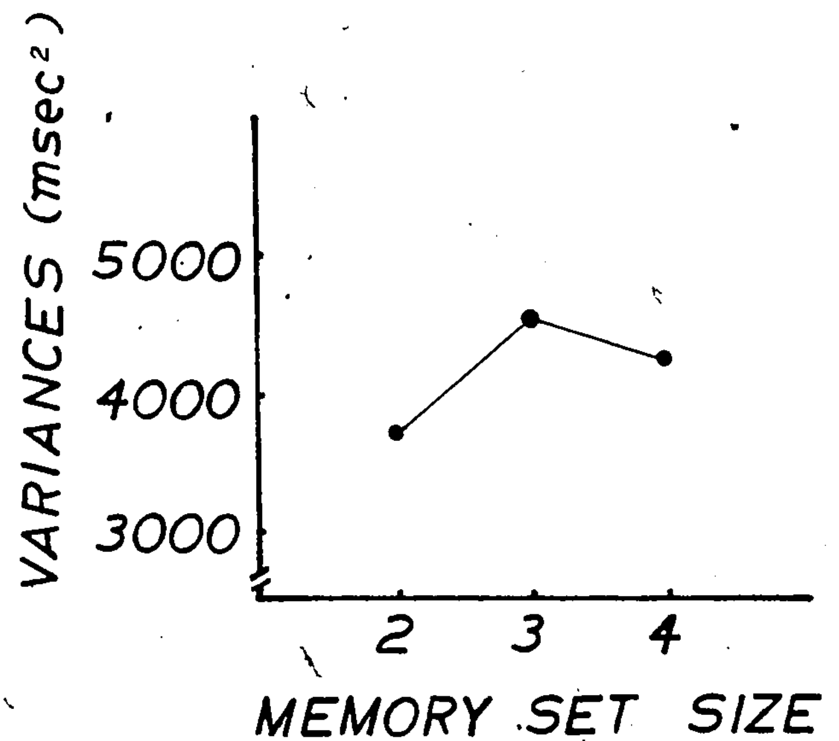


Positive .15 Percent Errors

Table 6: Individual subjects' percent errors for positive .15 responses are shown summarized over successive 6-day blocks for each set size separately in Experiment 1.

subject #	s=2	s=3	s=4
Days 1-6			
1	10.00	6.67	5.00
2	5.00	8.33	1.67
3	8.33	.00	.00
4	.00	.00	.00
5	1.67	6.67	.00
6	.00	1.67	.00
x	4.17	3.89	1.11
Days 7-12			
1	1.67	3.33	3.33
2	3.33	3.33	3.33
3	.00	1.67	.00
4	5.00	1.67	.00
5	1.67	10.00	1.67
6	1.67	.00	1.67
x	2.22	3.33	1.67
Days 13-18			
1	6.67	11.67	8.33
2	6.67	.00	.00
3	3.33	1.67	.00
4	.00	1.67	1.67
5	6.67	3.33	1.67
6	.00	.00	.00
x	3.89	3.06	1.95
Days 19-24			
1	5.00	10.00	6.67
2	3.33	6.67	.00
3	1.67	1.67	3.33
4	1.67	5.00	.00
5	.00	3.33	1.67
6	.00	.00	.00
x	1.95	4.45	1.95

Figure 16: Mean response variances are plotted against positive set size for positive .15 trials as averaged over all 24 days of Experiment 1 and over all six subjects.



Positive .15 Variances

Table 7: Individual subjects' response variances for positive .15 trials are shown summarized over successive 6-day blocks for each set size separately in Experiment 1.

subject #	s=2	s=3	s=4
Days 1-6			
1	5518.90	10061.64	9788.77
2	6979.25	6976.55	10787.15
3	4034.93	7714.54	4478.41
4	3376.02	2611.23	3084.49
5	3795.50	4105.66	2942.21
6	3347.96	3764.53	4271.03
x	4508.76	5872.36	5892.01
Days 7-12			
1	2822.40	2455.37	1770.92
2	4903.68	3389.71	4838.88
3	1586.69	2510.78	4427.14
4	3937.88	2300.97	2218.86
5	1758.70	3006.60	1715.38
6	8662.75	6954.21	3370.87
x	3945.35	3436.27	3057.01
Days 13-18			
1	2939.75	3167.83	2071.31
2	3901.15	2380.50	3300.85
3	1790.29	4540.69	5413.41
4	2708.19	4143.09	2778.46
5	3152.62	8654.37	1984.19
6	3461.52	9162.30	4962.42
x	2992.25	5341.46	3418.44
Days 19-24			
1	1328.95	1724.59	1932.94
2	4803.55	6693.32	6307.72
3	5074.70	3713.47	8866.25
4	2606.29	2704.18	3919.83
5	2555.22	2883.82	1767.07
6	3388.80	3425.70	4683.42
x	3292.92	3524.18	4579.54

2.2.3 Stimulus probability effects

In Figure 17, mean response latencies of the individual positive items are plotted against P for each set size separately and averaged over all 24 days. The individual subjects' data are shown in Table 8. Faster RTs were produced by more probable items. The form of the functions for set sizes 3 and 4 was not linear; low item presentation frequencies appear to have greater effects on mean RT than items with high presentation frequencies.

DISCUSSION

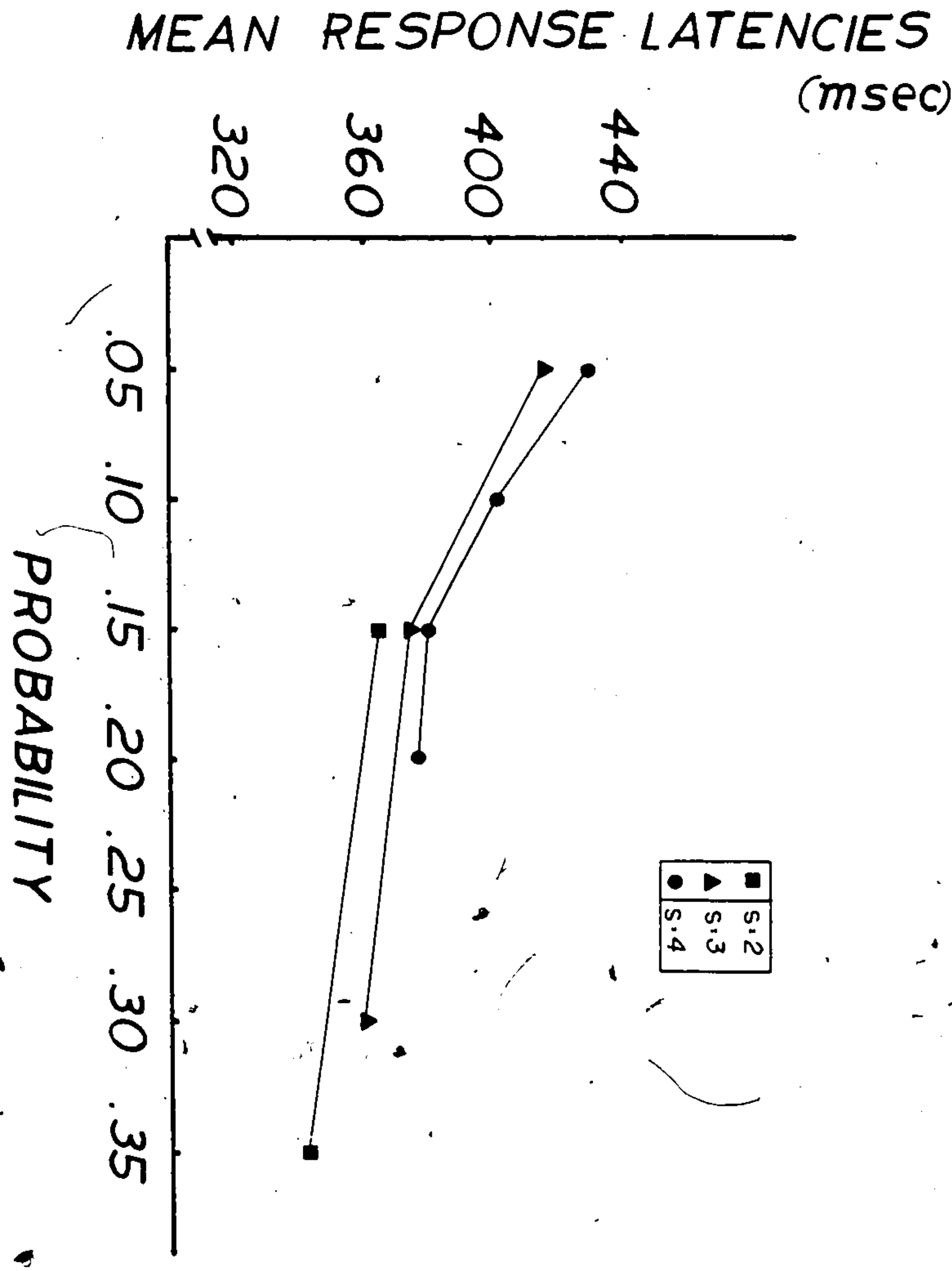
Experiment 1 was designed in an attempt to: (1) unconfound the two variables, s and P; (2) deviate as little as possible from a 'standard' item recognition task; and (3) investigate P effects over a period of prolonged practice. This was done by holding P constant at .15 for one positive item in each memory set size.

2.3.1 Summary of the memory set size effect

When the memory set size effect was examined for data where the confounding of P was present, both positive and negative mean RTs increased linearly with memory set size and these increases were significantly greater for negative mean RTs. This finding is reflected again in the results from the analysis of slope values: the negative slopes were significantly greater than positive slopes.

A small memory set size effect was found when the confounding of P was removed; further, these slope values were significantly smaller than those obtained when the confounding was present, and this

Figure 17: Mean response latencies of the individual positive items are plotted against probability for each set size separately as averaged over all 24 days of Experiment 1.


MEAN RESPONSE LATENCIES
(msec)
320
360
400
440
.05
.10
.15
.20
.25
.30
.35
PROBABILITY
S 2
S 3
S 4

Mean RTs of Each Individual Positive Item

Table 8: Mean RTs of each individual positive item are shown summarized for each set size and for each subject separately, as calculated over each successive 6-day period in Experiment 1.

	s=2		s=3			s=4			
S	.35	.15	.30	.15	.05	.20	.15	.10	.05
Days 1-6									
1	374.82	405.43	393.63	422.20	495.15	386.87	410.05	410.63	474.07
2	381.58	398.90	406.35	403.75	460.67	427.26	415.80	463.12	488.33
3	337.62	359.46	367.92	380.85	414.62	376.12	396.13	402.28	436.24
4	362.80	384.40	397.16	383.79	435.55	404.96	383.35	406.20	479.47
5	335.91	365.02	353.92	389.25	461.17	383.25	381.55	390.34	438.56
6	434.61	447.25	443.86	462.41	581.06	453.77	475.85	532.28	482.22
x	371.22	393.41	393.81	407.04	474.70	405.37	410.46	434.14	466.48
Days 7-12									
1	296.02	322.41	302.58	313.36	368.47	317.46	317.74	321.06	379.13
2	338.57	353.26	361.98	358.55	402.28	364.77	384.24	403.82	414.44
3	317.34	330.97	327.29	350.61	365.33	351.32	363.03	349.58	389.12
4	349.72	375.53	374.97	378.14	403.31	399.99	383.72	389.71	469.53
5	312.03	333.81	337.66	338.63	406.76	354.84	343.88	378.86	433.56
6	403.28	456.12	406.90	445.48	465.67	456.01	461.70	473.26	545.63
x	336.16	362.02	351.90	364.13	401.97	374.07	375.72	386.05	438.57
Days 13-18									
1	293.44	321.93	289.79	314.11	376.88	318.91	305.82	330.06	313.64
2	306.97	343.65	355.38	323.92	354.06	369.90	351.73	393.00	408.77
3	320.32	341.90	337.81	368.80	395.93	362.29	372.60	406.15	441.31
4	346.02	356.23	356.13	371.15	360.00	366.82	364.98	391.17	391.00
5	285.67	316.12	316.48	335.15	336.82	332.02	328.69	356.26	360.25
6	394.39	415.25	430.22	449.12	499.94	444.31	444.67	501.12	498.56
x	324.47	349.18	347.64	360.38	387.27	365.71	361.42	396.29	402.26
Days 19-24									
1	299.13	303.04	304.18	307.48	332.00	303.79	303.00	324.55	365.54
2	324.08	336.59	344.32	370.52	364.47	366.01	372.52	381.14	401.65
3	336.06	379.95	348.41	356.02	410.81	365.09	383.64	401.22	444.92
4	322.04	341.83	325.36	355.99	427.47	351.97	365.60	373.63	361.00
5	325.87	335.59	353.82	350.59	395.06	352.66	360.90	383.25	362.47
6	430.46	429.78	419.48	434.63	478.56	439.31	454.02	474.36	545.94
x	335.11	354.46	349.26	362.54	401.40	363.14	373.28	389.69	413.59
Days 1-24									
1	315.85	338.20	322.55	339.29	393.13	331.76	334.15	346.58	383.10
2	337.80	358.10	367.01	364.19	395.37	381.99	381.07	410.27	428.30
3	327.84	353.07	345.36	364.07	396.67	363.71	378.85	389.81	427.90
4	345.15	364.50	363.41	372.27	406.58	380.94	374.41	390.18	425.25
5	314.87	337.64	340.47	353.41	399.95	355.69	353.76	377.18	398.71
6	408.94	437.10	425.12	447.91	506.31	448.35	459.06	495.26	518.09
x	341.74	364.77	360.65	373.52	416.34	377.07	380.22	401.54	430.23

was true throughout the course of practice. The lack of a significant practice effect on slope values for the positive .15 items clearly indicates P has an immediate and stable influence on item recognition performance.

The clear and stable influence P has on item recognition performance is further reflected in the analyses showing that percent errors and variances obtained from positive trials where P = .15 did not change systematically with memory set size. In contrast, when the confounding of P was present, both variances and percent errors increased as set size increased for positive and negative trials. The finding, that overall positive and negative variances increase in parallel with set size increases, however, does satisfy (according to the traditional stage model) the assumption of stochastic independence: that the times required by the various stages on a given observation are independent of one another. Stochastic independence is tested by examining the additivity of the factor effects on variances. Sternberg (1967), however, recommends that primary reliance should be placed on tests among the means and notes that it is possible for stage durations to be additive but not stochastically independent.

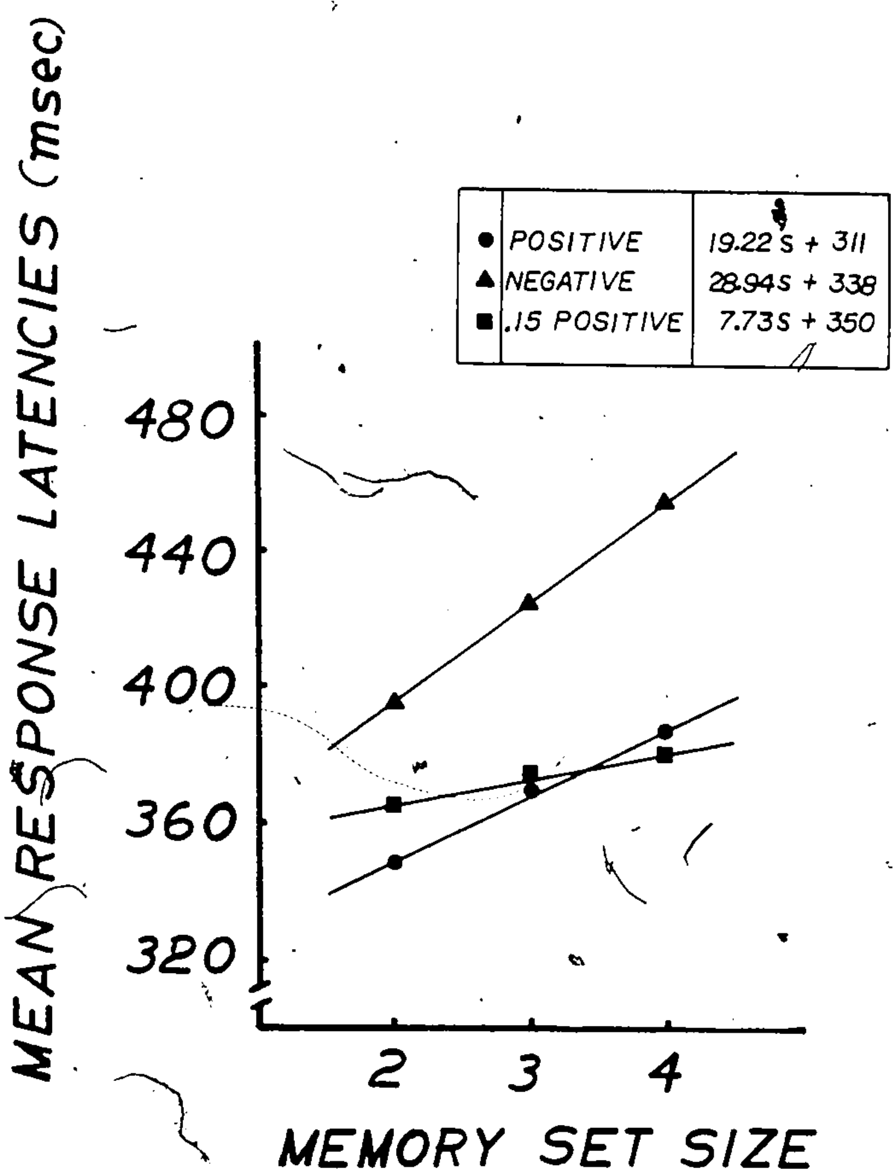
The author also wishes to bring to your attention Appendix 2. Appendix 2 presents the data and corresponding analyses obtained from a preliminary experiment where item recognition performance was examined for five subjects over each of three successive 6-day periods. Essentially, the procedure of the preliminary study was identical to that of Experiment 1; in the former study, however, the order of the individual items on the subjects' memory cards matched the order of the descending P values assigned to each item. Despite this discrepancy, the findings provided in Appendix 2 are in all important ways very similar to those reported for Experiment 1 and lead to the same conclusions.

2.3.2 Comparison with previous findings

The results of Experiment 1 are in general consistent with the standard findings. All item recognition functions, whether calculated from all positive, all negative or P = .15 positive trials only, are adequately described as linear. In Figure 18, each of the three item recognition functions as calculated over all 24 days of the experiment is shown plotted separately and illustrates that for each set of data, mean RT significantly increases with memory set size. Slope and intercept values are also given for each function. The data for the individual subjects are provided in Table 9.

The negative slope of 28.94 msec./item is also consistent with values usually found for the standard construction of the task. The slope for all positive items however, (19.22 msec./item) is significantly smaller than the negative slope and is lower than usually reported. Although the parallel increases in positive-negative response variances with set size increases does support the stage model's assumption of stochastic independence, the findings of a significant positive-negative and set size interaction (i.e. slope difference) does not appear to support a second assumption: that of stage independence (i.e. that a change in the distribution for one stage does not affect the distribution for the other stages). This discrepancy is not surprising, however, in view of the very small effect of set size

Figure 18: Mean response latencies are plotted against positive set size for positive, negative and .15 positive response trials over all 24 days of Experiment 1.



Positive, Negative and .15 Positive Mean RTs

Table 9: Individual subjects' mean response latencies are shown for positive, negative and .15 positive trials for Experiment 1 over all 24 days.

POSITIVE mRTs

S#	s=2	s=3	s=4	linear slope	intercept	r^2
1	322.50	333.37	340.08	8.80	305.61	.9817
2	344.06	368.50	390.60	23.27	297.91	.9992
3	335.55	355.34	378.61	21.53	291.91	.9978
4	350.93	369.79	384.68	16.88	317.84	.9954
5	321.84	349.37	362.56	20.37	283.51	.9603
6	417.68	439.78	466.60	24.47	367.97	.9969
x	348.76	369.36	387.19	19.22	310.79	.9983

NEGATIVE mRTs

S#	s=2	s=3	s=4	linear slope	intercept	r^2
1	362.59	381.48	405.34	21.38	319.01	.9955
2	409.44	441.29	475.75	33.16	342.70	.9995
3	380.43	408.65	442.60	31.09	317.31	.9972
4	378.99	409.50	438.22	29.63	320.06	.9997
5	363.63	390.49	423.59	29.99	302.63	.9964
6	481.41	510.89	538.23	28.42	424.95	.9995
x	396.08	423.71	453.96	28.94	337.76	.9993

.15 POSITIVE mRTs

S#	s=2	s=3	s=4	linear slope	intercept	r^2
1	338.20	339.29	334.15	-2.03	343.29	.5591
2	358.10	364.19	381.07	11.49	333.33	.9315
3	353.07	364.07	378.85	12.89	326.66	.9929
4	364.50	372.27	374.41	4.96	355.53	.9029
5	337.64	353.41	353.76	8.07	324.09	.7663
6	437.10	447.91	459.06	10.98	415.08	.9999
x	364.77	373.52	380.22	7.73	349.66	.9942

(7.73 msec./item) found when calculations are based only on those trials where P was held constant across set sizes. When these RTs, which make up 30% of the positive trials for each set size, are removed from calculation of the overall positive slopes, these slopes obviously become more similar to the negative slope values. In fact, positive slopes calculated in this manner yield a value of 24.5 msec./item. Although this slope value was found to be significantly lower than the negative slope value $[F(1,5)=121.14,\ p=.0004]$, it should be noted that even when the matched probability items are removed, the relations between s and P are not identical to those present in the standard task.

In this study when P was held constant over set sizes, there remained a small (7.73 msec./item) but significant effect of memory set size. Thus the data support the conclusion that increases in RT with increases in s are largely accounted for by the associated decreases in P.

Although they were working with different constructions of the task and considered only limited practice, Theios et al. (1973), Okada and Burrows (1974), and Raeburn (1974) also found that both P and s had significant effects on mean RTs. The slope values they obtained for trials where probability was held constant over s were very small, approximately 15 msec./item, 5 msec./item and 10 msec./item respectively.

2.3.3 Where does probability have its effects?

Experiment 1, unfortunately, does not allow any conclusions to be drawn as to whether the effects of s and P are additive or not, and thus does not provide evidence as to the locus (stage) of stimulus probability effects.

Sternberg (1975) has reviewed evidence available and concluded "that stimulus probability produces its effects by influencing one or more stages <u>other</u> than the serial comparison stage, and the encoding stage has been proposed as one possibility" (p. 14). The strongest evidence for this conclusion is found in the work of Miller and Pachella (1973). They manipulated P levels under conditions of degraded and intact stimuli and observed the obtained mean RTs. They found that the effects of stimulus legibility and stimulus probability are not additive and conclude therefore that a common stage is influenced, a stage they identify as the encoding stage. This finding does not, of course, rule out the possibility that probability may have effects in other stages as well.

No study, however, has been designed to determine whether P and s have additive effects in the comparison stage. Such a study would require obtaining RTs under conditions where frequency of occurrence of items within each set size is varied in such a way that at least two different values of P are held constant across all set sizes. This was the intent of Experiment 2.

To adequately address this issue, as to whether P and s have additive effects in the comparison stage, it was necessary to employ a larger stimulus ensemble than the digits 0 through 9 so that: (1) at least two different values of P could be held constant across all set sizes; and (2) the standard restriction of having a greater number of tested negative items than positive items could be maintained. The stimulus ensemble for the following experiments, then, consisted of the letters of the alphabet, A to N. However, few studies have investigated item recognition performance using the standard paradigm and letters as stimuli. Appendix 3 describes an experiment which was carried out (before proceeding with further experimentation concerning the confounding between P and s), using the standard item recognition paradigm and a fixed-set procedure and letters of the alphabet as stimuli. The effects of prolonged practice on the item recognition process were also examined.

In short, the findings from this experiment revealed that the typical features of the data reported in the standard item recognition experiment employing very limited practice and digits as stimuli hold up also under conditions of prolonged practice where the memory sets are comprised of letters. First, the relationship between mean RT and s remained linear throughout practice, supporting the idea of a serial comparison process in which the mean comparison rate for each item is the same. Second, the slopes of the item recognition functions for positive and for negative responses were found to be the same throughout practice, supporting the implications of an exhaustive search through the memory set. Third, the comparison rate remained reasonably constant with prolonged practice. Given the salient features of these data, Experiment 2 returns us to the central objective of the research, that of stimulus P and its effect on the memory scanning stage.

EXPERIMENT 2

3.1.1 Introduction

The findings obtained in Experiment 1 showed that the increase in RT, which has been attributed to s, may be accounted for largely by a decrease in the frequency of occurrence of each positive item resulting from set size increases. Consistent with the findings reported by Theios et al. (1973), Shiffrin and Schneider (1974), Raeburn (1974), and Okada and Burrows (1974), the data of Experiment 1 also showed that when P is held constant over set sizes, there remains a small but significant effect of positive set size which in Experiment 1 was approximately 8 msec./item.

It is unfortunate, however, that one cannot determine from these studies whether a small and constant set size effect would be obtained for different levels of P. Do the two factors, s and P, have additive or interacting effects? Despite the concerns raised against the acceptance of an independent and serial stage model of memory (i.e. Smith, 1968; Townsend, 1971, 1974; Taylor, 1976; Ratcliff, 1978; McClelland, 1979), the additive-factors methodology of Sternberg provides a powerful framework in which to address the confounding between s and P, and in fact, allows an important test of any theory in which item recognition invariably requires memory search and where the memory search is proposed to be of a constant rate and serial and exhaustive in nature for each probed trial (e.g. Sternberg, 1975; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). According to additive-factors logic, if the set size effect is the same for all levels of P, this would indicate that the effects of s and P are additive and would be consistent with a serial and exhaustive scanning process. P effects could be explained, then, in terms of changes in the duration of other processing stages. On the other hand, if the set size effect is not constant for different levels of P (s and P interact), this would indicate that frequency of occurrence influences the memory comparison stage. Such a finding would be incompatible with a serial and exhaustive scanning mechanism as proposed by Sternberg (see Sternberg, 1975, Section 5), and either would lead to the consideration of alternative models to determine their ability to account for P effects on item recognition performance (e.g. Theios et al., 1973; Theios, 1975; Atkinson & Juola, 1973, 1974; Young & Juola, 1977; Franklin, Okada, Burrows & Friendly, 1980), or would require an elaboration of the assumptions underlying the serial and exhaustive scanning mechanism examined here.

No studies, however, have been specifically designed, using the additive-factors logic, to test for P effects at the comparison stage. Such a study would require obtaining mean RTs where two items within each memory set size are assigned different probabilities that are identical over all set sizes.

Raeburn (1974), purported to, but did not in fact, carry out such an investigation. Raeburn assumed it was possible to determine where P had its effects (i.e. encoding or comparison stage) by comparing intercepts and slopes of item recognition functions obtained by partitioning her data into two components: frequently and infrequently tested items. Given her experimental design, this assumption is not a valid one. Although P was held constant across set sizes 4, 6 and 8 for the frequently tested items (i.e. P = .25 or P = .167), P was confounded with s in the usual way for the infrequently tested items. Further, the range over which P was varied with s was very similar to the range of P values that naturally covary with s when every member of each positive and negative stimulus set has an equal probability of being tested. Raeburn did not hold two values of P constant for two different items in each s, as is required to test for additivity. Raeburn, like other investigators (i.e. Theios et al., 1973; Shiffrin & Schneider, 1974; Burrows & Okada, 1974) found that when P was held constant across s (i.e. the frequently tested items), slope values were relatively low. Similarly, her data revealed that when P and s were confounded (infrequently tested items), slope values were relatively high. Raeburn interpreted the significant difference between these two slope values as indicating that frequently tested items are preferentially processed (i.e. that the effects of P are at the comparison stage). Such a conclusion is unwarranted from Raeburn's (1974) data. Her study can shed no light on the question of the locus of the P effect since she held only one value of P constant over set size.

In the present investigation, P effects are tested for at the comparison stage, using the additive-factors approach, while deviating minimally from the standard design.

A number of studies have employed the additive-factors method and have reported findings which show that P does affect stages other than the memory comparison stage (e.g. Klatzky & Smith, 1972; Biederman & Stacy, 1974; Blackman, 1975; Spector & Lyons, 1976; Gravetter, 1976; Miller & Pachella, 1973, 1976; Stanovich & Pachella, 1976, 1977; Pachella & Miller, 1976; Miller, 1979; Miller & Hardzinski, 1981; Dykes & Pascal, 1981). Some experimenters, for example, have obtained evidence consistent with the idea that P affects the response selection stage. Blackman (1975) and Spector and Lyons (1976) have shown that the P effect is smaller when the response is compatible with the stimulus than when the response is incompatible. (This particular interaction was tested by Stanovich and Pachella (1977) and the above finding was not replicated.)

In the main, investigations have been directed at determining whether P affects the encoding process. In these studies, various P levels were manipulated under conditions of degraded and intact stimuli (i.e. stimulus quality: a variable shown to have its effects at the encoding stage; c.f. Sternberg, 1975; Hardzinski & Pachella, 1980). An interaction between P and stimulus quality was observed in experiments where (1) subjects were required to name the probed stimulus (Miller & Pachella, 1973, 1976; Blackman, 1975; Stanovich & Pachella, 1977); (2) digits were used as stimuli in an item recognition task (Miller & Pachella, 1973, 1976); and (3) the response was the same to a given probed letter regardless of whether it was presented in uppercase or lowercase form in a same-different classification task (Pachella & Miller, 1976; Miller & Hardzinski, 1981). These investigators, however, failed to find an interaction between P and stimulus quality in: (1) item recognition tasks where forms or nonsense shapes were used as stimuli (Miller & Pachella, 1976); (2) button pressing tasks where there was a one-to-one response mapping with stimuli (Stanovich & Pachella, 1977); and (3) same-different classification tasks where responses to specific letter probes depended on whether the letter probed was in uppercase or lowercase form (Stanovich & Pachella, 1977).

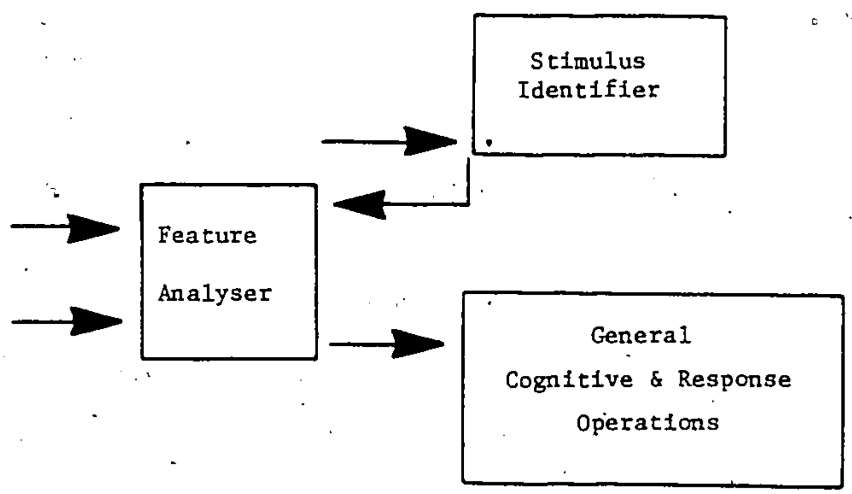
The finding that the encoding stage is not influenced by P in these latter studies is quite consistent with the 'temporal overlap' model described by Stanovich and Pachella (1977) and Miller (1979) and is outlined in Figure 19. In the temporal overlap model, the encoding process includes two sections: a feature analyser and a stimulus identifier. The feature analyser extracts information (or features) from the probed stimulus and is thought to be affected by the variable stimulus quality but not by P. The information extracted at this level can be sent to two different places: the stimulus identifier and/or to post-encoding cognitive response operations. The stimulus identifier is said to have connections with long-term memory where the name of the probed stimulus is identified. This process is affected by both stimulus quality and P. The feedback loop back to the feature analyser helps to "guide feature analysis" and accounts for the interaction of stimulus quality X P when observed. In cases where no stimulus quality X P interactions are found, it is assumed the information extracted at the feature analyser level is sent directly to other cognitive and response operations. These other cognitive processes are assumed to be unaffected by stimulus quality and are able to begin processing before all information at the feature analyser is extracted. Stimulus P may or may not affect these other processes.

It is unclear, from the above mentioned studies, whether to

A General Temporal Overlap Model

Figure 19: The temporal overlap model, as described by Stanovich and Pachella (1977), is shown. In this model, the encoding process includes two sections: a feature analyser and a stimulus identifier. When a probe stimulus is presented, the information extracted can follow one of two routes. The lower branch is one such route. Following the lower branch, the feature analyser extracts features from the stimulus over time. As information is extracted it is also sent to other cognitive, decision and response processes needed to perform the experimental task. A second route which extracted information can take is depicted in the upper branch. For this route, information extracted by the feature analyser is sent onward to the stimulus identifier. Here, there is a feedback loop from this process back to the feature analyser. As information from the stimulus identifier is sent back to the feature analyser, information is then forwarded on to the other cognitive and response processes.

ENCODING STAGE



(c.f. Stanovich & Pachella, 1977)

expect a significant effect of P at the encoding stage when letters are used as stimuli in an item recognition task. In any case, whether P does or does not affect the encoding process, the possibility cannot be ruled out that P affects one or more other processes as well.

Experiment 2 was specifically designed to determine whether P has effects at the memory scanning stage. Here, the confounding of set size and P is removed for two items in each set size: for one item within each memory set size, the probability of it appearing as a probe is .25, and for a second item within each memory set size, P is .15. If P has some or all of its effects at the comparison stage, the slope of the .25 function is expected to be significantly less than the slope of the .15 function. Such a finding would indicate that P interacts with the memory scanning stage and would be inconsistent with the memory scanning mechanism proposed by Sternberg. If P has some or all of its effects at stages other than the comparison stage, the intercept of the .25 function is expected to be significantly less than the intercept of the .15 function. This would lead to the conclusion that the P effect is located at some stage other than the serial comparison stage.

3.2.1 Method

A complete account of the procedure used for Experiment 2 will be provided even though the particulars of the present task design are essentially the same as that reported in the previous chapter. Here, however, an Apple II computer, instead of a 3-Field Tachistoscope, served to initiate the trial events. In contrast to stimuli displayed on a television screen, the stimuli displayed on a 3-Field Tachistoscope were larger and were black on a white background. As expected, overall response latencies were faster using a 3-Field Tachistoscope where stimulus contrast was of a better quality. The programmes which were written to execute the trial events for Experiments 3, 4 and 5 are presented in Appendix 4 for the reader's interest.

3.2.2 Subjects

Twelve paid student volunteers, who were naive to the experimental task, served as subjects and were tested individually for six consecutive daily sessions excluding weekends.

3.2.3 Design

There were three blocks of trials in each session, one for each of the memory set sizes, s=3, s=4, and s=5. Each of the six possible orders of the three set sizes was counterbalanced between and across six subjects over the six-day period. This process was repeated for an additional six subjects. A one minute break occurred between blocks.

In all 6 sessions, before each block, the letters contained in the current memory set were displayed horizontally and simultaneously on the TV screen. The subject was instructed to copy these letters on a blank card so they would be available for reference. On each trial, the subject's task was to determine whether a visually displayed letter was or was not a member of a previously memorized set of letters and to indicate his decision by pressing one of two response buttons. The subject was instructed to respond to positive set letters with his preferred hand and to all other letters with his nonpreferred hand.

Shown in Table 10 are the approximate probability of occurrence values and the presentation frequency values for the individual items within each set size. Note that for one item within each memory set size, the probability was .25, and for a second item within each memory set size the probability was .15.

Subjects were verbally encouraged to decrease their response latencies while maintaining their error level under 2%. Subjects were not given any information about the frequency of occurrence of items.

3.2.4 Apparatus and test stimuli

The test stimuli were the letters A to N and an Apple II computer was programmed to select at random the stimulus for each trial where frequency of occurrence of each stimulus item was preset by the experimenter. The computer also measured and recorded the RTs and timed the response-stimulus intertrial interval. The subject was seated and positioned the index finger of each hand on response buttons placed at table height and slightly to the left and right of a television's viewing screen.

3.2.5 Trial events

The sequence of events for each trial was as follows. A centered dot, which served both as a warning signal and a fixation aid, was displayed on the television screen for 1.6 seconds. It was immediately replaced by a letter, which was displayed until a response

Probability of Occurrence and Presentation Frequency Values of the Individual Items in Experiment 2

Table 10: Shown are the positive and negative presentation frequency values (and the approximate probability of occurrence values) which were assigned to the individual items within each set size in Experiment 2.

Probability of Occurrence and Presentation Frequency Values of Individual Items

Memory Set Size	Positive Items	Negative Items
3	40 (.25) 24 (.15) 16 (.10)	the remaining 11 items each occur 7 or 8 times (P=.045)
4	40 (.25) 24 (.15) 8 (.05) 8 (.05)	the remaining 10 items each occur 8 times (P=.05)
5	40 (.25) 24 (.15) 8 (.05) 5 (.03) 3 (.02)	the remaining 9 items each occur 8 or 9 times (P=.056)

was made. For all experiments generated by the Apple II computer, it was an arbitrary decision to have an infinite stimulus exposure duration. The time from the onset of the test item to the subject's response was recorded. Auditory feedback was used to inform the subject about the correctness of his response. Two and a half seconds elapsed between the subject's response and the onset of the dot for the next trial.

3.2.6 Assignment of letters to the positive and negative sets

Separately for each session and for each subject, non-intersecting sets of letters were assigned to the three positive set size conditions. Each day, from the 14 stimuli, a new assignment of letters to positive sets was made randomly without replacement and with the further restriction that over the course of the experiment, each letter was assigned to each of the presentation frequency values within each set size an equal number of times. When the memory set was displayed before each block, the order of the individual items was varied systematically to eliminate the possibility of the subject correctly inferring P values (or order of P values) associated with any items.

3.2.7 Test stimulus sequence

To familiarize the subject with the task and to allow for any questions prior to the experiment, the subject was given 24 practice trials using a positive set of three digits. Unlike Experiment 1, there were no practice trials except on day 1. This was done in order that the data could be examined in the context of other models which are discussed later in the thesis (i.e. the familiarity model). In each session, there were 160 trials for each of the three set sizes. For every session and every set size condition, items requiring a positive response were presented on 50% of the trials. The order of positive and negative trials was random.

RESULTS

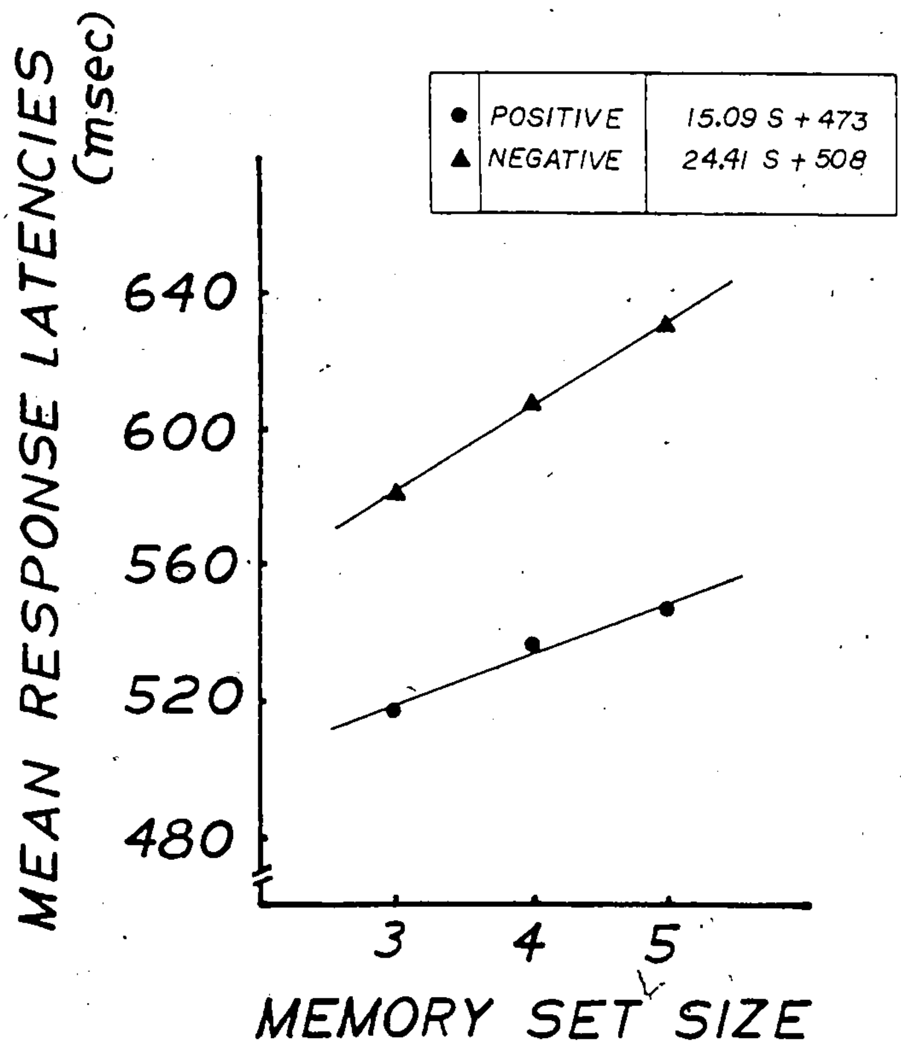
3.3.1 Memory set size effect confounded by probability

All correct responses, excepting practice trials on day 1, were used for calculating positive and negative mean RTs each day for each subject. In Figure 20, mean RTs averaged over all 12 subjects and over all six days are shown plotted against positive set size for negative and positive responses separately. In Table 11, the individual subjects' data averaged over all six days are summarized for each positive set size and for positive and negative responses separately. The slope and intercept values for each of the linear item recognition functions are also provided.

Also in Figure 20, least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are presented. As can be seen, the relationships between RT and set size were well described by linear functions. Linear regression accounted for 95.37% of the variance for positive trials and 99.9% of the variance for negative trials.

An analysis of variance was performed on the mean response latency values obtained from positive and from negative trials for set sizes 3, 4 and 5. Both main effects were significant: response latencies to negative trials were significantly greater than to positive

Figure 20: Mean response latencies are plotted against positive set size for all six days, for negative and positive responses separately over all 12 subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.



Positive and Negative Mean RTs

Table 11: Individual subjects' mean response latencies for positive and negative responses are shown summarized over the 6 days of Experiment 2 for each set size separately. Also shown are the corresponding slopes and coefficients of determination for each set of data.

POSITIVE mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	402.47	418.38	442.45	19.99	341.14	.9863
2	457.56	473.46	483.11	12.77	420.28	.9804
3	539.80	575.47	575.29	17.74	492.54	.7462
4	587.02	604.63	638.44	25.71	507.19	.9680
5	556.94	584.00	610.62	26.84	476.49	1.0000
6	489.48	488.91	507.62	9.07	459.06	.7265
7	437.37	455.25	476.95	19.79	377.36	.9969
8	698.35	723.12	725.83	13.74	660.81	.8232
9	440.25	471.20	469.32	14.54	402.12	.7017
10	607.90	604.99	616.98	4.55	591.80	.5270
11	488.67	527.55	498.26	4.80	485.65	.0560
12	488.61	517.66	511.72	11.56	459.78	.5669
x	516.20	537.05	546.38	15.09	472.85	.9537

NEGATIVE mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	491.95	505.32	536.35	22.20	422.41	.9499
2	525.46	542.42	558.27	16.41	476.43	.9996
3	606.29	645.31	671.36	32.54	510.85	.9869
4	668.46	696.43	774.55	53.05	500.97	.9307
5	604.43	624.15	665.97	30.77	508.44	.9588
6	579.36	604.14	633.73	27.19	497.00	.9974
7	495.08	509.91	525.24	15.08	443.96	.9999
8	718.15	725.98	778.36	30.11	620.41	.8457
9	516.80	547.22	563.47	23.34	449.16	.9702
10	665.23	680.82	687.45	11.11	633.39	.9486
11	543.45	603.68	574.22	15.39	512.24	.2610
12	562.22	591.91	593.56	15.68	519.88	.7894
x	581.41	606.44	630.21	24.41	507.93	.9998

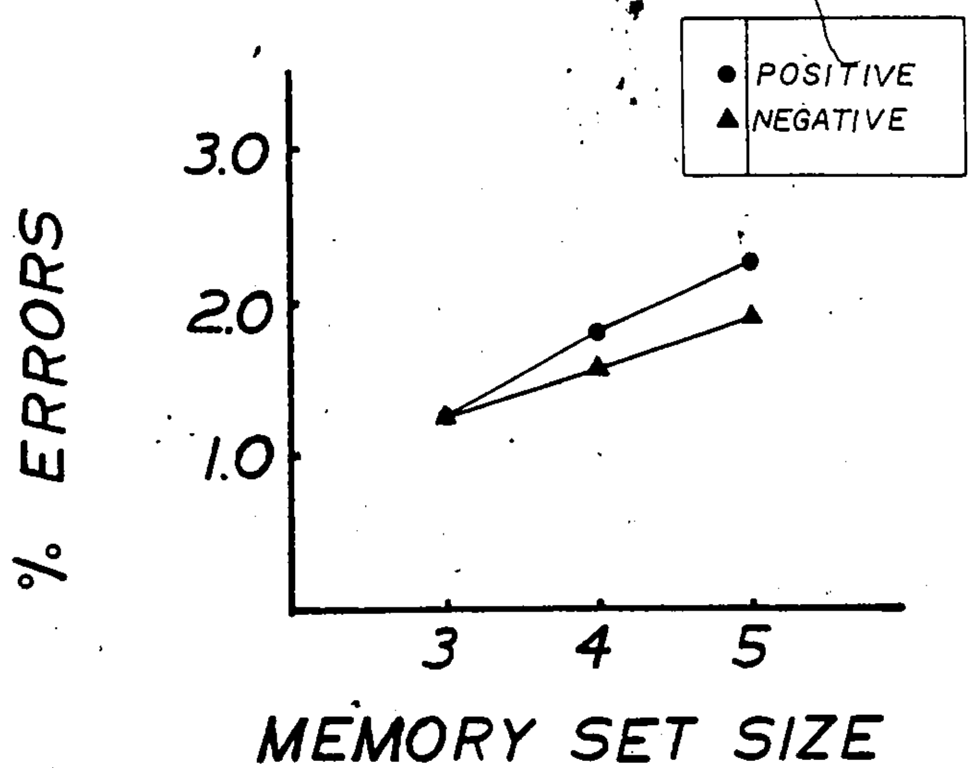
trials [F(1,11)=114.98, p=.0001] ; and as set size increased, response latencies increased significantly [F(2,22)=32.295, p=.0001] . The interaction was also significant [F(2,22)=8.862, p=.0018] , indicating that the increase in mean response latencies with set size for the negative trials was greater than for positive trials.

An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variable was positive-negative trials. The negative slope of 24 msec./ item was found to be significantly greater than the positive slope of 15 msec./item [F(1,11)=13.85, p=.004] .

Group error rates were maintained at a low level: 1.2%, 1.7% and 2.1% for the memory set sizes 3, 4 and 5 respectively. In Figure 21, mean percent errors averaged over the 6 days of the experiment are shown plotted against positive set size for positive and negative trials separately over all 12 subjects. The individual subjects' error data for each positive set size as calculated over the six days of the experiment are provided in Table 12 for the positive and negative response trials separately. An analysis of variance was performed on percent errors where the within variables were positive-negative and set size. Percent errors increased significantly as set size increased [F(2,22)=8.713, p=.0019] .

Standard deviation scores were obtained from positive and from negative trials for each memory set size and were calculated day by day for each subject and averaged over the successive 6-day period. (Due to limitations of the analysis of variance programme, the variances of the response latencies could not be analysed. Instead, the variability

Figure 21: Mean percent errors are plotted against positive set size over the six days of Experiment 2 for positive and negative trials separately for all 12 subjects.



Positive and Negative Percent Errors

Table 12: Individual subjects' percent errors for positive and negative responses are shown summarized over the six days of Experiment 2 for each set size separately.

POSITIVE % ERRORS

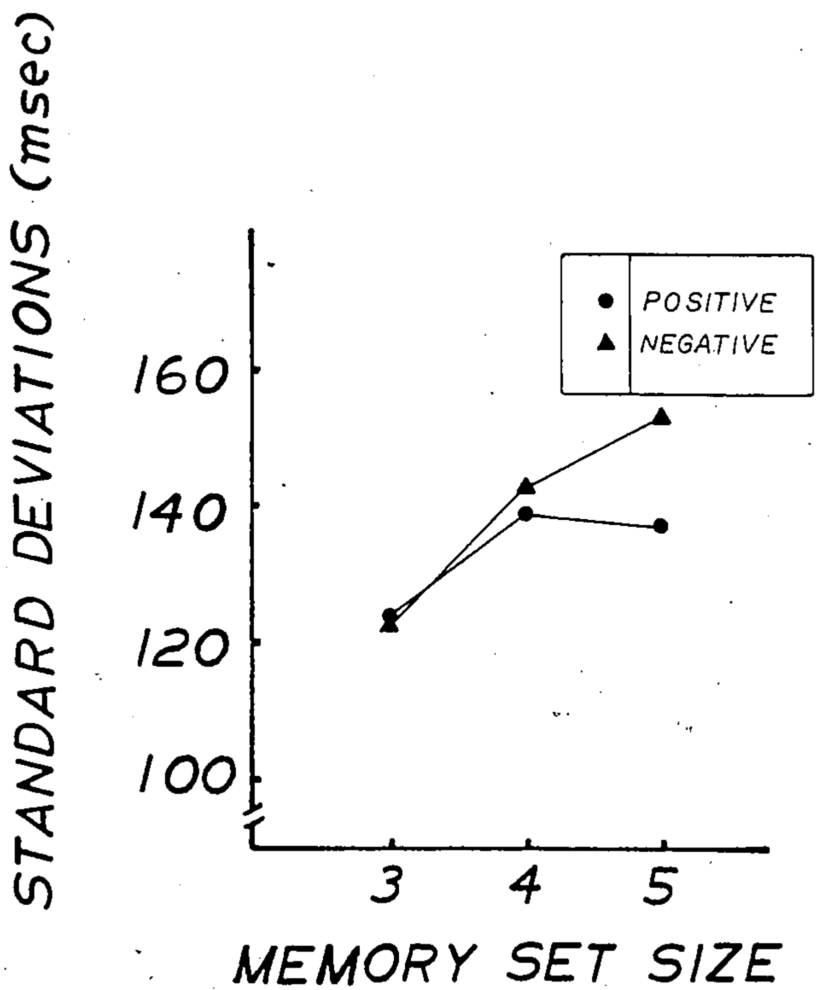
S#	s=3	s=4	s=5
1	1.04	2.29	3.13
2	1.46	2.50	4.38
3	.42	.63	1.88
4	1.25	2.08	2.29
5	.63	.42	.63
6	.42	1.67	2.29
7	1.88	1.67	2.08
8	1.46	1.04	2.08
9	.21	.42	.63
10	.21	.42	.42
11	4.17	7.29	5.21
12	1.88	1.25	2.08
x	1.[illegible]5	1.81	2.26

NEGATIVE % ERRORS

S#	s=3	s=4	s=5
1	1.04	2.29	3.13
2	1.88	2.08	4.38
3	.63	1.25	1.04
4	1.04	1.88	1.88
5	.42	.42	.83
6	1.46	1.46	1.46
7	1.67	1.46	1.67
8	1.04	.42	1.88
9	.83	1.67	.83
10	.21	.63	.00
11	3.96	3.54	4.79
12	.63	1.46	1.25
x	1.23	1.55	1.93

of the subjects' response latencies was analysed using the standard deviation scores (i.e. the square root of the obtained variance scores).) These data are shown in Table 13. In Figure 22, the response deviation scores, as averaged over the six days, are shown plotted against positive set size for positive and negative response trials separately and over all 12 subjects. An analysis of variance was performed where the within variables were positive-negative standard deviation scores and set size. Both positive and negative response standard deviations were found to increase significantly with set size increases [$F(2,22)=12.114$, $p=.0005$] .

Figure 22: Mean response standard deviations are plotted against positive set size for positive and negative responses separately for all 12 subjects over the six days of Experiment 2.



Positive and Negative Standard Deviations

Table 13: Individual subjects' positive and negative standard deviations are shown summarized over the six days of Experiment 2 for each set size separately.

POSITIVE STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	73.92	102.98	111.81
2	85.47	98.16	115.41
3	146.34	172.97	158.47
4	184.97	240.18	214.16
5	123.64	127.58	152.41
6	105.35	95.99	119.54
7	79.98	87.73	84.71
8	228.17	194.66	183.63
9	86.55	118.13	121.60
10	143.85	137.35	144.69
11	141.62	174.61	142.99
12	93.38	123.25	99.41
x	124.44	139.47	137.40

NEGATIVE STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	87.90	95.45	111.69
2	97.02	98.30	119.46
3	123.49	139.66	188.19
4	186.93	233.85	235.76
5	118.84	153.51	147.08
6	92.40	115.93	142.31
7	77.55	77.76	81.44
8	181.81	188.89	217.79
9	101.99	112.23	126.93
10	140.03	161.51	161.28
11	156.23	204.28	168.35
12	110.39	131.64	130.83
x	122.88	142.75	152.59

3.3.2 Memory set size effect unconfounded by probability (P = .25 and P = .15)

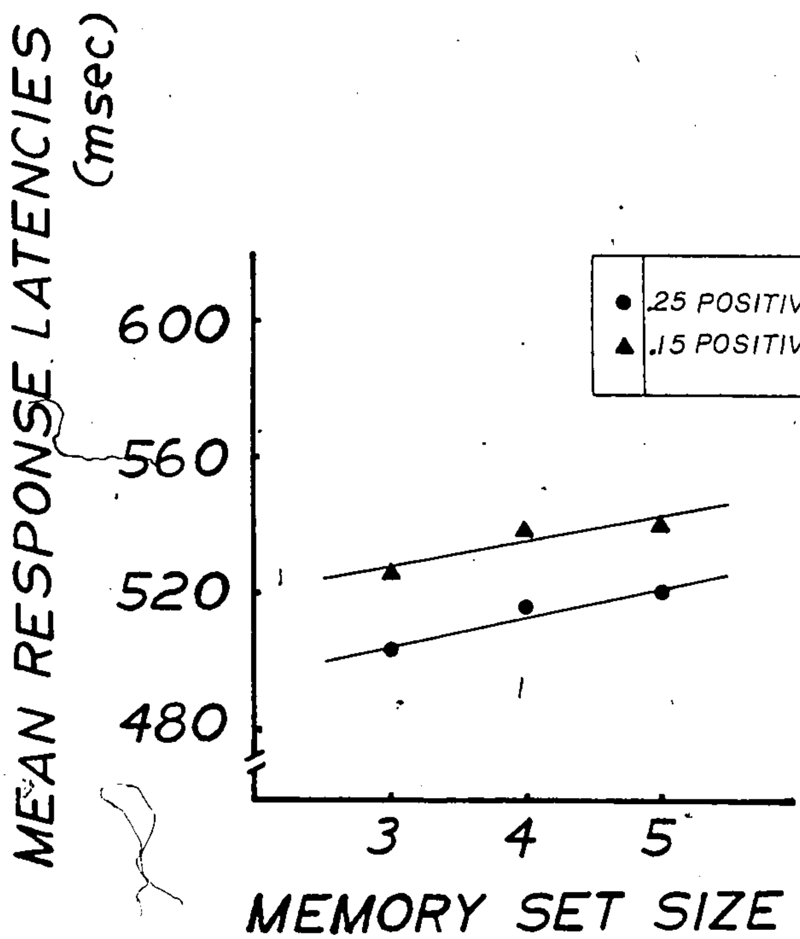
The following analyses relate directly to the effect of memory set size with the confounding of probability removed. Only trials for the P = .25 and P = .15 positive items were considered. In Figure 23, the mean of the correct RTs for the .25 and .15 items are plotted separately against positive set size for the six-day period. These data are summarized in Table 14 for each individual subject. Also included in Table 14 are the corresponding slope and intercept values of the linear item recognition functions.

An analysis of variance was performed on the mean response latency values obtained from .25 and .15 trials and for set sizes 3, 4 and 5. Both main effects were significant: RTs to .15 probes were significantly greater than .25 probes [$F(1,11)=37.08$, $p=.0002$], and as set size increased RTs increased significantly [$F(2,22)=7.16$, $p=.004$]. No interaction was found.

An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variable was the frequency of occurrence. The slopes of the .25 and .15 item recognition functions, 9 msec./item and 7 msec./item respectively, were not found to differ significantly [$F(1,11)=.31$, $p=.59$].

In order to determine whether the intercept values obtained from the .25 and .15 item recognition functions differed significantly, an analysis of variance was performed. No significant difference was found between the .25 intercept of 477 msec. and the .15 intercept of

Figure 23: Mean response latencies are plotted against positive set size for all 6 days of Experiment 2 for .25 and .15 positive responses for all 12 subjects. Least squares best fitting straight lines are drawn through each set of data,



Positive .25 and .15 Mean RTs

Table 14: Individual subjects' mean response latencies for positive .25 and .15 trials are shown summarized over the six days of Experiment 2 for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

.25 RESPONSES

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	402.12	397.29	426.00	11.94	360.71	.6033
2	441.55	457.83	452.92	5.68	428.03	.4634
3	514.57	536.50	545.69	15.56	470.01	.9471
4	554.22	564.31	602.02	23.90	477.92	.8999
5	546.95	565.66	575.88	14.46	504.97	.9721
6	477.91	475.18	481.37	1.73	471.23	.3110
7	439.19	445.34	458.90	9.86	408.39	.9550
8	691.01	712.01	692.83	.91	694.98	.0061
9	428.65	453.79	446.66	9.00	407.01	.4831
10	594.24	594.88	604.47	5.11	577.40	.7967
11	467.54	492.51	474.80	3.63	463.76	.0799
12	474.37	490.77	489.26	7.45	455.02	.6746
x	502.69	515.51	520.90	9.10	476.62	.9474

.15 RESPONSES

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	394.40	414.60	448.38	26.99	311.17	.9793
2	474.00	479.69	483.49	4.75	460.08	.9869
3	572.52	584.16	564.62	-3.95	589.57	.1615
4	620.87	614.61	620.41	-0.23	619.55	.0043
5	563.64	582.42	607.45	21.90	496.88	.9933
6	505.12	480.18	496.05	-4.54	511.92	.1291
7	429.95	449.65	475.90	22.98	359.93	.9933
8	696.01	725.20	715.08	9.54	673.96	.4138
9	450.35	474.67	457.68	3.67	446.24	.0863
10	619.47	594.47	617.85	-0.81	613.84	.0034
11	494.95	516.18	483.98	-5.49	520.31	.1123
12	492.48	535.76	514.25	10.89	470.62	.2530
x	526.15	537.63	540.43	7.14	506.17	.8903

506 msec. [$F(1,11)=3.02$, $p=.11$].

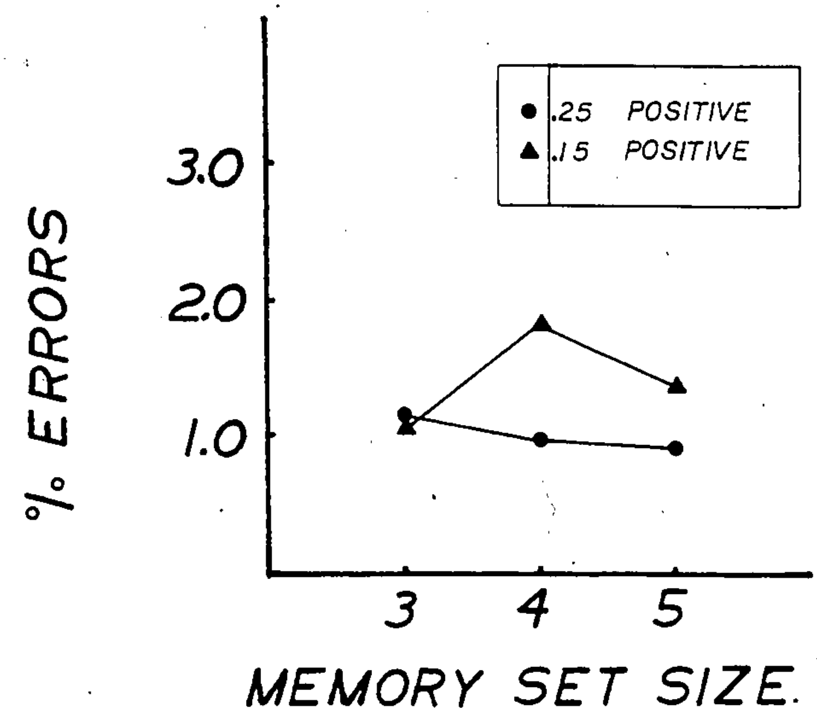
An analysis of variance was performed on percent errors for positive items where P = .25 and P = .15 and the within variables were frequency of occurrence and set size. No significant main effects were found nor was the interaction significant. Percent errors as calculated over the six days are summarized for each positive set size and for P = .25 and P = .15 trials separately for each subject in Table 15. Percent errors, averaged over the six days of the experiment, are shown plotted against positive set size for P = .25 and P = .15 trials separately and over all 12 subjects in Figure 24.

Standard deviations were obtained from trials where P was held constant at .25 and at .15 across set size and were calculated day by day for each subject and averaged over all six days. An analysis of variance was performed where the within variables were .25-.15 trials and memory set size. The .15 standard deviations were found to be significantly higher than the .25 standard deviation scores [$F(1,11)= 14.35$, $p=.0033$]. Standard deviations were not found to increase significantly with positive set size, nor was the interaction significant. In Figure 25, the standard deviation scores, as calculated over the six days, are shown plotted against positive set size for the .25 response trials and .15 response trials separately over all 12 subjects. The data for each individual subject are given in Table 16.

3.3.3 P effects for positive probes

In Figure 26, mean RTs for each set size, averaged over all six days, are plotted as a function of the P values of the individual

Figure 24: Percent errors are plotted against positive set size as averaged over the 6 days of Experiment 2 and over all 12 subjects for .25 and .15 positive responses, separately.



Positive .25 and .15 Percent Errors

Table 15: Individual subjects' percent errors for positive .25 and .15 responses are shown summarized over the six days of Experiment 2 for each set size separately.

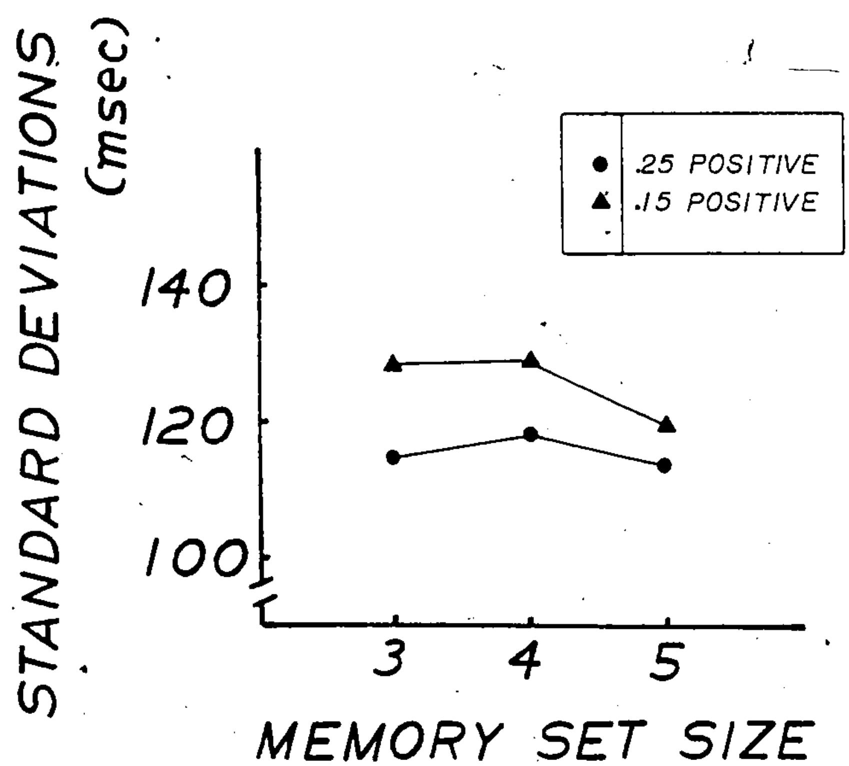
.25 % ERRORS

S#	s=3	s=4	s=5
1	.83	.42	.83
2	1.25	.83	1.25
3	.83	.00	.42
4	.83	1.67	1.25
5	.83	.00	.42
6	.00	.83	.83
7	1.67	1.25	1.25
8	1.25	.42	1.25
9	.00	.00	.00
10	.00	.00	.00
11	4.17	5.83	2.92
12	2.08	.42	.42
x	1.15	.97	.90

.15 % ERRORS

S#	s=3	s=4	s=5
1	2.09	4.17	2.08
2	1.39	3.47	2.78
3	.00	2.09	.70
4	3.47	1.39	.00
5	.00	.70	.00
6	.70	1.39	1.39
7	.70	1.39	.00
8	.70	2.08	1.39
9	.00	.00	.00
10	.70	.00	.70
11	2.08	3.47	6.25
12	.70	1.39	.70
x	1.04	1.80	1.33

Figure 25: Response standard deviations for positive .25 and .15 trials are plotted against set size as averaged over the six days of Experiment 2 and over all 12 subjects.



Positive .25 and .15 Standard Deviations

Table 16: Individual subjects' standard deviations for positive .25 and .15 trials are shown summarized over the six days of Experiment 2 for each set size separately.

.25 STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	70.43	74.77	93.31
2	74.31	88.90	86.95
3	118.05	124.58	140.82
4	155.81	218.95	204.04
5	127.22	119.03	110.13
6	89.91	84.40	85.66
7	82.56	75.57	71.40
8	216.77	188.12	157.24
9	69.94	98.90	85.13
10	153.55	137.89	131.83
11	125.03	116.77	116.33
12	87.55	92.25	81.75
x	114.26	118.34	113.72

.15 STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	67.16	88.18	108.79
2	94.52	93.59	108.33
3	170.52	160.94	127.18
4	202.63	202.54	169.78
5	106.32	124.64	131.24
6	124.57	78.80	103.46
7	78.88	82.79	85.74
8	232.04	175.06	155.97
9	96.40	111.02	102.83
10	134.04	135.07	150.92
11	136.81	140.39	107.42
12	89.61	150.18	80.86
x	127.79	128.60	119.38

positive items. The data for each subject are provided in Table 17. For each set size, a separate analysis of variance was performed on the mean RTs where the within variable was P. Significantly faster mean RTs were produced by more probable items: for s=3, [$F(2,22)=18.45$, $p=.0001$]; for s=4, [$F(2,22)=47.56$, $p=.0001$]; and for s=5, [$F(4,44)=53.55$, $p=.0001$]. Clearly, the form of the function for set size 5 was not linear. That is, small differences in the P of individual items had more marked effects on RT when P was low.

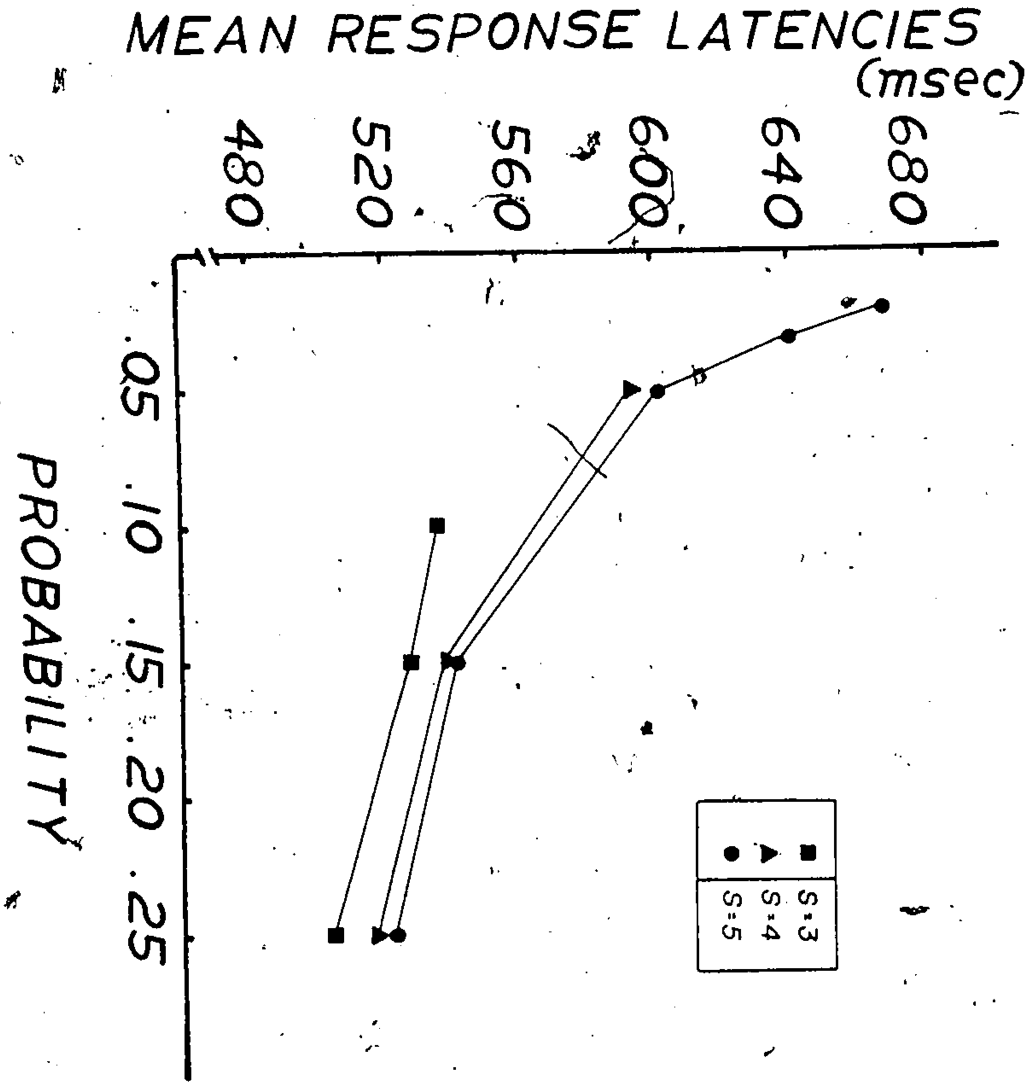
DISCUSSION

In Experiment 2, the confounding of set size and P was removed for two items in each set size: P was held constant at .25 for one item in each memory set size and at .15 for another item in each memory set size.[4] The findings of Experiment 2 (and those reported in Appendix 5)[4] replicate quite closely the results reported in Experiment 1 where P was held constant at .15 for an item in each memory set size. In Experiment 2, the rate of RT increase with set size for the .15 positive item was 7 msec./item; while in the previous study (Experiment 1), the slope obtained from the .15 positive item recognition function was 8 msec./item. Thus both studies show that there remains a small but significant effect of memory set size when the confounding of s by P was removed.

---

4 An identical experiment was carried out whereby data were collected for twelve additional subjects on the 3-Field Tachistoscope. The data obtained from the individual subjects and the corresponding data analysis are presented in Appendix 5. The findings from both studies were equivalent: for positive items where P was held constant at .25 and .15, the slopes were small (i.e. 2 and 6.5 msec./item respectively), and for these items neither slopes nor intercepts (i.e. 450 msec. for P=.25 and 455 msec. for P=.15) were found to differ significantly. These findings demonstrate the reliability of the Apple II computer and verify the reliability of the results reported.

Figure 26: Mean response latencies of the individual positive items is plotted against probability for each set size separately as averaged over the six days of Experiment 2.


MEAN RESPONSE LATENCIES
(msec)
480
520
560
600
640
680
.05
.10
.15
.20
.25
PROBABILITY
S=3
S=4
S=5

Mean RTs of Each Individual Positive Item

Table 17: Mean RTs of each individual positive item are shown summarized for each set size and for each subject separately over the six days of Experiment 2.

s=3

S#	.25	.15	.10
1	402.12	394.40	416.39
2	441.55	474.00	474.94
3	514.57	572.52	553.47
4	554.22	620.87	622.41
5	546.05	563.64	571.74
6	477.91	505.12	494.99
7	439.19	429.95	444.77
8	691.01	696.01	718.20
9	428.65	450.35	454.37
10	594.24	619.47	624.52
11	467.54	494.95	531.94
12	474.37	492.48	517.35
x	502.69	526.15	535.42

s=4

S#	.25	.15	.05/.05*	.05	.05
1	397.29	414.60	481.95	485.58	478.47
2	457.83	479.69	505.36	501.48	509.34
3	536.50	584.16	660.08	637.31	682.86
4	564.31	614.61	700.58	718.79	682.37
5	565.66	582.42	633.33	664.88	602.44
6	475.18	480.18	538.86	569.05	509.95
7	445.34	449.65	489.19	490.78	487.69
8	712.01	725.20	748.41	742.94	753.77
9	453.79	474.67	510.34	534.47	486.21
10	594.88	594.47	654.59	655.45	653.73
11	492.51	516.18	633.68	629.03	639.08
12	490.77	535.76	560.86	562.68	559.00
x	515.51	537.63	593.10	599.37	587.08

* weighted mean of the two .05 items

s=5

S#	.25	.15	.05	.03	.02
1	426.00	448.38	455.83	490.82	561.00
2	452.92	483.49	566.34	558.42	613.73
3	545.69	564.62	645.54	681.04	753.35
4	602.02	620.41	712.66	828.64	836.24
5	575.88	607.45	673.34	746.48	707.78
6	481.37	496.05	547.81	657.80	624.24
7	458.90	475.90	518.82	534.96	532.88
8	692.83	715.08	836.39	838.57	833.13
9	446.66	457.68	498.09	594.76	593.17
10	604.47	617.85	628.82	637.79	714.34
11	474.80	483.98	574.37	573.00	620.19
12	489.26	514.25	558.80	555.26	624.93
x	520.90	540.43	601.40	641.46	667.92

The rate of RT increase with set size of the .25 and .15 positive items (9 msec./item and 7 msec./item, respectively) did not differ significantly. The group means accurately reflect individual performance in that 5 subjects had higher slopes for the .15 positive item whereas 7 subjects had higher slopes for the .25 positive item. In answering the main question, whether P has effects at the memory scanning stage, this finding leads to the conclusion that it does not and that P must have its effects elsewhere.

Having found that P had no significant effect on the slope, I expected to find significant effects of P on the intercept (i.e. some stage or stages other than the serial comparison stage). Although the trend, for 8 subjects was a higher intercept value for the .15 items, an analysis of variance revealed that the mean intercept values of 506 msec. for the .15 items and 477 msec. for the .25 items did not differ significantly.

It is difficult, given the absence of a significant slope difference and the absence of a significant intercept difference, to conclude at what stage of processing P has its effects in item recognition. While it would seem easier to accept the conclusion that the .25/.15 intercepts do differ (that a significant difference was concealed because of the high variability in the data), the findings reported in Appendix 5 (see p. 340, 341) do not lend support to this conclusion. In terms of the data reported in Appendix 5, it would seem, instead, easier to accept the conclusion that the .25/.15 slopes differ.

Appendix 5 provides findings from an identical experiment, whereby data were collected for 12 additional subjects on the 3-Field

Tachistoscope. As in Experiment 2, P was held constant at .25 and .15. Essentially the findings from both studies were equivalent. As in Experiment 2, it was found (1) that the mean response latencies of the positive .15 items were significantly longer than the mean response latencies of the positive .25 items [$F(1,11)=20.69$, $p=.001$], (2) that the set size effect for both the .25 and .15 positive items was small but significant [$F(2,22)=4.02$, $p=.03$], (3) that the rate of RT increase with set size of the .25 and .15 positive items (2 and 6.5 msec./item, respectively) did not differ significantly [$F(1,11)=2.26$, $p=.16$] and (4) that P did not have a significant effect on the intercepts [$F(1,11)=.3$, $p=.6$] (i.e. 450 msec. for P = .25 and 455 msec. for P = .15).

However, in contrast to Experiment 2, there was <u>no</u> evidence of a trend for individual subjects to have a higher intercept value for the .15 items in that six subjects had higher intercepts for the .15 positive item whereas six subjects had higher intercepts for the .25 positive item. Instead, the trend, for eight subjects, was a higher slope value for the .25 item.

Given these findings, it is difficult to conclude at what stage of processing P has its effects in Sternberg's serial stage model of item recognition. However, the data are not inconsistent with the idea that the stages of the item recognition process are temporally overlapping and in such a way that the effects of P are being masked. Stanovich and Pachella (1977) developed such a model.

Stanovich and Pachella (1977), using the additive-factor method, obtained data supportive of their 'temporal overlap model'. Their model can also be illustrated in such a way to produce patterns of data largely consistent with those presented here. In the temporal overlap model, (see Figure 19), the encoding process includes two sections: a feature analyser and a stimulus identifier. When a probe stimulus is presented, the information extracted can follow one of two routes. The lower-branch, shown in Figure 19, is one such route; following the lower-branch, the feature analyser extracts features from the stimulus over time. This process is not affected by stimulus probability. As information is extracted it is also sent to other cognitive, decision and response processes needed to perform the experimental task. Stimulus probability may or may not, according to Stanovich and Pachella (1977), affect these other processes. Most important, though, once information is sent to the other cognitive processes there is no feedback loop exerting an influence on feature analysis. The model predicts, unless stimulus probability has influences on the other cognitive processes, no effect of stimulus probability should be observed. This route of processing, then, still leaves the question, as to where P has its effects, unanswered.

A second route which extracted information can take is depicted in the upper-branch of Figure 19. For this route, information extracted by the feature analyser is sent onward to the stimulus identifier, the second encoding process. This process presumably has connection with long term memory and leads to the identification of the probed stimulus. This particular process is thought to be affected by stimulus probability. Here, there is a feedback loop from this process back to the feature analyser and, thus, it is able to account for any observed interaction P may have at the encoding stage. As information from the stimulus identifier is sent back to the feature analyser, the information is then forwarded on to the other cognitive and response processes. Thus, it is predicted by the model, if data take the upper-branch route and stimulus probability has its effects only at the second encoding process (and not at any other cognitive/response process), an 'over additive' interaction should result. Such an effect, of course, was not observed in Experiment 2. The intercept value obtained from the .15 function was not significantly higher than the intercept obtained from the .25 function.

However, Stanovich and Pachella further note that if the stimulus identification process is completely overlapped by slow cognitive and response processes, the data will show an additive relation. Thus, no interaction of any sort would be observed. It is unclear, however, whether the slowness of these latter cognitive and response processes is a result of stimulus probability's influence on them, and if so, which process? It must be stressed, no claim is made by the temporal overlap model as to how the latter cognitive, decision and response processes operate for the item recognition task; the model, for the most part, has been devised only to explain P effects (when observed) at the encoding stage. Only if it can be shown there are strong implications that P is influencing the encoding process (i.e. as revealed by an interaction at the intercept or an 'under-additive' interaction, suggesting the stages are not discrete processes) will this model be worth pursuing.

In the following chapter, further explanations as to why P had no significant effect on the slope or on the intercept when using the additive-factor method are discussed. One of the explanations considered led to the design of the next experiment in which two very different values of P (i.e. P = .25 and P = .05) are held constant across set size.

EXPERIMENT 3

4.1.1 Introduction

There is evidence that suggests that different results might be obtained if the construction of Experiment 2 were altered with respect to the P values held constant over s. In particular, the line of evidence comes from a consideration of RT plotted as a function of P. Studies designed to determine this function have found that the effect of P on RT is quite small unless very low-probability stimuli are used (c.f. Miller & Pachella, 1973; Theios et al., 1973; Hawkins, McKay, Holley & Friedin, 1973; Miller & Hardzinski, 1981). More precisely, the function typically shows that small differences in the frequency of occurrence of items have quite large effects on RT when P is low, while smaller effects on RT are found when P is high. Such an exponential relationship between RT and P was also obtained in Experiment 1 and Experiment 2. This evidence suggests that had I held constant across set size a small value of P coupled with a large value of P, this would have been a more sensitive test as to where P has its effects. Further, since in Sternberg's paradigm positive set items varied in P from approximately .25 to .05, it would be of interest to determine whether s and P interact for this range of P values when s and P are unconfounded.

Experiment 3 was designed to do this. The confounding of s by P was removed by holding two very different probabilities (P = .25 and P = .05) constant for items in each positive set size.

4.2.1 Method

Twelve paid student volunteers, who were naive to the experimental task, served as subjects. The task, apparatus, test stimulus sequence and design were identical to Experiment 2, except for the assignment of presentation frequency values for the individual items within each set size. Here, the probabilities, .25 and .05 were assigned to at least two items within each memory set size. The presentation frequency values for the individual items within each set size are shown in Table 18.

RESULTS

4.3.1 Memory set size effect confounded by probability

All correct responses, excepting the practice trials on day 1, were used for calculating positive and negative mean RTs each day for each subject. In Figure 27, mean RTs averaged over all 12 subjects and over all 6 days are shown plotted against positive set size for positive and negative responses separately. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented. The relationships between response latency and set size were well described by linear functions. Linear regression accounted for 99.86% and 99.91% of the variance for negative and positive functions, respectively. These data are presented for each subject separately in Table 19.

An analysis of variance was performed on the mean response latency values obtained from positive and from negative trials for set sizes 3, 4 and 5. Both main effects were significant: response

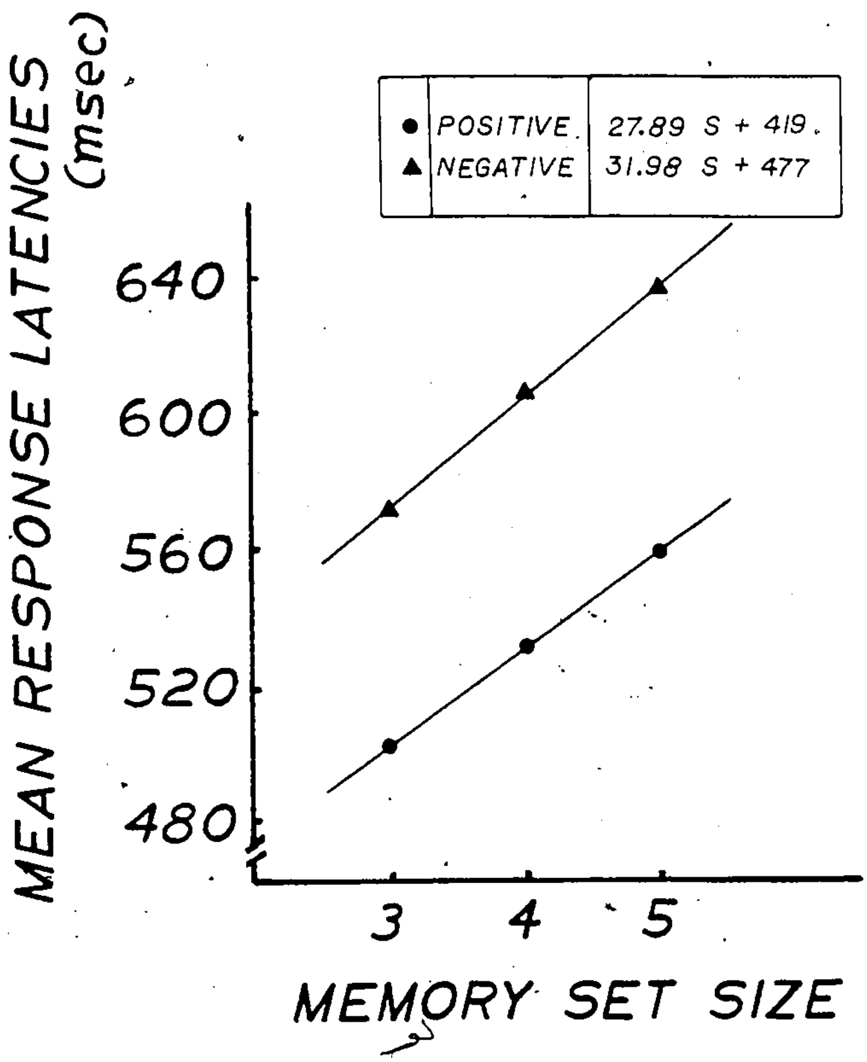
Probability of Occurrence and Presentation
Frequency Values of the Individual Items in Experiment 3

Table 18: Shown are the positive and negative presentation frequency values (and the approximate probability of occurrence values) which were assigned to the individual items within each set size in Experiment 3.

Probability of Occurrence and Presentation
Frequency Values of Individual Items

Memory Set Size	Positive Items	Negative Items
3	40 (.25) 32 (.20) 8 (.05)	the remaining 11 items each occur 7 or 8 times (P=.045)
4	40 (.25) 24 (.15) 8 (.05) 8 (.05).	the remaining 10 items each occur 8 times (P=.05)
5	40 (.25) 16 (.10) 8 (.05) 8 (.05) 8 (.05)	the remaining 9 items each occur 8 or 9 times (P=.056)

Figure 27: Mean response latencies are plotted against positive set size for all six days, for negative and positive responses separately over all 12 subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.



Positive and Negative Mean RTs

Table 19: Individual subjects' mean response latencies for positive and negative responses are shown summarized over the six days of Experiment 3 for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

POSITIVE mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	544.44	553.93	572.77	14.17	500.39	.9650
2	413.86	434.21	453.41	19.78	354.45	1.0000
3	686.77	767.64	738.63	25.93	627.29	.4006
4	512.84	538.94	558.95	23.06	444.69	.9942
5	425.30	447.05	483.41	29.05	335.70	.9794
6	519.30	533.60	578.56	29.63	425.30	.9181
7	426.24	445.90	456.89	15.33	381.71	.9740
8	441.32	451.80	485.46	22.07	371.25	.9158
9	478.91	536.93	544.45	32.77	389.02	.8348
10	503.82	515.82	608.77	52.47	332.91	.8345
11	451.92	460.31	492.69	20.39	386.77	.8965
12	618.57	689.75	718.49	49.96	475.76	.9433
X	501.94	531.32	557.71	27.89	418.76	.9991

NEGATIVE mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	560.24	568.37	593.01	16.39	508.33	.9220
2	467.27	485.68	522.20	27.47	381.86	.9650
3	732.37	846.85	832.78	50.21	603.18	.6467
4	598.83	593.34	625.36	13.27	552.78	.6001
5	484.90	500.31	544.19	29.65	391.23	.9286
6	594.01	614.89	638.87	22.43	526.20	.9984
7	484.11	503.33	530.24	23.07	413.64	.9908
8	526.12	536.51	586.54	30.21	428.88	.8745
9	580.24	658.12	671.74	45.75	453.70	.8588
10	617.97	635.84	705.21	43.62	478.53	.8959
11	517.90	526.66	559.64	20.87	451.25	.8991
12	700.87	803.59	822.43	60.78	532.51	.8630
x	572.07	606.12	636.02	31.98	476.84	.9986

latencies to negative trials were significantly greater than to positive trials [F(1,11)=90.816, p=.0001] ; and as set size increased response latencies increased significantly [F(2,22)=28.654, p=.0001] . The interaction was not significant.

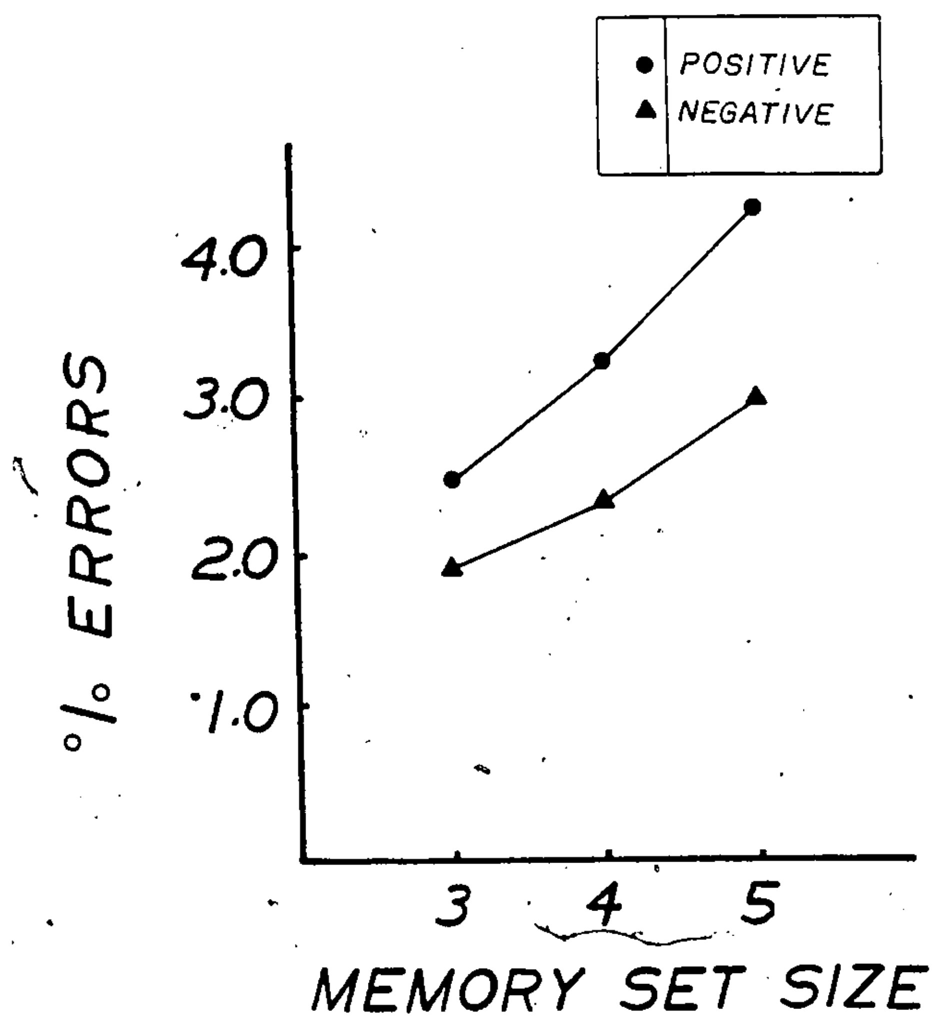
An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variable was positive-negative trials. The positive slope of 28 msec./item and the negative slope of 32 msec./item did not differ significantly [F(1,11)=2.027, p=.1800] .

Group error rates were maintained at a low level and were 2.2%, 2.8% and 3.6% for the memory set sizes 3, 4 and 5 respectively. In Figure 28, mean percent errors are shown plotted against positive set size over the six days for positive and negative trials separately over all 12 subjects. Positive and negative percent errors are presented in Table 20 for each subject separately as calculated over the six sessions.

An analysis of variance was performed on percent errors where the within variables were positive-negative, and set size. Both main effects were significant: positive percent errors were significantly greater than negative percent errors [F(1,11)=5.056, p=.0441] ; and percent positive errors and negative errors increased significantly as set size increased [F(2,22)=16.692, p=.0001].

The standard deviation scores were obtained from positive and from negative trials for each memory set size and were calculated day by day for each subject separately and averaged over the 6-day period. These data are shown in Table 21. In Figure 29, the standard deviation

Figure 28: Me-n percent errors are plotted against positive set size over the six days of Experiment 3 for positive and negative trials separately for all 12 subjects.



Positive and Negative Percent Errors

Table 20: Individual subjects' percent errors for positive and negative responses are shown summarized over the six days of Experiment 3 for each set size separately.

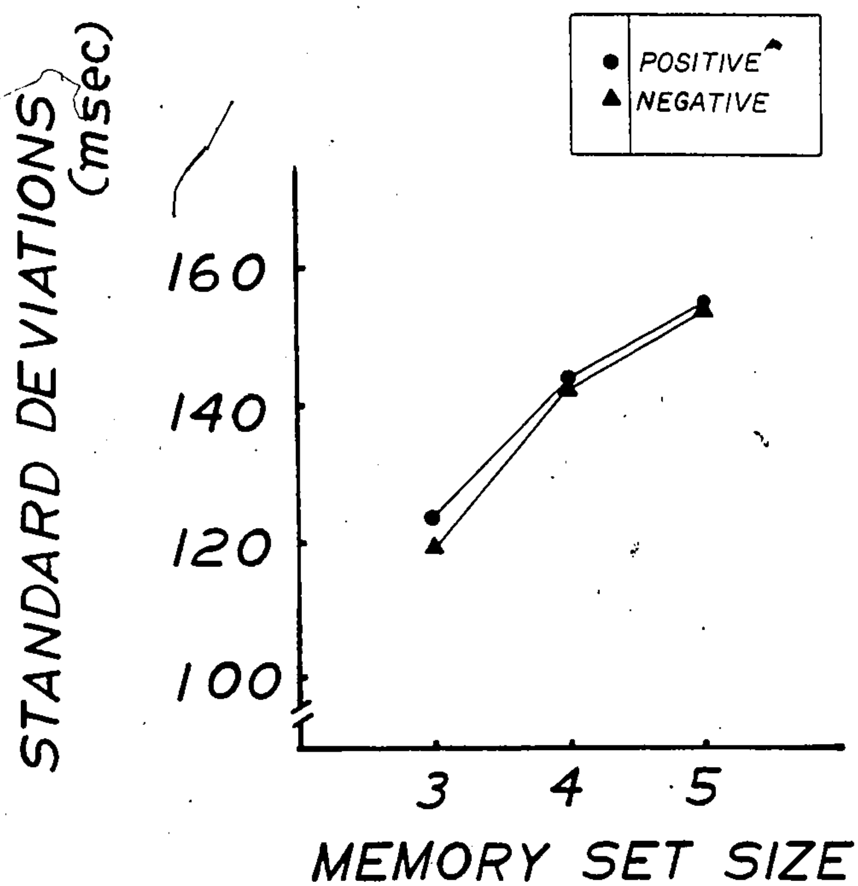
POSITIVE % ERRORS

S#	s=3	s=4	s=5
1	2.29	2.29	3.54
2	4.58	3.96	9.17
3	1.46	4.58	3.75
4	.83	2.29	3.13
5	6.67	6.25	9.17
6	.00	.00	.21
7	2.29	2.71	2.92
8	3.54	3.54	6.88
9	3.33	4.58	3.33
10	.83	1.88	1.46
11	.63	1.04	1.04
12	3.75	5.63	6.04
x	2.52	3.23	4.22

NEGATIVE % ERRORS

S#	s=3	s=4	s=5
1	.83	.83	1.04
2	2.29	1.46	3.54
3	1.25	2.29	2.71
4	2.71	2.29	1.67
5	3.54	4.58	4.17
6	.00	.21	.21
7	.83	1.67	2.92
8	2.50	4.58	3.75
9	3.54	4.17	7.50
10	.63	.42	1.67
11	.42	1.04	1.67
12	4.17	4.79	5.00
x	1.89	2.36	2.99

Figure 29: Mean response standard deviations are plotted against positive set size for positive and negative responses separately for all 12 subjects over the six days of Experiment 3.



Positive and Negative Standard Deviations

Table 21: Individual subjects' positive and negative standard deviations are shown summarized over the six days of Experiment 3 for each set size separately.

POSITIVE STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	111.43	125.26	118.11
2	76.20	94.13	111.09
3	225.97	305.63	286.60
4	125.65	165.29	144.25
5	96.90	92.90	114.05
6	81.12	112.11	143.37
7	80.23	85.98	106.78
8	103.21	115.40	117.83
9	164.45	166.90	187.73
10	148.62	146.56	200.63
11	73.48	96.14	112.77
12	200.61	222.47	213.18
x	123.99	144.06	154.70

NEGATIVE STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	106.79	112.58	119.64
2	59.23	78.02	120.52
3	221.22	299.94	285.60
4	127.96	150.86	154.36
5	94.94	92.58	109.42
6	93.37	110.63	119.34
7	72.73	81.29	114.98
8	116.62	108.85	128.07
9	132.88	206.29	180.83
10	157.23	181.59	192.06
11	69.03	74.42	94.08
12	177.72	216.28	233.56
x	119.14	142.78	154.37

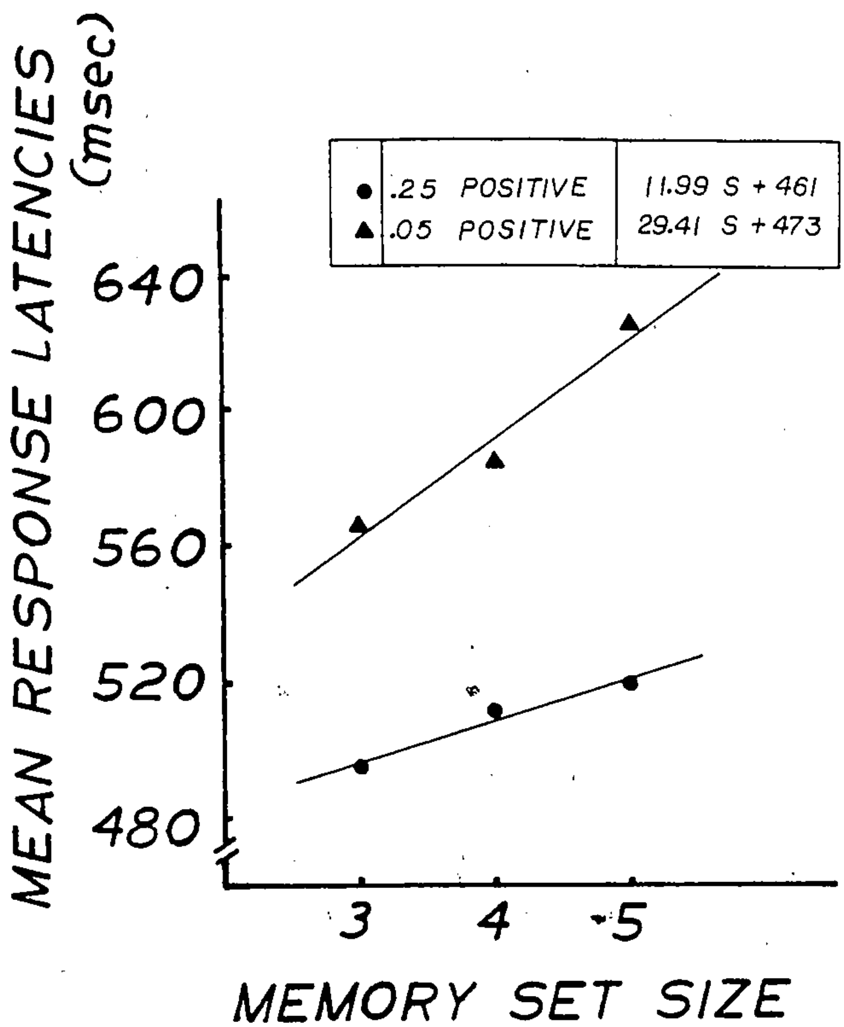
scores are shown plotted against memory set size over the six days for positive and negative response trials separately and over all 12 subjects. An analysis of variance was performed on the standard deviation scores where the within variables were positive-negative trials and set size. Both positive and negative standard deviation scores increased significantly with set size increases [$F(2,22)=20.778$, $p=.0001$].

4.3.2 Memory set size effect unconfounded by probability (P = .25 and P = .05)

Analyses related directly to the effect of memory set size in the absence of the confounding of probability were based on only correct responses to trials where positive items occurred with a probability of .25 and of .05 in each set size. In Figure 30, mean RTs calculated over the six days for the .25 and the .05 positive items are shown plotted separately against positive set size. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented. Linear regression accounted for 95.7% of the .25 variance and 96.47% of the .05 variance. These data are shown summarized for each subject separately in Table 22.

An analysis of variance was performed on the mean RTs obtained from .25 and from .05 trials for set sizes 3, 4 and 5. The main effects were significant: RTs to .05 probes were significantly greater than RTs to .25 probes [$F(1,11)=87.5$, $p=.0001$] and mean RTs were found to significantly increase with set size increases [$F(2,22)=14.19$, $p=.0002$] . As shown by the interaction, RTs to .05 probes increased more

Figure 30: Mean response latencies are plotted against positive set size for all six days of Experiment 3 for .25 and .05 positive responses for all 12 subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.



Positive .25 and .05 Mean RTs

Table 22: Individual subjects' mean response latencies for positive .25 and .05 trials are shown summarized over the six days of Experiment 3 for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

.25 RESPONSES

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	547.04	539.98	549.23	1.45	541.10	.0337
2	417.91	432.57	412.99	-2.46	430.23	.0736
3	661.56	719.34	695.59	17.02	624.10	.3432
4	512.22	510.32	527.47	7.63	486.17	.6578
5	416.76	421.69	452.71	17.97	358.49	.8507
6	511.64	505.15	552.26	20.31	441.78	.6328
7	427.47	438.37	422.55	-2.46	439.30	.0923
8	434.45	433.48	441.92	3.74	421.68	.6540
9	473.90	516.58	505.45	15.77	435.50	.5101
10	497.44	495.82	539.77	21.16	426.35	.7213
11	443.58	444.46	457.97	7.20	419.89	.7957
12	601.61	687.86	675.57	36.98	507.09	.6283
x	495.47	512.12	519.46	11.99	461.21	.9510

.05 RESPONSES

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	576.63	597.59	625.45	24.41	502.25	.9934
2	455.57	461.81	513.30	28.87	359.12	.8282
3	748.39	877.51	846.69	49.15	627.60	.5312
4	600.61	624.51	625.59	12.49	627.60	.5312
5	454.47	476.10	515.06	30.30	360.70	.9735
6	536.63	620.35	641.10	52.19	390.65	.8921
7	474.54	473.98	504.70	15.08	412.68	.8411
8	488.46	506.83	553.11	32.33	386.83	.9415
9	610.32	575.71	608.03	-1.15	605.78	.0124
10	655.27	585.07	724.75	34.74	516.07	.2474
11	482.05	516.93	548.74	33.35	382.53	.9993
12	707.02	706.19	789.37	41.18	569.49	.7424
x	565.84	585.22	624.66	29.41	473.38	.9627

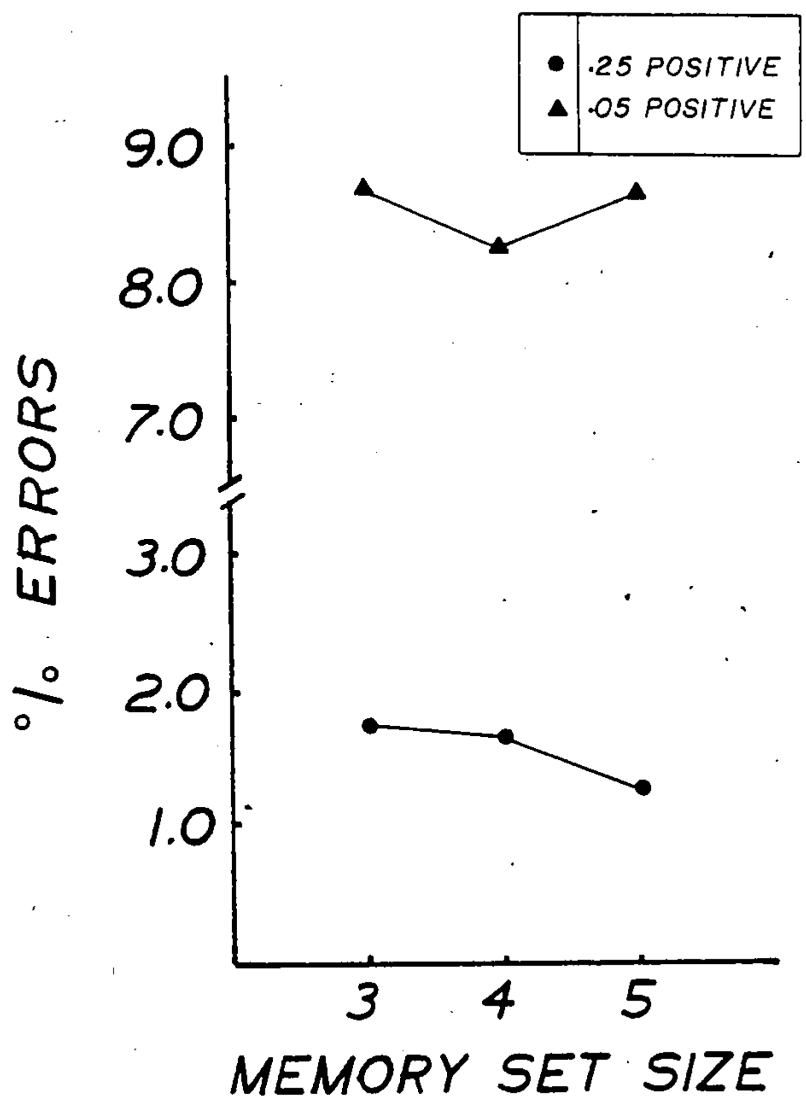
with set size than RTs to .25 probes [F(2,22)=4.75, p=.02] .

An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variable was .25-.05 trials. The slopes of the .25 and .05 item recognition functions differed significantly [F(1,11)=16.37, p=.002] , where the average slope values for the positive .25 and .05 trials were 12 and 30 msec./item respectively.

The intercepts for the positive linear functions where P = .25 and P = .05 were 461 and 473 msec., respectively. An analysis of variance was performed on these intercept values where the within variable was .25-.05 trials. No significant difference was found [F(1,11)=.06, p=.8] .

Percent errors made on trials where P was held constant at .25 and .05 across set size were calculated day by day for each subject. Errors occurred on an average of 1.6% for the .25 trials and 8.5% for the .05 positive test trials. An analysis of variance was performed on percent errors made over the 6-day period for positive items where P = .25 and P = .05 and the within variables were frequency of occurrence and set size. Subjects made significantly more errors on the .05 trials than on .25 test trials [F(1,11)=24.99, p=.0006] . In neither case did percent errors increase significantly with set size [F(2,22)= .08, p=.9231] , nor was the interaction significant [F(2,22)=.093, p=.9114] . In Figure 31, percent errors are shown plotted against memory set size over the 6-day period for the .25 trials and for the .05 positive test trials separately over all 12 subjects. These same data are shown in Table 23 for the individual subjects.

Figure 31: Percent errors are plotted against positive set size as averaged over the six days of Experiment 3 and over all 12 subjects for .25 and .05 positive responses, separately.



Positive .25 and .05 Percent Errors

Table 23: Individual subjects' percent errors for positive .25 and .05 responses are shown summarized over the six days of Experiment 3 for each set size separately.

.25 % ERRORS

S#	s=3	s=4	s=5
1	1.67	.83	.42
2	3.33	2.08	2.08
3	1.25	3.75	.42
4	.42	3.33	.42
5	6.67	1.67	2.92
6	.00	.00	.00
7	1.25	2.08	.42
8	.83	1.25	2.08
9	.83	2.08	2.08
10	.42	.00	.42
11	.00	.42	.00
12	4.17	2.08	4.58
x	1.74	1.63	1.32

.05 % ERRORS

S#	s=3	s=4	s=5
1	4.17	6.25	9.72
2	18.75	11.46	19.45
3	4.17	9.38	9.03
4	4.17	2.08	8.33
5	20.83	17.71	16.67
6	.00	.00	.70
7	10.42	6.25	6.25
8	18.75	10.42	14.58
9	14.58	13.54	5.56
10	6.25	5.21	4.17
11	2.08	4.17	2.09
12	.00	12.50	6.95
x	8.68	8.25	8.63

Standard deviations were obtained from trials where P was held constant at .25 and at .05 for each memory set size separately and were calculated day by day for each subject. The standard deviations obtained for each set size are shown summarized over the 6-day period for .25 response trials and for .05 response trials separately in Figure 32. The individual subjects' data are provided in Table 24. An analysis of variance was performed on the standard deviation scores where the within variables were .25-.05 trials and memory set size. Standard deviation was significantly higher for the .05 test trials than for the .25 test trials [$F(1,11)=24.244$, $p=.0007$] .

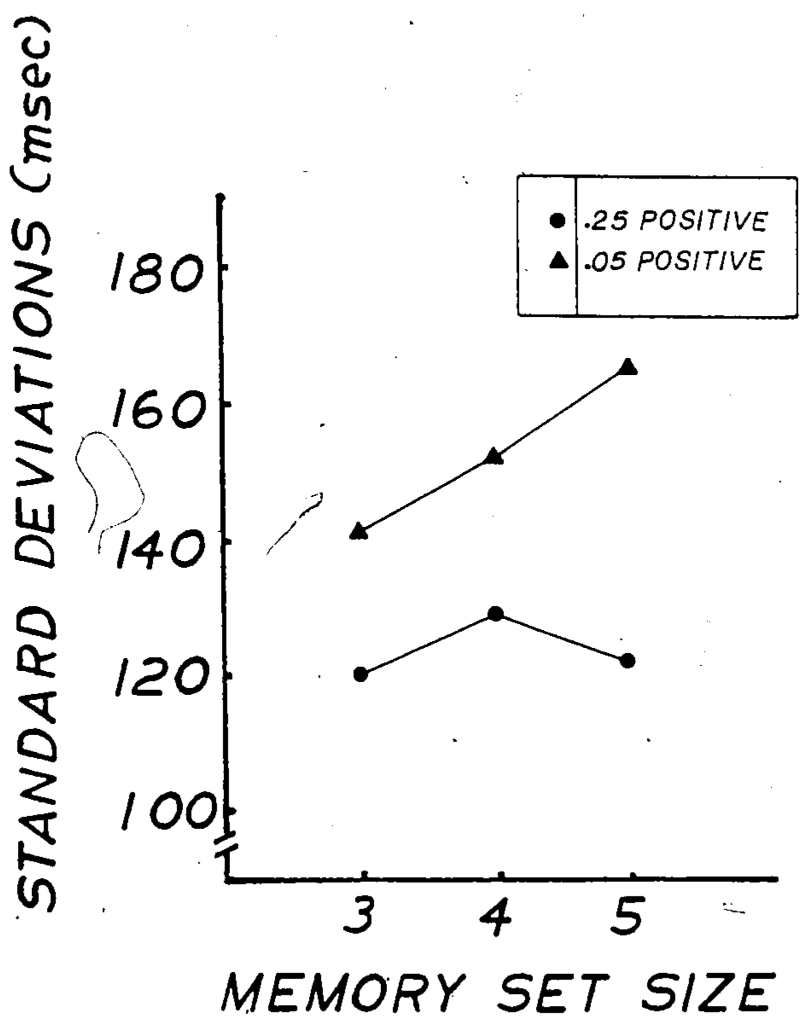
4.3.3 P effects for positive probes

In Figure 33, mean RTs for each item in each set size, averaged over all six days, are plotted against P for the positive items. In Table 25, these data are shown summarized for each subject separately. For each set size, a separate analysis of variance was performed where the within variable was P. In all cases, as P decreased, RTs significantly increased: for s=3, [$F(2,22)=23.47$, $p=.0001$] ; for s=4, [$F(2,22)=33.24$, $p=.0001$] ; for s=5, [$F(2,22)=55.87$, $p=.0001$] .

DISCUSSION

In Experiment 3, two very different P values, P = .25 and P = .05, were assigned to an item in each set size. This experiment and Experiments 1 and 2 showed that the effect of memory set size is small (around 9 to 12 msec./item) when large values of P (i.e. P = .25) are held constant over s. However, unlike the findings in Experiment 2,

Figure 32: Response standard deviations for positive .25 and .05 trials are plotted against set size as averaged over the six days of Experiment 3 and over all 12 subjects.



Positive .25 and .05 Standard Deviations

Table 24. Individual subjects' standard deviations for positive .25 and .05 trials are shown summarized over the six days of Experiment 3 for each set size separately.

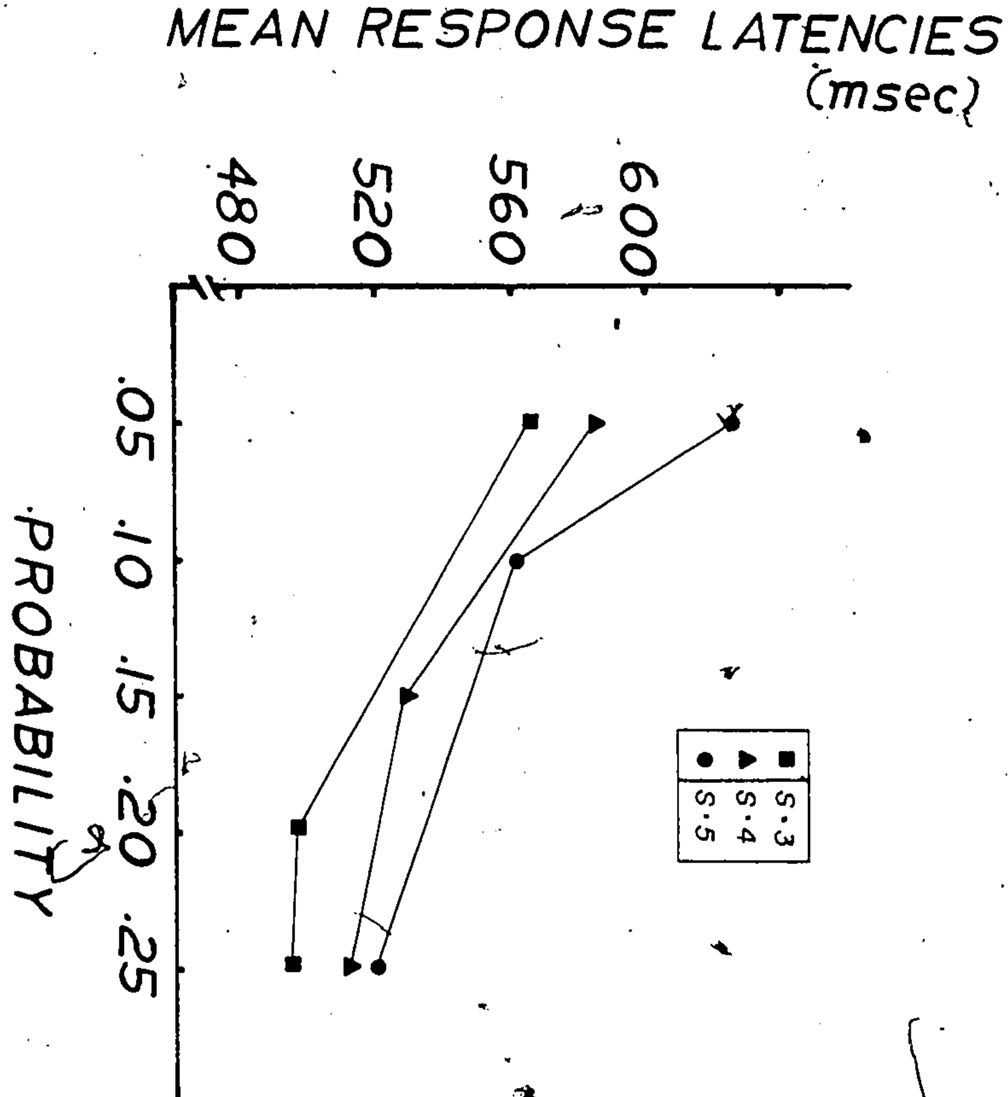
.25 STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	108.85	119.80	94.82
2	69.18	77.43	64.81
3	225.39	285.91	273.69
4	124.79	144.93	109.03
5	98.57	76.48	84.65
6	77.13	69.65	108.63
7	74.16	74.11	69.32
8	105.09	99.32	92.12
9	164.08	153.38	170.34
10	127.88	129.67	139.22
11	69.74	79.87	80.83
12	200.85	241.61	172.40
x	120.48	129.35	121.61

.05 STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	134.48	151.48	160.82
2	78.89	111.36	127.88
3	190.54	287.94	275.19
4	116.24	201.93	137.52
5	94.45	92.36	110.96
6	102.31	142.10	158.89
7	111.09	91.55	120.87
8	105.01	122.81	134.28
9	196.48	178.11	189.05
10	218.86	169.74	218.97
11	87.10	101.66	119.87
12	251.84	169.97	231.19
x	140.61	151.75	165.46

Figure 33: Mean response latencies of the individual items are plotted against probability for each set size separately as averaged over the six days of Experiment 3.


MEAN RESPONSE LATENCIES (msec)
480
520
560
600
.05
.10
.15
.20
.25
PROBABILITY
S·3
S·4
S·5

Mean RTs of Each Individual Positive Item

Table 25: Mean RTs of each individual positive item are shown summarized for each set size and for each subject separately over the six days of Experiment 3.

s=3

S#	.25	.20	.05
1	547.04	533.59	576.63
2	417.91	400.29	455.57
3	661.56	702.12	748.39
4	512.22	491.97	600.61
5	416.76	430.19	454.47
6	511.64	524.50	536.73
7	427.47	414.52	474.54
8	434.45	439.43	488.46
9	473.90	457.97	610.32
10	497.44	480.24	655.27
11	443.58	454.97	482.05
12	601.61	617.64	707.02
x	495.47	495.62	565.84

s=4

S#	.25	.15	.05*	.05	.05
1	538.91	549.57	597.59	571.00	623.04
2	430.57	422.19	461.81	462.04	461.56
3	719.34	758.05	877.51	883.48	870.65
4	510.32	525.91	624.51	610.49	638.83
5	421.69	475.18	476.10	501.11	454.07
6	505.15	523.19	620.35	639.92	600.77
7	438.37	439.51	473.98	475.49	472.60
8	433.48	450.13	506.83	512.45	501.94
9	516.45	549.74	575.71	571.23	580.77
10	495.82	504.24	585.07	579.76	590.49
11	444.46	450.87	516.93	492.55	543.52
12	687.86	682.35	706.19	661.32	756.79
x	512.12	527.58	585.22	580.07	591.25

* weighted mean of the two .05 items

s=5

S#	.25	.10	.05*	.05	.05	.05
1	549.23	567.51	625.45	592.09	648.48	637.67
2	412.99	478.19	513.30	528.36	502.91	509.15
3	695.59	694.04	846.69	798.88	887.21	853.62
4	527.47	544.85	625.59	588.82	633.38	658.29
5	452.71	527.33	515.06	534.24	486.60	523.82
6	552.26	551.17	641.10	604.85	700.25	617.44
7	422.55	473.51	504.70	486.69	502.47	524.94
8	441.92	507.68	553.11	551.40	574.77	535.29
9	505.45	549.75	608.03	611.48	567.36	647.13
10	539.77	618.99	724.75	723.56	727.62	722.98
11	457.97	496.57	548.74	551.77	529.21	565.24
12	675.57	724.62	789.37	773.11	779.36	815.04
x	519.46	561.18	624.66	612.10	628.30	634.22

* weighted mean of the three .05 items

a significant difference was found in this experiment between the slope values obtained for the high and low P items. While positive set size was found to have a small effect on the .25 items (i.e. 12 msec./item), a relatively large effect of memory set size was obtained for the .05 items (i.e. 30 msec./item). This difference was quite reliable for individual subjects: for 11 of the 12 subjects the slope was larger for the .05 items than for the .25 items. This finding supports the interpretation that P affects the comparison stage, thereby violating a major assumption of a serial and exhaustive scanning model, i.e. that for each probed trial, each memory representation receives equal and constant processing time during the scanning stage regardless of its probability.

The intercept values of 461 msec. and 473 msec. obtained from the .25 and the .05 positive item recognition functions, respectively, did not differ significantly. Again, the group data reflect nicely the individual performance: for six subjects, larger intercept values were found for the .25 positive items and for the other six subjects, larger intercept values were found for the .05 positive items. This absence of an intercept difference strongly supports the interpretation that P has no significant effects at stages of processing other than the memory comparison stage.

These findings contradict conclusions drawn from various studies purported to investigate whether the P and s effects interact. As pointed out in the introduction, however, this question has never been adequately addressed in that there are no studies where two or more P levels were held constant across s. The results which were obtained in Experiment 2, where this approach was taken, revealed:

(1) there was no interaction between P and s, and (2) small slope values were found when relatively large P values were held constant across s. This latter finding is consistent with previous findings where only one positive value of P was held constant across s. In these studies, the value of P was always .15 or greater. The positive slope values Theios et al. (1973), Okada and Burrows (1974) and Raeburn (1974) obtained were approximately 15, 5 and 10 msec./item, respectively. Only when a relatively large P value and a relatively small P value were held constant for an item in each set size (Experiment 3) was a significant interaction obtained. The finding that slope values obtained for P levels of .25 and .15 were very similar and small, while the slope value for .05 level of P was significantly larger, leads to the conclusion that the relationship between slope and P is not linear.

The validity of this interaction is made even more compelling when other aspects of the obtained data are considered through post hoc analyses.

In all the experiments carried out by the present author, the frequency of occurrence of negative items within each set size was virtually the same: here the individual negative items occurred with a probability of approximately .05. Thus, it was possible to compare the item recognition function obtained from negative items to the item recognition function obtained from positive items where P was held constant at .05 (Experiment 3). An analysis of variance was performed on the slopes and intercepts obtained from the positive .05 and the negative trials. Neither the slope values (negative =

32 msec./item vs positive .05 = 30 msec./item) [$F(1,11)=.195$, $p=.6696$] , nor the intercept values (negative = 477 msec. vs positive .05 = 473 msec.) [$F(1,11)=.03$, $p=.86$] , differed significantly.

These findings suggest that the processing strategies for the negative and the positive .05 probed items were essentially the same. It should be further noted that these similarities were obtained even though aspects of the design for positive trials and negative trials differed markedly; (1) while the range of P values assigned to the individual positive items in each set size was .25 to .05, the P values assigned to the individual negative items was invariant, thus (2) all negative trials are included in the negative item recognition function, whereas, only the positive trials having a P value of .05 contribute to the positive .05 curve.

Not only is Sternberg's serial stage model, where scanning is depicted to be serial, exhaustive and of a constant rate on each trial, unable to handle P effects at the comparison stage (i.e. an s X P interaction) but, contrary to general belief (e.g. Sternberg, 1975; Shiffrin & Schneider, 1974; Biederman & Stacy, 1974), it would also have difficulty explaining an effect of P at other processing stages.

Assuming (1) P has its effects at stages other than the comparison stage and (2) a small slope value is obtained when s is unconfounded by P (as indicated by the literature purporting to address the confounding between s and P), a serial stage model having an exhaustive scanning stage would predict that (1) the slope of the negative item recognition function and the slopes of positive item recognition functions where the confounding of s by P has been removed

(as in Experiment 2 and 3) would be similar and small, and (2) the intercept value obtained from the negative item recognition function would be significantly larger than the intercept values obtained from positive item recognition functions where large values of P are held constant over s.

The data, however, did not meet these predictions. An analysis of variance was run to determine whether the slope and the intercept values for the negative trials differed significantly from the positive trials where P was held constant at .25 across s (Experiment 3). The analysis indicated that the set size effect of 32 msec./item for the negative trials was significantly greater than the positive .25 slope of 12 msec./item [$F(1,11)=47.022$, $p=.0001$]. The intercept value of 477 msec. obtained from the negative item recognition function, however, did not differ significantly from the intercept value of 461 msec. obtained from the positive .25 function [$F(1,11)=1.761$, $p=.2095$].[5]

Similarly, in the standard item recognition task, the frequency of occurrence of the negative items within each set size is also virtually the same; only with positive items is there a confounding of P and set size effects. In assuming, then, that: (1) P affects stages other than the serial comparison stage; and (2) for all

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5 Similar analyses were carried out for Experiment 2. As in Experiment 3, significant differences were found between (1) the positive .25 slope and the negative slope (negative = 24 msec./item vs positive .25 = 9 msec./item) [$F(1,11)=39.135$, $p=.0002$], and (2) the positive .15 slope and the negative slope (negative = 24 msec./item vs positive .15 = 7 msec./item) [$F(1,11)=11.881$, $p=.0056$]. While no differences were observed between the .15 positive and negative intercept values (i.e. 506 msec. and 508 msec. respectively) [$F(1,11)=.008$, $p=.9272$], a significant difference was found between the .25 positive and negative intercept values (i.e. 477 msec. and 508 msec. respectively) [$F(1,11)=8.319$, $p=.0145$].

levels of P the set size effect is small for items where the confounding of s by P has been removed, one would expect the slope values obtained from the negative item recognition functions to be very small, certainly smaller than the positive slopes and <u>not</u> the well established findings of relatively large negative slopes.

In summary, then, whether one considers P effects at (1) the comparison stage or (2) some other stage(s), there are features of the present investigator's data which cannot be interpreted within the context of a serial and exhaustive scanning model. These features include: (1) the s by P interaction; (2) the similarities between the .05 positive and negative functions; (3) the significant difference between negative and positive .25 slopes; and (4) the non-significant difference between negative and positive .25 intercepts.

4.4.1 <u>Theoretical implications</u>

The data strongly suggest that the serial and exhaustive scanning model, as proposed by Sternberg, is unable to handle the effects of P. Three different sets of models, the temporal overlap model (e.g. Stanovich & Pachella, 1977), a serial self-terminating model (e.g. Theios et al., 1973), and an elaboration of an exhaustive serial search model - the familiarity model - (e.g. Juola, Fischler, Wood & Atkinson, 1971; Atkinson & Juola, 1973, 1974; Young & Juola, 1977), have been proposed in item recognition which may be able to explain some of the features of the data.

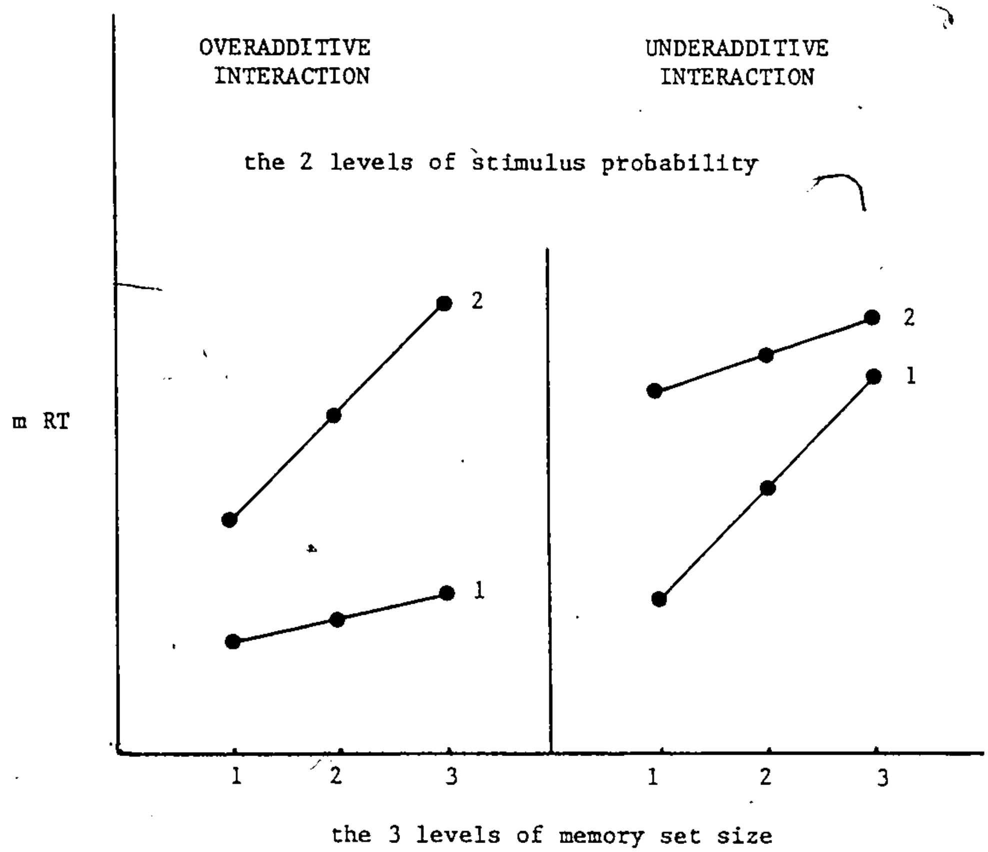
4.4.2 The temporal overlap model

In the previous chapter, Stanovich and Pachella's (1977) temporal overlap model was discussed. Their primary reason for suggesting a temporal overlap conceptualization was that models containing assumptions of strict seriality of stages could not easily accommodate the particular pattern of results they were obtaining. In one of their studies, for example, various P levels were manipulated under conditions of degraded and intact stimuli (i.e. stimulus quality) and under conditions of stimulus-response compatibility and incompatibility in a button pressing task where there was a one-to-one response mapping with the digit stimuli. They found stimulus quality and stimulus-response compatibility to display an underadditive interaction, and stimulus probability and stimulus-response compatibility to display an overadditive interaction; no interaction was found between stimulus quality and stimulus probability, a consistent finding reported for many button-pressing tasks (see Chapter 3).

While most interactions in the additive-factors literature are of an overadditive variety (i.e. one variable having a greater effect on the slower levels of the other variable), underadditivity occurs when a factor that slows processing has a larger effect on the faster of the levels of the other variable. Underadditive and overadditive interactions are displayed separately in Figure 34. The figure illustrates these two types of interactions for the two factors (or experimental variables), (1) stimulus probability and (2) memory set size. Here, the mean RTs for 2 levels of stimulus probability are shown plotted separately against the 3 levels of memory set size. In

Overadditive and Underadditive Interactions

Figure 34: An illustration of an overadditive interaction and an underadditive interaction is shown. Mean response latency, mRT, for 2 levels of stimulus probability are plotted separately as a function of memory set size at levels 1, 2 and 3.



the overadditive condition, there is a greater difference in mean RT between the levels of P at level 3 of memory set size; the slope of the stimulus probability function at level 2 is greater than the slope of the stimulus probability function at level 1. The reverse, though is true for the case of an underadditive interaction; here, there is a greater difference between the mean RTs of the levels of P for memory set size at level 1.

Stanovich and Pachella claim that the existence of under-additive interactions indicate that the stages are not discrete processes but that the stages are tapped by interacting factors which are overlapping in time. On the other hand, a consistent finding of overadditive interactions indicates that the stages of the process are serial and temporally discrete.

In Experiment 2, two very similar levels of P were held constant across set size (i.e. P = .25 and P = .15). The possibility that P was exerting some influence on the encoding process (a constant finding in item recognition studies where levels of P have been manipulated under conditions of intact and degraded stimuli in tasks using digits as the stimuli: see Miller & Pachella, 1973, 1976) but that its effects had been completely masked (or overlapped) by the other slower cognitive and response processes was suggested as one explanation to account for: (1) the additive relationship observed between stimulus P and memory set size and (2) the insignificant difference between the intercept values of the .25 function and the .15

function. However, there was indication that had two very different levels of P been held constant across set size (i.e. P = .25 and P = .05), a significant effect of P would have been revealed, either at the intercept and/or at the slope of the .25 and .05 item recognition function (Experiment 3).

In Experiment 3, an overadditive interaction between P and memory set size was found: the increase in mean RT with set size was greater for items where P was held constant at .05 than for items where P was held constant at .25. However, no significant difference was observed at the intercept of these two functions. Such findings buttress the view that the stages of the item recognition process are discrete and that the effects of P are located at the comparison stage.

The author has stressed previously, that no claim has been offered by the temporal overlap model as to what the features of the later cognitive, decision and response processes are. The self-terminating model proposed by Theios et al. (1973) and the familiarity model proposed by Atkinson and Juola (1974) are two sets of models where the stages are depicted as serial and discrete, and they offer a scanning process which may be compatible with the data reported in Experiment 2 and Experiment 3.

4.4.3 Theios et al.'s self-terminating model

Theios et al. (1973) proposed a serial self-terminating model of memory retrieval designed to deal explicitly with P effects. In their model, memory is conceived of as a dynamic stack or hierarchy in which representations of the set of possible positive and negative stimuli are organized on the basis of probability (i.e. on the average, the more frequent and more recent stimuli have their memory representations stored higher in the stack) and response type (i.e. positive item representations are given preference in the stack over negative item representations). It is further assumed that the memory stack is of limited capacity and that infrequent and non-recent stimuli may not be represented in the memory stack, but have their representations retrieved from long term memory (LTM). During a test trial, the probed stimulus is compared serially, starting at the top of the memory stack, to each memory representation until a match occurs, at which point the indicated response is initiated. Representations of the set of possible stimuli change positions from trial to trial and movement in the stack is such that, when a probe stimulus is presented and its representation moves to the top of the memory stack, all the remaining intervening stimulus item representations in the stack move down one position and their order is preserved. According to Theios et al., it is neither necessary to assume that stimulus encoding varies with P, nor that there is a difference between positive and negative responses in decision or execution time. In fact, Theios et al. find their data are best fit by their model when the difference between negative and positive decisions and response execution times is equal to zero. Thus, their model attempts to account for P effects, s effects and response type effects as all being due to the memory scanning process.

In Theios et al.'s model, only four parameters are used to determine the number of item representations scanned when a given probe stimulus is presented. These parameters are: the probability of a positive stimulus moving to the top of the memory stack when presented; the probability of a negative stimulus moving to the top of the stack when presented; the size of the short term memory stack; and the time it takes to locate a stimulus in LTM. The data of Experiment 2 and Experiment 3 were examined within the framework of Theios et al.'s model by assigning various values to these parameters and it was found that the best fits occurred when: (1) all positive items had their memory representations located in the memory stack and the probability of moving to the top of the stack was more probable for items having a higher frequency of occurrence; (2) negative stimuli were seldom represented in the memory stack but had their representations retrieved from LTM; (3) the size of the short term memory stack was equal to positive set size; and (4) the short term memory stack was scanned before representations were retrieved from LTM and scanned.

Given the frequency of occurrence of the items in Experiment 2, the following notations about stack order and the predictions made by Theios et al.'s model should be made. The most frequent item in each set size was .25 and thus its representation would most often be located at the top of the hierarchy. Because of the trial-by-trial stochastic nature of the organization of the memory stack and the fact that the size of the memory stack increases with positive set size increases, the average [illegible] of item representations that would have to be scanned, when a p[illegible].25 item is presented, increases as set size increases. Thus when a positive .25 item is tested in a set size of 3, on the average fewer item representations in the memory stack would have to be scanned before a response would be made than when a .25 positive item is presented in set size 5. However, since the .25 positive item is the most frequently occurring item in each set size and would be located at the top of the memory stack more often than the remaining items represented in the stack, a very small set size effect (i.e. slope) would be expected for these items. The positive .15 item on the other hand is the second most frequently occurring item. Although the average number of item representations scanned is greater for all set sizes for the .15 positive item than the .25 positive item, the difference in the number of representations scanned for these two P levels (.25 and .15) is a constant in all set sizes. Thus, the slope of the .15 positive function is expected to equal the slope of the .25 positive function. However, since more item representations on the average have to be scanned, the .15 item recognition function should have a larger intercept value. It follows, then, an increasingly greater number of item representations would have to be scanned for the remaining less frequently occurring positive items (i.e. the .10 item for s=3; the two .05 items for s=4; and the .05, .03 and .02 items for s=5). Further, since P is decreasing with set size for these infrequently occurring positive items, the increases in mean RTs with s would be relatively large; here, both the slope and intercept values of this positive function would be larger than the slope and intercept of the .25 and the .15 positive functions. The negative stimuli, given the assumption that their representations are retrieved from LTM, should have a larger slope and intercept value than the .25 and the .15 positive item recognition functions. Further, in comparing the functions for the negative stimuli to the function for the positive items where the confounding of s by P is present, it is expected that the intercept value for the negative items should be greater and that the slope value should be at least as great.

A number of features of the data in Experiment 2 are consistent with the predictions made by Theios et al.'s model: (1) small and similar slope values were obtained from the .15 and the .25 positive item recognition functions; (2) although it was not statistically significant, a larger intercept value was obtained from the .15 positive function than from the .25 positive function; (3) increases in mean RTs with s for the infrequently occurring positive items were found to be large (i.e. 45 msec./item); and (4) the slope value of 24 msec./item obtained from the negative item recognition function was considerably larger than the slope obtained from the .15 and the .25 positive functions.

However, there are a number of features of the Experiment 2 data that do not fit the predictions. Several intercept values did not show the predicted relationship: (1) the intercept value of 405 msec. obtained from the positive items, where the confounding of s by P was present, was significantly smaller than the intercept values obtained from the .25 and the .15 positive function (i.e. 477 msec. and 506 msec. respectively); and (2) the negative intercept value of 508 msec. was not larger than the intercept values obtained from the positive .25 and the .15 item recognition functions. In further contrast to the predictions made by the model, the slope obtained from the function for infrequently occurring positive items was much larger than the slope obtained from the negative item recognition function.

Similar discrepancies between the findings and the predictions were noted when the data in Experiment 3 were examined: (1) the intercept value of 419 msec. obtained from the positive items, where the confounding of s by P was present was significantly smaller than the intercept value obtained from the .25 positive function (i.e. 461 msec.); (2) the intercept value of 461 msec. obtained from the .25 positive items was not significantly smaller than the intercept values obtained from the .05 positive function (i.e. 473 msec.), nor from the negative function (i.e. 477 msec.); and (3) the slope (i.e. 33 msec./item) obtained from the function for the positive items where the confounding of s by P was present (i.e. s=3, P = .15; s=4, P = .15; s=5, P = .10) was as large as the slope obtained from the function for the infrequently occurring negative items (i.e. 32 msec./item).

It is clear that these latter findings do not reconcile with a model which attempts to account for P effects, s effects and response type effects as all being due to the memory scanning process. The general features of the data, however, do reconcile reasonably well with the familiarity model where it is hypothesized that subjects do not perform an exhaustive search of the memorized list on every trial. On trials in which subjects do scan the memorized list, though, Sternberg's theory of a serial and exhaustive scanning process is maintained.

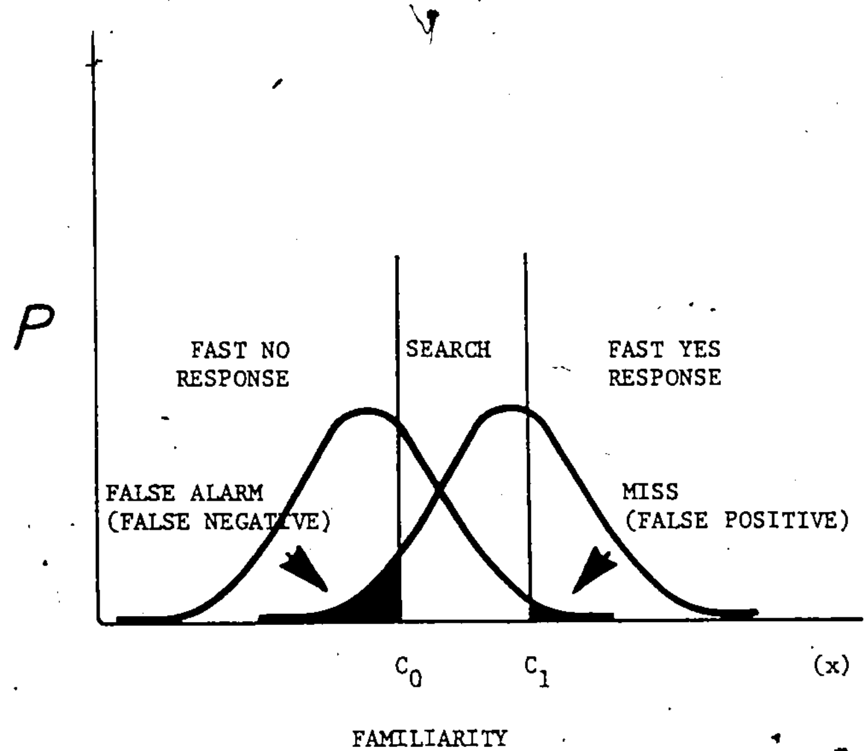
4.4.4 Atkinson and Juola's familiarity model

A fruitful elaboration of the exhaustive scanning model, referred to as the 'familiarity model', has been developed by Atkinson and Juola (1973, 1974), to explain item recognition performance for long lists of items. Mean RTs for positive and negative trials increase in parallel and linearly with set size, but the slopes for long lists are routinely found to be smaller than the slopes for small memory lists (e.g. Sternberg, Knoll & Nasto, 1969; Burrows & Okada, 1975; Okada & Burrows, 1978; Juola et al., 1971; Atkinson & Juola, 1973, 1974; Young & Juola, 1977; Mohs, Wescourt & Atkinson, 1973; Franklin, Okada, Burrows & Friendly, 1980). According to the familiarity model, when a subject is confronted with new information (such as a list of items), he/she represents this information in the form of an array of internal codes, or nodes, which is copied and placed in the lexical (or event knowledge - E/K) store. It is further assumed that each node or stored item in the lexicon has associated with it a familiarity measure that can be regarded as a value on a continuous scale. When a positive or a negative test item is presented, this test item's familiarity is assessed. This assessed value in part determines whether or not subjects will perform a search of the memorized list.

The familiarity model for recognition assumes that for each positive and negative probe item there is a probability density function of values which is distributed along the familiarity continuum, x, as shown in Figure 35. These probability density functions, Øi, n(x), are assumed to be normally distributed with unit variance for all values of i and n. While the familiarity values for positive probe items are assumed to have a mean that is higher than the mean for negative probe items (since it is the positive items the subjects are asked to memorize), the two distributions may overlap. C_0 and C_1 are the criteria values set by the subject and are assumed to stabilize over time. On trials in which the familiarity value falls between these two values an exhaustive search of the memory set will be made. For such trials, it is assumed that responses are error free. However, on trials in which the familiarity value is greater than C_1, one of two possible outcomes could occur: (1) a fast positive response could be made or (2) a false alarm could occur. The converse is true for trials in which the familiarity value is less than C_0. Either (1) a fast

The Familiarity Continuum (x)

Figure 35: The basic assumptions underlying the familiarity model are illustrated. The probability density functions for a positive (right hand side) and for a negative (left hand side) probe item are shown normally distributed along the familiarity continuum, x. C_0 and C_1 are the criteria values set by the subject. On trials in which the familiarity value falls between C_0 and C_1, an exhaustive search of the memory set will be made and responses will be error free. On trials in which the familiarity value is greater than C_1, a fast positive response will be made or a false alarm will occur. In contrast, on trials in which the familiarity value is less than C_0, either a fast negative response will be emitted or a miss will occur.



negative response will be emitted or (2) a miss will occur.

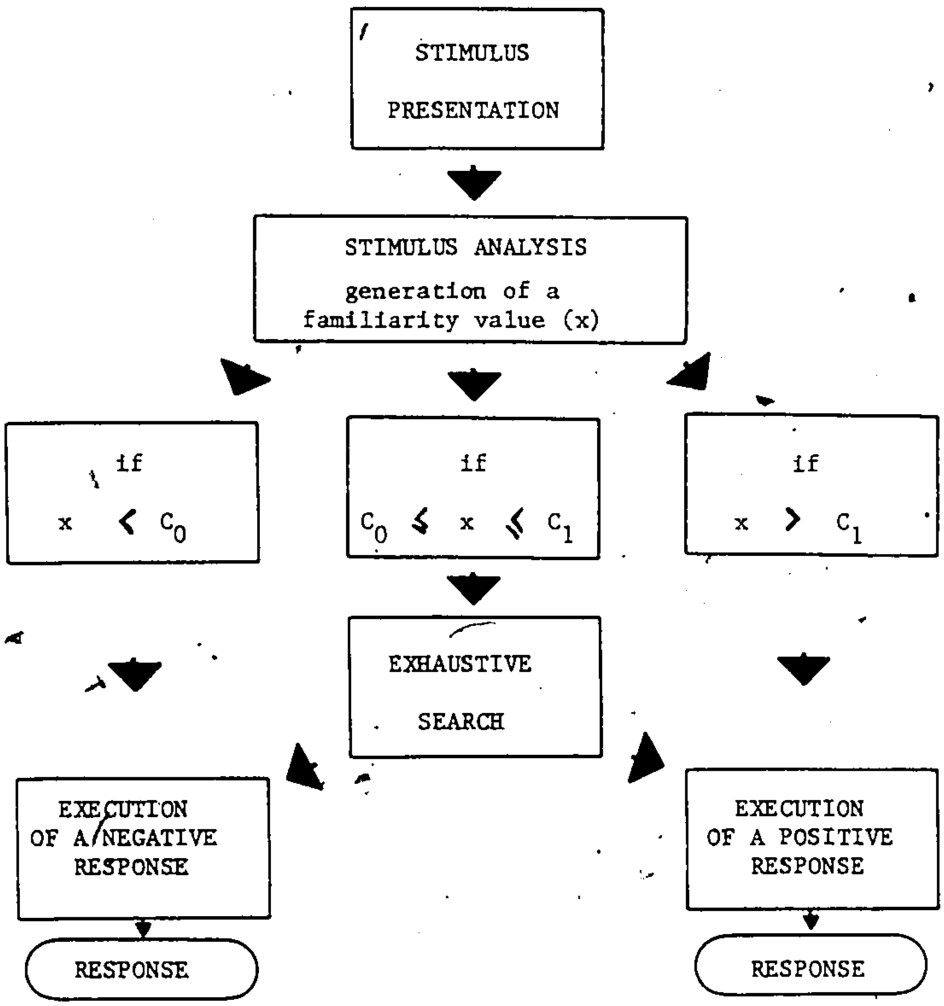
The basic processes underlying the familiarity model are shown in Figure 36. When an exhaustive search of memory is made, the successive and independent stages of the process include the encoding, memory scanning, decision and response execution stages. With the exception of the memory scanning stage, all the other stages of the process are carried out in succession and independently on trials in which the familiarity value is greater than C_1 or less than C_0.

Further, it is predicted by the familiarity model that repetition of an item as a probe increases the familiarity of both positive and negative test items. Here, it is assumed that subsequent presentations of a probe item cause the probability density functions to shift up the familiarity continuum, x, without changing their form or variance.

Given the above assumptions underlying the familiarity model, it is very probable that when a positive item is probed for the first time it will not be overly familiar and that the subject will then be required to scan through the memorized list before responding. With repetition, however, the mean familiarity value of a positive probe item should increase thereby resulting in a lower proportion of trials on which a search through the memorized list will be required, a reduction in the number of misses, and a reduction in response latency. What happens when a negative probe item is presented for the first time will depend largely on the mean of the associated probability density function. If the familiarity values for positive probe items have a mean value that is higher than the mean for negative probe items,

The Familiarity Model

Figure 36: The basic processes underlying the familiarity model are illustrated. When a positive or a negative test item is presented, this test item's familiarity is assessed (i.e. encoding stage). On trials in which the familiarity rating is greater than criterion C_0 and less than criterion C_1, an exhaustive search of memory is made. On such trials, the successive and independent stages of the process include the encoding, memory scanning, decision and response execution stages. On trials in which the familiarity rating is greater than C_1 or less than C_0, the successive and independent stages of the process include the encoding, decision and response execution stages.

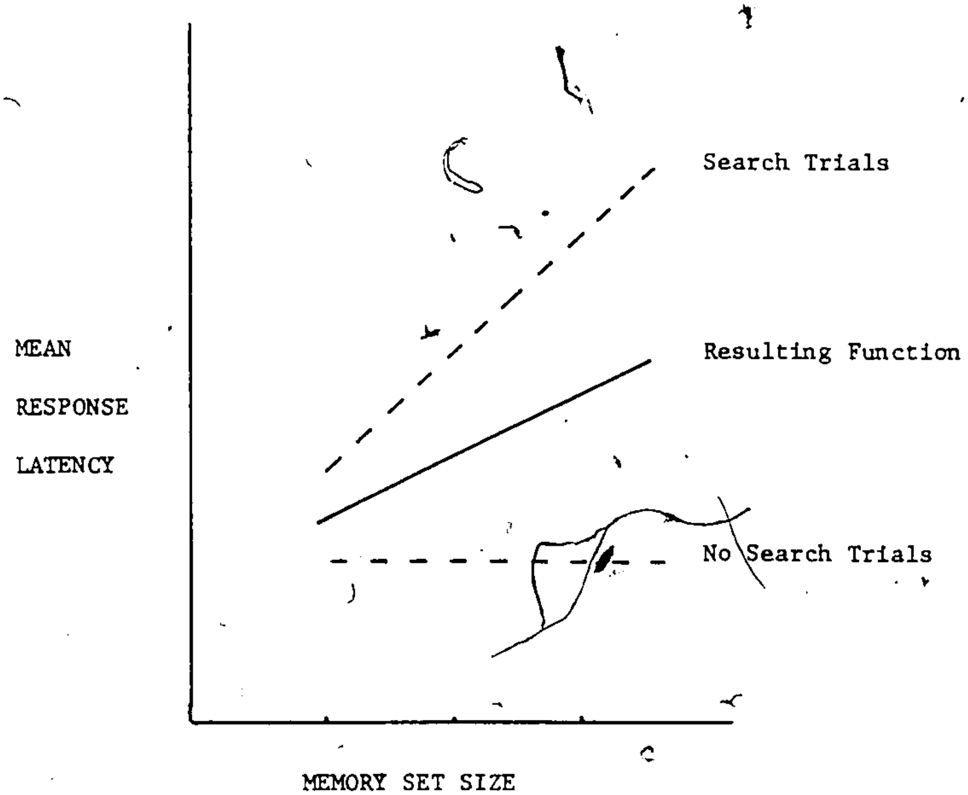


it is more likely a fast negative response will be executed on first presentation. However, if the positive and negative distributions overlap, it is likely an exhaustive search of the memory list will be performed. Repetition of a negative probe item in either case should increase its mean familiarity value and the likelihood of an exhaustive search through the memory list with a related increase in RT. An increase in the number of false alarms would also be observed with such increases in the negative item's familiarity rating.

It can be seen then, that slopes are determined by two considerations: (1) the probability that an item's familiarity rating will be between the criteria C_0 and C_1; and (2) the scanning rate per item. However, on trials in which an item's familiarity rating is less than C_0 or greater than C_1, an immediate response will be executed or a positive/negative error will be emitted. Thus, the obtained RT function for the positive and for the negative items is predicted to be a probabilistic mixture of two functions, where for one function, mean RTs are constant over s and for the other function, mean RTs are increasing linearly with s. These functions are illustrated in Figure 37.

A number of experimenters have examined their results in terms of the model (e.g. Juola et al., 1971; Mohs et al., 1973; Atkinson & Juola, 1973, 1974; Young & Juola, 1977; Franklin et al., 1980). Atkinson and Juola (1973, 1974), for example, found when positive and negative probe words were presented for the first time, the set size effect (i.e. slope) was greater for the positive probed items than for the negative probed items and the number of misses exceeded the

Figure 37: Mean response latency functions for the positive and for the negative items are shown. In terms of the familiarity model, the obtained RT function (or resulting function) for the positive and for the negative items is predicted to be a probabilistic mixture of two functions, where for one function, mean RTs are constant over s (no search trials; i.e. trials in which the familiarity rating is less than C_0 or greater than C_1) and for the other function, mean RTs are increasing linearly with s (search trials; i.e. trials in which the familiarity rating is between C_0 and C_1).



number of false alarms. Such findings suggest that it is more probable for an exhaustive search of the memory list to occur when a positive item is probed for the first time than when a negative probe is presented for the first time. Further, they also found mean RTs were longer for initial presentations of the positive items than for initial presentations of negative items. If it is the case that the duration of the other processing stages is the same for the positive and negative probed items, longer positive mean RTs would be expected if it is more likely for scanning to occur for initial positive probe trials than for the initial negative probed trials. On subsequent presentations, however, Atkinson and Juola's data revealed that the set size effect was greater for negative probed items than for positive probed items, and that the number of false alarms exceeded the number of misses. Further, response latencies to negative test items increased while response latencies to positive test items decreased. These findings are in accord with the assumption that frequent repetition of an item as a probe increases the familiarity of both positive and negative test items. The positive and negative probability density functions, then, would be positioned along the familiarity continuum such that scanning would be more probable for the negative probed items than for the positive probe items.

In contrast to these findings, however, Juola et al. (1971) and Young and Juola (1977) did not find a significant increase in the set size effect for subsequent presentations of the negative probe items. These investigators concluded that the repetition effect for negative items is transient and one that is <u>not</u> comparable to the large and lasting effect apparent when positive probe items are repeated.

The data in Experiment 3 [6] were examined to determine what if any shifts of the probability density functions along the familiarity continuum with repetition would be revealed. Here, the slopes of the positive and negative item recognition functions and percent misses and false alarms for initial presentations and for all subsequent tests of the positive and negative items were looked at separately over all days and subjects. It was found that when probe items were presented for the first time, (1) the positive slope was 33 msec./item and the negative slope was 27 msec./item, and (2) subjects missed 10.4% of the positive probed trials and gave 2.9% false alarms. When the slopes and percent errors were examined for subsequent tests of the

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6 The assumptions of the familiarity model were also examined for the data reported in Experiment 2, where P was held constant at .25 and .15 for at least one positive item in each set size. As in Experiment 3, a substantially large and similar positive-negative slope value was found on first presentation and the number of misses exceeded the number of false alarms. In constrast to Experiment 3, however, repetition of the positive and negative items seemed to have influenced the movements of their distributions. Here, it appears repetition of a positive or negative probe item made it more likely for a fast response to occur than when a positive or negative item was first probed. It should be noted though, repetition had a significantly larger effect on the positive probed items. The finding of a strong and significant repetition effect for all positive items in Experiment 2 is not surprising given that two positive items within each set size were probed relatively frequently (i.e. P = .25 and P = .15). As in Experiment 3, though, a striking effect of repeated presentations on mean RTs was found when the P = .25 positive item in each set size was examined separately. For the P = .25 positive and the P = .15 positive items, the probability density function changed similarly with repetition, suggesting that both items can be considered as frequently occurring items. This then, can account for the non-significant s by P interaction which was found. See Appendix 6 for the presentation and discussion of these data. Also reported in Appendix 6 are the individual subjects' data obtained in Experiment 3 and a detailed outline of the corresponding analyses.

positive and negative items, (1) a positive slope of 27 msec./item and a negative slope of 33 msec./item were found, and (2) that subjects missed 2.6% of the positive probed trials and gave 2.3% false alarms.

The findings of a substantially large and similar positive-negative slope value on first presentation and that the number of misses exceeded the number of false alarms, indicate that the distributions of the negative and positive probability functions (1) are very close together, (2) are largely within the boundaries of the criteria, C_0 and C_1, and (3) are positioned more towards the criteria C_0. The findings of (1) a slight increase in the negative slope value, (2) a slight decrease in the positive slope value, (3) an equal proportion of misses and false alarms, and (4) a substantial decrease in percent misses on subsequent presentations suggest the positive and negative probability density functions again (1) are overlapped, (2) are largely within the boundaries of C_0 and C_1, but (3) that there has been a slight shift of the positive density function towards the criteria C_1. Thus for both initial and subsequent presentations of the test items, it appears the probability of an exhaustive search exceeds the probability of a fast response for both positive and negative probed trials; repetition of the positive and negative probe items did not seem to significantly influence the movement of their distributions. This is not surprising given the relatively low probability of occurrence values which were assigned to some of the positive probed items and given the low P values of the negative probed items. In studies where there is evidence of greater shifts in the corresponding distributions, the positive and negative items were generally probed much more frequently. However, a more striking effect of repeated presentations on mean RT was found when the frequently occurring .25 positive item in each set size was examined separately. Here, the slope of the .25 positive response function for initial presentations (i.e. 23 msec./item) was much larger than the slope of the .25 positive response function on subsequent tests (i.e. 12 msec./item) and the number of misses on initial presentation (10.2%) exceeded the number of misses on subsequent trials (1.5%).

The features of the data are even more striking when the overall response latencies of the positive, negative, .25 positive and .05 positive probed items on first and on subsequent presentations were examined. On first presentation, the overall mean RT of the positive, negative, .25 positive and .05 positive probed items were very similar (e.g. 590, 605, 602 and 591 msec., respectively). The overall response latencies to the negative probed items and the .05 positive probed items did not change, however, with repetition (i.e. 605 and 593 msec., respectively). The decrease in the overall positive response latencies observed with repetition (i.e. 527 msec.) reflects the substantial decrease in the .25 positive RTs from 602 msec. on first presentation to 507 msec. with subsequent presentations. Thus, assuming everything else equal (e.g. positive, negative, .25 positive and .05 positive decision times), the pattern of RT findings for first and subsequent presentations corresponds nicely with the slope pattern previously examined.

In terms of the familiarity model, the data of Experiment 3 provide some evidence to support the hypothesis that frequent repetition of a positive probe item will result in shifts of the probability density functions along the familiarity continuum (also see Appendix 6). The findings showed that the more frequently a positive item is probed, the greater the decrease in (1) slope, (2) response latency and (3) percent errors, implying that when positive items are probed frequently, the probability of a fast response exceeds the probability of an exhaustive search.

The familiarity model is also able to handle the s by P interaction observed in Experiment 3. As was true for response latencies, the .25 positive slope and the .05 positive slope for first presentation did not differ significantly. The group data reflect nicely the individual performance: for six subjects, larger slope values were found for the .25 positive items and for the other six subjects, larger slope values were found for the .05 positive items for first presentation. However, when the .25 positive slope and the .05 positive slope for subsequent presentations were examined, a significant difference in slope was observed: the .25 positive slope decreased significantly more with repetition than did the .05 positive slope. Again, this difference was quite reliable for individual subjects: for all 12 subjects the slope was smaller for the .25 items than for the .05 items for subsequent presentations.

Thus, it is apparent that the .25 positive and .05 positive probability density functions did not change similarly with subsequent presentations. Given the .25 positive items were probed many more times than the .05 positive items, it would be expected that there should be differences in their familiarity ratings, such that the probability of a fast response would be more likely for the positive .25 items than for the positive .05 items.

SUMMARY OF PART I

Experiments 1 through 3 were designed to examine Sternberg's model (1971) of information retrieval in greater detail. In particular, the present investigation focused on the confounding between frequency of occurrence, P, and positive set size, s. The experiments were designed to examine the possibility that the increase in RT with increases in s (which has been attributed to set size) is, in whole or in part, an effect of variations in the frequency of occurrence. In summary, each experiment examined the memory scanning stage of the linear additive model.

In Experiment 1, the two variables, s and P, were unconfounded for some trials by holding constant the frequency of occurrence for one item in each set size. This approach made it possible to determine separately the effects of set size when P is held constant across all set sizes and when it is not. Here, it was found that when P was held constant over set sizes, there remained a small (7.73 msec./item) but significant effect of memory set size, supporting the conclusion that increases in mean RTs which have been attributed solely to increases in s are largely accounted for by the associated decreases in P.

To determine whether or not the variable, P, has additive or interacting effects on the scanning stage, the additive-factors method was employed in the subsequent experiments. Mean RTs were obtained where at least two positive items within each memory set were assigned different P values and these particular values of P were found in all set sizes. In Experiment 2, it was found that P had additive effects (i.e. equal slopes) when values of P were held constant across s at .25 and .15. In contrast, when values of P were held constant across s where P levels equalled .25 and .05, a significant difference was found between the slope of these two P functions, demonstrating that P does have interacting effects at the memory scanning stage. Such findings are compelling when response latencies plotted as a function of P are considered. Here, the function typically shows that small differences in the frequency of occurrence of items have quite large effects on RT when P is low, while smaller effects on RT are found when P is high.

The finding of a significant interaction between P and s, then, strongly suggests that the serial and exhaustive scanning model, as proposed by Sternberg, is unable to handle the effects of P. In an attempt to explain some of the features of the data, three different sets of models were examined.

The first model examined was Stanovich and Pachella's temporal overlap model. In their model, an interaction is predicted if the stages of the item recognition process operate simultaneously. Support of their model would require finding an underadditive interaction between s and P. However, the finding of an overadditive interaction between P and s in Experiment 3 was obtained. Further, in their model, the effects of P are primarily located at the encoding stage. This was not supported by the data in Experiments 2 or 3, as an insignificant intercept difference between the .25 and the .15 item recognition functions and the .25 and the .05 item recognition functions, respectively, was found. The present findings, then, clearly indicated a need for a model where the stages of the item recognition process are depicted as serial and temporally discrete, and which offers a comparison process compatible with the data reported in Experiments 2 and 3. (It should be noted, however, that the present findings do not dispel the possibility that an accurate model of item recognition is one in which the stages of the process are not serial and temporally discrete. Support for a non-serial and a temporal overlap model would require designing an experiment where a third factor is varied, (in addition to P and s), and would require obtaining an under-additive interaction between the third factor and that of P and/or s. Since this was not the intent of the present investigation, the present findings are dealt with on their own merit to avoid becoming overtly speculative.)

Theios et al.'s self-terminating model was considered. However, several features of the data did not reconcile with a model which attempts to account for P effects, s effects and response type effects as all being due to the memory scanning process. More precisely, several relationships between several intercept values did not support Theios et al.'s conception of memory as a hierarchy in which representations of the set of possible positive and negative stimuli are organized on the basis of probability and response type. In some instances, significant reversals between the intercepts occurred and in other instances, expected differences between intercepts did not occur. For example, in Experiment 2, the intercept value obtained from the negative item recognition function did not differ significantly from the intercept values obtained from the positive .25 and the positive .15 functions. If scanning is thought to terminate once a match between a memory item and test item representation occurs, then clearly, responses to the highly probable positive items should be faster than those to a negative probe item regardless of the set size.

The general features of the data, however, did reconcile reasonably well with the familiarity model where it is hypothesized that subjects do not perform an exhaustive search of the memorized list on every trial. The data showed that for positive items which were probed frequently (i.e. P = .25 and P = .15), the slope values, response latencies and percent errors were much lower for subsequent presentations than for first presentations. Such findings support the familiarity model's assumption that repetition of an item as a probe will result in an increase in its familiarity measure and, thereby, increase the likelihood that a fast positive response will be made (i.e. a familiarity value which falls beyond the criteria C_1 causing the subject to bypass the memory scanning stage).

The importance of repetition, however, was especially compelling when the data for the positive probed positive items on subsequent presentations were examined. In contrast to the positive items which were probed frequently in each set size, relatively large slope values, longer response latencies and higher percent errors were found. It seems here that for many of these probed trials the familiarity value fell between the criteria, C_0 and C_1, thus necessitating subjects to perform an exhaustive search of the set they were asked to commit to memory. Overall, then, the data reveal that repetition is an important variable of the item recognition process in that scanning of the memory list seems to be influenced by how often a positive item is probed.

Working within the basic concepts underlying the familiarity model, Part II of this Thesis describes an experiment which was carried out in an attempt to determine what aspects of repetition affect familiarity.

It should be noted, though, that while it is clear that frequency facilitates the process of memory retrieval for the positive items and that some reformulation of Sternberg's scanning model is required, it is possible that Sternberg's logic is essentially correct. If it is assumed that the rate with which a probed item is serially compared with each memory item representation in storage is determined by factors such as repetition, it follows then, that more frequent testing of an item is more likely to result in a faster rate of scanning. Accommodation of such a process, of course, would require not only the removal of the assumption of stochastic independence (i.e. that the times required by the various stages on a given observation are independent of one another), but would also entail a more detailed description of the properties underlying the encoding stage, whereby, depending on the output of the encoding stage, a decision would be made concerning the rate of scanning. Such a model would be worth pursuing, especially if in future studies, the predicted changes in familiarity for positive and negative items are not observed.

Part 2

6.1.1 Introduction

In the previous section, the familiarity model was discussed as being a potentially suitable model to account for item recognition performance in the memory scanning task, at least for the case where P has been varied systematically in each set size.

In determining whether or not changes are occurring in a probe item's familiarity value over time (i.e., to test whether or not repetition is a major determinant of familiarity), previous investigators have usually compared response latencies obtained from probed items on first presentation to those obtained on subsequent presentations (e.g., Juola et al., 1971; Atkinson & Juola, 1973, 1974; Franklin et al., 1980). However, it remains unclear whether such a comparison provides a sensitive measure of the movements or shifts occurring in the probability density function (i.e., familiarity) of a probed item over time. Under these conditions, then, repetition per se is a rather vague definition of familiarity; in otherwords, what aspects of repetition determine familiarity. If repetition is simply the number of times a probe item has been presented, then a likely determinant of familiarity would be frequency of occurrence.

It has been already shown that when an item is probed frequently, there is a substantial change over time in both the set size effect and mean response latency value. In Experiment 2, when the probabilities .25 and .15 were held constant across set size, it was found that for subsequent presentations of these items the slopes, response latencies and percent misses were much smaller than when these same items were probed for the first time. While the same was true of the positive .25 probed items in Experiment 3, little or no change was observed in the slopes, response latencies and percent misses with subsequent presentations for the positive items having a P value of .05. Further, no substantial change in either Experiments 2 or 3 was observed in the set size effect and response latency values with repetition for the infrequently occurring negative items.

One variable, however, which covaries with frequency of occurrence and which warrents some consideration before concluding that the likely determinant of familiarity is frequency of occurrence, is the lag (or number of intervening items) occurring between consecutive tests of a positive or negative probed item.

In Experiment 2, where the probabilities .25 and .15 were held constant across set size, the number of intervening items occurring between subsequent presentations of these positive items (i.e. lag length) was usually small and ranged primarily between 0-9 intervening items. In Experiment 3, however, where the probabilities .25 and .05 were held constant across set size, the range of the lag length intervals differed markedly between the positive .25 and positive .05 items. For a positive .25 item, lag lengths of 0-4 intervening items occurred on 75% of the probed trials, whereas for a positive .05 item, lag lengths of 20 or more intervening items occurred on 75% of the probed trials. Thus the possibility remains that had a large number of the positive .05 probe trials been of a short lag length and more of the positive .25 trials been of a long lag length, similar changes in slope, response latency and errors would have been found for subsequent presentations of these items. Even in the standard item recognition task, where there is a complete confounding between s and P, the average number of trials contributing to a short lag length changes markedly with set size increases: when memory set size is small, the number of items occurring between subsequent presentations of a positive item is also small; when memory set size is large, the number of items occurring between subsequent presentations of a positive item is large. Therefore, the larger the P value, the smaller the lag lengths, the smaller the P value, the larger the lag lengths.

It has been mentioned by Juola et al. (1971) and others (e.g. Atkinson & Juola, 1973, 1974) that lag length is one uncontrolled variable which may be accounting for some of the set size effects. They have reported that the effect on mean RTs of repeated positive probe items decreases as a function of the lag between repetitions. As expected, negative mean RTs appeared to be an inverse function of the lag between successive repetitions of negative probe items (e.g. Juola et al., 1971).

The number of items intervening between subsequent presentations of an item has been reported to be a very important variable in many studies (e.g. Hyman, 1953; Hohle & Gholson, 1968; Hintzman, 1969; Hintzman & Summers, 1973; Hintzman & Rogers, 1973; Kirsner & Craik, 1971; Kirsner, 1973; Kirsner & Smith, 1974; Scarborough, Cortese & Scarborough, 1977; Proctor, 1977; Corbett & Wickelgren, 1978).

Hintzman (1969) for example, recorded recognition time in a continuous memory task. Here subjects were presented with a long series of words in which some words were repeated after 1, 2, 4, 8 or 16 intervening items and subjects were asked to indicate as each word appeared whether or not they had seen it earlier during the experiment. Hintzman found that RTs to the repeated words increased significantly as the number of intervening items increased.

Can it be that lag length is an important determinant of familiarity? Given the familiarity model's supposition that subjects do not always perform an exhaustive search of the memorized list as the familiarity value of a positive probe item increases (i.e. exceeds a value beyond the criterion C_1) and the notion that lag length is a major determinant of familiarity, a number of predictions can be made. First, it is predicted that regardless of how frequently a positive item is repeated, a short lag length will more often generate a familiarity value which exceeds the criterion C_1, and thus produce fast positive response latencies; whereas, a long lag length will more often generate a familiarity value between the criteria C_0 and C_1 and will result in producing longer response latencies. The reciprocal should be true of negative probed items. Here, it is predicted that a short lag length will more often generate a familiarity value between the criteria C_0 and C_1, and will result in producing longer response latencies; whereas a long lag length will more often generate a familiarity value which lies below the criterion C_0, and thus produce fast negative responses. Second, this should be independent of the size of the set from which a positive or a negative item is probed. It follows, then, that the set size effect will also be influenced by lag length. For the positive item recognition function, it is predicted that the shorter the lag length the smaller the slope and the longer the lag length the larger the slope. The converse is predicted of the negative item recognition function; here, the shorter the lag length, the larger the slope and the longer the lag length the smaller the slope.

The data of Experiments 2 and 3 were examined in terms of these predictions.[7] For each set size separately, the mean RTs for the lag lengths 0-4, 5-9, 10-19, 20-29, and 30 or more were examined in Experiment 2 and are shown summarized for each lag length across all subjects and all days in Table 26. As others have shown, mean RTs to positive probed items increased significantly as the number of intervening items between their presentations increased. This was also true for the positive .25 and positive .15 items when examined separately (see Table 26). Further, these differences were quite reliable for individual subjects. For the most part, as the number of intervening items occurring between subsequent presentations of an item increased, so did the response latencies of the 12 subjects. A reciprocal finding, however, was not observed for the negative probed items: negative mean RTs did not decrease as lag length increased.

The mean RTs for the lag lengths 0-4, 5-9, 10-19, 20-29 and 30 or more were also examined in Experiment 3. As was found above, mean

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7 Appendix 7 provides a summary of these data. Analyses of the data are also reported.

RTs to positive probed items and to the .25 positive and .05 positive probed items, when examined separately, increased significantly as the number of intervening items between their presentations increased. As was found in Experiment 2, negative mean RTs did not decrease as lag length increased (see Table 26).

With the exception of the negative probed trials (on which further speculation will be made later in the chapter), the first prediction has been satisfied. It has been shown that regardless of how frequently a positive item has been repeated, a short lag length seems to more often generate a fast positive response, whereas, a long lag length seems to more often generate a response which is longer in latency.

To determine whether set size effect is also influenced by lag length (i.e. the second prediction), the slopes for the lag lengths 0-4, 5-9, 10-19 and 20-29 were examined in Experiment 2. It was found that positive slopes increased significantly as the lag length increased (i.e. 8, 14, 21 and 32 msec./item for the lag lengths 0-4, 5-9, 10-19 and 20-29, respectively). In order to obtain a pure measure of lag length's effect on the set size effect, the data from items where P was held constant across s were examined (i.e. items having a P value of .25 and .15). For the frequently occurring .25 positive items, slopes were found to systematically increase as lag length increased. Here, the slopes of the .25 positive response functions for the lag lengths of 0-4, 5-9 and 10-19 were 8, 9 and 24 msec./item, respectively. Although the increase in slope with lag length was not significant, this change was quite reliable for

Lag Length Effect on Response Latencies

Table 26: Mean response latencies for the lag lengths 0-4, 5-9, 10-19, 20-29, and 30 or more are shown summarized over all days and over all subjects for each set size separately in Experiments 2 and 3.

	Lag Length				
	0-4	5-9	10-19	20-29	30-
Exp. 2, Positive					
s=3	495.96	535.35	557.65	587.79	
s=4	508.42	552.59	589.21	617.80	
s=5	512.21	563.71	599.12	651.64	
.25 Positive					
s=3	490.78	536.51	544.79		
s=4	501.00	553.56	581.87		
s=5	506.90	554.02	592.86		
.15 Positive					
s=3	504.72	529.92	568.58		
s=4	513.35	543.44	585.64	610.03	
s=5	519.33	563.01	584.20	615.24	
Negative					
s=3	574.83	580.49	587.61	587.82	602.70
s=4	590.41	614.76	617.57	618.97	629.46
s=5	623.26	634.06	631.09	642.85	655.47

Table 26 continued.....

	Lag Length				
	0-4	5-9	10-19	20-29	30-
Exp. 3, Positive					
s=3	480.25	524.66	562.28	572.71	631.08
s=4	502.31	546.51	573.30	604.69	667.58
s=5	513.86	569.29	605.49	633.50	687.29
.25 Positive					
s=3	481.42	524.58	557.58		
s=4	497.17	545.56	570.87		
s=5	503.52	552.45	601.75		
.05 Positive					
s=3	509.70	538.74	596.22	576.01	
s=4	530.45	567.25	586.10	597.61	
s=5	564.09	613.53	625.03	638.99	
Negative					
s=3	567.24	572.00	572.10	567.25	575.17
s=4	603.02	599.60	608.94	608.45	618.81
s=5	629.64	646.42	631.20	648.85	634.35

individual subjects. For 8 of the 12 subjects, there was quite a dramatic increase in the .25 positive slope for the lag length of 10-19 intervening items. When the effect of lag length on slope was examined for the .15 positive items, again, for many of the subjects, slopes increased as lag length increased.

The effect of lag length on slope was also examined for the positive, the .25 positive and the .05 positive probed items, separately in Experiment 3. Again, it was found that for a large number of the subjects, slopes increased as lag length increased.

It appears, then, that the number of items intervening between subsequent presentations of a positive probe item can strongly influence item recognition performance. As others have shown, mean RTs to positive probed items increased significantly as the number of intervening items between their presentations increased. Further, as lag length increased, there was also a tendency for the set size effect to increase.

Given the above findings, it can also be questioned whether lag length is a major variable contributing to the changes typically reported with increases in s using the 'standard' paradigm. It can be recalled that in the 'standard' item recognition task, where there is a complete confounding between s and P, the average number of trials contributing to a short lag length changes markedly with set size increases. More precisely, when memory set size is small, the number of items occurring between subsequent presentations of a positive item is also small, and when memory set size is large, the number of items occurring between subsequent presentations of a positive item is large. If the supposition, that lag length is an important determinant of item recognition performance, is true, then the typical findings of large increases in RT with s and , thus, large slope values can be readily explained.

To determine whether or not response latencies and slopes systematically increase as a function of lag length increases in the 'standard' item recognition task, a post hoc analysis was also performed on the data reported in Appendix 3 where the 'standard' design was employed (see Appendix 7 for the corresponding data and analyses). As was found in Experiments 2 and 3, mean RTs to positive probed items significantly increased as the number of intervening items between their presentations increased. When the effect of lag length on slope was examined for the positive items, there was for four of the six subjects a strong tendency for the set size effect to increase as lag length increased.

However, it is obvious that Experiments 2 and 3 and the experiment reported in Appendix 3 were not designed to determine the importance of the variable lag length on familiarity. Experiment 4, then, was designed to investigate the importance of lag length in the item recognition task. Here, the probabilities .25 and .10[8] were assigned to at least two items within each set size. Further, for these items where P was held constant across s, lag length was

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8 In order to (1) have enough trials to draw conclusions on the importance of lag length and (2) determine whether the number of times an item is probed at a particular lag interval (i.e. repetition) is also an important variable, the probabilities .25 and .10 were held constant across set size.

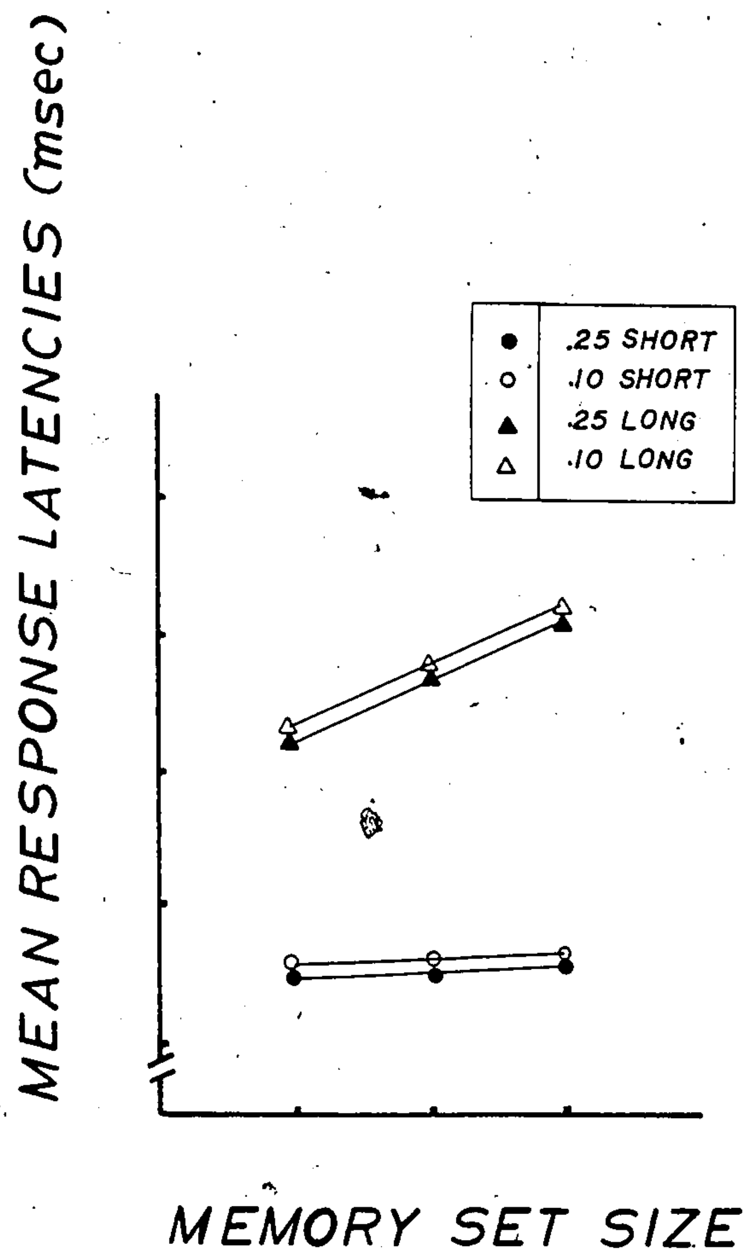
controlled so that for some of the trials, the positive .25 items and the .10 items were probed after 0 to 2 intervening items (i.e. short lag) and for the other trials, the positive .25 items and .10 items were probed after 8 to 10 intervening items (i.e. long lag).

It is predicted that regardless of whether a positive item has a probability of .25 or .10, a short lag length will more often generate a familiarity value which exceeds the criterion C_1, and thus produce fast positive responses; whereas, a long lag length will more often generate a familiarity value between the criteria C_0 and C_1, and will result in producing longer response latencies. This should hold true regardless of the size of the set from which a positive item is probed. It follows, then, that set size effect will also be influenced by lag length; that the shorter the lag length, the smaller the slope, and the longer the lag length, the larger the slope, as shown in Figure 38.

6.2.1 Method

Six paid student volunteers, who were naive to the experimental task, served as subjects. The task, apparatus, test stimulus sequence, and design were identical to Experiments 2 and 3, except that (1) the assignment of presentation frequency values for the individual items within each set size differed and (2) for at least two positive items within each set size the number of intervening items occurring between their subsequent presentation (i.e. lag length) was varied systematically. In Experiment 4, the probabilities .25 and .10 were assigned to at least two items within each memory set size. Further, for these items where P was held constant across s, lag length was controlled so

Figure 38: The predicted mean response latency functions for the positive .25 and for the positive .10 responses for short and for long lag length intervals are shown. On trials where lag length is short, it is predicted that the mean RTs for the positive .25 and the positive .10 responses will be constant over s. In contrast, on trials where lag length is long, it is predicted that the mean RTs for the positive .25 and the positive .10 responses will increase linearly with s.



MEAN RESPONSE LATENCIES (msec)
.25 SHORT
.10 SHORT
.25 LONG
.10 LONG
MEMORY SET SIZE

that: (1) for 29 of the 40 positive .25 probed trials, the positive .25 item was probed after 0 to 2 intervening items (i.e. short-.25 lag), (2) for 10 of the 40 positive .25 probed trials, the positive .25 item was probed after 8 to 10 intervening items (i.e. long-.25 lag), (3) for 4 of the 16 positive .10 probed trials, the positive .10 item was probed after 0 to 2 intervening items (i.e. short-.10 lag), and (4) for 11 of the 16 positive .10 probed trials, the positive .10 item was probed after 8 to 10 intervening items (i.e. long-.10 lag). The order of positive and negative trials was random with the restriction that (1) lag length was controlled for the positive .25 and positive .10 items as described above and (2) the short-lag and long-lag intervals for the positive .25 and positive .10 probed items were approximately evenly distributed over each of the three 160 trial blocks in each session. The presentation frequency values for the individual items composing each set are shown in Table 29.

RESULTS

6.3.1 Memory set size effect confounded by probability

All correct responses, excepting the practice trials on day 1, were used for calculating positive and negative mean RTs for each day for each subject. Group error rates were maintained at a low level, and were 1.8%, 1.8% and 2.9% for the memory set sizes 3, 4 and 5, respectively.[9]

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9 See Appendix 8 for further details concerning percent error and standard deviation scores obtained from positive and from negative trials for each memory set size and for each subject averaged over the six day period.

Probability of Occurrence and Presentation Frequency Values of the Individual Items in Experiment 4

Table 27: Shown are the positive and negative presentation frequency values (and the approximate probability of occurrence values) which were assigned to the individual items within each set size in Experiment 4.

Probability of Occurrence and Presentation Frequency Values of Individual Items

Memory Set Size	Positive Items	Negative Items
3	40 (.25) 24 (.15) 16 (.10)	the remaining 11 items each occur 7 or 8 times (P=.045)
4	40 (.25) 16 (.10) 16 (.10)* 8 (.05)	the remaining 10 items each occur 8 times (P=.05)
5	40 (.25) 16 (.10) 8 (.05) 8 (.05) 8 (.05)	the remaining 9 items each occur 8 or 9 times (P=.056)

* It can be seen that a probability value of .10 occurs twice in the set size of 4. For these two items, lag length was handled in the same way. For each item, separately, 4 of the 16 .10 probed trials were probed after 0 to 2 intervening items (short-.10 lag) and 11 of the 16 positive .10 probed trials were probed after 8 to 10 intervening items (long-.10 lag).

Since an analysis of variance indicated that response latencies, RT standard deviations, and percent errors did not differ significantly between these two items, neither for short lags nor long lag intervals, the data of the two P = .10 items in s=4 were combined.

In Figure 39, mean RTs averaged over all six subjects and over all six days are shown plotted against positive set size for positive and negative responses separately. Least squares best fitting straight lines are drawn through each set of data. Mean response latencies for each set size, slope and intercept values are also presented for the individual subjects in Table 28 and are summarized over the six days of the experiment. Linear regression accounted for 98.13% and 94.51% of the variance for negative and positive functions, respectively.

An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variable was positive-negative trials. The positive slope of 27 msec./item and the negative slope of 31 msec./item did not differ significantly [$F(1,5)=4.43$, $p=.09$] .

Figure 39: Mean response latencies averaged over all 6 subjects and over the six days of Experiment 4 are shown plotted against positive set size for positive and negative responses separately. Least square best fitting straight lines are drawn through each set of data.

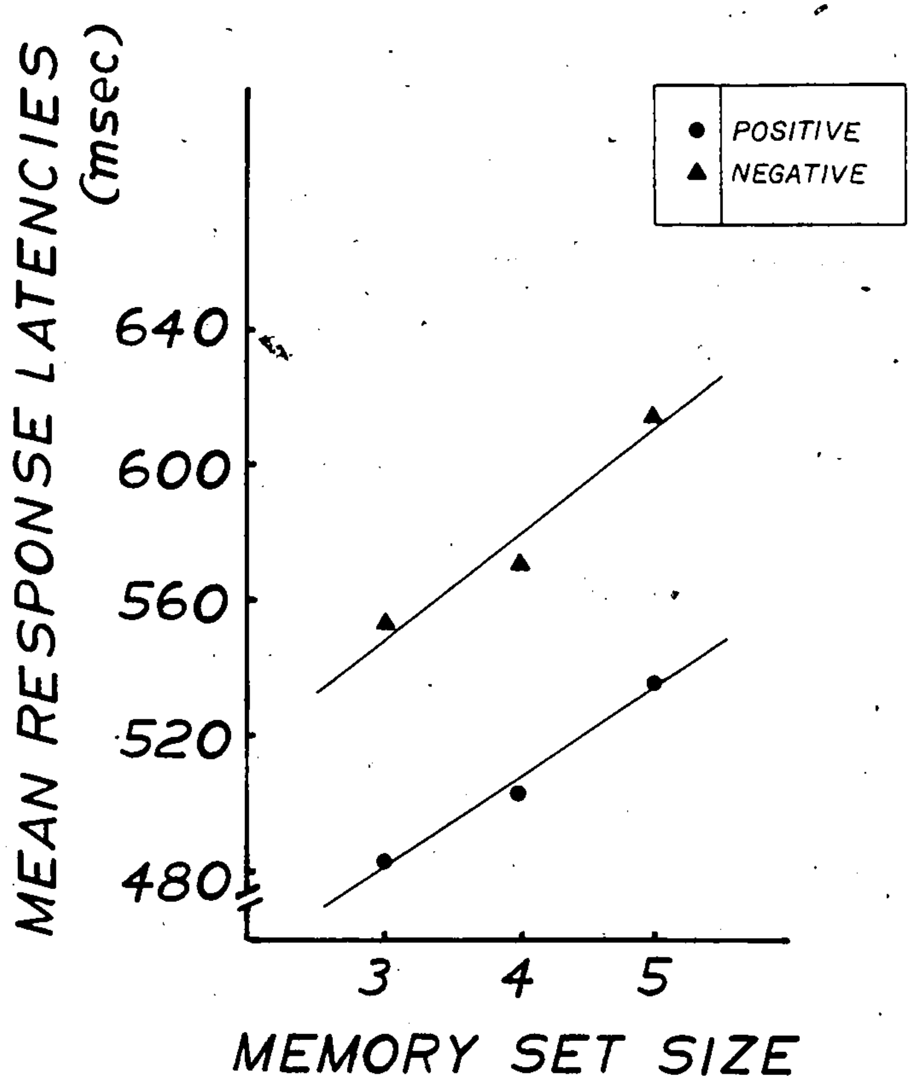

Table 28: Individual subjects' mean response latencies for positive and for negative responses are shown summarized over the six days of Experiment 4 for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

POSITIVE RESPONSES

S#	s=3	s=4	s=5	Linear Slope	r^2	Intercept
1	505.39	500.27	588.83	41.72	.7041	364.62
2	597.48	607.78	630.77	16.65	.9536	545.43
3	513.67	547.94	562.17	24.25	.9462	444.26
4	422.42	443.50	456.42	17.00	.9812	372.78
5	362.29	381.33	408.65	23.18	.9895	291.37
6	497.78	539.13	570.13	36.18	.9932	390.98
x	483.17	503.33	536.16	26.50	.9813	401.57

NEGATIVE RESPONSES

S#	s=3	s=4	s=5	Linear Slope	r^2	Intercept
1	548.47	563.43	656.12	53.83	.8519	374.04
2	710.18	716.10	735.88	12.85	.9116	669.32
3	575.55	606.33	638.12	31.28	.9999	481.53
4	472.61	491.97	508.22	17.81	.9975	419.71
5	432.77	449.62	493.02	30.13	.9392	337.97
6	577.26	598.58	660.48	41.61	.9266	445.67
x	552.81	571.01	615.31	31.25	.9451	454.71

An analysis of variance was performed on positive and negative mean response latencies.

within variables
w(1): positive vs negative mean RTs
w(2): set size

findings
w(1): $F(1,5)=74.46$, $p=.0008$
w(2): $F(2,10)=20.14$, $p=.0005$
w(1,2): $F(2,10)=3.15$, $p=.09$

6.3.2 A comparison of the memory set size effect unconfounded by probability for short-positive .25 lag intervals and for long-positive .25 lag intervals

Analyses related directly to the effect of memory set size in the absence of the confounding of probability were based on only correct responses to trials where positive items occurred with a frequency of .25 and were probed after either (1) a presentation of 0 to 2 intervening items (short-.25 lag) or (2) a presentation of 8 to 10 intervening items (long-.25 lag). Errors occurred on an average of .67% of the short-.25 lag probed trials and 1.3% of the long-.25 lag probed trials.[10]

An analysis of variance was performed on the mean RTs obtained from short-.25 lag trials and from long-.25 lag trials for set sizes 3, 4 and 5. Only the main effect of lag length was significant: RTs to long-.25 lag probed trials were significantly greater than RTs to short-.25 lag probed trials [$F(1,5)=44.24$, $p=.0018$] . Although there was a tendency towards significance, neither the main effect of set size nor the interaction between set size and lag length was significant ([$F(2,10)=3.1$, $p=.08$] and [$F(2,10)=3.1$, $p=.09$] , respectively).

An analysis of variance was performed on the slope values

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10 See Appendix 8 for the individual subjects' .25 positive mean response latencies for each short lag and for each long lag interval for each set size separately. These data are shown for the .10 positive mean response latencies as well. Percent error scores and standard deviation scores of the individual subjects are also provided in Appendix 8 for the .25 and .10 positive items for short lags and for long lags and for each set size separately.

obtained from the linear item recognition functions where the within variable was short-long .25 lag trials. The slopes of the short-.25 lag and long-.25 lag item recognition functions differed significantly [$F(1,5) = 11.25$, $p = .02$], where the average slope values for the short-.25 lag trials and the long-.25 lag trials were 10 and 19 msec./item, respectively.

The intercepts for the positive .25 linear functions where lag length was short and long were 426 and 443 msec. respectively. An analysis of variance was performed on these intercept values where the within variable was short vs long-.25 lag trials. No significant difference was found [$F(1,5) = 1.7$, $p = .25$].

Table 29 provides a summary of the individual subjects' .25 positive mean response latencies for short and for long lag intervals for each set size separately, as well as the corresponding linear slopes, intercepts and coefficients of determination for each set of data.

6.3.3 A comparison of the memory set size effect unconfounded by probability for short-positive .10 lag intervals and for long-positive .10 lag intervals

Analyses related directly to the effect of memory set size in the absence of the confounding of probability were based on only correct responses to trials where positive items occurred with a frequency of .10 and were probed after either (1) a presentation of 0 to 2 intervening items (short-.10 lag) or (2) a presentation of 8 to 10 intervening items (long-.10 lag). Errors occurred on .67% of the short-.10 lag trials and 1.62% of the long-.10 lag trials.

An analysis of variance was performed on the mean RTs obtained

Table 29: The individual subjects; .25 positive mean response latencies for short lag intervals (0-2) and for long lag intervals (8-10) are shown summarized over the six days of Experiment 4 for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

.25 ITEMS, SHORT LAGS (0-2)

S#	s=3	s=4	s=5	Linear Slope	r^2	Intercept
1	484.80	432.52	513.28	14.24	.1209	419.91
2	562.11	574.57	558.00	-2.06	.0567	573.11
3	490.80	500.17	522.16	15.68	.9488	441.66
4	402.69	419.22	416.46	6.89	.6045	385.25
5	334.73	362.19	364.38	14.83	.8051	294.47
6	469.49	505.98	492.83	11.67	.3988	442.75
x	457.44	465.78	477.85	10.21	.9890	426.20

.25 ITEMS, LONG LAGS (8-10)

S#	s=3	s=4	s=5	Linear Slope	r^2	Intercept
1	560.85	506.25	593.22	16.19	.1356	488.70
2	600.13	613.75	629.87	14.87	.9977	555.10
3	518.29	564.75	573.38	27.55	.8642	441.96
4	426.53	446.44	460.60	17.04	.9906	376.38
5	376.54	379.08	406.68	15.07	.8127	327.15
6	528.17	587.07	574.15	22.99	.5515	471.17
x	501.75	516.22	539.65	18.95	.9817	443.41

from short-.10 lag trials and from long-.10 lag trials for set sizes 3, 4 and 5. The only significant main effect was that of lag length: RTs to long-.10 lag probed trials were significantly greater than RTs to short-.10 lag probed trials [$F(1,5)=82.14$, $p=.0007$]. Neither the main effect of set size nor the interaction between set size and lag length were significant ([$F(2,10)=1.8$, $p=.21$] and [$F(2,10)=1.67$, $p=.24$] respectively).

An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variable was short-long .10 lag trials. The slope of 17 msec./item obtained from the short-.10 lag item recognition function did not differ significantly from the slope of 10 msec./item obtained from the long-.10 lag item recognition function [$F(1,5)=3.03$, $p=.14$].

The intercepts for the positive .10 linear functions where lag length was short and long were 411 and 488 msec. respectively. An analysis of variance was performed on these intercept values where the within variable was short-long .10 lag trials. A significant difference was found [$F(1,5)=18.25$, $p=.0086$].

Table 30 provides a summary of the individual subjects' .10 positive mean response latencies for short lag intervals and for long lag intervals for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

Table 30: The individual subjects' .10 positive mean response latencies for short lag intervals (0-2) and for long lag intervals (8-10) are shown summarized over the six days of Experiment 4 for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

.10 ITEMS, SHORT LAGS (0-2)

S#	s=3	s=4*	s=5	Linear Slope	r^2	Intercept
1	466.65	468.73	521.75	27.55	.7783	375.51
2	590.46	552.89	570.75	-9.86	.2750	610.79
3	514.48	516.72	518.21	1.87	.9867	509.01
4	408.08	421.02	428.42	10.17	.9759	378.49
5	368.58	372.04	389.48	10.45	.8702	334.90
6	465.08	489.61	593.71	64.32	.8869	258.87
$\bar{x}$	468.89	470.17	503.72	17.42	.7775	411.27

.10 ITEMS, LONG LAGS (8-10)

S#	s=3	s=4*	s=5	Linear Slope	r^2	Intercept
1	522.80	526.78	588.40	32.80	.7953	414.79
2	667.31	631.29	613.23	-27.04	.9645	745.44
3	557.85	565.45	534.65	-11.60	.5227	599.05
4	465.66	472.36	472.79	3.57	.7951	456.01
5	404.97	388.85	435.28	15.16	.4133	349.08
6	510.27	564.17	607.36	48.55	.9960	366.42
$\bar{x}$	521.48	524.82	541.95	10.24	.8686	488.48

* weighted average of the two .10 items

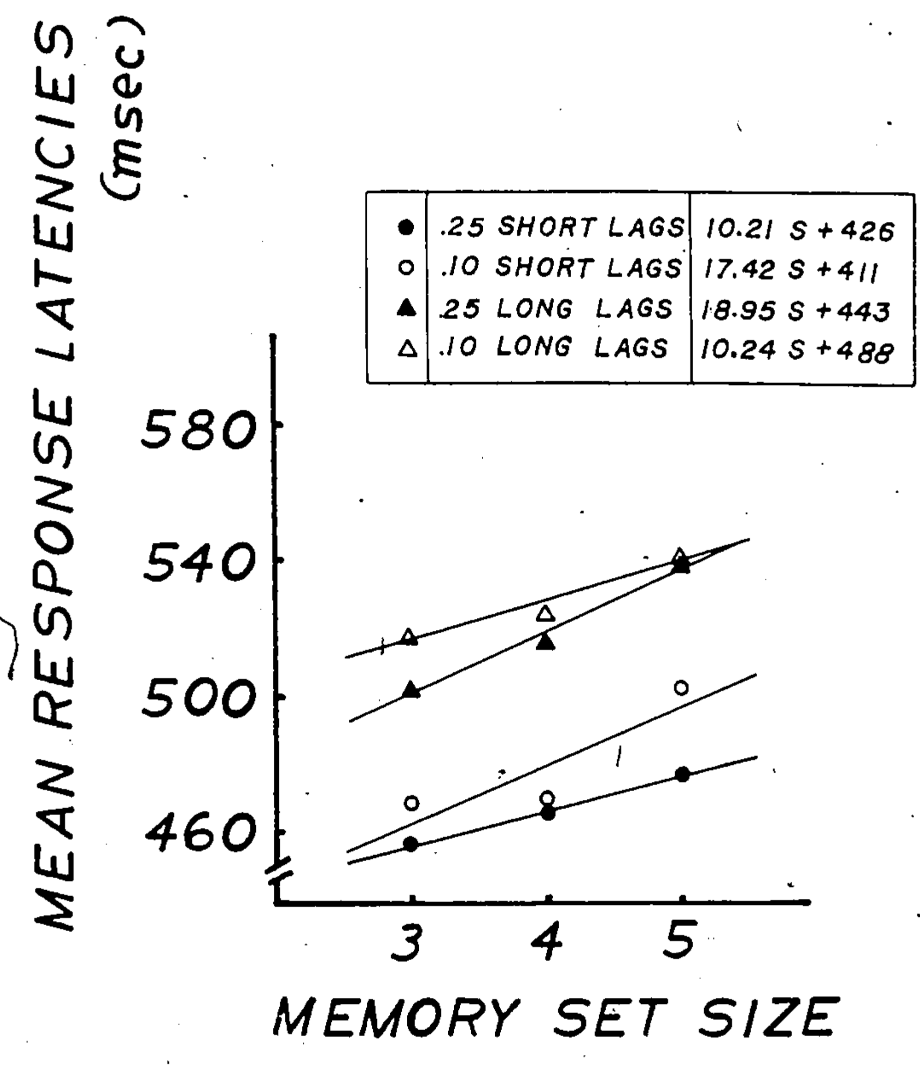
6.3.4 A comparison of the short and long lag interval probed trials for the .25 and .10 positive items where the confounding of s by P was removed

In Figure 40, mean RTs calculated over the six days for the .25 positive items and .10 positive items and for short and long-lag intervals separately are shown plotted against positive set size. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented. Linear regression accounted for 98.9% of the short-.25 lag variance, 98.17% of the long-.25 lag variance, 77.75% of the short-.10 lag variance and 86.86% of the long-.10 lag variance.

For each set size, a separate analysis of variance was performed on mean response latencies where the within variables were .25-.10 response trials and short-long intervals. For no set size was a significant main effect found between the .25 and .10 response latencies (s=3, [$F(1,5)=1.73$, $p=.24$] ; s=4, [$F(1,5)=.97$, $p=.63$] ; s=5, [$F(1,5)=1.3$, $p=.31$]). However, the main effect of lag length was significant. Regardless of whether the item probed was a positive .25 item or a positive .10 item, the longer the lag length the greater the response latency. This was true for all set sizes (s=3, [$F(1,5)=97.13$, $p=.0006$]; s=4, [$F(1,5)=35.68$, $p=.0026$] ; and s=5, [$F(1,5)=80.52$, $p=.0007$]). No significant interactions were observed between the within variables, .25-.10 response trials and lag length, (s=3, [$F(1,5)=.68$, $p=.55$] ; s=4, [$F(1,5)=.19$, $p=.68$] ; and s=5, [$F(1,5)=4.74$, $p=.08$]).

An analysis of variance was performed on the slope values obtained from the .25 and the .10 item recognition functions for short-

Figure 40: Mean response latencies calculated over all six subjects and over the six days of Experiment 4 for the .25 positive items and for the .10 positive items and for short and long lag intervals separately, are shown plotted against positive set size. Least squares bestfitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.



lag intervals and long-lag intervals, separately. No significant difference was found between the .25 slope of 10 msec./item and the .10 slope of 17 msec./item for short-lag intervals [F(1,5)=.53, p=.5]; nor was a significant difference found between the .25 slope of 19 msec./item and the .10 slope of 10 msec./item for long-lag intervals [F(1,5)=.58, p=.51].

In order to determine whether the intercept values obtained from the .25 and the .10 item recognition functions for short-lag intervals and long-lag intervals differed significantly, an analysis of variance was performed. No significant difference was found between the .25 intercept of 426 msec. and the .10 intercept of 411 msec. for short-lag intervals [F(1,5)=.16, p=.71]; nor was a significant difference found between the .25 intercept of 443 msec. and the .10 intercept of 488 msec. for long-lag intervals [F(1,5)=.85, p=.6].

6.3.5 Positive trials where lag length was not controlled

The average number of trials contributing to each lag interval each day for positive items where lag length was not controlled is shown in Table 31. In Figure 41, mean RTs for each set size, averaged over all six days, are shown plotted as a function of the lag lengths 0-4, 5-9, 10-19 and 20-29 for positive items where lag length was not controlled and the confounding between s and P was present. The individual subjects' mean response latencies for these positive items which had uncontrolled lag intervals are summarized in Table 32 for each set size separately.

An analysis of variance was performed on the mean RTs obtained

Table 31: The average number of trials contributing to each lag interval each day for each subject is shown for positive items where lag length was not controlled in Experiment 4.

memory set size	LAG INTERVAL 0-4	5-9	10-19	20-29	30-
3 (P=.15)	12-13	6-7	3-4	.5	.1
4 (P=.05)	.5	1-2	3	1.5	1
5 (P=.05)	.5	1-2	2	2	1-1.33

Figure 41: Mean response latencies for each set size, averaged over the six days of Experiment 4 are shown plotted as a function of the lag lengths 0–4, 5–9, 10–19 and 20–29 for positive items where lag length was not controlled and the confounding between s and P was present.

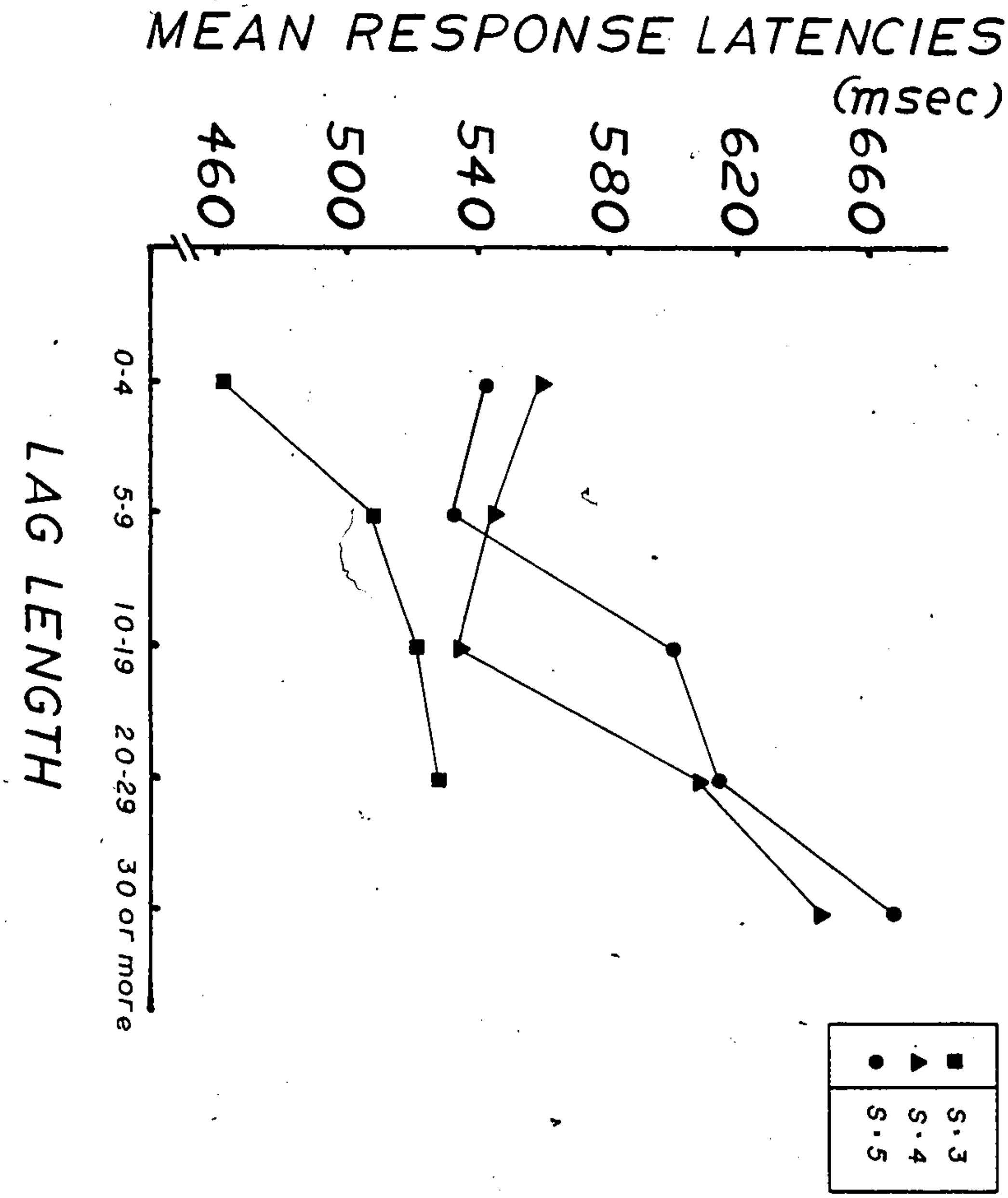

MEAN RESPONSE LATENCIES
(msec)
460
500
540
580
620
660
0-4
5-9
10-19
20-29
30 or more
LAG LENGTH
S-3
S-4
S-5

Table 32: The individual subjects' mean response latencies for those positive items which had uncontrolled lag intervals are shown summarized over the six days of Experiment 4 for the lag intervals 0-4, 5-9, 10-19, 20-29 and 30 and more, separately.

s=3, P=.15

S#	0-4	5-9	10-19	20-29	30-
1	474.05	568.46	510.95	475.00	371.00
2	570.19	621.85	696.20	481.00	552.00
3	494.43	536.54	546.33	487.33	653.00
4	404.93	430.42	420.25	488.33	
5	347.47	390.67	370.67	331.00	445.00
6	485.81	507.17	593.25	913.00	499.00
x̄	462.81	509.19	522.94	529.28	

s=4, P=.05

S#	0-4	5-9	10-19	20-29	30-
1	667.50	723.25	567.89	725.70	719.00
2	599.50	578.75	646.88	782.40	776.60
3	601.50	529.00	618.72	726.78	709.67
4	518.50	477.25	421.25	424.10	559.50
5	367.75	438.75	409.47	433.14	568.50
6	613.50	535.75	551.28	565.44	557.33
x̄	561.38	547.13	535.92	609.59	648.43

s=5, P=.05*

S#	0-4	5-9	10-19	20-29	30-
1	637.75	620.28	689.81	732.50	815.58
2	645.67	640.41	725.85	762.36	703.58
3	539.31	543.12	617.42	612.21	737.04
4	461.75	431.53	484.82	478.06	534.17
5	407.13	422.35	468.38	442.18	520.50
6	569.40	554.18	625.73	666.57	703.86
x̄	543.50	535.31	602.00	615.65	669.12

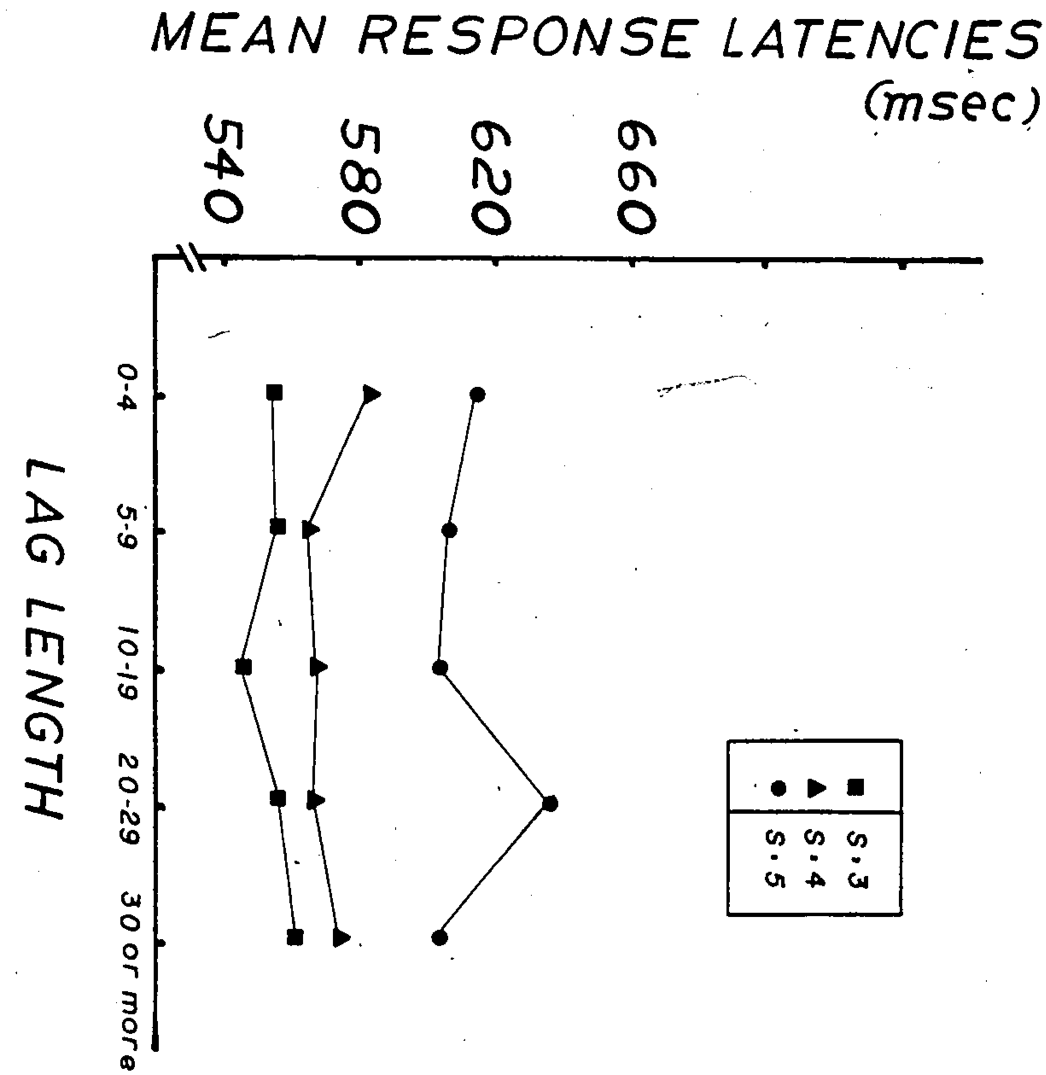
* average of three .05 items

from positive items where lag-interval was not controlled and where the within variables were (1) memory set size and (2) lag length. Both main effects were significant: (1) mean RTs increased as set size increased [$F(2,10)=4.6$, $p=.04$]; and (2) as lag-length increased, mean RTs increased [$F(3,15)=3.67$, $p=.03$]. The interaction was not significant [$F(6,30)=.79$, $p=.59$].

6.3.6 Lag length effects for negative items

In Figure 42, mean RTs for each set size, averaged over all six days are shown plotted as a function of the lag lengths 0–4, 5–9, 10–19, 20–29 and 30 or more, for the negative items. For these items, lag length was not controlled. The individual subjects' mean response latencies for the negative items are summarized in Table 33 for each set and for each lag interval separately. No systematic changes were observed in the mean response latencies with increases in the lag length interval.

Figure 42: Mean response latencies for each set size averaged over the six days of Experiment 4 and over the six subjects are shown plotted as a function of the lag length intervals 0-4, 5-9, 10-19, 20-29 and 30 or more for the negative items where lag length was not controlled.


MEAN RESPONSE LATENCIES (msec)
540
580
620
660
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S.3
S.4
S.5

Negative mRTs for Each Lag Interval

Table 33: The individual subjects' mean response latencies for negative items are shown summarized over the six days of Experiment 4 for the lag intervals 0-4, 5-9, 10-19, 20-29, and 30 or more, for each set size, separately.

s=3

S#	0-4	5-9	10-19	20-29	30-
1	565.59	515.09	566.80	558.17	558.94
2	705.56	756.60	675.55	723.03	719.26
3	571.93	562.11	571.18	578.37	587.60
4	483.79	464.89	466.34	463.07	489.22
5	430.25	432.52	426.60	439.84	433.91
6	569.54	607.47	564.55	575.30	575.43
x	554.44	556.45	545.17	556.30	560.73

s=4

S#	0-4	5-9	10-19	20-29	30-
1	566.49	558.04	562.92	554.24	564.81
2	724.80	734.95	708.30	715.26	722.87
3	605.12	596.38	605.50	604.29	613.47
4	519.67	487.19	487.40	482.97	475.97
5	453.04	459.09	444.23	447.67	451.45
6	628.18	557.20	596.27	598.04	619.92
x	582.88	565.48	567.44	567.08	574.75

s=5

S#	0-4	5-9	10-19	20-29	30-
1	657.81	662.14	634.40	694.13	664.73
2	744.69	722.21	736.53	751.87	712.94
3	615.62	634.78	629.75	654.74	637.31
4	532.16	495.76	487.53	534.77	472.49
5	488.14	481.70	485.13	507.62	496.84
6	648.99	645.25	647.68	681.59	641.72
x	614.57	606.97	603.50	637.45	604.34

6.3.7 P Effects for Positive Probes

In Figure 43, mean RTs for each item in each set size averaged over all six days, are plotted against P for the positive items. In Table 34, these data are shown summarized for each subject separately. For each set size, a separate analysis of variance was performed where the within variable was P. In all cases, as P decreased, RTs significantly increased: for s=3, [$F(2,10)=9.17$, $p=.0058$] ; for s=4, [$F(2,10)=10.61$, $p=.0037$] ; for s=5, [$F(2,10)=19.57$, $p=.0006$] .

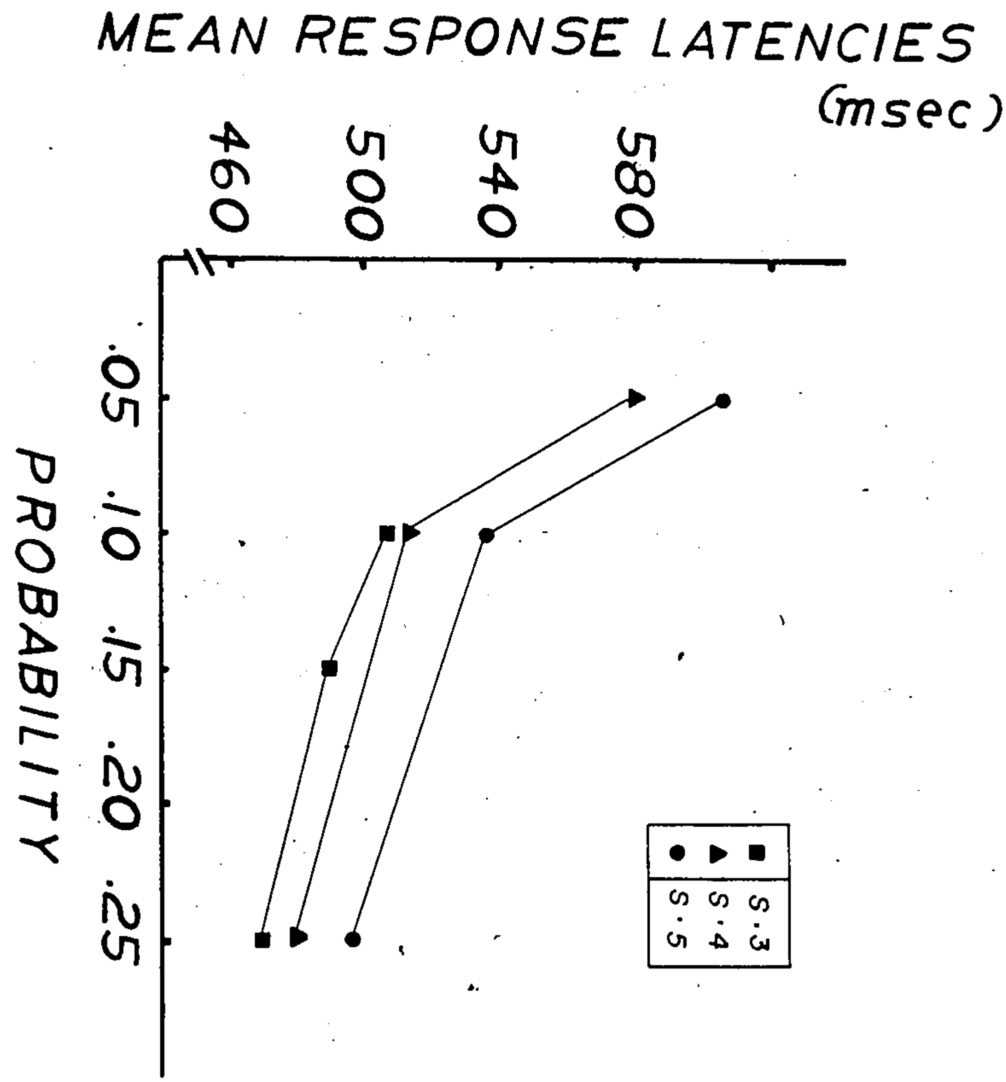
Discussion

6.4.1 Summary of the Lag Length Effect on Memory Scanning for the Positive .25 and the Positive .10 Items

In examining the effect lag length has on item recognition performance for the data of Experiments 2 and 3, it was found that the shorter the lag length, the faster the response latency. The data further revealed that as lag length increased, there was a strong tendency for slopes to increase. However, it was felt that a more striking effect of lag length on slope would have been revealed had lag length been controlled. Thus, Experiment 4 was designed to examine the influence which lag length, a variable which covaries with P, has on familiarity (i.e. the memory scanning stage). Here, the probabilities .25 and .10 were held constant across set size and lag length was controlled so that for some of the trials, the positive .25 items and the positive .10 items were probed after a short lag length and for other trials these items were probed after a long lag length.

Given the design of Experiment 4 and the supposition that lag

Figure 43: Mean response latencies of the individual positive items is plotted against probability for each set size separately as averaged over the six days of Experiment 4.


MEAN RESPONSE LATENCIES (msec)
460
500
540
580
.05
.10
.15
.20
.25
PROBABILITY
S.3
S.4
S.5

Mean RTs for Each Individual Positive Item

Table 34: Individual subjects' mean response latencies for the individual positive items within each set size are shown summarized over all six days of Experiment 4.

s=3

S#	.25	.15	.10
1	504.39	504.91	510.09
2	573.97	605.70	646.00
3	499.76	515.85	545.57
4	413.90	418.31	449.57
5	346.34	367.45	395.14
6	484.49	518.92	497.12
x	470.48	488.52	507.25

s=4

S#	.25	.10*	.05	.10	.10
1	451.86	520.32	668.07	514.13	526.78
2	587.14	609.66	709.87	610.62	608.66
3	519.05	559.19	652.18	540.19	578.19
4	427.46	461.24	459.02	472.51	449.96
5	368.17	386.87	430.64	389.78	383.90
6	529.46	545.43	562.21	548.29	542.54
x	480.52	513.79	580.33	512.59	515.01

s=5

S#	.25	.10	.05**	.05	.05	.05
1	533.69	571.03	705.23	769.42	641.77	703.02
2	583.70	606.29	732.51	705.83	768.62	721.05
3	540.32	535.81	618.09	563.36	666.33	623.51
4	429.23	471.70	493.41	505.63	478.43	494.87
5	377.63	422.25	455.14	445.80	489.13	428.69
6	516.65	613.72	636.77	601.19	670.81	635.09
x	496.87	536.80	606.86	598.54	619.18	601.04

* weighted average of the two .10 items
** weighted average of the three .05 items

length is a primary determinant of familiarity, a number of predictions were made. In short, it was predicted that (1) for short lags, the mean RTs and the slope values obtained from the .25 and the .10 positive item recognition functions would be significantly faster than those values obtained from the long lag trials; (2) for short lag lengths, the mean RTs and the slopes of the .25 positive item recognition function would not differ significantly from the mean RTs and the slopes of the .10 positive item recognition function, and (3) for long lag lengths, the mean RTs and slopes of the .25 positive item recognition function would not differ significantly from the mean RTs and slopes of the .10 positive item recognition function.

In terms of the predictions made for the response latencies, the findings of Experiment 4 revealed the following: (1) the mean RTs of the positive .25 and the positive .10 probed items for short lag lengths were significantly faster than the mean RTs of long lag lengths; (2) the mean RTs to short-.25 lag probed trials did not differ significantly from the mean RTs to short-.10 lag probed trials; and (3) the mean RTs to long-.25 lag probed trials did not differ significantly from the mean RTs to long-.10 lag probed trials. These findings clearly indicated that lag length has a strong influence on item recognition processing.

Needless to say, however, not all of the experimental findings lent support to the hypothesis that lag length is a major determinant of the set size effect (i.e. familiarity). Although the findings that (1) the slope of the positive .25 item recognition function for short lags was significantly smaller than the slope of the positive .25

item recognition function for long lags, (2) the slopes of the short-.25 lag and short-.10 lag item recognition functions did not differ significantly, and (3) the slopes of the long-.25 lag and long-.10 lag item recognition functions did not differ significantly, support the hypothesis that lag length exerts a strong influence on the memory scanning stage, the findings obtained from the .10-short and .10-long lag trials did not support this supposition. Here, the slope of the long-.10 lag item recognition function was smaller than the slope of the short-.10 lag item recognition function (i.e. 10 msec./item and 17 msec./item, respectively). Although this finding was not statistically significant, the direction of slope changes for short and long lag lengths was the reverse of that expected for four of the six subjects (see Table 30).

6.4.2 The Effects of Lag Length at Stages Other Than the Scanning Stage of the Item Recognition Process

It should be noted, of course, that lag length may have a large influence at stages other than the scanning stage of the item recognition process. If so, it would be expected that the intercepts of the .10 positive and the .25 positive item recognition functions for short lags would be significantly smaller than the intercepts for long lags. In general, then, the shorter the lag length, the smaller should be the intercept values obtained from corresponding positive item recognition functions.

In examining the data of Experiment 4 in terms of these predictions, it was found that the intercept of the short-.10 lag item recognition function (411 msec.) was significantly smaller than the intercept of the long-.10 lag item recognition function (488 msec.). However, a similar effect of lag length was not observed for the intercepts of the short and long lag .25 positive item recognition functions where the intercepts obtained were 426 msec. and 443 msec., respectively. For three of the six subjects, the intercept of the short-.25 lag item recognition function was smaller than the intercept of the long-.25 lag item recognition function, whereas, for the other three subjects, the reverse was true (see Table 29).

To further test whether lag length has a large influence at stages other than the memory comparison stage, a post hoc analysis was performed on the data obtained in Experiments 2 and 3. In Table 35, the individual subjects' intercept values obtained from the item recognition functions for the overall positive, .25 positive and .15 positive trials separately are shown summarized over the six days of Experiment 2 for the lag lengths 0-4, 5-9, 10-19 and 20-29. For Experiment 2, analyses of variance were performed on the overall positive intercept values, the .25 positive intercept values and the .15 positive intercept values, separately, where the within variable was lag length. With the exception of the positive .15 responses, intercepts were not found to increase significantly with lag length increases. (For all positive items, [$F(3,33)=.358$, $p=.7866$]; and for .25 positive items, [$F(2,22)=.71$, $p=.51$] .) The intercept increase with lag length increase was only marginally significant for the positive .15 intercepts [$F(2,22)=3.37$, $p=.052$]. This trend was not consistent for the individual subjects; for five of the twelve subjects, intercepts

Overall Positive, .25 and .15 Positive Intercepts by Lag Length

Table 35: The individual subjects' intercept values obtained from the item recognition functions for all positive probed trials, for the .25 positive probed trials, and for the .15 positive probed trials are shown separately, over the six days of Experiment 2 for the lag lengths 0-4, 5-9, 10-19 and 20-29.

OVERALL POSITIVE INTERCEPTS

S#	0–4	5–9	10–19	20–29
1	360.44	343.04	287.12	381.75
2	420.31	494.05	406.08	408.99
3	468.76	555.94	630.67	623.09
4	508.08	607.42	495.30	523.96
5	484.11	524.85	521.90	676.48
6	462.01	477.30	542.47	525.28
7	397.74	368.54	338.18	373.42
8	657.59	696.95	674.96	607.24
9	428.53	231.82	357.22	97.16
10	567.04	633.81	620.69	593.62
11	482.48	516.99	546.43	556.30
12	439.27	475.19	567.53	529.29
x	473.03	493.83	499.05	491.38

	.25 POSITIVE INTERCEPTS			.15 POSITIVE INTERCEPTS		
S#	0–4	5–9	10–19	0–4	5–9	10–19
1	366.69	372.64	238.29	355.66	264.45	259.45
2	413.95	509.12	357.10	429.26	460.14	471.23
3	449.73	506.05	596.22	494.54	695.18	659.30
4	470.35	610.43	516.54	596.49	606.05	576.35
5	490.77	566.85	245.03	481.48	509.57	676.03
6	461.64	512.49	543.28	452.29	502.06	671.61
7	411.82	384.57	388.27	345.94	370.85	355.99
8	676.19	844.85	599.87	677.05	527.37	738.13
9	418.92	250.02	514.90	454.71	227.35	386.14
10	548.93	641.45	470.35	587.52	587.44	689.23
11	462.85	447.72	684.14	491.61	549.01	503.98
12	436.04	510.07	570.30	432.53	451.82	591.28
x	467.32	513.01	477.03	483.25	479.28	548.23

did not systematically increase as lag length increased, whereas, for the remaining seven subjects, intercepts did increase as lag length increased.

Similarly, for Experiment 3, separate analyses of variance were performed on the overall positive intercept values, the .25 positive intercept values and the .05 positive intercept values, where the within variable was lag length. Although there was a tendency for intercepts to increase with lag length increases, this trend was not significant. (For all positive items, [$F(3,33)=2.34$, $p=.09$] ; for .25 positive items [$F(2,22)=.3$, $p=.74$] ; and for .05 positive items [$F(3,33)=2.58$, $p=.07$].) In Table 36, the individual subjects' intercept values obtained from the item recognition functions for the overall positive, the .25 positive and the .05 positive probed trials are shown summarized separately, over the six days of Experiment 3 for the lag lengths 0-4, 5-9, 10-19 and 20-29.

In summary, then, the data discussed here do not lend support to the interpretation that lag length has a large influence at stages other than the memory scanning stage.

6.4.3 The lag length effect on item recognition performance for positive items where lag length was not controlled

There are, however, several explanations as to why lag length did not have the predicted influence on the slopes of the positive .10-long lag item recognition function. First, it is conceivable that had the controlled long lag length interval been longer than 8 to 10 intervening items, a much larger effect of lag length would have been

Overall Positive, .25 and .05 Positive Intercepts by Lag Length

Table 36: The individual subjects' intercept values obtained from the item recognition functions for all positive probed trials, for the .25 positive probed trials, and for the .05 positive probed trials are shown summarized, separately over the six days of Experiment 3 for the lag lengths 0-4, 5-9, 10-19 and 20-29.

OVERALL POSITIVE INTERCEPTS

S#	0–4	5–9	10–19	20–29
1	486.90	493.48	598.62	597.50
2	359.95	352.82	460.54	357.76
3	671.56	682.68	669.49	578.57
4	445.57	504.90	501.66	484.27
5	340.50	332.70	419.38	346.07
6	452.64	495.43	498.30	394.62
7	398.86	388.72	464.73	461.96
8	396.19	386.75	394.70	452.32
9	383.00	470.15	542.85	768.26
10	357.53	405.89	453.23	497.61
11	427.48	396.04	363.71	392.97
12	458.87	581.30	559.82	452.60
x	431.59	457.56	493.94	482.05

.25 POSITIVE INTERCEPTS

S#	0–4	5–9	10–19
1	518.02	517.58	726.44
2	417.67	433.79	640.88
3	651.10	651.18	119.65
4	471.77	549.37	480.76
5	343.52	338.49	610.57
6	441.34	484.61	492.53
7	424.73	511.10	336.22
8	429.29	369.06	388.41
9	429.25	508.66	356.15
10	413.96	361.77	629.67
11	419.19	427.98	403.31
12	438.30	667.95	675.94
x	449.84	485.12	488.39

.05 POSITIVE INTERCEPTS

S#	0–4	5–9	10–19	20–29
1	321.81	348.37	574.92	609.28
2	260.84	311.05	369.35	266.13
3	625.43	462.90	715.38	497.49
4	643.20	442.53	640.03	430.09
5	343.41	658.41	322.80	443.33
6	451.30	626.57	438.96	394.29
7	424.84	298.73	606.62	448.98
8	353.14	288.96	558.74	369.25
9	416.17	580.24	762.87	954.41
10	349.99	236.58	657.53	445.10
11	421.24	312.35	320.81	377.82
12	500.22	516.46	570.02	502.88
x	425.97	423.59	544.83	476.14

observed for the .10 positive items. To investigate this possibility, the positive items where lag length was not controlled were examined. Lag lengths for these positive items ranged from 0-4 to 20-29 intervening items. If it is true that the effects of lag length on slope are more pronounced at longer lag intervals, then it is predicted that for these positive items, slopes should increase as lag length increases.

The slopes of the uncontrolled positive items for the individual subjects are shown summarized in Table 37 over the six days of Experiment 4 and for the lag lengths 0-4, 5-9, 10-19 and 20-29, separately. Although it can be seen that for four of the six subjects, slopes markedly increased as set size increased, a significant change was not revealed when an analysis of variance was performed on these slope values [$F(3,15)=.519$, $p=.68$].

To test whether lag length is having a larger effect at stages other than the memory scanning stage for these positive items, a post hoc analysis was also performed on the intercept values where the within variable was lag lengths 0-4, 5-9, 10-19 and 20-29. However, increases in lag length did not result in significant increases in the intercept value [$F(2,10)=.183$, $p=.8360$]. In fact, only one of the six subjects showed a systematic increase in intercepts with lag length increases. Table 38 provides a summary of the intercept values which were obtained from the positive item recognition functions where lag length was not controlled.

It can be seen from Table 31, though, that the average number of trials contributing to each lag interval each day and for each

Slopes of Uncontrolled Positives for Each Lag Interval

Table 37: The individual subjects' slope values obtained from the positive item recognition functions where lag length was not controlled are shown summarized over the six days of Experiment 4 for the lag lengths 0-4, 5-9, 10-19 and 20-29.

	SLOPES			
S#	0-4	5-9	10-19	20-29
1	81.85	25.91	89.43	128.75
2	37.74	9.28	14.83	140.68
3	22.44	3.29	35.55	62.44
4	28.41	0.56	32.29	-5.14
5	29.83	15.84	48.86	55.59
6	41.80	23.51	16.24	-123.22
x	40.35	13.06	39.53	43.19

Intercepts of Uncontrolled Positives for Each Lag Interval

Table 38: The individual subjects' intercept values obtained from the positive item recognition functions where lag length was not controlled are shown, summarized over the six days of Experiment 4 for the lag lengths 0-4, 5-9, 10-19 and 20-29.

INTERCEPTS

S#	0-4	5-9	10-19	20-29
1	265.70	533.69	281.83	129.40
2	454.16	576.55	680.34	112.53
3	455.32	523.06	451.98	359.01
4	348.09	444.18	312.97	484.04
5	254.80	353.90	220.75	179.75
6	389.06	438.35	525.13	1207.86
x	361.18	478.30	395.50	412.10

subject differed markedly for a positive item having a P value of .15 in set size 3 from items having a P value of .05 in set sizes 4 and 5. Here, the number of trials contributing to particular lag length intervals are more equivalent across set sizes for the lag lengths 5-9 and 10-19. When an analysis of variance was performed on the slope values of these two lag intervals, slopes were found to be significantly higher for the lag length 10-19 than the lag length 5-9 [$F(1,5)=6.884$, $p=.0462$]. Referring to Table 37, slopes markedly increased for five of the six subjects. Further, when an analysis of variance was performed on the intercept values for the lag lengths 5-9 vs. 10-19, intercepts were not found to be consistently higher for the lag length interval of 10-19 intervening items [$F(2,10)=.183$, $p=.8360$] (see Table 38).

Thus it is possible that had the long lag length interval of the .10 items been greater than 8 to 10 intervening items, a larger slope value would have been obtained for these positive probed trials. However, this line of reasoning would have to be directly tested since it fails to explain why, for the positive .25 probed trials, a long lag length interval of 8 to 10 intervening items resulted in a significantly larger slope value than a short lag length interval.

It is also conceivable, however, that the problem stems from the short lag trials. One aspect of the data, in particular, is worth noting, for it suggests that in part, lag length did have the predicted influence on the slopes of the .10 positive short and long lag length probed trials. Special reference should be made to Figure 85 (p. 436, 437), in Appendix 8, where the .10 positive mean response latencies are shown plotted against each short lag interval (i.e. lag lengths 0, 1 and 2) and each long lag interval (i.e. lag lengths 8, 9 and 10) for each set size separately. While it can be seen, for each set size, that mean RTs did not increase markedly as the long lag length interval increased (suggesting that these intervals had the same effect on mean RTs), the converse was true of the .10 positive mean RTs in the set size of 5 for the short lag length intervals. It can be seen from Table 94, where the individual subjects' .10 positive mean response latencies for each short lag and for each long lag interval are shown summarized over the six days of Experiment 4 for each set size, that the positive .10 mean response latencies for the positive set size of 5, significantly increased as the short lag interval increased. It can be further seen that for a lag length of 0 intervening items, the increase in the positive .10 mean RTs with s was, in fact, very small. Here, a lag length of 0 intervening items yielded a .10 positive slope value of -2.6 msec./item, a value which is considerably lower than the slope which was reported for the overall short-.10 lag length probed trials (i.e. 17 msec./item) and, for that matter, the slope which was reported for the overall long-.10 positive lag length probed trials (i.e. 10 msec./item).

Such findings, however, should be taken with caution, since only four positive .10 probed trials contributed to the data for the short lag length intervals in each set size, each day. Thus, for the short lag length interval of 0 intervening items, even fewer trials were contributing to these data.

Although the variability of the .10 positive probed trials for short lag lengths was reasonably low (see Appendix 8), there remains the further possibility that had more than four trials contributed to the .10 positive short lag length intervals in each set size, the findings would have been in the direction predicted.

6.4.4 Summary of the repetition effect (i.e. frequency of occurrence) on memory scanning for the positive probed items

Up to this point, we have seen, for the most part, that there was a noticeable tendency for slopes to increase with increases in the lag length interval (i.e. Experiments 2, 3 and 4). However, it is clear from the .10 positive findings (Experiment 4) that the variable, lag length, is not the sole determinant of familiarity.

Despite the lack of a significant interaction between lag length (i.e. 0-2 and 8-10 intervening items) and frequency of occurrence (i.e. repetition, P=.25 and P=.10) in Experiment 4, several aspects of the data, however, do suggest that the number of times a positive item is probed (i.e. repetition per se) is a second variable which in addition to lag length determines familiarity. For example, in the case of the positive items where lag length was uncontrolled and where the positive item in the set size 3 was probed many more times than the positive items in the set sizes 4 and 5, it can be seen from Table 39 that a very large set size effect of 59.17 msec./item was obtained, a finding which cannot be attributed to that of lag length alone. This value, of course, is reflected in the function for the overall positive items where a relatively large but smaller set size effect of 26.5 msec./item was found.

To examine further the notion that the more frequently a positive item is probed the less likely that an exhaustive search of the memory set will be made, the response latency functions obtained from the overall positive, .25 positive and .10 positive response trials, separately, on first presentation were compared to the corresponding

Mean RTs of Positive Items Uncontrolled for Lag Length

Table 39: Individual subjects' mean response latencies for those items which had uncontrolled lag intervals are shown summarized over the six days of Experiment 4 . Also provided are the slope and intercept values of the resulting item recognition functions.

POSITIVE mRTs

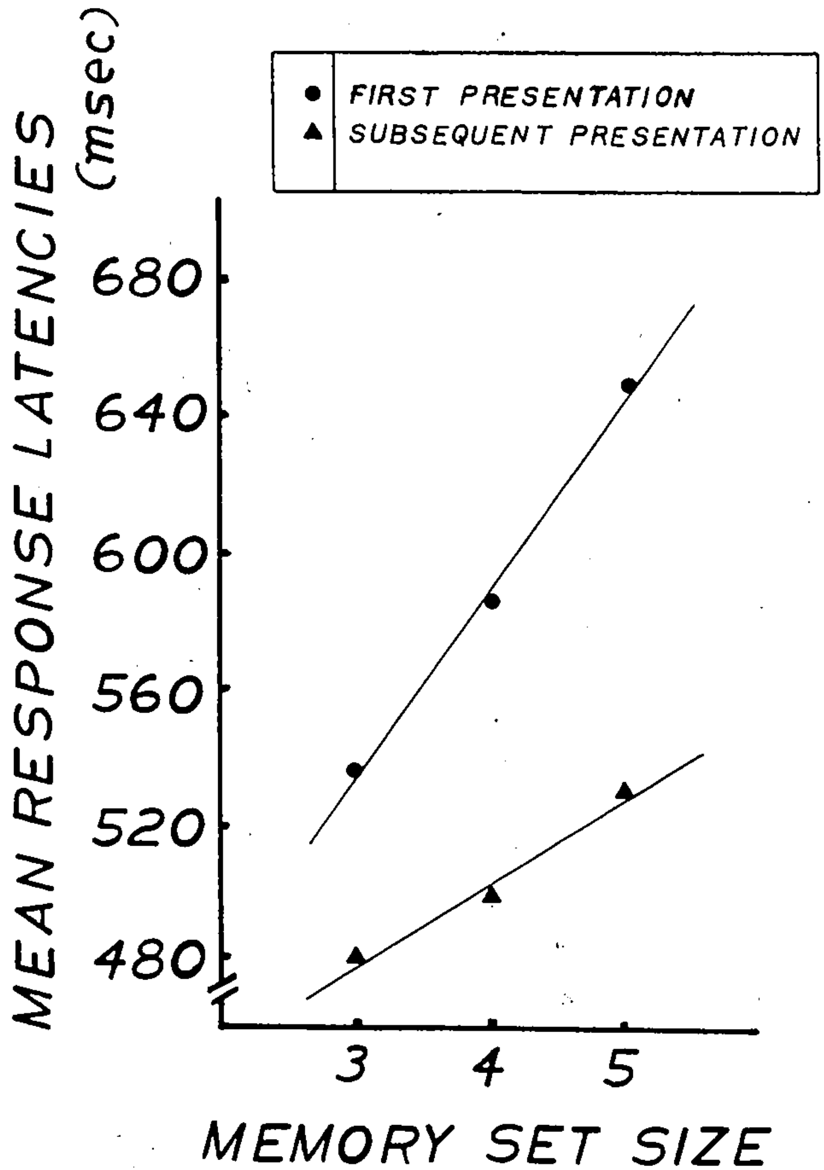
S#	s=3	s=4	s=5	linear slope	intercept
1	504.91	520.32	705.23	100.16	176.18
2	605.70	609.66	732.51	63.41	395.67
3	515.85	559.19	618.09	51.12	359.90
4	418.31	461.24	493.41	37.55	307.45
5	367.45	386.87	455.14	43.85	227.77
6	518.92	545.43	636.77	58.93	331.34
x	488.52	513.79	606.86	59.17	299.71

functions obtained on subsequent presentations.

In Figure 44, the overall positive mean response latencies for first presentation and for subsequent presentations of these items over the six days of the experiment and over all subjects are shown plotted against positive set size. Table 40 provides a summary of these data for the individual subjects and the slope and intercept values for the resulting item recognition functions are shown. From the data, it appears that repetition of the positive probe items increased the likelihood of a fast response occurring. It can be seen that (1) for all subjects, mean RTs were faster on subsequent presentations than on first presentation [$F(1,5)=33.55$, $p=.003$] and (2) with the exception of one subject, positive slopes markedly decreased with subsequent presentations [$F(1,5)=3.63$, $p=.11$]. Further, subsequent presentations seemed to have no systematic influence on the intercept values [$F(1,5)=.57$, $p=.51$] which leads to the inference that overall, the effect of repetition is primarily located at the memory scanning stage.

In viewing Figure 45, where the .25 positive mean response latencies for first presentation and for subsequent presentations are shown plotted against positive set size, a similar effect of repeated presentations on slopes and response latencies was observed for these frequently occurring positive items. Here, the slope of the .25 positive response function for initial presentation (i.e. 55.36 msec./item) was much larger than the slope of the .25 positive response function for subsequent tests (i.e. 12.5 msec./item). Although the decrease in slope with repetition was not significant [$F(1,5)=1.6$, $p=.26$], this change was quite reliable for individual subjects. With

Figure 44: Positive mean response latencies for first and subsequent presentations in Experiment 4 are shown plotted against memory set size. Least squares best fitting straight lines are drawn through each set of data.



Mean RTs for First and Subsequent Presentations

Table 40: The individual subjects' positive mean response latencies for first presentation and for subsequent presentations of target items are summarized over the six days of Experiment 4 for each set size separately. Also provided are the slope and intercept values for the resulting item recognition functions.

FIRST PRESENTATION

S#	s=3	s=4	s=5	linear slope	intercept
1	527.41	655.43	652.73	62.66	361.22
2	675.00	699.55	891.70	108.35	322.02
3	552.83	664.91	649.85	48.51	428.49
4	523.19	487.70	566.00	21.41	440.01
5	421.00	413.00	428.12	3.56	406.47
6	515.63	587.43	703.95	94.16	225.70
x	535.84	584.67	648.73	56.45	363.97

SUBSEQUENT PRESENTATIONS

S#	s=3	s=4	s=5	linear slope	intercept
1	504.86	492.33	585.12	40.13	366.92
2	594.50	603.73	617.62	11.56	559.04
3	512.06	542.26	556.80	22.37	447.56
4	418.58	441.91	448.82	15.12	375.96
5	360.20	379.88	407.29	23.55	288.28
6	496.67	536.60	563.33	33.33	398.88
x	481.15	499.45	529.83	24.34	406.12

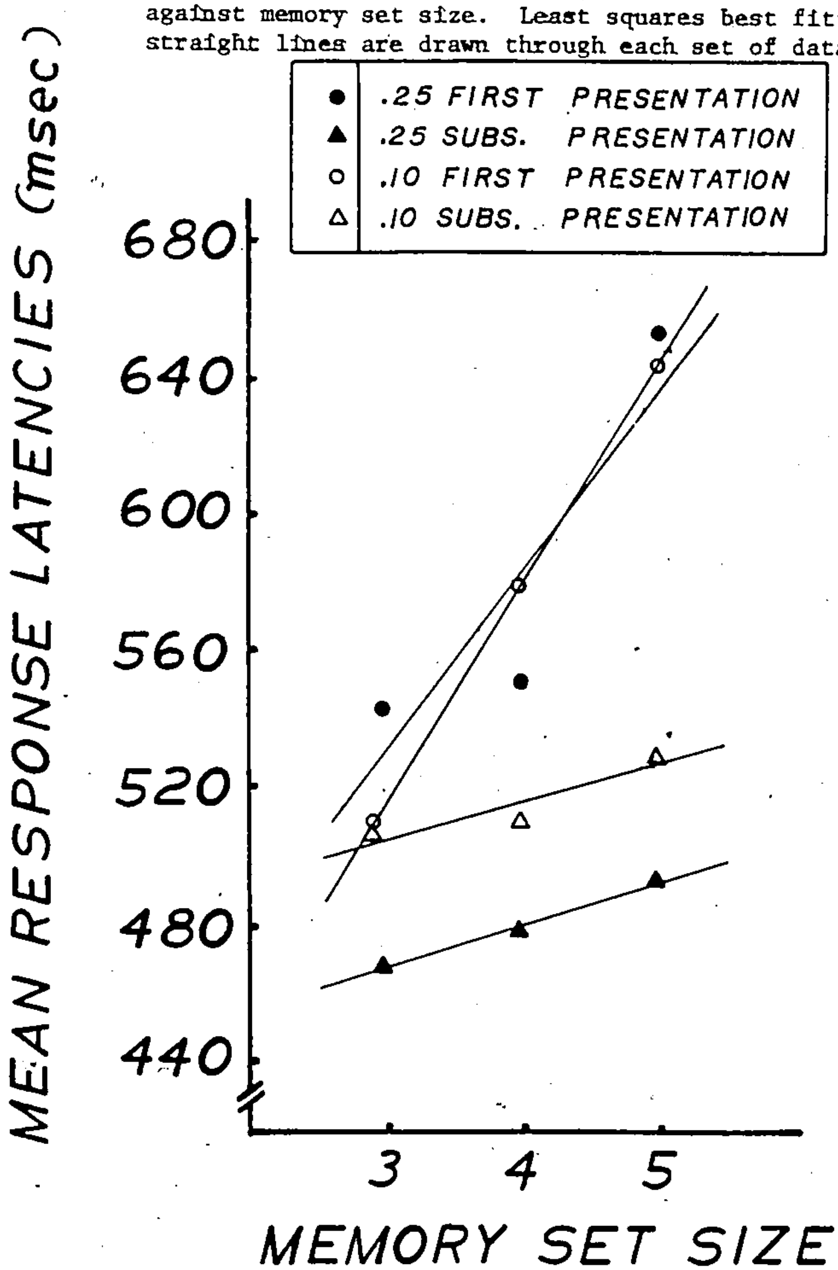
the exception of one subject, there was a decrease in the .25 positive slope for subsequent presentations. The slope data also correspond nicely with the response latencies obtained for first and for subsequent presentations of the .25 probed items. a significant decrease in response latency was observed with repetition $[F(1,5)=17.48, p=.009]$. Table 41 provides a summary of these data for the individual subjects.

Also shown in Figure 45, are the .10 positive mean response latencies for first and subsequent presentations plotted against positive set size. Table 42 provides a summary of these data for the individual subjects. The findings once again showed that (1) the mean RTs were faster on subsequent presentations than on first presentation $[F(1,5)=16.83, p=.01]$ and (2) with the exception of two subjects, the .10 positive slopes dramatically decreased with subsequent presentations $[F(1,5)=4.44, p=.088]$.

While there was a tendency for the .25 positive and the .10 positive intercepts to <u>increase</u> with subsequent presentations (see Tables 41 and 42) these findings did not approach significance ($[F(1,5)=.3, p=.61]$ and $[F(1,5)=2.8, p=.2]$ for the .25 and .10 positive intercepts, respectively).

In terms of the familiarity model, the findings of Experiment 4 support the supposition that repetition of a positive probed item will result in shifts of the probability density functions along the familiarity continuum (i.e. an increase in familiarity). In contrast to the overall positive response trials, the findings revealed that the .25 positive and the .10 positive probability density functions changed similarly with repetition. The findings of a nonsignificant interaction

Figure 45: Positive .25 and .10 mean response latencies for first and subsequent presentations in Experiment 4 are shown plotted against memory set size. Least squares best fitting straight lines are drawn through each set of data.



.25 Mean RTs for First and Subsequent Presentations

Table 41: The individual subjects' positive .25 mean response latencies for first presentation and for subsequent presentations of target items are summarized over the six days of Experiment 4 for each set size separately. Also provided are the slope and intercept values for the resulting item recognition functions.

FIRST PRESENTATION

S#	s=3	s=4	s=5	linear slope	intercept
1	507.33	468.67	540.33	16.50	439.44
2	650.33	683.33	914.00	131.84	221.88
3	580.33	609.33	834.50	127.09	166.38
4	656.00	477.00	485.67	-85.17	880.22
5	384.17	433.33	471.17	43.50	255.56
6	487.67	631.83	684.50	98.42	207.67
x	544.31	550.58	655.03	55.36	361.87

SUBSEQUENT PRESENTATIONS

S#	s=3	s=4	s=5	linear slope	intercept
1	504.31	451.42	533.52	14.61	438.00
2	571.99	584.65	576.59	2.30	568.54
3	497.67	516.73	535.30	18.82	441.31
4	408.52	426.17	427.78	9.63	382.30
5	345.36	366.49	375.23	14.94	302.62
6	484.41	526.78	513.77	14.68	449.60
x	468.71	478.71	493.70	12.50	430.39

.10 Mean RTs for First and Subsequent Presentations

Table 42: The individual subjects' positive .10 mean response latencies for first presentation and for subsequent presentations of target items are summarized over the six days of Experiment 4 for each set size separately. Also provided are the slope and intercept values for the resulting item recognition functions.

FIRST PRESENTATION

S#	s=3	s=4	s=5	linear slope	intercept
1	544.60	681.91	581.80	18.60	528.37
2	648.40	596.00	706.75	29.18	533.68
3	533.83	696.40	635.60	50.89	418.40
4	452.40	512.25	633.33	90.47	170.80
5	396.80	416.45	403.60	3.40	392.02
6	485.50	568.09	907.33	210.92	-190.02
x	510.26	578.52	644.74	67.24	308.88

SUBSEQUENT PRESENTATIONS

S#	s=3	s=4	s=5	linear slope	intercept
1	508.12	510.16	570.43	31.16	404.95
2	645.86	610.35	601.78	-22.04	707.49
3	546.38	551.57	530.27	-8.06	574.96
4	449.40	458.92	460.55	5.58	433.99
5	395.05	385.04	423.31	14.13	344.61
6	497.66	544.01	603.60	52.97	336.54
x	507.08	510.01	531.66	12.29	467.09

between the slopes of the .25 and the .10 positive probed trials for first and subsequent presentations [$F(1,5)=.09$, $p=.77$] and a nonsignificant interaction between the response latencies of the .25 and the .10 positive probed trials for first and subsequent presentations [$F(2,10)=.54$, $p=.60$] suggest that the probability of bypassing the memory scanning stage (i.e. the probability of a fast response) was the same for both sets of data.

It appears, then, that the supposition that the more frequently a positive item is probed, the less likely that an exhaustive search of the memory list will be made, is able to provide a somewhat more interpretable framework for the .10 positive probed items in Experiment 4. However, this statement is not to be taken to imply that repetition is a better determinant of familiarity than is lag length. For example, when the positive .25 items were probed at a short lag interval (i.e. 0-2 intervening items) a significantly smaller slope was obtained for these positive items than when they were probed at a long lag interval (i.e. 8-10 intervening items). Although the findings were in the right direction, a nonsignificant effect on slope with repetition was observed for these same items.

Further, although in all cases examined, it was found that as frequency of presentation of the individual items decreased, mean RTs significantly increased (see Figure 43), this was not true for the positive .25 and .10 response trials. When a comparison was made between the .25 positive and .10 positive mean response latencies, an analysis of variance revealed that the .25 positive mean RTs were not significantly faster than the .10 positive mean RTs [$F(2,10)=.18$, $p=.84$].

These findings are quite meaningful given the previous finding in Experiments 2 and 3 where lag length was not controlled. In Experiment 2, a mean response latency of 503 msec. for the .25 positive item in the set size of 3 was significantly smaller than the mean response latency of 535 msec. for the .10 positive item in the set size of 3 [$F(1,11)=36.5$, $p=.0002$] . Similarly, in Experiment 3 for the set size of 5, the response latencies of 519 msec. and 561 msec. for the positive .25 and .10 items, respectively, also differed significantly [$F(1,11)=26.67$, $p=.0005$] .

In examining these data, it must be questioned, then, whether or not similar changes in the .25 positive and the .10 positive probability density functions with repetition would have occurred had lag length <u>not</u> been manipulated. Would a significant interaction between s and P (as was found in Experiment 3, where P was held constant across s at .25 and .05) been revealed here? In other words, what absolute effect did controlling for lag length for the .25 and .10 positive probed items have on the memory scanning stage?

It is obvious, given the design of Experiment 4, that these questions cannot be answered here. Answers to these questions require an experiment which directly focuses on this issue. For example, a between subjects design could be employed, where for half of the subjects the P levels, .25 and .10, are held constant across s and lag length is controlled for these positive items (case 1); whereas, for the remaining subjects, positive items having a P value of .25 and .10 are held constant across s but lag length is not controlled (case 2). However, a within subjects design could also be employed where on some days subjects are given the task as outlined in case 1 and on other days these same subjects are given the task as outlined in case 2.

At the same time, though, it should be noted that there may be other determinants of familiarity besides that of lag length and repetition.

6.4.5 Summary of the lag length effect and repetition effect on memory scanning for the negative probed items

For the data of Experiments 2, 3 and 4, it was shown that regardless of how frequently a positive item was repeated, a short lag length more often generated a fast response, whereas a long lag length more often generated a response which was longer in latency. In terms of the assumptions outlined previously (i.e. Introduction, Part 2), a reciprocal finding was expected for the negative probed items. In short, it was predicted that a short lag length should more often generate a familiarity value between the criteria C_0 and C_1, and result in producing longer response latencies; whereas, a long lag length should more often generate a familiarity value which lies below the criterion C_0, and thus produce fast negative responses. Secondly, this should be independent of the size of the set from which a negative item is probed: for negative probed items, the shorter the lag length the larger should be the slope and the longer the length the smaller should be the slope.

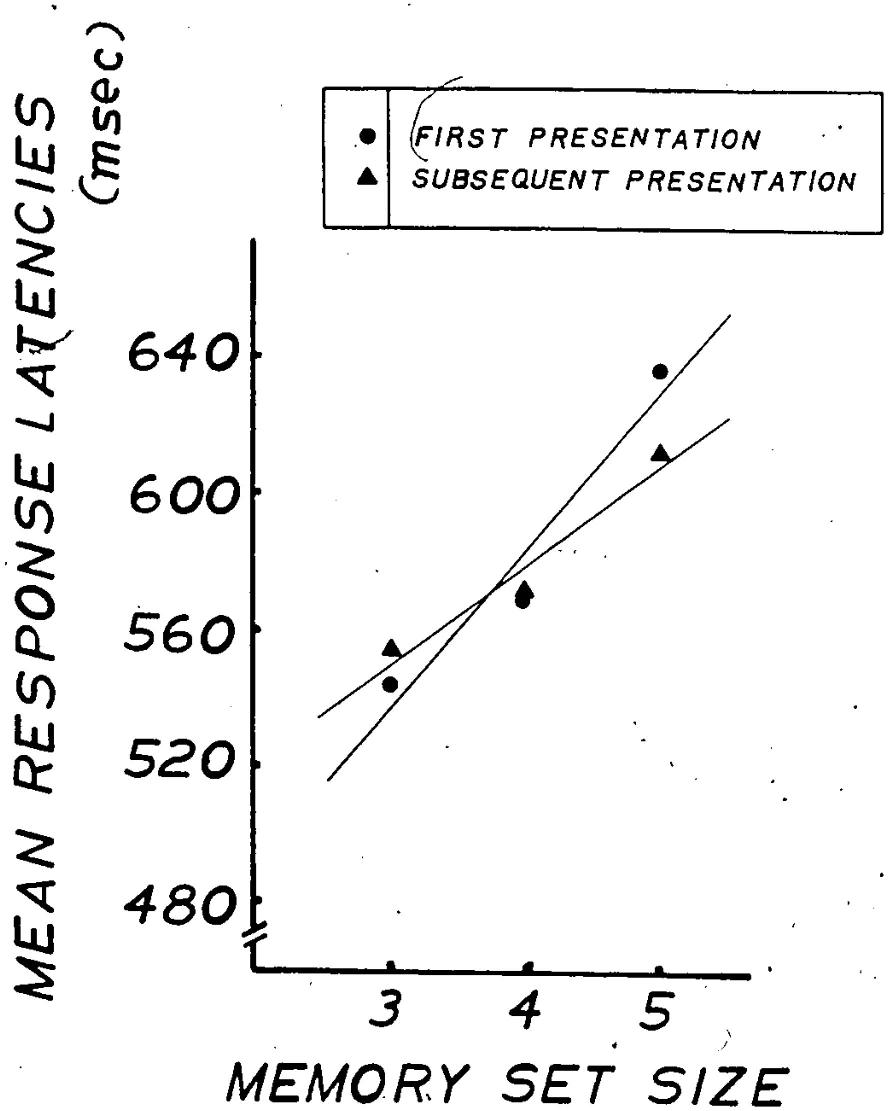
However, when the negative mean RTs for the lag lengths 0-4, 5-9, 10-19, 20-29 and 30 or more were examined for the data in Experiments 2 and 3, the expected decrease in the negative mean RTs

(and hence slopes) with lag length increases was not observed. This was also true of the negative probed trials in Experiment 4 (see Figure 42 and Table 33); no systematic changes were observed in the negative response latencies with increases in lag length.

To test whether or not repetition per se is having a significant influence on the negative response latencies (i.e. resulting in an increase in RT), an analysis of variance was performed on the negative mean response latencies where the within variables were (1) first and subsequent presentations and (2) the positive set sizes 3, 4 and 5. Only the main effect of set size was significant [$F(2,10)=22.96$, $p=.0004$] . It can be seen from Figure 46, where the negative mean response latencies for first presentation and for subsequent presentations, summarized over the six days of the experiment and across all subjects, are shown plotted against positive set size that for both sets of data, mean RTs markedly increased with set size increases. Further, it is quite apparent from the summary of these data for the individual subjects shown in Table 43, that repetition had little influence on the negative mean RTs. Here, it can be seen that a significant increase in the negative mean RTs with subsequent presentations did not result [$F(1,5)=.23$, $p=.66$] .

The finding that neither lag length nor repetition per se seems to have a systematic influence on the negative response latencies, suggests that neither lag length nor repetition has an effect on the negative items but if so, this effect is transient and not comparable to the large effect these same variables have on the positive probed items. Juola et al. (1971) and Young and Juola (1977) stated a similar conclusion when

Figure 46: Negative mean response latencies for first and subsequent presentations in Experiment 4 are shown plotted against memory set size. Least squares best fitting straight lines are drawn through each set of data.



First and Subsequent Presentations for Negative Mean RTs

Table 43: The individual subjects' negative mean response latencies for first presentation and for subsequent presentations are summarized over the six days of Experiment 4 for each set size separately.

FIRST PRESENTATION

S#	s=3	s=4	s=5
1	505.04	576.80	640.19
2	698.64	676.35	726.70
3	581.67	617.26	688.54
4	462.99	501.46	525.13
5	435.91	440.38	512.84
6	580.23	596.64	728.95
x	544.08	568.15	637.06

SUBSEQUENT PRESENTATIONS

S#	s=3	s=4	s=5
1	555.14	561.41	658.94
2	712.22	720.69	734.89
3	574.44	604.75	631.61
4	473.81	490.50	505.62
5	432.20	450.89	490.46
6	576.61	598.51	651.91
x	554.07	571.13	612.24

they failed to find a significant increase in the set size effect for subsequent presentations of the negative probed items. Since in the present investigation (1) the size difference between the number of positive and negative items in each set was quite substantial, (2) it was the positive set items subjects were shown to memorize, and (3) the frequency in which the negative items were probed was very low (i.e. P = .05), (resulting in very few trials contributing to each lag interval for any given negative item on each day), it seems reasonable to expect that there would be minimal changes in a negative probe item's familiarity value with changes in lag length and for that matter, with repetition. There are studies (i.e. Juola et al., 1971; Atkinson & Juola, 1973, 1974), where a negative probe item's familiarity value has been reported to significantly increase with repetition and with changes in lag length which support this view. Juola et al. (1971), for example, gave subjects lists of either 16, 24 or 32 words. Subjects were asked to make either a positive or negative response to test items which were probed over a test sequence of 80 consecutive trials. In their experiment, test trials were divided into four blocks so that (1) for block I, four positive and four negative words were probed, (2) for block II, the above four positive and four negative words were repeated plus four new positive and four new negative words were probed, (3) for block III the above eight positive and eight negative words were repeated plus four new positive and four new negative words were probed and, similarly, (4) for block IV, the above 16 positive and 16 negative words were repeated plus four new positive and four new negative words were probed. It can be seen, then, that the test trials were arranged in such a way that (1) the negative items were probed as frequently as the positive items, (2) the frequency with which some of the negative items were probed was relatively high and (3) the number of intervening items between repeated presentations of a negative (and a positive) item systematically increased over blocks of trials. Whether a significant increase in familiarity would have been observed had frequency of occurrence and lag length been manipulated for the negative items, remains to be tested.

However, the possibility remains that there are other determinants of familiarity which are, in an additive or interactive manner, influencing the memory scanning process.

SUMMARY OF PART 2

Experiments 1 through 3 (i.e. Part 1) were designed to examine the possibility that the increase in RT with increases in s (which has been attributed to set size) is in whole or in part, an effect of variations in the frequency of occurrence. Using the additive-factors method it was found that when values of P were held constant across s where P levels equalled .25 and .05, a significant difference was found between the slope of these two functions indicating that the increase in RT with increases in s can be largely attributed to frequency of occurrence. The finding of a significant interaction between P and s, then, strongly suggested that the serial and exhaustive scanning model, as proposed by Sternberg, is unable to handle the effects of P. Instead, the general features of the data reconciled reasonably well with the familiarity model where it is hypothesized that subjects do not perform an exhaustive search of the memorized list on every trial. Here, it is assumed that repetition of an item as a probe will result in an increase in its familiarity measure and, thereby, increase the likelihood that a fast positive response will be made.

In determining whether or not changes are occurring in a probe item's familiarity value over time, previous investigators have usually compared response latencies obtained from probed items on first presentation to those obtained on subsequent presentations: in other words, to test whether or not repetition is a major determinant of familiarity.

The data of Experiments 2 and 3 were examined in these terms, and it was found that when an item was probed frequently, there was a substantial change over time in both the set size effect and mean response latency value. In contrast, little or no change was observed in slopes and response latencies with subsequent presentations for positive items which were probed infrequently.

However, it was felt that under these conditions, repetition per se was a rather vague definition of familiarity and it was questioned what aspects of repetition determine familiarity. If repetition is simply the number of times a probe item has been presented, then a likely determinant of familiarity would be frequency of occurrence.

One variable though, which covaries with frequency of occurrence and which was the primary concern of Part 2, is lag length. It was noted that when a frequently occurring positive item and an infrequently occurring positive item are found in each set size, the range of the lag length intervals differs markedly between these two sets of items. More precisely, the lag length interval for frequently probed positive items on the average is much shorter (i.e. 0-4 intervening items) than the lag length interval for infrequently positive probed trials (i.e. 20 or more intervening items). It was thought that if a greater number of the infrequently probed positive trials were of a shorter lag length and a greater number of the frequently probed positive trials were of a longer lag length, similar changes in slopes and response latencies with subsequent presentations would be observed for these two items. If so, then the relatively large set size effect generally reported for positive items in the standard item recognition task, where there is a complete confounding between s and P and where the average number of trials contributing to a short lag length decreases markedly with set size increases, could be readily explained.

Experiment 4, then, was designed to investigate the importance of lag length in the item recognition task, where (1) the probabilities .25 and .10 were assigned to at least two items within each set size, and (2) for some of the trials, the positive .25 items and the .10 items were probed after 0-2 intervening items (short lag) and for other trials, the positive .25 items and .10 items were probed after 8 to 10 intervening items (long lag). Although it would have been ideal to control lag length for positive items where the probabilities .25 and .05 were held constant across s (given the significant interaction revealed between s and P in Experiment 3), this was not possible. In order to (1) have enough trials to draw conclusions on the importance of lag length and (2) determine whether the number of times an item is probed at a particular lag interval (i.e. repetition) is also an important variable, the probabilities .25 and .10 had to be held constant across set size instead.

In terms of the variable lag length, it was predicted that regardless of whether a positive item has a probability of .25 or .10, a short lag length should more often generate fast positive responses; whereas, a long lag length should more often result in producing longer response latencies. Further, this should hold true regardless of the size of the set from which a positive item is probed. Hence, the set size effect should also be influenced by lag length, in that the shorter the lag length, the smaller should be the slope, and the longer the lag length, the larger should be the slope.

While for the most part, the data of Experiment 4 indicated that lag length strongly influences item recognition performance, the finding that the slope of the long-.10 lag item recognition function was smaller than the slope of the short-.10 lag item recognition function made it clear that the variable lag length is not the sole determinant of familiarity (i.e. the positive set size effect).

Although the interaction between lag length (i.e. 0-2 vs 8-10 intervening items) and frequency of occurrence (i.e. P=.25 vs P=.10) was not significant, several aspects of the data did suggest that the number of times a positive item is probed is a second variable which in addition to lag length determines familiarity. In summary, a very large set size effect, which could not be accounted for by lag length alone, was obtained for positive items where (1) lag length had not been controlled and (2) the confounding of s by P was present. Secondly, in all cases examined, the data supported the supposition that repetition of a positive probe item will result in shifts of the probability density function along the familiarity continuum (i.e. an increase in familiarity), thus increasing the likelihood of a fast positive response occurring (i.e. a bypassing of the memory scanning stage). Further, the finding of a nonsignificant interaction between the slopes of the .25 and the .10 positive probed trials for first and subsequent presentations and a nonsignificant interaction between the response latencies of the .25 and the .10 positive probed trials for first and subsequent presentations, suggesting that the probability of bypassing the memory scanning stage was the same for both sets of data.

However, it was questioned whether or not similar changes in the .25 positive and the .10 positive probability density functions with repetition would have occurred had lag length not been controlled for these positive items. In other words, what effect did the controlling for lag length for the .25 and the .10 positive probed items have on the memory scanning stage? To determine this, it is obvious that a further experiment would have to be completed in order to examine the effect of repetition on the .25 and the .10 positive items when the confounding of lag length is present and when it is not.

While it can be concluded that the familiarity model is partially correct in assuming that repeated presentations of a positive item as a probe increases the familiarity value of that item, it is not totally clear to what extent the variable, lag length, is influencing these changes. It is obvious though, from the data in Experiments 2, 3 and 4, that lag length is one important determinant of familiarity, at least for the positive probed items. Whether the assumptions underlying the familiarity model also apply to negative probed items, however, is still to be tested. There is the possibility that had some of the negative items been probed more frequently and had lag length been controlled more systematically, an increase in familiarity would have been obse..ed for negative probed items with repetition and with decreases in lag ·ngth.

APPENDIX 1

Instructions read to each subject on day one for experiments performed on the 3-Field Tachistoscope (Experiment 1 and the experiments reported in Appendices 2, 3 and 5)

Instructions

Day 1

Adjust the subject's chair and show him how he should place his face against the viewing hood during the experiment. Determine whether the subject is right or left handed. In the experiment the subject will always use the preferred hand to make the positive responses. Show the subject how he should keep his hands positioned so that his index fingers are always making contact with the telegraph keys.

"In this experiment you will first be asked to memorize some digits (letters). Then on each trial, you will first see a black dot. Keep your eyes fixated on the dot. After a short time, the dot will be replaced by a digit (letter). If the digit (letter) is the same as any of the digits (letters) you have memorized, press the right hand (left hand) key as quickly as possible. If the digit (letter) is not one that you have memorized, press the left hand (right hand) key. If you have responded correctly, you will hear one auditory tone (demonstrate). If your response is incorrect, you will hear two auditory tones (demonstrate)."

"Do you have any questions?"

"All right - here are the digits (letters) you are to memorize for the first group of trials. (Place card containing the memory set before the subject.) On each of the following trials, if the digit (letter) you see in the same as one of those you have been given to memorize, press the right hand (left hand) key. If the digit (letter) is not one you have been given to memorize, press the left hand (right hand) key. Both speed and accuracy are important. Respond as quickly as you can without making errors."

Day 2

"The task is the same today as yesterday, but today the sets of digits (letters) have changed."

Instructions read to each subject on day one for experiments performed on the Apple II computer (Experiments 2, 3 and 4)

Instructions

Day I

Adjust the subject's chair and show him the TV screen he will be viewing during the experiment. Determine whether the subject is right or left handed and adjust the buttons so the preffered hand makes the positive responses. Show the subject how he should keep his hands positioned so that his index finger is always making contact with the buttons.

24 Practice Trials

"To familiarize you with this experiment, I have included today, some practice trials where you will be asked to memorize three digits or numbers. Read the TV screen carefully. When you are ready to begin a series of trials, you must press the space bar (press space bar). Displayed on the TV screen are the three numbers you are to remember. Copy these numbers down in case you will need to refer to them later. On each trial you will first see a white dot. Keep your eyes fixed on the dot and have your index fingers, at all times, making contact with the response buttons. After a short time, the dot will be replaced by a number. If the number is the same as any of the numbers you have memorized, press the right hand (left hand) button as quickly as possible. If the number is not one you have memorized, press the left hand (right hand) button as quickly as possible. If you have responded correctly, you will hear one auditory tone. If your response was incorrect, you will hear two auditory tones."

"Remember, both speed and accuracy are important. Respond as quickly as you can without making errors. Do you have any questions?"

"All right - let's do the practice trials. Read the TV screen carefully. It tells you to copy these three digits down and when you are ready to begin, press the space bar. Immediately reposition your index fingers on the response buttons and keep your hands in this position throughout the series of trials and keep your eyes fixed on the TV screen."

24 practice trials are done by subject

"Are there any questions?"

Experimental Trials

"The following experiment is slightly different. The task is the same, but now you will be working with letters. Before each group of trials, you will be given a new group of letters to memorize. Remember to write down the letters and refer to these letters if necessary. Once a series of trials is finished, discard the letters. A short break is given between the groups of trials and a loud auditory noise will sound when the break is finished. Then a new set of letters will appear on the screen. Again, remember both speed and accuracy are important. Respond as quickly as you can without making errors."

"Do you have any questions?"

Day 2

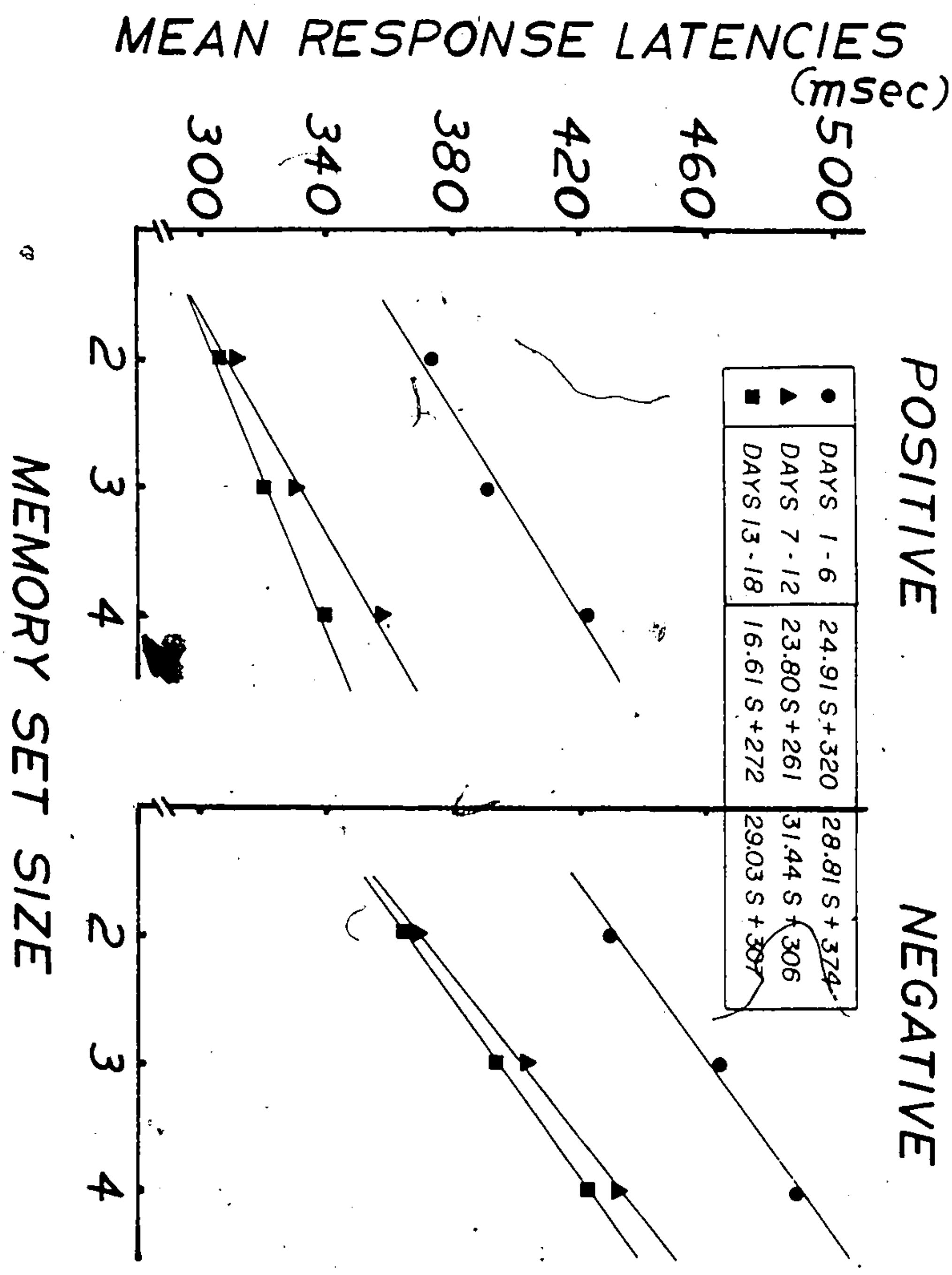
"The task is the same today as yesterday, but today the sets of letters have changed."

Appendix 2: A Replication of Experiment 1

The following data and corresponding analyses relate to a preliminary experiment which was carried out prior to Experiment 1. Essentially the design and method are identical to Experiment 1 with the following exceptions: (1) each of the six possible orders of the three set sizes was counterbalanced across five subjects over each of three successive 6-day periods (i.e. 18 days); and (2) the order of the individual items on the subjects' memory cards matched the order of the descending P values assigned to each item.

Despite the additional confounding between the order of P values and order of memory items given to the subjects, the implications of this study were essentially the same as those described in Experiment 1: that the increase in RT, which has been attributed to s, can be accounted for largely by a decrease in the frequency of occurrence of each positive item as the set size increases. However, in this study, an insignificant effect of positive set size was obtained for items where P was held constant at .15 over set size.

Figure 47: Mean response latencies are plotted against positive set size for each successive 6-day period, for negative and positive responses separately over all five subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.


MEAN RESPONSE LATENCIES (msec)
300
340
380
420
460
500
POSITIVE
NEGATIVE
DAYS 1-6
DAYS 7-12
DAYS 13-18
24.91 S+320
23.80 S+261
16.61 S+272
28.81 S+374
31.44 S+306
29.03 S+307
2
3
4
2
3
4
MEMORY SET SIZE

Positive Mean RTs

Table 44a: Individual subjects' mean response latencies for positive responses are shown summarized over successive 6-day blocks for each set size. Also shown are the corresponding slopes and coefficients of determination for each set of data.

S#	s=2	s=3	s=4	linear slope	r^2
Days 1-6					
1	382.65	405.44	416.58	16.96	.9622
2	433.03	470.01	505.54	36.26	.9999
3	332.77	350.40	376.03	21.63	.9887
4	356.09	356.31	397.92	20.92	.7539
5	355.71	369.15	413.22	28.76	.9136
x	372.05	390.26	421.86	24.91	.9765
Days 7-12					
1	318.10	343.71	351.44	16.67	.9125
2	287.07	314.68	335.41	24.17	.9933
3	292.76	313.91	342.82	25.03	.9921
4	313.94	333.10	376.26	31.17	.9529
5	336.42	339.09	380.34	21.96	.7954
x	309.66	328.90	357.27	23.80	.9879
Days 13-18					
1	305.43	325.43	349.45	22.02	.9972
2	278.39	299.14	318.14	19.88	.9994
3	299.47	301.58	317.17	8.85	.8381
4	335.87	347.83	372.12	18.13	.9629
5	311.25	323.51	339.61	14.19	.9939
x	306.08	319.50	339.30	16.61	.9879
Summary of the data over Days 1-18					
1	335.39	358.19	372.49	18.55	.9828
2	332.83	361.28	386.36	26.77	.9987
3	308.33	321.96	345.34	18.50	.9774
4	335.30	345.75	382.10	23.41	.9074
5	334.46	343.92	377.72	21.64	.9045
x	329.26	346.22	372.80	21.77	.9840

Table 44b: Individual subjects' mean response latencies for negative responses are shown summarized over successive 6-day blocks for each set size. Also shown are the corresponding slopes and coefficients of determination for each set of data.

S#	s=2	s=3	s=4	linear slope	r^2
Days 1-6					
1	417.87	456.75	456.02	19.08	.7357
2	522.06	560.98	622.46	50.20	.9834
3	373.83	408.00	434.52	30.35	.9947
4	406.99	416.96	446.87	19.94	.9231
5	431.53	476.00	480.53	24.50	.8187
x	430.46	463.74	488.08	28.81	.9920
Days 7-12					
1	351.43	412.60	417.28	32.92	.8030
2	366.40	391.67	427.35	30.48	.9904
3	368.12	390.77	402.96	17.43	.9708
4	363.89	394.43	448.75	42.43	.9745
5	390.55	423.95	458.47	33.96	.9999
x	368.08	402.68	430.96	31.44	.9966
Days 13-18					
1	355.45	387.14	421.40	32.98	.9995
2	349.12	380.77	407.06	28.97	.9972
3	360.07	382.59	399.25	19.59	.9926
4	392.02	415.43	474.14	41.06	.9420
5	367.67	400.05	412.78	22.56	.9405
x	364.87	393.20	422.93	29.03	.9998
Summary of the data over Days 1-18					
1	374.92	418.83	431.57	28.33	.9083
2	412.53	444.47	485.62	36.55	.9947
3	367.34	393.79	412.24	22.46	.9895
4	387.63	408.94	456.59	34.48	.9536
5	396.58	433.33	450.59	27.01	.9584
x	387.80	419.87	447.32	29.76	.9980

Analysis of Variance

performed on mean response latencies calculated over successive 6-day periods and for set sizes 2, 3 and 4

within variables: w(1): positive/negative mean RTs
w(2): successive 6-day periods
w(3): set size

Findings:
w(1): $F(1,4)=142.421$, $p=.001$
w(2): $F(2,8)=5.381$, $p=.0328$
w(3): $F(2,8)=78.816$, $p=.0001$
w(1,2): $F(2,8)=.381$, $p=.6988$
w(1,3): $F(2,8)=8.206$, $p=.0117$
w(2,3): $F(4,16)=.480$, $p=.7524$
w(1,2,3): $F(4,16)=1.234$, $p=.3358$

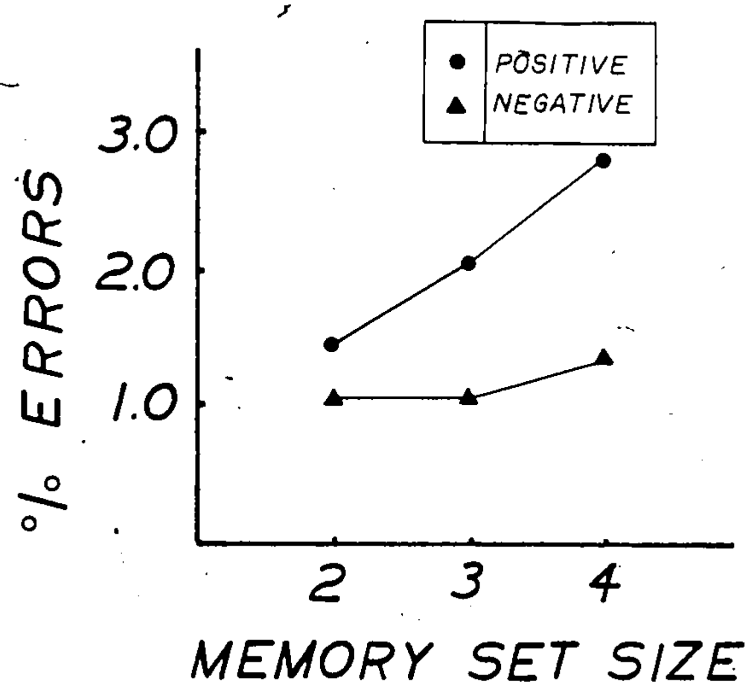
Analysis of Variance

performed on the slopes obtained from the positive and from the negative item recognition functions

within variables: w(1): positive/negative slopes
w(2): successive 6-day periods

Findings:
w(1): $F(1,4)=32.844$, $p=.0059$
w(2): $F(2,8)=.599$, $p=.5759$
w(1,2): $F(2,8)=1.249$, $p=.3379$

Figure 48: Mean percent errors are plotted against positive set size over days 1 to 18, for positive and negative trials separately over all five subjects.



Positive and Negative Percent Errors

Table 45: Individual subjects' percent errors for positive and negative responses are shown summarized over successive 6-day blocks for each set size separately.

	POSITIVE % ERRORS			NEGATIVE % ERRORS		
S#	s=2	s=3	s=4	s=2	s=3	s=4
Days 1-6						
1	1.00	1.00	.50	1.00	.00	.00
2	.50	.50	1.60	.50	.00	.50
3	1.60	2.60	3.60	1.00	1.00	2.60
4	1.00	1.00	2.10	.50	.00	1.00
5	2.60	1.60	3.10	3.10	3.10	2.60
x	1.34	1.34	2.18	1.22	.82	1.34
Days 7-12						
1	1.60	2.10	4.20	.00	.50	.00
2	1.60	4.70	4.70	2.10	2.10	.50
3	1.60	1.60	1.00	2.10	2.10	1.60
4	.00	1.60	1.00	.00	.50	1.00
5	1.60	1.60	3.10	2.10	2.60	2.10
x	1.28	2.32	2.80	1.26	1.56	1.04
Days 13-18						
1	1.00	1.00	4.20	.00	.50	1.00
2	2.60	2.60	5.70	.50	1.60	1.60
3	3.10	5.20	3.10	3.10	.00	2.60
4	.00	1.00	.50	.00	.50	.00
5	2.10	2.60	3.60	.00	1.60	3.10
x	1.76	2.48	3.42	.72	.84	1.66
Summary of the daya over Days 1-18						
1	1.20	1.37	2.97	.33	.33	.33
2	1.56	2.60	4.00	1.03	1.23	.87
3	2.10	3.13	2.57	2.07	1.03	2.27
4	.33	1.20	1.20	.17	.33	.67
5	2.10	1.93	3.27	1.73	2.43	2.60
x	1.46	2.05	2.80	1.07	1.07	1.35

Analysis of Variance
performed on positive and negative percent errors

within variables: w(1): positive/negative percent errors
w(2): successive 6-day periods
w(3): set size

Findings:

w(1):	F(1,4)=10.758, p=.0311
w(2):	F(2,8)=.618, p=.5665
w(3):	F(2,8)=20.735, p=.001
w(1,2):	F(2,8)=1.584, p=.2630
w(1,3):	F(2,8)=1.842, p=.2193
w(2,3):	F(4,16)=1.273, p=.3212
w(1,2,3):	F(4,16)=.374, p=.8247

Figure 49: Response variances for positive and negative trials plotted against set size as averaged over all 18 days and over all five subjects.

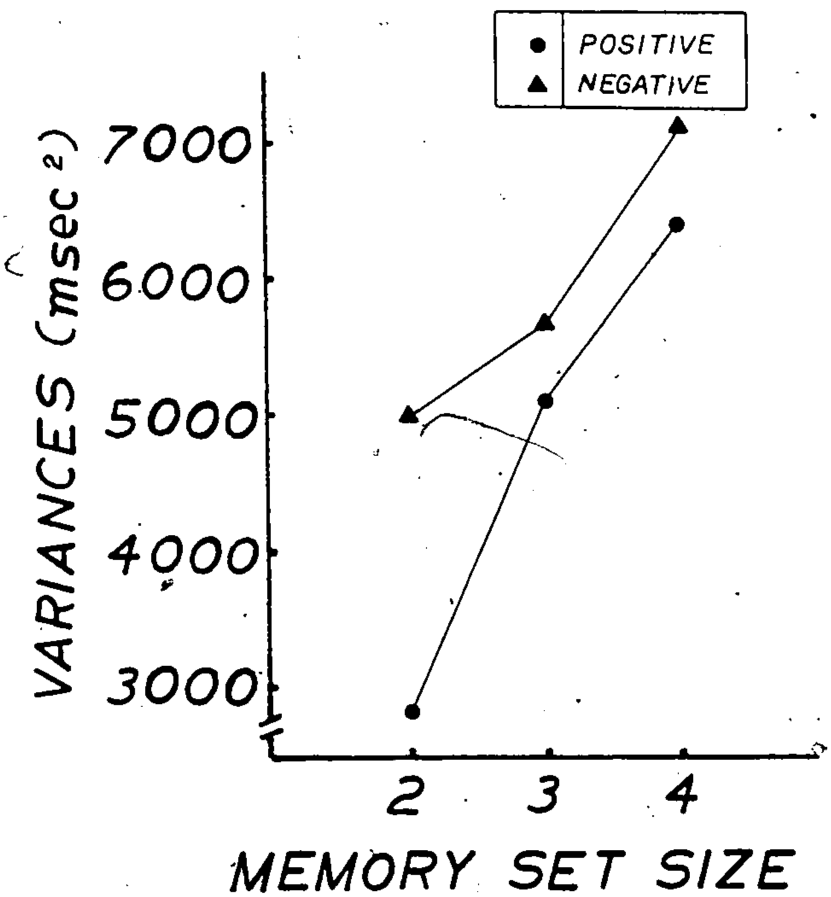


Table 46: Positive and Negative Variances

	POSITIVE VARIANCES			NEGATIVE VARIANCES		
S#	s=2	s=3	s=4	s=2	s=3	s=4
Days 1-6						
1	4275.86	9705.50	6646.99	6486.66	7629.14	6810.11
2	6018.14	16170.27	10285.61	9751.10	13097.14	18811.69
3	3029.60	3443.90	6841.99	7929.64	6150.27	4849.16
4	3956.70	5858.43	7573.83	7451.70	5138.86	6351.80
5	4529.64	8190.91	12319.69	16906.52	15486.46	10046.07
x	4361.99	8673.80	8733.62	9705.12	9500.37	9373.77
Days 7-12						
1	1793.66	5447.74	4515.69	2497.18	5637.24	4724.81
2	1839.93	4388.15	4990.91	2544.34	2487.68	5062.13
3	2280.68	3126.17	4451.29	2667.00	2799.88	3305.04
4	2489.42	3209.05	11059.06	3571.56	6781.73	11821.93
5	1948.32	2507.70	4173.49	3865.51	2999.65	6761.90
x	2070.40	3735.76	5838.09	3029.12	4143.24	6335.16
Days 13-18						
1	1811.22	3914.95	4799.10	2969.11	2697.75	5018.71
2	2056.73	2934.32	4333.34	1577.95	2424.21	3565.67
3	1732.43	2118.06	1990.76	2498.62	2983.35	2478.92
4	2176.93	3377.89	8521.35	2598.89	4261.86	11467.73
5	1735.85	2040.75	3734.84	2079.35	3924.30	5075.12
x	1902.63	2877.19	4675.88	2344.78	3258.29	5521.23
Summary of the data over Days 1-18						
1	2626.91	6356.06	5320.59	3984.32	5321.38	5517.88
2	3304.93	7830.91	6536.62	4624.46	6006.34	9146.50
3	2347.57	2896.04	4428.01	4365.09	3977.83	3544.37
4	2874.35	4148.46	9051.41	4540.72	5394.15	9880.49
5	2737.94	4246.45	6742.67	7617.13	7470.14	7294.36
x	2778.34	5095.58	6415.86	5026.34	5633.97	7076.72

Analysis of Variance
performed on positive and negative response variances

within variables: w(1): positive/negative variances
w(2): successive 6-day periods
w(3): set size

Findings: w(1): $F(1,4)=6.08$, $p=.0691$
w(2): $F(2,8)=7.431$, $p=.0151$
w(3): $F(2,8)=6.52$, $p=.0208$
w(1,2): $F(2,8)=2.478$, $p=.1448$
w(1,3): $F(2,8)=1.972$, $p=.2006$
w(2,3): $F(4,16)=1.143$, $p=.3721$
w(1,2,3): $F(4,16)=1.529$, $p=.2406$

Figure 50: Mean response latencies are plotted against positive set size for each successive 6-day period, for .15 positive responses for all five subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.

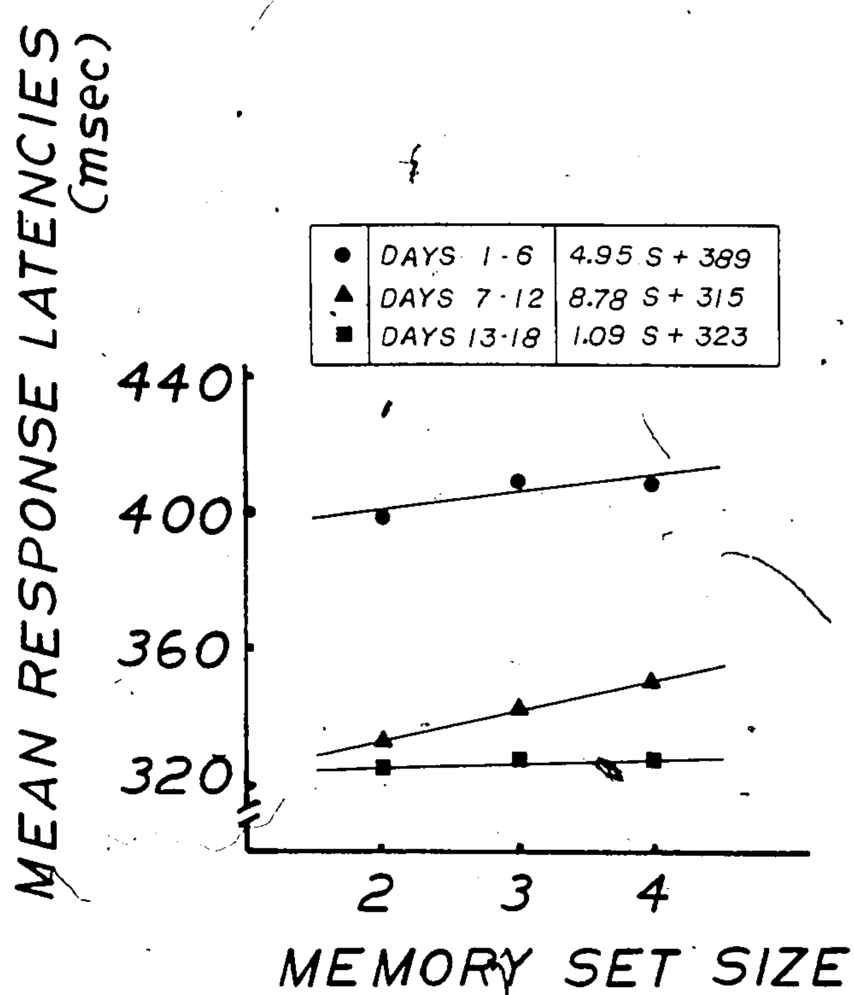


Table 47: Positive .15 Mean RTs

S#	s=2	s=3	s=4	linear slope
Days 1-6				
1	406.23	435.17	392.40	-6.92
2	464.43	478.97	488.98	12.28
3	343.12	344.24	359.94	8.41
4	398.20	397.18	384.50	-6.85
5	376.15	382.13	411.77	17.81
x	397.63	407.54	407.52	4.95
Days 7-12				
1	337.60	364.87	336.38	-0.61
2	311.66	339.28	327.39	7.87
3	318.38	310.99	347.40	14.51
4	336.28	343.94	353.88	8.80
5	358.22	345.72	384.91	13.35
x	332.43	340.96	349.99	8.78
Days 13-18				
1	326.74	330.22	327.93	0.60
2	307.94	312.49	302.96	-2.49
3	326.26	313.11	305.65	-10.31
4	350.88	354.36	351.55	0.34
5	311.78	326.17	346.38	17.30
x	324.72	327.27	326.89	1.09
Summary of the data over Days 1-18				
1	356.86	376.75	352.24	-2.31
2	361.34	376.91	373.11	5.89
3	329.25	322.78	337.66	4.20
4	361.79	365.16	363.31	.76
5	348.72	351.34	381.02	16.15
x	351.59	358.59	361.47	4.94

Analysis of Variance
performed on the mean response latencies of positive .15 items over successive 6-day periods and for set sizes 2, 3 and 4

within variables: w(1): successive 6-day periods
w(2): set size

Findings: w(1): F(2,8)=8.638, p=.0103
w(2): F(2,8)=1.060, p=.3923
w(1,2): F(4,16)=.798, p=.5455

Analysis of Variance
performed on slopes obtained from the .15 positive linear item recognition functions

within variables: w(1): successive 6-day periods

Findings: w(1): F(2,8)=1.264, p=.3341

Figure 51: Response variances for positive .15 trials are plotted against set size as averaged over all 18 days and over all five subjects.

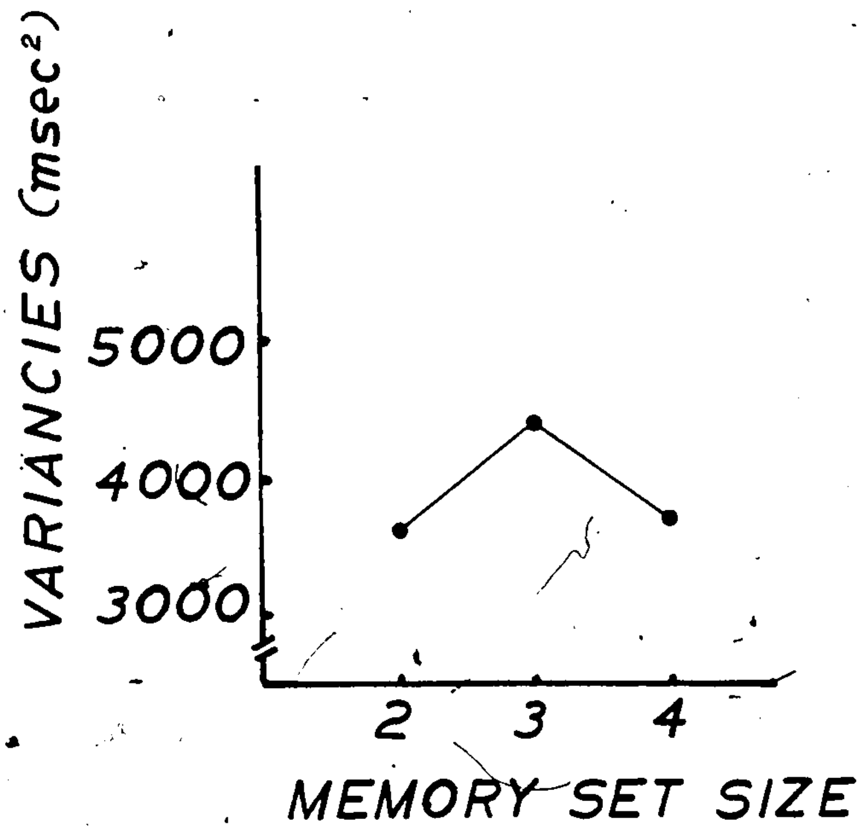


Table 48: Positive .15 Variances

S#	s=2	s=3	s=4
Days 1-6			
1	5542.72	8033.40	3003.90
2	9555.04	8585.59	5864.78
3	3014.78	2348.41	3439.30
4	6029.02	5649.03	5692.48
5	5060.43	9959.72	11716.41
x	5840.40	6915.23	5943.37
Days 7-12			
1	1702.23	5120.84	1136.57
2	2190.00	3323.41	3132.25
3	3580.53	3128.88	4569.42
4	3091.65	2464.78	3830.22
5	3217.01	3139.13	2963.27
x	2756.28	3435.41	3126.35
Days 13-18			
1	1884.64	1428.63	1809.69
2	2332.18	2796.67	2017.54
3	2153.03	3664.49	1294.75
4	2217.59	4117.42	3353.96
5	2083.81	2032.30	1899.66
x	2134.25	2807.90	2075.12
Summary of the data over Days 1-18			
1	3043.20	4860.96	1983.39
2	4692.41	4901.89	3671.52
3	2916.11	3047.26	3101.16
4	3779.42	4077.08	4292.22
5	3453.75	5043.72	5526.45
x	3576.98	4386.18	3714.95

Analysis of Variance
performed on the variances of the positive .15 response trials

within variables: w(1): successive 6-day periods
w(2): set size

Findings: w(1): $F(2,8)=9.573$, $p=.0079$
w(2): $F(2,8)=1.308$, $p=.3230$
w(1,2): $F(4,16)=.074$, $p=.9862$

Figure 52: Mean response latencies of the individual positive items is plotted against probability for each set size separately as averaged over all 18 days of the experiment.

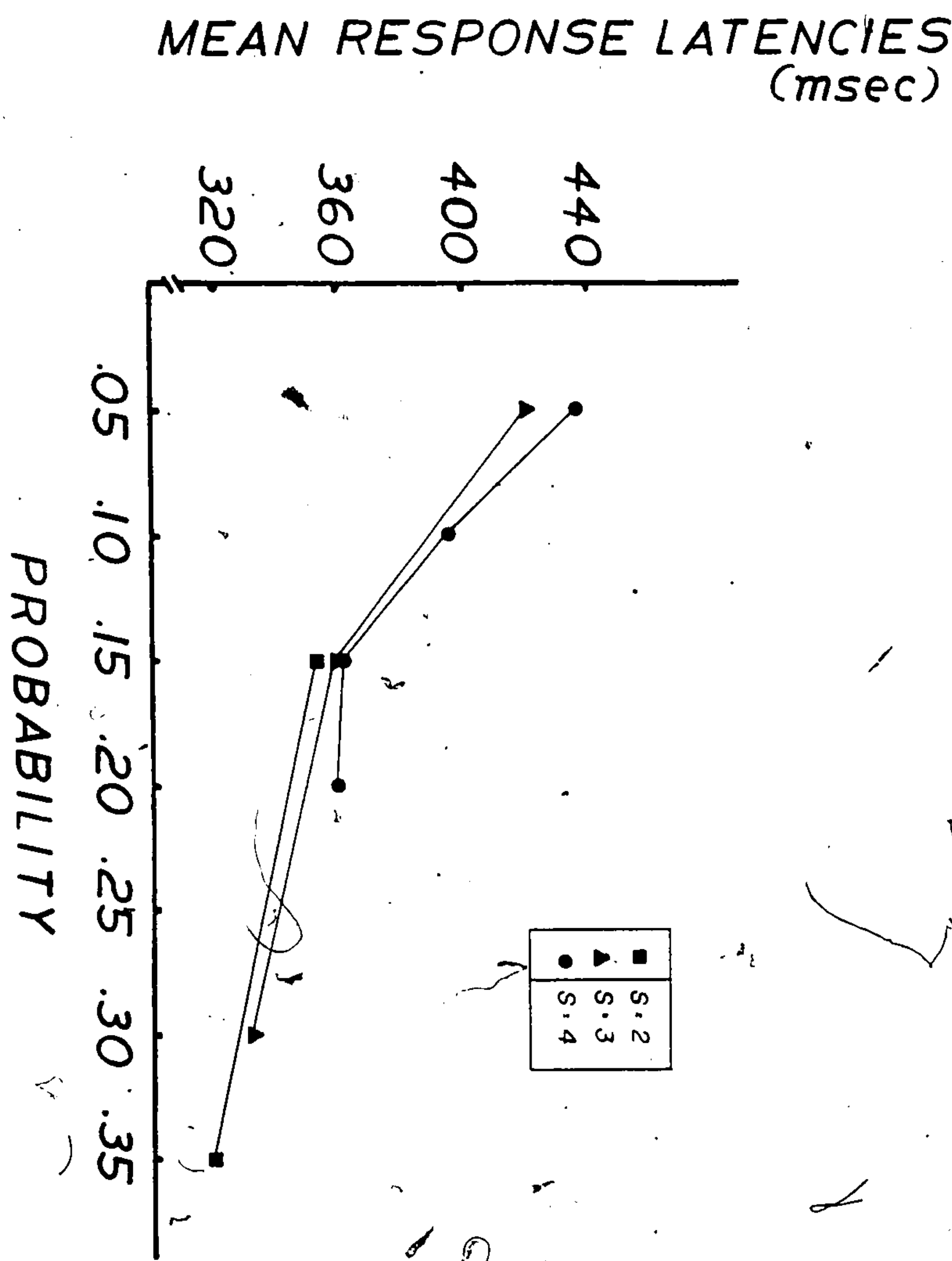

MEAN RESPONSE LATENCIES
(msec)
320
360
400
440
.05
.10
.15
.20
.25
.30
.35
PROBABILITY
S·2
S·3
S·4

Table 49: Mean RTs of Each Individual Positive Item

	s=2		s=3			s=4			
S#	.35	.15	.30	.15	.05	.20	.15	.10	.05
Days 1-6									
1	371.96	406.23	367.33	435.17	563.47	389.41	392.40	468.86	521.25
2	418.46	464.43	442.00	478.97	613.17	484.6[illegible]	488.98	541.56	576.31
3	328.29	343.12	352.04	344.24	368.25	378.51	359.94	369.40	443.88
4	337.48	398.20	327.77	397.18	402.17	384.05	384.50	414.19	463.22
5	346.52	376.15	350.96	382.13	442.22	413.36	411.77	404.12	456.81
x	360.54	397.63	368.02	407.54	477.86	409.99	407.52	439.63	492.29
Days 7-12									
1	309.83	337.60	316.18	364.87	472.00	325.86	336.38	401.15	448.61
2	275.73	311.66	288.30	339.28	424.83	314.53	327.39	355.69	412.14
3	281.52	318.38	309.33	310.99	356.83	331.96	347.40	362.46	336.95
4	303.78	336.28	317.97	343.94	390.03	378.11	353.88	384.75	430.94
5	326.38	358.22	357.77	345.72	372.89	358.58	384.91	410.86	403.39
x	299.45	332.43	317.91	340.96	403.32	341.81	349.99	382.98	406.41
Days 13-18									
1	295.31	326.74	306.13	330.22	435.80	334.37	327.93	385.72	472.00
2	265.29	307.94	286.36	312.49	356.86	301.52	302.96	349.07	405.17
3	288.58	326.26	291.18	313.11	352.72	321.30	305.65	314.21	354.97
4	329.05	350.88	337.97	354.36	394.97	351.83	351.55	411.36	449.28
5	311.29	311.78	318.48	326.17	351.33	323.51	346.38	354.92	359.39
x	297.90	324.72	308.02	327.27	378.34	326.51	326.89	363.06	408.16
Summary of the data over Days 1-18									
1	325.70	356.86	329.88	376.75	490.42	349.88	352.24	418.58	480.62
2	319.83	361.34	338.89	376.91	464.95	366.88	373.11	415.44	464.54
3	299.46	329.25	317.52	322.78	359.27	343.92	337.66	348.69	378.60
4	323.44	361.79	327.90	365.16	395.72	371.33	363.31	403.43	447.81
5	328.06	348.72	342.40	351.34	388.81	365.15	381.02	389.97	406.53
x	319.30	351.59	331.32	358.59	419.83	359.44	361.47	395.22	435.62

Analyses of Variance

performed on the mean RTs of each individual positive item for each set size separately

s=2

within variables: w(1): successive 6-day periods
w(2): P(.35)/P(.15)

Findings: w(1): $F(2,8)=7.560$, $p=.0145$
w(2): $F(1.4)=78.765$, $p=.0019$
w(1,2): $F(2,8)=.684$, $p=.5351$

s=3

within variables: w(1): successive 6-day periods
w(2): P(.30)/P(.15)/P(.05)

Findings: w(1): $F(2,8)=6.249$, $p=.0231$
w(2): $F(2,8)=13.706$, $p=.0031$
w(1,2): $F(4,16)=1.474$, $p=.2558$

s=4

within variables: w(1): successive 6-day periods
w(2): P(.20)/P(.15)/P(.10)/P(.05)

Findings: w(1): $F(2,8)=7.397$, $p=.0153$
w(2): $F(3,12)=15.790$, $p=.0004$
w(1,2): $F(6,24)=1.302$, $p=.2937$

APPENDIX 3

The Standard Item Recognition Paradigm with Letters of the Alphabet as the Stimuli

Appendix 3 describes an experiment which investigates the effects of prolonged practice, for letter stimuli, on those features of the data obtained from the standard item recognition task which led Sternberg (1966) to conclude that memory search is a high speed internal exhaustive serial comparison process. The specific questions which this study addresses, then include: (1) how does prolonged practice affect the form of the functions relating response latency and positive set size for letter stimuli; (2) is equality of slopes as determined from positive and negative response trials separately, maintained after prolonged practice; and (3) does the estimate of the comparison rate (i.e. absolute slope value) remain constant with prolonged practice.

The standard item recognition paradigm and the fixed-set and varied set procedures

Two procedures that have been used within the standard item recognition paradigm are (1) the varied-set procedure, and (2) the fixed-set procedure as shown in Figure 53a and b. In the fixed-set procedure, the same positive set is used for a long series of trials, and each trial consists of a warning signal, test (or probe) stimulus, and a response. The experiments contained in this Thesis employed the fixed-set procedure.

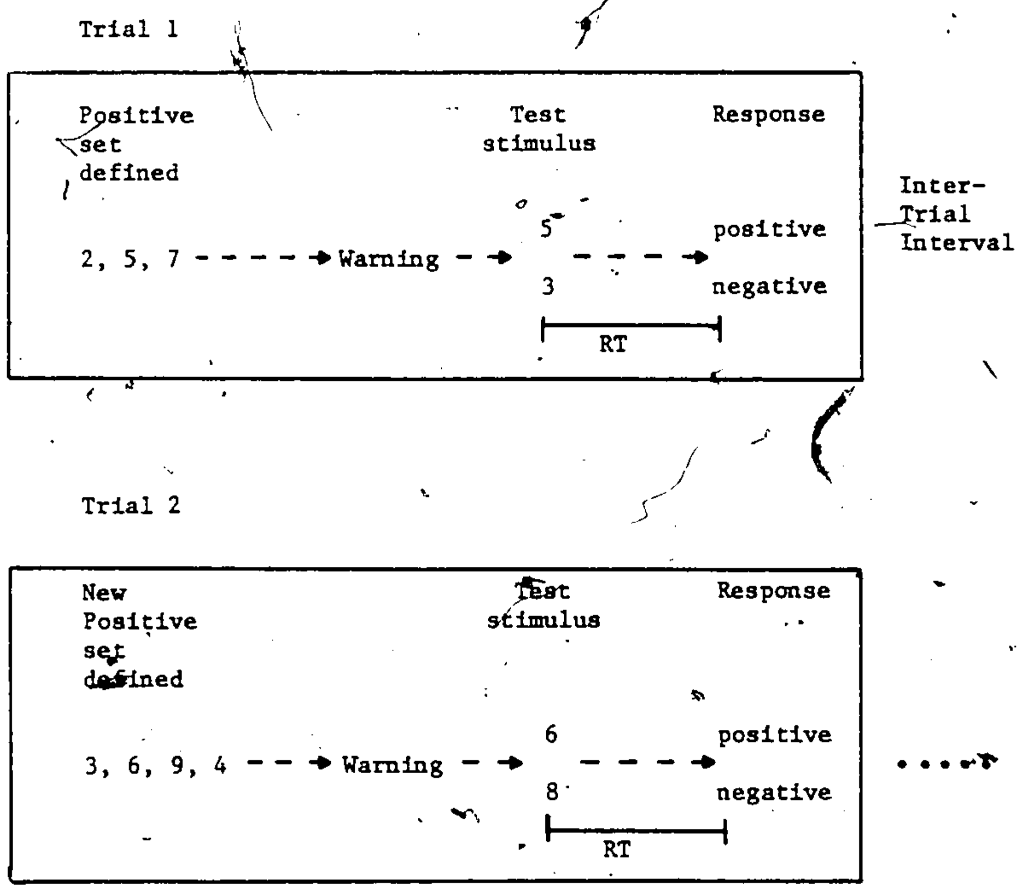
In contrast to the fixed-set procedure, a trial for the varied-set procedure consists of the visual presentation of the positive set (where generally the positive items are shown one at a time) and is followed, after a brief retention interval, by a probe. On each trial a new memory set is drawn at random from the total ensemble and is composed of 1 to s items.

The empirical findings of linear and equal increases in the mean RTs with memory set size for positive and for negative test stimuli have been confirmed in substance by many investigators using either of the two procedures; thus, supporting the implication of a serial and exhaustive scan (e.g. Briggs & Blaha, 1969; Chase & Calfee, 1969; De Rosa, 1969; Hoving, Morin & Konick, 1970; Wingfield & Branca, 1970; Burrows & Okada, 1971).

In these early experiments, however, the stimulus ensemble usually employed one-digit numerals from which the positive sets were arbitrarily selected. While several studies have been carried out using the varied-set procedure and letters as the stimuli (e.g. Clifton & Birenbaum, 1970; Cavanagh & Chase, 1971; Corballis et al., 1972; Forrin & Cunningham, 1973), relatively few item recognition investigations have been completed whereby letters have been assigned to the positive sets and used for a long series of trials. Although Corballis, Katz and Schwartz (1980) do report finding a positive/negative linear item recognition function having an absolute slope value of 34 msec. per letter in a study using the fixed-set procedure for memory set sizes ranging from 2 to 16 letters, they fail to provide

The Varied-Set Procedure

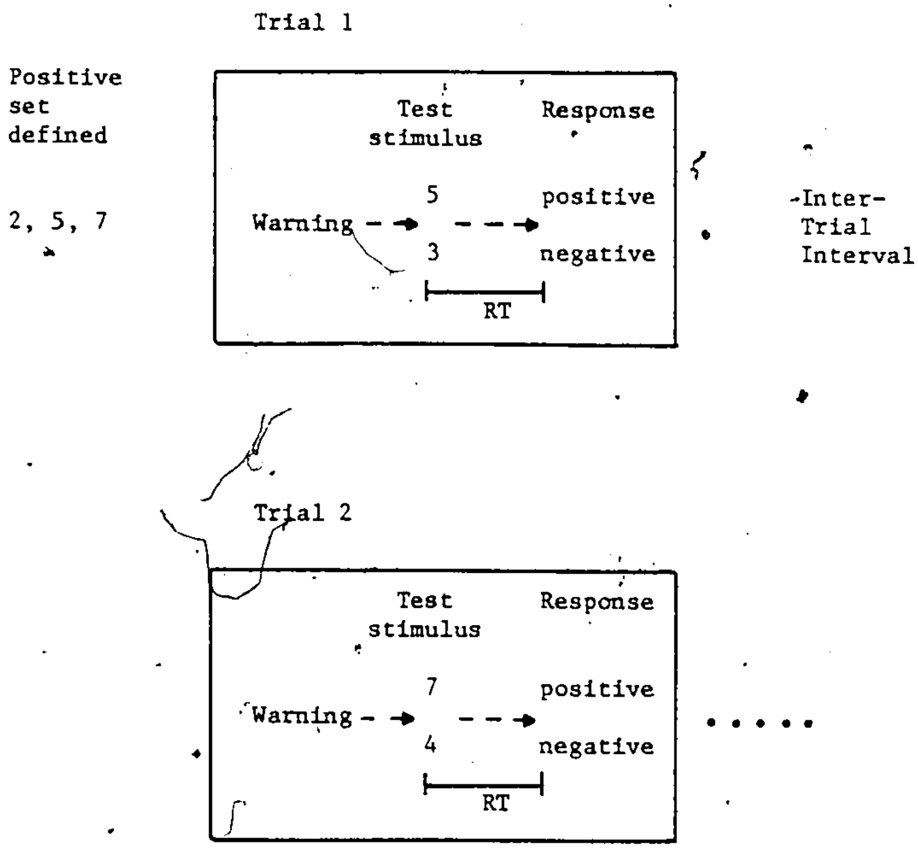
Figure 53a: Shown is a schematic outine of the varied-set procedure. Here a trial consists of the visual presentation of the positive set and is followed, after a brief retention, by a probe. On each trial a new memory set is drawn at random from the total stimulus ensemble.



(c.f. Sternberg, 1975)

The Fixed-Set Procedure

Figure 53b: Shown is a schematic outline of the fixed-set procedure. Here, the same positive set is used for a long series of trials, and each trial consists of a warning signal, test (or probe) stimulus, and a response.



(c.f. Sternberg, 1975)

enough information to answer the major questions the present investigation addresses.

The effects of extended practice on item recognition performance

To date, very few standard item recognition experiments have investigated the effects of practice on item recognition. In fact, only one such study has been reported (Kristofferson, 1972b). For each subject separately, and on each of 30 days, Kristofferson (1972b) assigned non-intersecting sets of digits to three positive set size conditions (i.e. s=1, s=2 and s=4). The fixed-set procedure was used. Analyses of the data, from seven subjects who each performed under three positive set size conditions on each of 30 sessions, revealed that throughout the course of the experiment: (1) the relationship between set size and response latency remained linear; (2) equality of slopes obtained from positive and negative trials was maintained; and (3) the estimate of scanning rate was stable.

This experiment also examines the effect of prolonged practice on item recognition performance. Here, however, the effects of prolonged practice on item recognition performance for letter stimuli is the focus of main concern.

The problem of serial position effects

Since it is thought that all comparisons are attempted before the scan is terminated, it follows that the time to recognize a target item cannot be influenced by its serial position in the memory set. Sternberg (1969) has reported finding no systematic effects of serial position on response latency, but this seems the exception rather than the rule. A growing body of evidence points to reliably shorter response latencies to probes of the first presented (i.e. primacy effect) and last presented (i.e. recency effect) items in the memory set (e.g. Corballis, 1967; Morin, De Rosa & Stultz, 1967; Forrin & Morin, 1969; Kennedy & Hamilton, 1969; Clifton & Birenbaum, 1970; Klatzky, Juola & Atkinson, 1971; Kirsner & Craik, 1971; Burrows & Okada, 1971; Corballis, et al., 1972; Corballis & Miller, 1973; Forrin & Cunningham, 1973). These findings are of special significance in that they do not accord with the high-speed, serial exhaustive comparison process proposed by Sternberg (1966).

Sternberg (1975) suggests that serial position effects may occur only when items are primarily in sensory memory as distinct from active memory. It is true that the RTs for different set size effects appear to be most marked when the list to be memorized is presented rapidly and the interval between the list presentation and test trials is brief. Investigators reporting sizable recency effects have commonly used faster presentation rates (.25 - .50 sec./ memory set item) and briefer probe delays (i.e. under 1 sec.) than those typically employed by Sternberg (1.20 sec./ item and over 2 sec., respectively). Forrin and Cunningham (1973), for example, report two experiments which support the view that serial position effects may be limited to recognition memory tasks with relatively brief retention intervals.

While such an explanation can account for serial position effects in procedures where different memory lists are rapidly presented on each trial (i.e. the varied-set procedure) and the interval between the list presentation and test stimulus is brief, it cannot handle the serial position effects reported in experiments using a fixed-set procedure (e.f. Corballis & Miller, 1973; Corballis et al., 1972). The finding of serial position effects for the fixed-set procedure, however, is in accord with the view that it is some stage (i.e. encoding stage) other than the serial comparison stage which is sensitive to both the age and the input position of the item to be recognized.

Regardless of what the main determinants of the serial position effects are, it is important to determine whether the position a target item has in a given memorized list influences item recognition performance in the present experiment. It is important to know whether to expect a contamination of serial position effects in the data of later experiments where the confounding between s and P (i.e. Experiments 2 and 3) is addressed.

Method

Six paid student volunteers, who were naive to the experimental task, served as subjects. The task, apparatus, trial events, assignment of stimuli to the positive and negative sets, and test stimulus sequence were identical to Experiment 1. The present experiment differed from Experiment 1 as follows: (1) the test stimuli were the letters A to N; (2) the memory set sizes used for the three blocks of trials in each session were s=2, s=4 and s=6; and (3) the presentation frequency values for the individual items within each set size were the same. As in the standard item recognition task, then, the individual items comprising each positive and negative set were probed an equal number of times. Shown in Table 50 are the presentation frequency values for the individual items within each set size. Note that as positive set size increases the frequency of occurrence of the individual positive items within each set size decreases.

Results

All correct responses, excepting practice trials, were used for calculating positive and negative mean response latencies separately each day for each subject. In Figure 54, mean response latencies are plotted against positive set size for each successive 6-day period and for negative and positive responses separately over all six subjects.

Also in Figure 54, least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented. The relationships between response latency and set size were well described by linear functions. Linear regression accounted for between 95.3% and 99.9% of the variance and did not show any systematic trend over blocks of days.

Mean response latencies for each set size, for each successive 6-day period and for negative and positive responses separately are summarized for each subject in Table 51. The corresponding slope values are included. These data are also summarized over all 24 days of the experiment in Figure 55 and Table 51a and b.

An analysis of variance was performed on the mean response

Probability Values of the Individual Items in this Experiment

Table 50: Shown are the positive and negative probability values which were assigned to the individual items within each set size.

Memory Set Size	Probability Values for Individual Items	
	Positive Items	Negative Items
2	for each of 2 items, P=.25	remaining 12 items, P=.0416
4	for each of 4 items, P=.125	remaining 10 items, P=.05
6	for each of 6 items, P=.083	remaining 8 items, P=.062

Figure 54: Mean response latencies are plotted against positive set size for each successive 6-day period, for negative and positive responses separately over all six subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are shown.

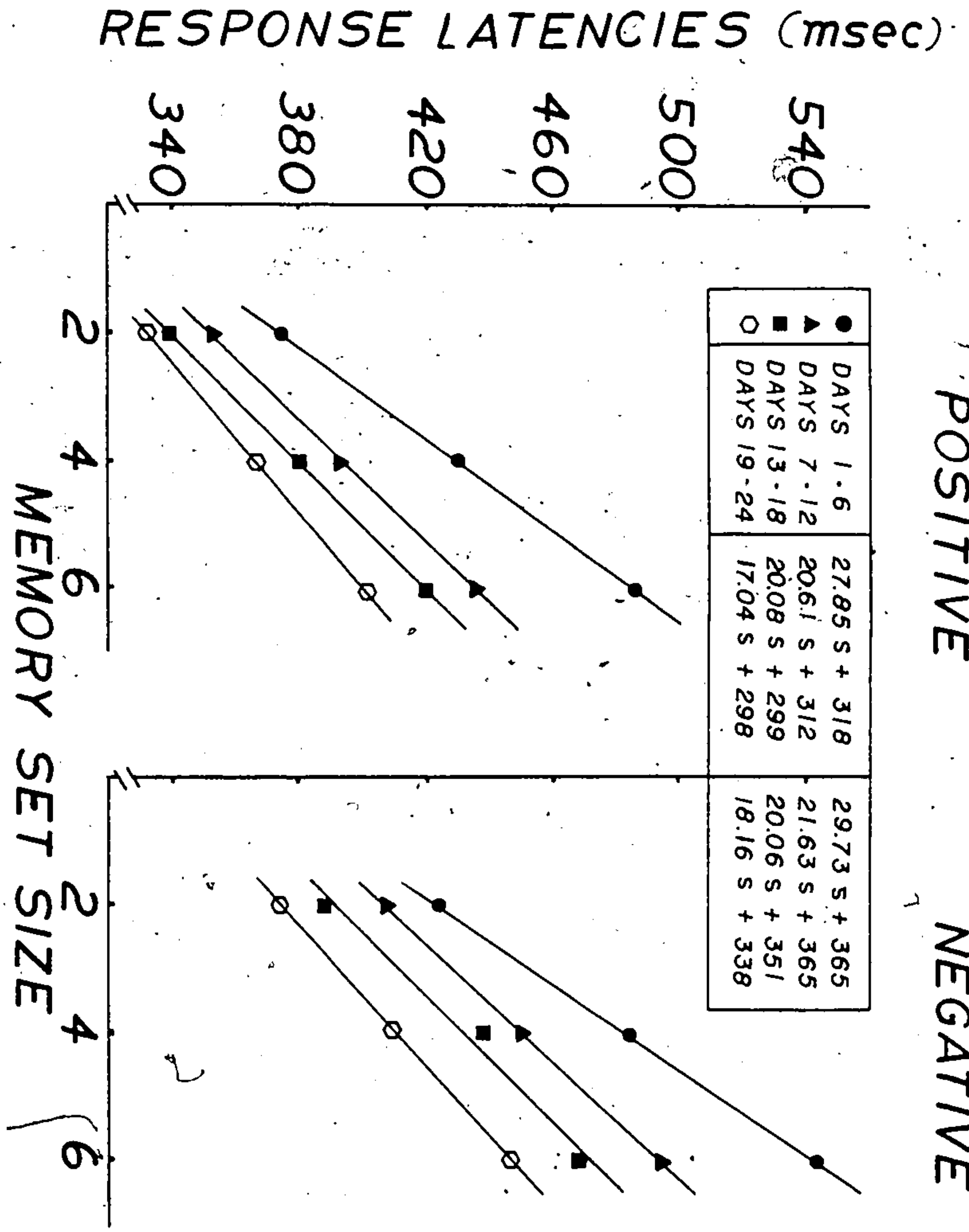
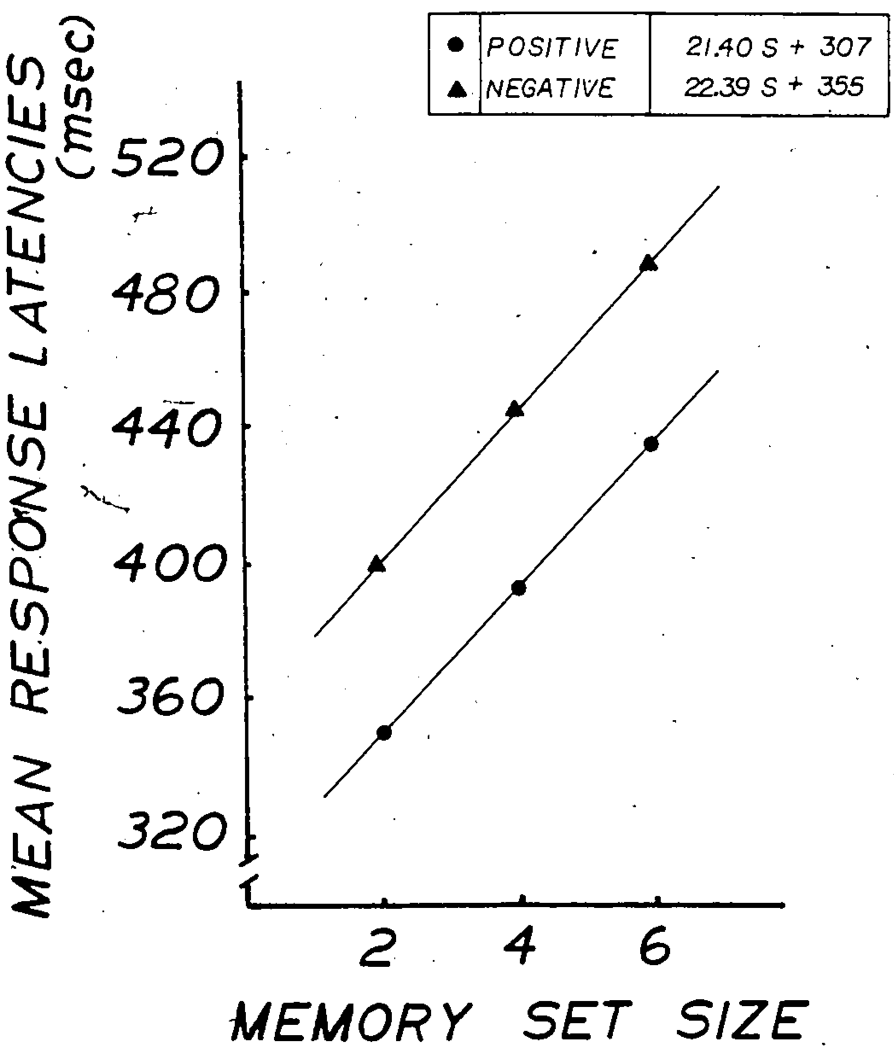

RESPONSE LATENCIES (msec)
540
500
460
420
380
340
POSITIVE
NEGATIVE
DAYS 1-6 27.85 s + 318 29.73 s + 365
DAYS 7-12 20.61 s + 312 21.63 s + 365
DAYS 13-18 20.08 s + 299 20.06 s + 351
DAYS 19-24 17.04 s + 298 18.16 s + 338
2
4
6
MEMORY SET SIZE

Figure 55: Mean response latencies are plotted against positive set size for all 24 days, for negative and positive responses separately over all six subjects. Least squares best fitting straight lines are drawn through each set of data, and the slope and intercept values are also presented.



Positive Mean RTs

Table 51a: Positive mean RTs are shown summarized for each set size and for each subject as calculated over each successive 6-day period. Also shown are the slopes and coefficients of determination for each set of data.

S#	s=2	s=4	s=6	linear slope	r^2
Days 1-6					
1	370.90	410.08	496.90	31.50	.9545
2	431.43	488.96	521.35	22.48	.9746
3	354.10	447.28	484.20	32.53	.9413
4	353.04	391.92	429.42	19.09	.9999
5	379.90	431.92	487.55	26.92	.9996
6	356.10	406.90	494.32	34.56	.9771
x	374.25	429.51	485.62	27.85	1.0000
Days 7-12					
1	438.85	385.56	445.38	24.13	.9813
2	401.08	421.91	468.71	16.91	.9532
3	345.51	396.57	431.60	21.52	.9886
4	316.66	354.15	406.41	22.44	.9911
5	372.95	414.23	457.91	21.24	.9997
6	338.50	394.05	408.20	17.43	.8948
x	353.93	394.41	436.37	20.61	.9999
Days 13-18					
1	343.78	389.97	418.66	18.72	.9821
2	392.13	431.79	467.64	18.88	.9992
3	326.45	370.13	416.23	22.45	.9998
4	292.98	340.53	392.92	24.99	.9992
5	337.98	383.32	423.70	21.43	.9989
6	342.72	366.09	398.63	13.98	.9911
x	339.34	380.31	419.63	20.08	.9999
Days 19-24					
1	335.73	373.00	418.14	20.60	.9970
2	379.85	398.60	440.79	15.24	.9530
3	326.61	364.99	393.47	16.72	.9927
4	284.52	327.63	363.48	19.74	.9972
5	314.38	347.76	380.44	16.52	1.0000
6	348.54	383.45	402.24	13.42	.9708
x	331.61	365.91	399.76	17.04	1.0000
Summary of the data over Days 1-24					
1	349.82	389.65	444.77	23.74	.9914
2	401.12	435.32	474.62	18.38	.9984
3	338.17	394.74	431.38	23.31	.9850
4	311.80	353.56	398.06	21.57	.9997
5	351.30	394.31	437.40	21.53	1.0000
6	346.47	387.62	425.85	19.85	.9995
x	349.78	392.53	435.35	21.40	1.0000

Negative Mean RTs

Table 51b: Negative mean RTs are shown summarized for each set size and for each subject as calculated over each successive 6-day period. Also shown are the slopes and coefficents of determination for each set of data.

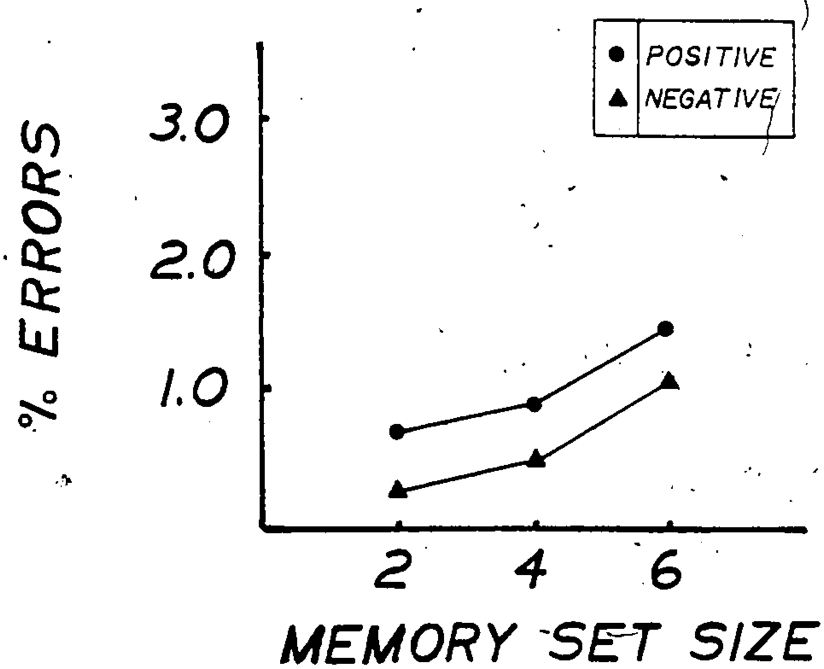
S#	s=2	s=4	s=6	linear slope	r^2
Days 1-6					
1	389.39	452.89	534.97	36.40	.9946
2	474.73	530.01	564.27	22.39	.9820
3	400.38	472.20	546.42	36.51	.9999
4	405.52	461.00	462.64	14.28	.7715
5	428.46	497.03	548.33	29.97	.9931
6	448.72	495.81	603.98	38.82	.9509
x	424.53	484.82	543.44	29.73	.9999
Days 7-12					
1	382.90	433.08	495.74	28.21	.9959
2	444.79	472.98	524.77	20.00	.9718
3	394.32	450.22	490.25	23.99	.9910
4	366.09	404.91	447.03	20.23	.9994
5	440.77	472.57	528.32	21.89	.9757
6	423.01	469.24	484.88	15.47	.9247
x	408.65	450.50	495.17	21.63	.9996
Days 13-18					
1	384.03	421.49	463.25	19.81	.9990
2	411.57	460.18	492.89	20.33	.9874
3	356.59	423.15	462.89	26.58	.9792
4	335.53	408.27	428.26	23.19	.9026
5	421.78	470.86	489.93	17.04	.9393
6	416.72	448.59	470.25	13.38	.9880
x	387.70	438.76	467.91	20.06	.9757
Days 19-24					
1	367.28	406.85	478.87	27.90	.9726
2	401.00	431.72	465.17	16.05	.9994
3	348.32	398.99	425.59	19.32	.9687
4	337.12	364.49	408.71	17.90	.9819
5	372.62	390.99	429.21	14.15	.9606
6	421.24	462.10	475.71	13.62	.9230
x	374.60	409.19	447.21	18.16	.9993
Summary of the data over Days 1-24					
1	380.90	428.58	493.21	28.08	.9925
2	433.02	473.72	511.78	19.69	.9996
3	374.90	436.14	481.29	26.60	.9924
4	361.07	409.67	436.66	18.90	.9735
5	415.91	457.86	498.95	20.76	1.0000
6	427.42	468.94	508.71	20.32	.9998
x	398.87	445.82	488.43	22.39	.9992

latency values obtained from positive and from negative trials, over the successive 6-day period and for set sizes 2, 4 and 6. All main effects were significant: response latencies to negative trials were significantly greater than to positive trials [$F(1,5)=52.65$, $p=.0014$] ; response latencies decreased over practice [$F(3,15)=41.15$, $p=.0001$] ; and as set size increased, response latencies increased significantly [$F(2,10)=267.02$, $p=.0001$] . A significant interaction was found between day blocks and set size [$F(6,30)=4.273$, $p=.0034$] . A Duncan's Multiple Range test ($p=.05$) revealed that the increase in mean response latency with set size was greater for the first 6-day period than for the remaining three successive 6-day periods. These three successive 6-day periods did not differ significantly.

An analysis of variance was performed on the slope values obtained from the linear item recognition functions where the within variables were positive-negative trials and successive 6-day periods (see Table 51a and b for slope values). Positive-negative slopes were significantly greater for the first successive 6-day period [$F(3,15)=5.907$, $p=.0074$].

Errors were maintained at a low level and no subject made errors on more than 2.25% of the total trials. The group error rates were 1.02%, 1.41% and 2.58% for the memory set sizes 2, 4 and 6 respectively. In Figure 56, mean percent errors are shown plotted against positive set size, as calculated over the 24 days of the experiment, for negative and positive response errors separately over all six subjects. The individual subjects' error data are summarized for each successive 6-day period in Table 52. An analysis of variance

Figure 56: Mean percent errors are plotted against positive set size over the 24 days of the experiment for positive and negative trials separately for all six subjects.



Positive and Negative Percent Errors

Table 52: Individual subjects' mean percent errors for positive and negative responses are shown summarized over each successive 6-day period for each set size separately.

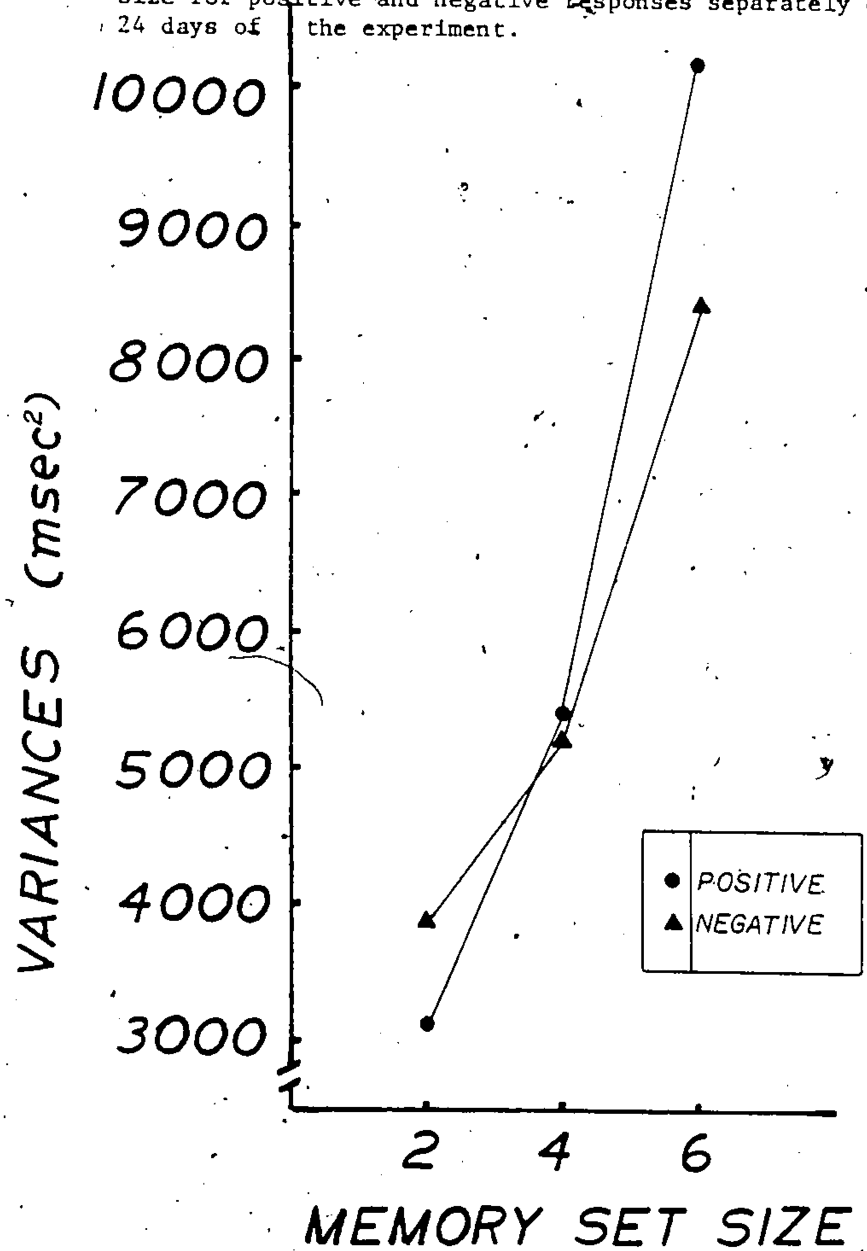
		POSITIVE % ERRORS			NEGATIVE % ERRORS		
	S#	s=2	s=4	s=6	s=2	s=4	s=6
Days 1-6	1	.50	.50	1.33	.00	.00	.50
	2	.17	1.67	2.00	.00	1.00	1.17
	3	.83	1.00	2.50	.50	1.00	2.33
	4	1.33	.67	1.67	.33	.17	.33
	5	.50	.33	.83	.17	.50	.50
	6	.63	.83	1.00	.67	.50	2.17
	x	.66	.83	1.56	.28	.53	1.17
Days 7-12	1	.17	.67	.17	.00	.00	.83
	2	.33	.50	1.00	.17	.17	.83
	3	1.50	1.00	1.67	.33	.17	.67
	4	.33	.67	2.00	.17	.33	.67
	5	.17	.67	.33	.50	.50	.67
	6	.50	.33	1.00	.17	1.17	1.67
	x	.50	.64	1.03	.22	.39	.89
Days 13-18	1	.67	.17	.67	.17	.17	.33
	2	.50	1.00	2.33	.00	.67	1.67
	3	.83	1.33	2.50	.33	.33	.83
	4	1.00	1.33	1.67	.50	.83	1.83
	5	.67	1.00	1.17	.33	.50	1.17
	6	.83	.67	.50	.50	.17	1.00
	x	.75	.92	1.47	.31	.45	1.14
Days 19-24	1	.67	.67	1.00	.17	.17	.17
	2	1.00	1.33	2.67	.67	.83	.83
	3	1.33	2.17	2.33	.00	.50	1.00
	4	1.00	1.33	2.50	.50	.33	1.50
	5	1.50	1.17	2.00	1.00	1.33	1.50
	6	.17	.67	.50	.17	.67	.83
	x	.95	1.22	1.83	.42	.64	.97
Summary of the data over Days 1-24							
	1	.50	.50	.79	.09	.09	.46
	2	.30	1.13	2.00	.21	.67	1.13
	3	1.12	1.38	2.25	.29	.50	1.21
	4	.92	1.00	1.96	.38	.42	1.08
	5	.71	.79	1.08	.50	.71	.96
	6	.53	.63	.75	.38	.63	1.42
	x	.71	.91	1.47	.31	.50	1.04

was performed on percent errors where the within variables were positive-negative, successive 6-day periods and set size. Percent errors were significantly greater for positive than for negative trials [$F(1,5)=7.042$, $p=.0446$] ; and the errors increased significantly as positive set size increased [$F(2,10)=26.973$, $p=.0002$] .

Variances were obtained from positive and from negative trials for each memory set size and were calculated day be day for each subject and averaged over successive 6-day periods. These data are shown summarized for the individual subjects in Table 53. In Figure 57, the variances are shown plotted against positive set size, as calculated over the course fo the experiment, for positive and negative responses separately over all six subjects. An analysis of variance was performed where the within variables were positive-negative response variances, successive 6-day periods, and set size. A significant main effect of successive 6-day periods was found [$F(3,15)=18.579$, $p=.0001$]; and variances were found to significantly increase with set size increases [$F(2,10)=41.49$, $p=.0001$] . A significant interaction was revealed between successive 6-day periods and set size [$F(6,30)=3.247$, $p=.014$] , indicating that for the first successive 6-day block the increase in variance with set size was greater than the remaining successive 6-day periods.

In Figure 58, the serial position of the individual positive items is plotted against mean response latency for each set size separately as averaged over all 24 days of the experiment. The individual subjects' data are shown in Table 54. For each positive set size separately, an analysis of variance was performed where the

Figure 57: Mean response variances are plotted against positive set size for positive and negative responses separately over the 24 days of the experiment.

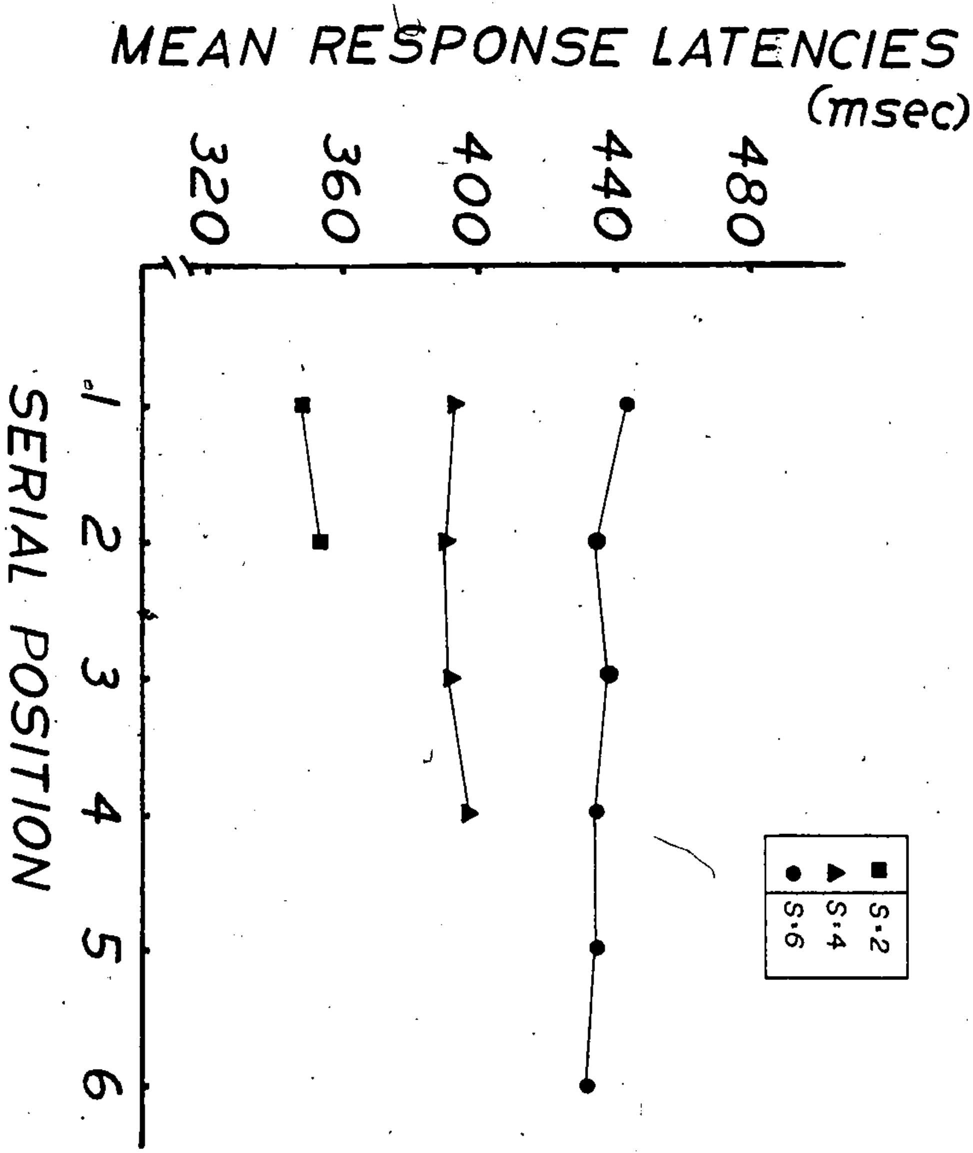


Positive and Negative Variances

Table 53: Individual subjects' mean response variances for positive and negative trials are shown summarized over each successive 6-day period for each set size separately.

	POSITIVE VARIANCES			NEGATIVE VARIANCES		
S#	s=2	s=4	s=6	s=2	s=4	s=6
Days 1-6						
1	2643.26	3840.00	10352.56	3592.91	5155.68	18248.92
2	7851.28	7161.31	12630.52	7026.16	7525.18	12057.93
3	3912.10	8356.83	13243.28	4159.19	9141.64	18216.60
4	4099.85	14459.01	19584.29	7498.95	11281.74	10349.86
5	3970.57	8685.84	10945.33	6929.54	9828.52	12765.98
6	3795.53	5636.47	42884.83	3888.63	6555.88	22385.65
x	4378.77	8023.24	18273.47	5515.90	8248.11	15670.82
Days 7-12						
1	2040.61	3409.88	8385.36	3373.99	2730.30	6957.29
2	4090.82	4415.61	11081.57	3945.93	3405.56	8782.71
3	2641.07	5082.69	7056.94	4256.25	3728.97	6637.13
4	2726.83	5277.40	10499.55	2887.88	4239.36	6701.38
5	4207.01	6789.22	11657.46	6654.16	8567.93	8255.75
6	2563.16	4934.79	4898.99	3335.82	3573.37	3232.08
x	3044.92	4984.93	8929.98	4075.67	4374.25	6761.06
Days 13-18						
1	2015.58	4129.63	5919.76	1801.06	3132.46	4472.11
2	2986.67	4162.76	5687.76	2782.55	5530.71	6361.73
3	1398.55	3497.72	10035.41	1644.08	2982.23	5325.49
4	4028.11	5040.65	10867.59	3062.50	5892.60	7109.63
5	3003.32	5985.69	10792.94	5572.67	7741.71	5610.63
6	2611.72	4050.26	4413.06	3035.82	3734.36	4065.21
x	2673.99	4477.79	7952.75	2983.11	4835.68	5490.80
Days 19-24						
1	1401.03	2537.01	5518.79	1482.08	1815.72	13196.00
2	2587.85	4150.03	6103.63	2827.23	4389.76	3879.30
3	2744.62	3761.20	4539.30	1958.03	2809.99	2601.91
4	1932.95	4917.82	7630.77	5039.77	4260.32	6466.55
5	2620.64	5009.32	4664.67	4465.55	3808.85	3477.15
6	2237.17	4230.17	5166.03	2973.67	2940.06	4061.01
x	2254.04	4100.93	5603.87	3124.39	3337.45	5613.65
Summary of the data over Days 1-24						
1	2025.12	3479.13	7544.12	2562.51	3208.54	10718.58
2	4379.16	4972.43	8875.87	4145.47	5212.80	7770.42
3	2674.09	5174.61	8718.73	3004.39	4665.71	8195.28
4	3196.94	7423.72	12145.55	4622.28	6418.51	7656.86
5	3450.39	6617.52	9515.10	5905.48	7486.75	7527.38
6	2801.90	4712.92	14340.73	3308.49	4200.92	8435.99
x	3087.93	5396.72	10190.02	3924.77	5198.87	8384.09

Figure 58: Mean response latencies of the individual positive items are shown plotted against serial position for each set size separately as averaged over all 24 days of the experiment.


MEAN RESPONSE LATENCIES
(msec)
320
360
400
440
480
SERIAL POSITION
1
2
3
4
5
6
S-2
S-4
S-6

Serial Position Effects

Table 54: Individual subjects' mean response latencies for each positive item in each set size are shown summarized over the 24 days of the experiment.

SERIAL POSITION	1	2	3	4	5	6
S#	s=2					
1	340.96	358.73				
2	405.08	397.76				
3	336.40	340.33				
4	307.97	315.57				
5	348.12	354.27				
6	342.88	349.84				
x	346.90	352.75				
	s=4					
1	386.95	374.34	389.65	407.92		
2	443.40	433.63	432.73	432.42		
3	388.51	399.56	393.09	384.63		
4	343.17	352.22	360.38	358.64		
5	392.49	392.83	384.08	408.70		
6	394.69	387.02	385.06	383.16		
x	391.54	389.93	390.83	395.91		
	s=6					
1	443.98	434.23	449.00	445.05	444.69	453.97
2	482.89	473.50	473.51	475.52	477.15	468.27
3	433.92	430.39	434.13	435.55	422.94	431.51
4	402.69	403.24	414.47	393.57	407.15	374.19
5	466.40	429.92	430.04	448.15	418.38	435.49
6	427.05	433.72	423.92	412.88	435.57	421.08
x	442.82	434.17	437.51	435.12	434.31	430.75

within variables were successive 6-day periods and the serial position of each positive item. The only significant main effect revealed was that of practice. Positive mean response latencies for set sizes 2, 4 and 6 decreased significantly over the successive 6-day periods (s=2: [$F(3,15)=14.745$, $p=.0002$]), (s=4: [$F(3,15)=20.608$, $p=.0001$]), and (s=6: [$F(3,15)=48.08$, $p=.0001$]).

Discussion

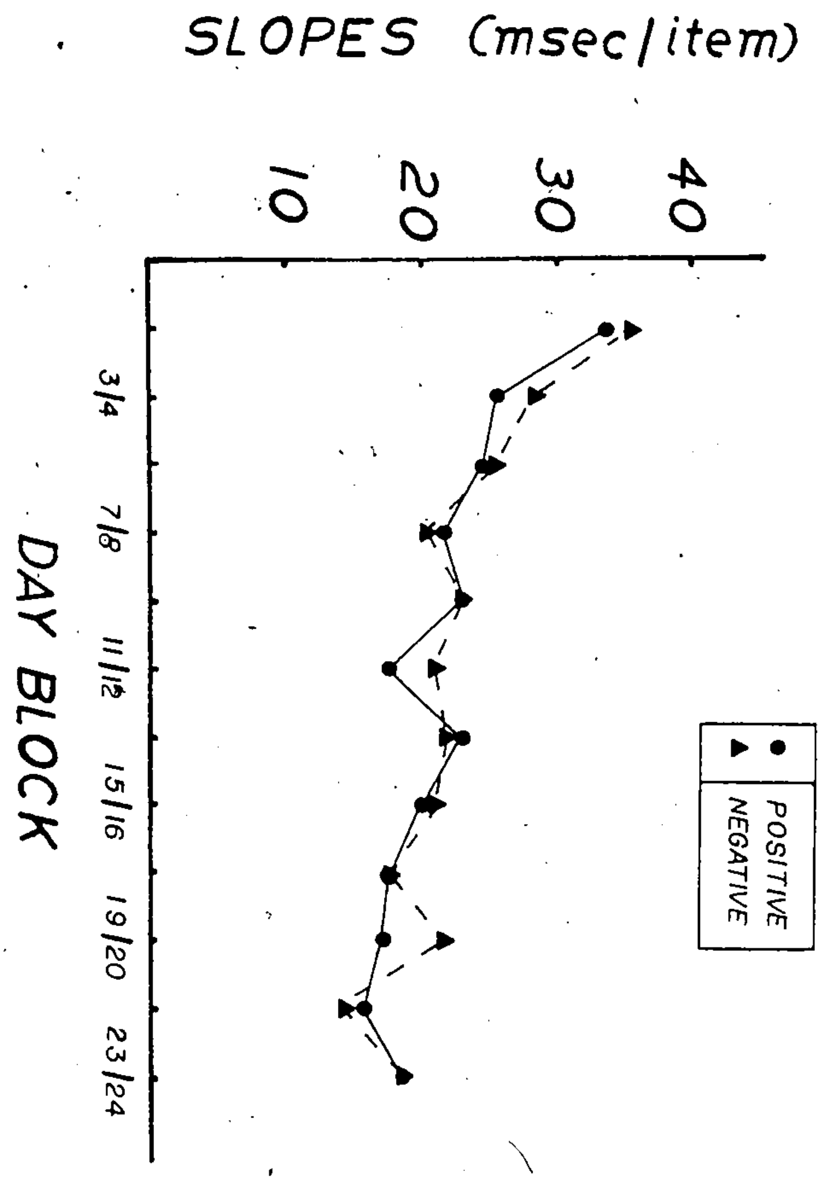
The findings from this experiment reveal that the typical features of the data reported in standard item recognition experiments employing very limited practice and digits as stimuli hold up also under conditions of prolonged practice where the memory sets are comprised of letters. First, the relation between mean response latency and set size remained linear throughout practice, supporting the idea of a serial comparison process in which the mean comparison rate for each item is approximately the same. Second, the slopes of the item recognition functions for positive and for negative responses were found to be the same throughout practice, supporting the implications of an exhaustive search through the memory set. Third, the comparison rate remained reasonably constant with prolonged practice. Although an analysis of variance revealed that there was a significant practice effect on the absolute slope values over successive 2-day periods [$F(11,55)=3.036$, $p=.0034$] , a significant main effect was <u>not</u> obtained when the first 2-day block of data was removed from the overall analysis [$F(10,55)=1.777$, $p=.09$]. For the remaining successive 2-day periods, the absolute values of the slopes of the functions relating mean response latencies and set size remained constant over days, suggesting that the average rate of the serial comparison process in this study was approximately 20 msec./letter. In Figure 59, the slopes obtained from the positive and negative trials separately are shown plotted against successive 2-day periods.

Thus, the findings of this experiment, using the fixed-set procedure, agree reasonably well with findings reported from other studies which (1) used the varied-set procedure, where on each trial a new memory set is drawn from the total stimulus ensemble on each trial and is composed of 1 to s letters; (2) employed the same positive set for a long series of trials and letters are the stimuli (i.e. Corballis et al., 1980); and (3) investigated item recognition performance for digit stimuli under conditions of prolonged practice (Kristofferson, 1972b). In all cases, the findings are consistent with the characterization of memory search as a high speed internal exhaustive serial comparison.

Also consistent with a number of reports (i.e. Sternberg, 1969b) was the finding of no systematic effects of serial position on response latency in this study, supporting the implication that all comparisons are attempted before the scan is terminated and that the time to recognize a target item is not influenced by its serial position in the memory set.

Given the salient features of the data reported here, such as (1) the linear and equal increases in mean RT with memory set size for positive and negative probed items, (2) a reasonably constant comparison rate over prolonged practice, and (3) the lack of serial position effects

<u>Figure 59</u>: Slopes obtained from the positive and negative item recognition functions are shown plotted against 2-day blocks.


SLOPES (msec/item)
10
20
30
40
3/4
7/8
11/12
15/16
19/20
23/24
DAY BLOCK
POSITIVE
NEGATIVE

on response latency, the remaining experiments of this Thesis were conducted. Experiment 2 returns us to the central objective of the research, that of stimulus probability and its effect on the memory scanning process.

APPENDIX 4

Appendix 4 provides a listing of the programmes which were used to execute the stimulus and trial events for each subject on each day for Experiments 2, 3 and 4. Also provided are the listings of the programmes used to calculate the mean RT summaries, errors, variances and standard deviations for the unconfounded positive probed trials, and the overall positive and negative probed trials. A flow chart outlining the programme used to calculate lags, means and other data summaries for Experiment 4 and an illustration of the variables used to define the experiments run on the Apple computer are presented as a further guide.

A short documentation of the programmes has been provided for the reader's convenience.

Experiment 4

This programme does not generate the sequence of stimulus items itself. Instead, in order to control the lag lengths of particular items, the order of the trial events was determined in advance and recorded on cassette. Line 140 recalls the necessary information from the cassette. Line 220 checks to see if session 1 is being run. If so, a short block of practice trials is presented to acquaint the subject with the task and equipment. After the experimental session is finished the programme performs the standard raw data analysis: means, variances and errors for each set size, positive and negative separately. These means are then used in linear regression: set size vs mean and $\log_2$ set size vs mean, positive and negative separately. The raw data are saved on cassette for further analyses at a subsequent time.

Experiment 3

This programme is similar to the above one except that the programme generates the order of the trials before each session for each subject. This is done in SUBROUTINE 1670.

Experiment 2

This programme is the same as the one above, except a new variable MIN has been introduced. It was noted that occasionally a subject would press a button faster than he could have realistically responded to the stimulus item. To prevent these responses from being included in the data analysis, MIN=150 msec. was chosen as a minimum acceptable RT.

Symbol Table for Experiment 4

1a) Integer Variables

NERR%	-number of incorrect negative responses
NN%	-number of correct negative responses
PERR%	-number of incorrect positive responses
PP%	-number of correct positive responses
RESP%=0 or 1	-indicates subject's response: non-preferred or preferred hand respectively
WW%	-test variable to prevent division by zero

b) Real Variables

A	-intercept value obtained from linear regression
BEEP	-temporary storage used on the generation of a tone from the APPLE speaker
BSLOPE	-slope value obtained from linear regression
E0	-mean RT of incorrect negative responses
E1	-mean RT of incorrect positive responses
FINISH	-actual time S responded to stimulus
HUNDREDS	-used to convert APPLE clock time to time in secs.
I	-index variable, often refers to trial number in block J
J	-index variable, usually refers to block of trials
K	-index variable
L	-index variable
MAX=2000	-response times greater than MAX were excluded from analysis
NM	-mean RT of correct negative responses rounded to 2 places
NSTDEV	-sample standard deviation of correct negative responses
NVAR	-sample variance of correct negative responses
PAUSE	-index variable used to create a pause between trials, blocks of trials, etc.
PM	-mean RT of correct positive responses rounded to 2 places
PSTDEV	-sample standard deviation of correct positive responses
PVAR	-sample variance of correct positive responses
R2	-coefficient of determination, r^2, obtained from linear regression
S=-16336	-BEEP=PEEK(S) toggles the APPLE speaker. This generates a tone if done repeatedly.
SEC	-used to convert APPLE clock time to time in secs.
START	-actual time the stimulus item is first displayed on the screen
TENS	-used to convert APPLE clock time to time in secs.
TIME	-temporary storage of START and FINISH
UNITS	-used to convert APPLE clock time to time in secs.
X	-temporary storage of the stimulus item -also the sum of the set sizes, used in linear regression
XX	-the sum of the squares of all set sizes, used in linear regression

XY	-the sum of the products obtained from set size x mean RT used in linear regression
Y	-the sum of the mean RTs for each set size, used in linear regression
YY	-the sum of the squares of all mean RTs for each set size used in linear regression

c) String Variables

S$	-used to await keyboard response in GET S$

2a) Integer Arrays

RESP%(3,160)	-RESP%(J,I)=0 or 1 which indicates the correctness of the response to trial I in block J: 0 if incorrect, 1 if correct
SNUMBER%(3)	-identifies S: SNUMBER%(I). I=1 indicates subject number, I=2 indicates session number, I=3 indicates experiment number (see Figure 60)
TRIAL%(3,160)	-stimulus sequences: TRIAL%(J,I). For block J and TRIAL I, indicates which stimulus item is to be presented to the subject. (see Figure 60)

b) Real Arrays

BN(6)	-defines the negative sets by their boundaries: BN(I). I=1,3,5 are the lower boundaries of the first, second, and third negative sets the S will work with. I=2,4,6 indicate how many items are in the respective negative sets. (see Figure 60)
BP(6)	-defines the positive sets by their boundaries: BP(I). I=1,3,5 are the lower boundaries of the first, second and third positive sets the S will work with. I=2,4,6 indicate the upper bounds of the respective positive sets. (see Figure 60)
ESUM(1)	-sum of the RTs for error trials: ESUM(I). I=0 for negative trials, I=1 for positive trials
MEAN(1,3)	-mean RTs for correct responses:MEAN(J,I). I=0 for negative mean RTs and I=1 for positive mean RTs. J=1,2,3 for the three set sizes in the order in which they were presented
RESP(24)	-correct button press for practice trials on Day 1: RESP(I)= 0 or 1. 0 for button 0 (or negative response), 1 for button 1 (or positive response). I=1 to 24 for 24 practice trials
RT(3,160)	-response times array: RT(J,I). Response time in msec. to trial I in block J.
S(3)	-temporary storage of SETSIZE(J) and $\log_2$ SETSIZE(J)

SETSIZE(3)	-set size order array: SETSIZE(I). I=0 holds the number of trials/block which is 160. I=1,2 and 3 hold the set sizes 3, 4 and 5 in the order in which they occur. (see Figure 60)
SMSQ(1)	-holds the sum of the squares of the correct RTs: SMSQ(I). Positive RTs when I=1, negative RTs when I=0.
STIM(9)	-stimulus pool of digits for practice trials on Day 1
SUM(1)	-holds the sum of the correct RTs: SUM(I). Positive RTs when I=1, negative RTs when I=0
T(4)	-temporary storage: T(I). During the experimental session, T(I) holds the contents of locations 839, 840, 841 and 842 (decimal) to calculate time START, then the array holds the contents of locations 844, 845, 846 and 847 to calculate time FINISH.
	-After the session, during the analysis, T is used to print the $\log_2$ of the set size values to 2 decimals.
TEST(24)	-practice trials sequence: TEST(I). For I=1 to 24, the 24 digit stimuli for the practice trials on Day 1.

c) String Arrays

STIMSET$(25)	-pool of stimulus letters. (see Figure 60)
SUBSTIM$(3)	-subject's stimulus sets with order unconfounded with P: SUBSTIM$(J). When J=1 this is the set the S will memorize for the first block of trials. J=2 and 3 refer to the second and third blocks of trials. (see Figure 60)

<u>Figure 60</u>: Shown here is an example illustrating the parameters of an experimental session, and the values that the variables may take on. This set up was used for all experiments run on the APPLE II computer, Experiments 2, 3, and 4.

Subject #1, Session #5, Experiment #3

set size order = 5, 3, 4

SNUMBER%(1)=1
SNUMBER%(2)=5
SNUMBER%(3)=3

SETSIZE(0)=160
SETSIZE(1)=5
SETSIZE(2)=3
SETSIZE(3)=4

SUBSTIM$(1)= J H K I L
SUBSTIM$(2)= B C A
SUBSTIM$(3)= D G E F

	s=3			s=4				s=5													
TRIAL%(J,I)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
STIMSET$(I)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	A	B	C	D	E	F	G

negative set for s=3 (D–N)

negative set for s=4 (H–C)

negative set for s=5 (M–G)

BP(1)=8 BP(2)=12
BP(3)=1 BP(4)=3
BP(5)=4 BP(6)=7

BN(1)=13 BN(2)=9
BN(3)=4 BN(4)=11
BN(5)=8 BN(6)=10

List of Experimental Programmes

Experiment 4

```
10   DIM STIMSET$(25),TRIAL%(3,160),RESP%(3,160),RT(3,160),SETSIZE(3),SNUM
     BER%(3),BP(6),BN(6)
20   DIM SUM(1),SMSQ(1),MEAN(1,3),S(3),T(4),TEST(24),RESP(24)
30   FOR I = 768 TO 827: READ X: POKE I,X: NEXT I
40   DATA    162,0,232,224,6,240,9,             189,191,192,157,69,3,76,2,3,
                173,97,192,201,128,176,8,169             ,0,141,68,3,76,4
     3
50   DATA    3,173,98,192,201,128,1             76,234,169,1,141,68,3,162,0,
                232,224,6,240,9,189,191,192,              157,74,3,76,45,3
     ,96
60   HOME
70 P = 100: DEF  FN DP(X) =  INT (X * P + .5) / P
80 MAX = 2000: PRINT "DO YOU WISH TO CHANGE MAX OF ";MAX;: INPUT S$
90   IF S$ = "N" GOTO 120
100   IF S$ <> "Y" THEN  GOTO 80
110   INPUT "NEW MAX = ";MAX
120   PRINT "ITEM RECOGNITION  -  2-CHOICE REACTION TIME TASK": PRINT
130   PRINT "READ IN TRIAL EVENTS.": PRINT "WHEN RECORDER IS RUNNING,": PRINT
      "PRESS SPACE BAR.": GET S$
140   RECALL SETSIZE: RECALL TRIAL%: RECALL BP: RECALL BN
150   PRINT : PRINT "SETSIZE ORDER IS ";SETSIZE(1); SPC( 3);SETSIZE(2); SPC(
      3);SETSIZE(3): PRINT
160   INPUT "TYPE THE SUBJECT'S +VE SETS.";SUBSTIM$(1),SUBSTIM$(2),SUBSTIM
      $(3)
170   PRINT "TYPE THE STIMULUS POOL."
180   FOR I = 1 TO 21: INPUT STIMSET$(I): NEXT I: PRINT
190   PRINT "TYPE SUBJECT NUMBER,SESSION NUMBER,": INPUT "EXPERIMENT NUMBE
      R.";SNUMBER%(1),SNUMBER%(2),SNUMBER%(3): PRINT
200   PRINT "YOU ARE READY TO BEGIN THE SESSION.": PRINT "PLACE COVER OVER
       KEYBOARD AND SPACE.": GET S$: HOME
210   VTAB 8: PRINT "SUBJECT # ";SNUMBER%(1); SPC( 2);"SESSION # ";SNUMBER
      %(2); SPC( 2);"EXP # ";SNUMBER%(3): VTAB 11: PRINT "WHEN READY TO BE
      GIN, PRESS SPACE BAR.": GET S$: HOME
220   IF SNUMBER%(2) = 1 THEN  GOSUB 1430
230   HOME : VTAB 10: PRINT  TAB( 10);"ASK ANY QUESTIONS NOW.": PRINT : VTAB
      15: PRINT "WHEN READY TO BEGIN SESSION, SPACE.": GET S$: HOME
240   FOR J = 1 TO 3
250   POKE  - 16368,0
260   GOSUB 1270
270   VTAB 5: PRINT "      HERE IS THE SET OF LETTERS": PRINT  TAB( 10);"YO
      U ARE TO MEMORIZE."
280   VTAB 8: PRINT  TAB( 5);"COPY THEM DOWN BEFORE CONTINUING."
290   VTAB 14: HTAB 21 - (SETSIZE(J) - 1) * 2: PRINT SUBSTIM$(J)
300   VTAB 20: PRINT  TAB( 6);"WHEN YOU ARE READY TO PROCEED": PRINT  TAB(
      11);"PRESS THE SPACE BAR": GET S$
310   FOR PAUSE = 1 TO 1000: NEXT PAUSE: HOME : FOR PAUSE = 1 TO 1000: NEXT
      PAUSE
320   FOR I = 1 TO SETSIZE(0):X = TRIAL%(J,I)
330   GOSUB 1160: REM  DISPLAY STIMULUS ITEM
340 RESP% =  PEEK (836): REM    0 FOR BUTTON 0, 1 FOR BUTTON 1
350   GOSUB 1280: REM    GIVE AUDIO  FEEDBACK
360   FOR L = 1 TO 4:T(L) =  PEEK (838 + L): NEXT L: GOSUB 1210:START = TI
      ME
370   FOR L = 1 TO 4:T(L) =  PEEK (843 + L): NEXT L: GOSUB 1210:FINISH = T
      IME
380 T(1) =  PEEK (838):T(2) =  PEEK (843): IF T(1) <> T(2) THEN RESP%(J
      ,I) = 3: REM   CHECK FOR TIME ERROR WITH 1ST CLOCK BIT
390 RT(J,I) =  INT ((FINISH - START) * 1000 + .5): REM   CONVERT TO MSEC
400   FOR PAUSE = 1 TO 1000: NEXT PAUSE
410   NEXT I
420   IF J = 3 GOTO 460
430   VTAB 14: HTAB 8: PRINT "END OF SECTION ";J;" OF THIS SESSION ": PRINT
```

```
440  PRINT  TAB( 8);"YOU WILL NOW HAVE A SHORT BREAK."
450  FOR PAUSE = 1 TO 16000: NEXT PAUSE: HOME : NEXT J
460  VTAB 14: HTAB 12: PRINT "END OF SESSION": PRINT  TAB( 5);"YOU MAY NO
     W LEAVE. THANK YOU.": GET S$
470  INPUT "ARE YOU READY TO CALCULATE DATA?";S$
480  IF  LEFT$ (S$,1) <  > "Y" GOTO 470
490  HOME : PRINT "SUBJECT # ";SNUMBER%(1);"SESSION # ";SNUMBER%(2);"EXP
     # ";SNUMBER%(3)
500  PRINT "SAVE RAW DATA. WHEN RECORDER RUNNING,": PRINT "PRESS SPACE BA
     R.": GET S$
510  STORE SNUMBER%: STORE TRIAL%: STORE RESP%: STORE RT: STORE SETSIZE: STORE
     BP: STORE BN:
520  PRINT "AFTER RECORDING NUMBER FROM TAPE COUNTER": PRINT "HIT SPACE B
     AR.": GET S$
530  STORE SNUMBER%: STORE TRIAL%: STORE RESP%: STORE RT: STORE SETSIZE: STORE
     BP: STORE BN:
540  PRINT "END OF DATA STORAGE"
550  FOR J = 1 TO 3
560  FOR I = 1 TO SETSIZE(0)
570  IF RT(J,I) > MAX GOTO 660
580  IF TRIAL%(J,I) <  = BP(2 * J) THEN  GOTO 630
590  IF RESP%(J,I) = 0 THEN NERR% = NERR% + 1:ESUM(0) = ESUM(0) + RT(J,I)
     : GOTO 660
600  IF RESP%(J,I) = 3 THEN  GOTO 660
610 SUM(0) = SUM(0) + RT(J,I):SMSQ(0) = SMSQ(0) + RT(J,I) ^ 2:NN% = NN% +
     1: REM   CORRECT - VE RESPONSE
620  GOTO 660
630  IF RESP%(J,I) = 0 THEN PERR% = PERR% + 1:ESUM(1) = ESUM(1) + RT(J,I)
     : GOTO 660
640  IF RESP%(J,I) = 3 THEN  GOTO 660
650 SUM(1) = SUM(1) + RT(J,I):SMSQ(1) = SMSQ(1) + RT(J,I) ^ 2:PP% = PP% +
     1: REM    CORRECT +  VE RESPONSE
660  NEXT I
670  IF NN% <  = 1 OR PP% <  = 1 THEN  PRINT "THERE ARE TOO FEW TR IALS T
     O CALCULATE ": PRINT "VARIANCE.": GOTO 880
680 MEAN(1,J) = SUM(1) / PP%:MEAN(0,J) = SUM(0) / NN%: IF WW% = 2 GOTO 72
     0
690 PVAR = (SMSQ(1) - (SUM(1) ^ 2 / PP%)) / (PP% - 1):NVAR = (SMSQ(0) - (
     SUM(0) ^ 2 / NN%)) / (NN% - 1)
700 PSTDEV =  SQR (PVAR):NSTDEV =  SQR (NVAR)
710 PM =  FN DP(MEAN(1,J)):NM =  FN DP(MEAN(0,J)):PVAR =  FN DP(PVAR):NVA
     R =  FN DP(NVAR):PSTDEV =  FN DP(PSTDEV):NSTDEV =  FN DP(NSTDEV):SUM
     (1) =  FN DP(SUM(1)):SUM(0) =  FN DP(SUM(0))
720  PRINT "PAGE ";J;"  S.S.= ";SETSIZE(J);" +VE STIMULI ARE ";BP(2 * J -
     1);" TO ";BP(2 * J): PRINT
730  PRINT "+VE"; SPC( 2);"SUMX= ";SUM(1); SPC( 3);"-VE"; TAB( 25);"SUMX=
     ";SUM(0)
740  PRINT  TAB( 9);"N= ";PP%; TAB( 28);"N= ";NN%
750  PRINT  TAB( 6);"MEAN= ";PM; TAB( 25);"MEAN= ";NM
760  IF WW% = 2 THEN  GOTO 790
770  PRINT  TAB( 7);"VAR= ";PVAR; TAB( 26);"VAR= ";NVAR
780  PRINT  TAB( 5);"STDEV= ";PSTDEV; TAB( 24);"STDEV= ";NSTDEV
790  PRINT  TAB( 4);"ERRORS= ";PERR%; TAB( 23);"ERRORS= ";NERR%
800  IF PERR% <  > 0 THEN E1 =  FN DP(ESUM(1) / PERR%)
810  IF NERR% <  > 0 THEN E0 =  FN DP(ESUM(0) / NERR%)
820  PRINT  TAB( 2);"MEAN ERR= ";E1; TAB( 21);"MEAN ERR= ";E0
830  PRINT : PRINT
840  PRINT "FOR NEXT SET SIZE PRESS SPACE BAR.": GET S$: PRINT : PRINT
850 PP% = 0:NN% = PP%:PERR% = PP%:NERR% = PP%:SUM(0) = PP%:SUM(1) = PP%:S
     MSQ(0) = PP%:SMSQ(1) = PP%
860 ESUM(0) = 0:ESUM(1) = 0
870  GOTO 900
880  IF NN% = 0 OR PP% = 0 THEN WW% = 1: GOTO 900
890 WW% = 2: GOTO 680
900  NEXT J
910  IF WW% = 1 GOTO 1120
```

```
920  PRINT "END OF RAW DATA CALCULATIONS"
930 X = 0: FOR I = 1 TO 3:S(I) = SETSIZE(I): NEXT I
940  FOR I = 1 TO 0 STEP  - 1
950  FOR J = 1 TO 3
960  GOSUB 1320
970  NEXT J
980  IF I = 1 THEN  PRINT "+VE  -  LINEAR": PRINT : PRINT
990  IF I = 0 THEN  PRINT "-VE  -  LINEAR": PRINT : PRINT
1000  GOSUB 1380
1010 X = 0:Y = X:XY = X:XX = X:YY = X: NEXT I
1020  PRINT : PRINT : PRINT "WHEN READY FOR LOG CALCULATIONS,SPACE.": PRINT
     : PRINT
1030  GET S$
1040  FOR I = 1 TO 3:S(I) =  LOG (SETSIZE(I)) /  LOG (2):T(I) =  FN DP(S(
     I)): PRINT "LOG ";SETSIZE(I);"= ";T(I); SPC( 2);: NEXT I: PRINT
1050  PRINT
1060  FOR I = 1 TO 0 STEP  - 1
1070  FOR J = 1 TO 3
1080  GOSUB 1320
1090  NEXT J
1100  IF I = 1 THEN  PRINT "+VE  -  LOG": PRINT : PRINT
1110  IF I = 0 THEN  PRINT "-VE  -  LOG": PRINT : PRINT
1120  GOSUB 1380
1130 X = 0:Y = X:XY = X:XX = X:YY = X: NEXT I
1140  PRINT "END OF SLOPE CALCULATIONS":
1150  END
1160  HOME : HTAB 21: VTAB 14
1170  PRINT "'": FOR PAUSE = 1 TO 1000: NEXT PAUSE
1180  HTAB 21: VTAB 14: PRINT STIMSET$(X)
1190  CALL 768
1200  HOME : RETURN
1210 TENS =  INT (T(4) / 16):UNITS = T(4) - TENS * 16:SEC =  INT (T(3) /
     16):HUNDREDS = T(3) - SEC * 16
1220 TIME = SEC + HUNDREDS / 10 + TENS / 100 + UNITS / 1000 + T(2) * 16 +
     T(1) * 4096
1230  RETURN
1240 S =  - 16336
1250  FOR K = 1 TO 8:BEEP =  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK (S)
      +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK
     (S) +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK
     (S): NEXT K
1260  RETURN
1270  GOSUB 1240: FOR PAUSE = 1 TO 20: NEXT PAUSE: GOSUB 1240: RETURN
1280  IF X <  = BP(2 * J) AND RESP% = 1 THEN  GOSUB 1240:RESP%(J,I) = 1: GOTO
     1310
1290  IF X >  = BN(2 * J - 1) AND RESP% = 0 THEN  GOSUB 1240:RESP%(J,I) =
     1: GOTO 1310
1300  GOSUB 1270:RESP%(J,I) = 0
1310  RETURN
1320 XY = MEAN(I,J) * S(J) + XY
1330 Y = MEAN(I,J) + Y
1340 X = S(J) + X
1350 XX = S(J) ^ 2 + XX
1360 YY = MEAN(I,J) ^ 2 + YY
1370  RETURN
1380 BSLOPE = (XY - (X * Y) / 3) / (XX - (X * X) / 3)
1390 A = Y / 3 - BSLOPE * (X / 3)
1400 R2 = ((XY - (X * Y) / 3) ^ 2) / ((XX - (X * X) / 3) * (YY - (Y * Y) /
     3))
1410 R2 =  INT (R2 * 10000 + .5) / 10000:BSLOPE =  FN DP(BSLOPE):A =  FN
     DP(A)
1420  PRINT "R SQUARED= ";R2; SPC( 5);"SLOPE= ";BSLOPE: PRINT "INTERCEPT=
     ";A: PRINT : RETURN
1430  FOR I = 1 TO 24: READ TES(I),RESP(I): NEXT I
1440  DATA  1,0,2,1,3,1,7,0,4,1,4,1,3,1,7,0,3,1,6,0,3,1,4,1,1,0,2,1,2,1,4
     ,1,5,0,8,0,2,1,9,0,8,0,5,0,6,?,9,0
```

```
1450  FOR I = 1 TO 9: READ STIM(I): NEXT I
1460  DATA  5,7,3,8,1,6,4,2,9
1470  VTAB 5: PRINT "      HERE IS THE SET OF NUMBERS": PRINT  TAB( 10);"Y
     OU ARE TO MEMORIZE.": PRINT  TAB( 5);"COPY THEM DOWN BEFORE CONTINUI
     NG."
1480  VTAB 14: HTAB 17: FOR I = 2 TO 4: PRINT STIM(I); SPC( 3);: NEXT I: PRINT

1490  VTAB 20: PRINT  TAB( 6);"WHEN YOU ARE READY TO PROCEED,": PRINT  TAB(
     11);"PRESS THE SPACE BAR.": GET S$
1500  FOR PAUSE = 1 TO 2000: NEXT PAUSE
1510  FOR I = 1 TO 24: HOME : HTAB 21: VTAB 14: PRINT "'": FOR PAUSE = 1 TO
     1000: NEXT PAUSE
1520  HTAB 21: VTAB 14: PRINT STIM(TEST(I)): CALL 768: HOME :
1530 RESP% =  PEEK (836): IF RESP% = RESP(I) THEN  GOSUB 1240: GOTO 1550
1540  GOSUB 1270
1550  FOR PAUSE = 1 TO 1500: NEXT PAUSE
1560  NEXT I
1570  RETURN
```

Trial Sequence - Experiment 4

```
10  DIM SETSIZE(3),TRIAL%(3,160),BP(6),BN(6)
20  INPUT "SETSIZE ORDER";SETSIZE(1),SETSIZE(2),SETSIZE(3)
30  INPUT " NUMBER OF TRIALS PER SETSIZE ";SETSIZE(0)
40  INPUT "BOUNDS OF +VE SETS";BP(1),BP(2),BP(3),BP(4),BP(5),BP(6)
50  INPUT "BOUNDS OF -VE SETS";BN(1),BN(2),BN(3),BN(4),BN(5),BN(6)
60  FOR J = 1 TO 3: FOR I = 1 TO 160: PRINT "TRIAL ";I;: INPUT TRIAL%(J,I
     ): NEXT I
70  PRINT "NEW SETSIZE ": PRINT : NEXT J
80  PRINT "ANY CHANGES": INPUT S$: IF S$ = "N" GOTO 110
90  PRINT "TYPE TRIAL #,AND CORRECT STIMULUS #": INPUT J,I,TRIAL%(J,I)
100  INPUT "ANY  MORE CORRECTIONS? ";S$: IF S$ = "Y" THEN  GOTO 90
110  PRINT "READY TO STORE ARRAYS": PRINT "START RECORDER THEN SPACE.": GET
     S$
120  STORE SETSIZE: STORE TRIAL%: STORE BP: STORE BN: FOR I = 1 TO 100:X =
      PEEK ( - 16336): NEXT I: PRINT "RECORD NUMBER FROM COUNTER.": GET S
     $
130  STORE SETSIZE: STORE TRIAL%: STORE BP: STORE BN
140  END
```

Experiment 3

```
10  DIM STIMSET$(25),TRIAL%(3,160),RESP%(3,160),RT(3,160),SETSIZE(3),SNUM
     BER%(3),BP(6),BN(6)
20  DIM SUM(1),SMSQ(1),MEAN(1,3),S(3),T(4),TEST(24),RESP(24)
25  DIM IMEAN(21),ITEMS(21)
30  FOR I = 768 TO 927: READ X: POKE I,X: NEXT I
40  DATA   162,0,232,224,6,240,9,             189,191,192,157,69,3,76,2,3,
                173,97,192,201,128,176,8,169                  ,0,141,68,3,76,4
     3
50  DATA   3,173,98,192,201,128,1                76,234,169,1,141,68,3,162,0,
                232,224,6,240,9,189,191,192,                   157,74,3,76,45,3
     ,96
60  HOME
70  DEF  FN DP(X) =  INT (100 * X + .5) / 100
80  PRINT "ITEM RECOGNITION  -  2-CHOICE REACTION TIME TASK": PRINT
90  PRINT " EXPERIMENT D-8": PRINT : PRINT "PRACTICE TRIALS OCCUR BEFORE
     SESSION ": PRINT "ONE ONLY."
100 MAX = 3000: PRINT "DO YOU WISH TO CHANGE MAX OF ";MAX;: INPUT S$
110  IF S$ = "N" GOTO 140
120  IF S$       "Y" THEN  GOTO 100
130  INPUT "NEW MAX = ";MAX
140  READ N,SETSIZE(0)
150  DATA  21,160
160  PRINT : PRINT : PRINT "# OF STIMULI= ";N;" # OF TRIALS/SS = ";SETSIZ
     E(0)
170  INPUT "TYPE THE SETSIZE ORDER ";SETSIZE(1),SETSIZE(2),SETSIZE(3)
180  FOR I = 1 TO 3
190  IF SETSIZE(I) = 3 THEN BP(I * 2 - 1) = 1:BP(I * 2) = 3:BN(2 * I - 1)
      = 4:BN(2 * I) = 11
200  IF SETSIZE(I) = 4 THEN BP(I * 2 - 1) = 4:BP(I * 2) = 7:BN(2 * I - 1)
      = 8:BN(2 * I) = 10
210  IF SETSIZE(I) = 5 THEN BP(I * 2 - 1) = 8:BP(I * 2) = 12:BN(2 * I - 1
     ) = 13:BN(2 * I) = 9
220  NEXT I
230  INPUT "TYPE THE SUBJECT'S +VE SETS.";SUBSTIM$(1),SUBSTIM$(2),SUBSTIM
     $(3)
240  PRINT "TYPE THE STIMULUS POOL."
250  FOR I = 1 TO 21: INPUT STIMSET$(I): NEXT I: PRINT
260  GOSUB 1670
270  PRINT "TYPE SUBJECT NUMBER,SESSION NUMBER,": INPUT "EXPERIMENT NUMBE
     R.";SNUMBER%(1),SNUMBER%(2),SNUMBER%(3): PRINT
280  PRINT "YOU ARE READY TO BEGIN THE SESSION.": PRINT "PLACE COVER OVER
      KEYBOARD AND SPACE.": GET S$: HOME
290  VTAB 8: PRINT "SUBJECT # ";SNUMBER%(1); SPC( 2);"SESSION # ";SNUMBER
     %(2); SPC( 2);"EXP # ";SNUMBER%(3): VTAB 11: PRINT "WHEN READY TO BE
     GIN, PRESS SPACE BAR": GET S$: HOME
300  IF SNUMBER%(2) = 1 THEN  GOSUB 1520
310  HOME : VTAB 10: PRINT  TAB( 10);"ASK ANY QUESTIONS NOW.": PRINT : VTAB
     15: PRINT "WHEN READY TO BEGIN SESSION, SPACE.": GET S$: HOME
320  FOR J = 1 TO 3

340  GOSUB 1360
350  VTAB 5: PRINT "      HERE IS THE SET OF LETTERS": PRINT  TAB( 10);"YO
     U ARE TO MEMORIZE."
360  VTAB 8: PRINT  TAB( 5);"COPY THEM DOWN BEFORE CONTINUING."
370  VTAB 14: HTAB 21 - (SETSIZE(J) - 1) * 2: PRINT SUBSTIM$(J)
380  VTAB 20: PRINT  TAB( 6);"WHEN YOU ARE READY TO PROCEED": PRINT  TAB(
     11);"PRESS THE SPACE BAR": GET S$
390  FOR PAUSE = 1 TO 1000: NEXT PAUSE: HOME : FOR PAUSE = 1 TO 1000: NEXT
     PAUSE
400  FOR I = 1 TO SETSIZE(0):X = TRIAL%(J,I)
410  GOSUB 1250: REM  DISPLAY STIMULUS ITEM
420 RESP% =  PEEK (836): REM     0 FOR BUTTON 0, 1 FOR BUTTON 1
430  GOSUB 1370: REM    GIVE AUDIO  FEEDBACK
440  FOR L = 1 TO 4:T(L) =  PEEK (838 + L): NEXT L: GOSUB 1300:START = TI
```

```
ME
450  FOR L = 1 TO 4:T(L) =  PEEK (843 + L): NEXT L: GOSUB 1300:FINISH = T
     IME
460 T(1) =  PEEK (838):T(2) =  PEEK (843): IF T(1) <> T(2) THEN RESP%(J
     ,I) = 3: REM   CHECK FOR TIME ERROR WITH 1ST CLOCK BIT
470 RT(J,I) =  INT ((FINISH - START) * 1000 + .5): REM   CONVERT TO MSEC
480  FOR PAUSE = 1 TO 1000: NEXT PAUSE
490  NEXT I
500  IF J = 3 GOTO 540
510  VTAB 14: HTAB 8: PRINT "END OF SECTION ";J;" OF THIS SESSION ": PRINT

520  PRINT  TAB( 8);"YOU WILL NOW HAVE A SHORT BREAK."
530  FOR PAUSE = 1 TO 16000: NEXT PAUSE: HOME : NEXT J
540  VTAB 14: HTAB 12: PRINT "END OF SESSION": PRINT  TAB( 5);"YOU MAY NO
     W LEAVE. THANK YOU.": GET S$
550  INPUT "ARE YOU READY TO CALCULATE DATA?";S$
560  IF  LEFT$ (S$,1) <  > "Y" GOTO 550
570  HOME : PRINT "SUBJECT # ";SNUMBER%(1);"SESSION # ";SNUMBER%(2);"EXP
     # ";SNUMBER%(3)
580  PRINT "SAVE RAW DATA. WHEN RECORDER RUNNING.": PRINT "PRESS SPACE BA
     R.": GET S$
590  STORE SNUMBER%: STORE TRIAL%: STORE RESP%: STORE RT: STORE SETSIZE: STORE
     BP: STORE BN:
600  PRINT "AFTER RECORDING NUMBER FROM TAPE COUNTER": PRINT "HIT SPACE B
     AR.": GET S$
610  STORE SNUMBER%: STORE TRIAL%: STORE RESP%: STORE RT: STORE SETSIZE: STORE
     BP: STORE BN:
620  PRINT "END OF DATA STORAGE"
630  FOR J = 1 TO 3
640  FOR I = 1 TO SETSIZE(0)
650  IF RT(J,I) > MAX GOTO 740
660  IF TRIAL%(J,I) <  = BP(2 * J) THEN  GOTO 710
670  IF RESP%(J,I) = 0 THEN NERR% = NERR% + 1:ESUM(0) = ESUM(0) + RT(J,I)
     : GOTO 740
680  IF RESP%(J,I) = 3 THEN  GOTO 740
690 SUM(0) = SUM(0) + RT(J,I):SMSQ(0) = SMSQ(0) + RT(J,I) ^ 2:NN% = NN% +
     1: REM   CORRECT - VE RESPONSE
700  GOTO 740
710  IF RESP%(J,I) = 0 THEN PERR% = PERR% + 1:ESUM(1) = ESUM(1) + RT(J,I)
     : GOTO 740
720  IF RESP%(J,I) = 3 THEN  GOTO 740
730 SUM(1) = SUM(1) + RT(J,I):SMSQ(1) = SMSQ(1) + RT(J,I) ^ 2:PP% = PP% +
     1: REM    CORRECT +  VE RESPONSE
740  NEXT I
750  IF NN% <  = 1 OR PP% <  = 1 THEN  PRINT "THERE ARE TOO FEW TRIALS T
     O CALCULATE ": PRINT "VARIANCE.": GOTO 960
760 MEAN(1,J) = SUM(1) / PP%:MEAN(0,J) = SUM(0) / NN%: IF WW% = 2 GOTO 80
     0
770 PVAR = (SMSQ(1) - (SUM(1) ^ 2 / PP%)) / (PP% - 1):NVAR = (SMSQ(0) - (
     SUM(0) ^ 2 / NN%)) / (NN% - 1)
780 PSTDEV =  SQR (PVAR):NSTDEV =  SQR (NVAR)
790 PM =  FN DP(MEAN(1,J)):NM =  FN DP(MEAN(0,J)):PVAR =  FN DP(PVAR):NVA
     R =  FN DP(NVAR):PSTDEV =  FN DP(PSTDEV):NSTDEV =  FN DP(NSTDEV):SUM
     (1) =  FN DP(SUM(1)):SUM(0) =  FN DP(SUM(0))
800  PRINT "PAGE ";J;"  S.S.= ";SETSIZE(J);" +VE STIMULI ARE ";BP(2 * J -
     1);" TO ";BP(2 * J): PRINT
810  PRINT "+VE"; SPC( 2);"SUMX= ";SUM(1); SPC( 3);"-VE"; TAB( 25);"SUMX=
     ";SUM(0)
820  PRINT  TAB( 9);"N= ";PP%; TAB( 29);"N= ";NN%
830  PRINT  TAB( 6);"MEAN= ";PM; TAB( 25);"MEAN= ";NM
840  IF WW% = 2 THEN  GOTO 870
850  PRINT  TAB( 7);"VAR= ";PVAR; TAB( 26);"VAR= ";NVAR
860  PRINT  TAB( 5);"STDEV= ";PSTDEV; TAB( 24);"STDEV= ";NSTDEV
870  PRINT  TAB( 4);"ERRORS= ";PERR%; TAB( 23);"ERRORS= ";NERR%
880  IF PERR% <  > 0 THEN E1 =  FN DP(ESUM(1) / PERR%)
890  IF NERR% <  > 0 THEN E0 =  FN DP(ESUM(0) / NERR%)
```

```
900  PRINT  TAB( 2);"MEAN ERR= ";E1; TAB( 21);"MEAN ERR= ";E0
910  PRINT : PRINT
920  PRINT "FOR NEXT SET SIZE PRESS SPACE BAR.": GET S$: PRINT : PRINT
930 PP% = 0:NN% = PP%:PERR% = PP%:NERR% = PP%:SUM(0) = PP%:SUM(1) = PP%:S
     MSQ(0) = PP%:SMSQ(1) = PP%
940 ESUM(0) = 0:ESUM(1) = 0
950  GOTO 980
960  IF NN% = 0 OR PP% = 0 THEN WW% = 1: GOTO 980
970 WW% = 2: GOTO 960
980  NEXT J
990  IF WW% = 1 GOTO 1200
1000  PRINT "END OF RAW DATA CALCULATIONS"
1010 X = 0: FOR I = 1 TO 3:S(I) = SETSIZE(I): NEXT I
1020  FOR I = 1 TO 0 STEP  - 1
1030  FOR J = 1 TO 3
1040  GOSUB 1410
1050  NEXT J
1060  IF I = 1 THEN  PRINT "+VE  -  LINEAR": PRINT : PRINT
1070  IF I = 0 THEN  PRINT "-VE  -  LINEAR": PRINT : PRINT
1080  GOSUB 1470
1090 X = 0:Y = X:XY = X:XX = X:YY = X: NEXT I
1100  PRINT : PRINT : PRINT "WHEN READY FOR LOG CALCULATIONS,SPACE.": PRINT
     : PRINT
1110  GET S$
1120  FOR I = 1 TO 3:S(I) =  LOG (SETSIZE(I)) /  LOG (2):T(I) =  FN DP(S(
     I)): PRINT "LOG ";SETSIZE(I);"= ";T(I); SPC( 2);: NEXT I: PRINT
1130  PRINT
1140  FOR I = 1 TO 0 STEP  - 1
1150  FOR J = 1 TO 3
1160  GOSUB 1410
1170  NEXT J
1180  IF I = 1 THEN  PRINT "+VE  -  LOG": PRINT : PRINT
1190  IF I = 0 THEN  PRINT "-VE  -  LOG": PRINT : PRINT
1200  GOSUB 1470
1210 X = 0:Y = X:XY = X:XX = X:YY = X: NEXT I
1220  PRINT "END OF SLOPE CALCULATIONS":
1240  END
1250  HOME : HTAB 21: VTAB 14
1260  PRINT "'": FOR PAUSE = 1 TO 1000: NEXT PAUSE
1270  HTAB 21: VTAB 14: PRINT STIMSET$(X)
1280  CALL 768
1290  HOME : RETURN
1300 TENS =  INT (T(4) / 16):UNITS = T(4) - TENS * 16:SEC =  INT (T(3) /
     16):HUNDREDS = T(3) - SEC * 16
1310 TIME = SEC + HUNDREDS / 10 + TENS / 100 + UNITS / 1000 + T(2) * 16 +
     T(1) * 4096
1320  RETURN
1330 S =  - 16336
1340  FOR K = 1 TO 8:BEEP =  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK (S)
      +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK
     (S) +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK (S) +  PEEK (S) -  PEEK
     (S): NEXT K
1350  RETURN
1360  GOSUB 1330: FOR PAUSE = 1 TO 20: NEXT PAUSE: GOSUB 1330: RETURN
1370  IF X <  = BP(2 * J) AND RESP% = 1 THEN  GOSUB 1330:RESP%(J,I) = 1: GOTO
     1400
1380  IF X >  = BN(2 * J - 1) AND RESP% = 0 THEN  GOSUB 1330:RESP%(J,I) =
     1: GOTO 1400
1390  GOSUB 1360:RESP%(J,I) = 0
1400  RETURN
1410 XY = MEAN(I,J) * S(J) + XY
1420 Y = MEAN(I,J) + Y
1430 X = S(J) + X
1440 XX = S(J) ^ 2 + XX
1450 YY = MEAN(I,J) ^ 2 + YY
1460  RETURN
```

```
1470 BSLOPE = (XY - (X * Y) / 3) / (XX - (X * X) / 3)
1480 A = Y / 3 - BSLOPE * (X / 3)
1490 R2 = ((XY - (X * Y) / 3) ^ 2) / ((XX - (X * X) / 3) * ((YY - (Y * Y) /
     3))
1500 R2 =  INT (R2 * 10000 + .5) / 10000:BSLOPE =  FN DP(BSLOPE):A =  FN
     DP(A)
1510  PRINT "R SQUARED= ";R2; SPC( 5);"SLOPE= ";BSLOPE: PRINT "INTERCEPT=
     ";A: PRINT : RETURN
1520  FOR I = 1 TO 24: READ TEST(I),RESP(I): NEXT I
1530  DATA  1,0,2,1,3,1,7,0,4,1,4,1,3,1,7,0,3,1,6,0,3,1,4,1,1,0,2,1,2,1,4
     ,1,5,0,8,0,2,1,9,0,8,0,5,0,6,0,9,0
1540  FOR I = 1 TO 9: READ STIM(I): NEXT I
1550  DATA  5,7,3,8,1,6,4,2,9
1560  VTAB 5: PRINT "      HERE IS THE SET OF NUMBERS": PRINT  TAB( 10);"Y
     OU ARE TO MEMORIZE.": PRINT  TAB( 5);"COPY THEM DOWN BEFORE CONTINUI
     NG."
1570  VTAB 14: HTAB 17: FOR I = 2 TO 4: PRINT STIM(I); SPC( 3);: NEXT I: PRINT

1580  VTAB 20: PRINT  TAB( 6);"WHEN YOU ARE READY TO PROCEED,": PRINT  TAB(
     11);"PRESS THE SPACE BAR.": GET S$
1590  FOR PAUSE = 1 TO 2000: NEXT PAUSE
1600  FOR I = 1 TO 24: HOME : HTAB 21: VTAB 14: PRINT "*": FOR PAUSE = 1 TO
     1000: NEXT PAUSE
1610  HTAB 21: VTAB 14: PRINT STIM(TEST(I)): CALL 768: HOME :
1620 RESP% =  PEEK (806): IF RESP% = RESP(I) THEN  GOSUB 1330: GOTO 1640
1630  GOSUB 1360
1640  FOR PAUSE = 1 TO 1500: NEXT PAUSE
1650  NEXT I
1660  RETURN
1670  FOR I = 1 TO 3: ON SETSIZE(I) GOTO 1670,1670,1690,1720,1750
1680  REM  S=3
1690 C1 = 1:C2 = 2:C3 = 3:B1 = 40:B2 = 32:B3 = 8: GOSUB 1850
1700  GOTO 1760
1710  REM  S=4
1720 C1 = 4:C2 = 5:C3 = 6:C4 = 7:B1 = 40:B2 = 24:B3 = 8:B4 = 8: GOSUB 185
     0
1730  GOTO 1760
1740  REM  S=5
1750 C1 = 8:C2 = 9:C3 = 10:C4 = 11:C5 = 12:B1 = 40:B2 = 16:B3 = 8:B4 = 8:
     B5 = 8: GOSUB 1850
1760  NEXT I
1770  FOR J = 1 TO 3: FOR I = 81 TO SETSIZE(0) STEP BN(2 * J)
1780  FOR L = 0 TO BN(2 * J) - 1
1790  IF SETSIZE(0) < I + L THEN  GOTO 1810
1800 TRIAL%(J,I + L) = BN(2 * J - 1) + L:
1810  NEXT L: NEXT I
1820  FOR L = 1 TO 3: FOR I = 1 TO SETSIZE(0)
1830 Z =  INT ( RND (1) * SETSIZE(0)) + 1:T = TRIAL%(J,I):TRIAL%(J,I) = T
     RIAL%(J,Z):TRIAL%(J,Z) = T
1840  NEXT I: NEXT L: NEXT J: RETURN
1850  FOR J = 1 TO B1:TRIAL%(I,J) = C1: NEXT J:YY = B1
1860  FOR J = YY + 1 TO YY + B2:TRIAL%(I,J) = C2: NEXT J:YY = YY + B2
1870  FOR J = YY + 1 TO YY + B3:TRIAL%(I,J) = C3: NEXT J:YY = YY + B3
1880  IF YY >  = 80 THEN  RETURN
1890  FOR J = YY + 1 TO YY + B4:TRIAL%(I,J) = C4: NEXT J:YY = YY + B4
1900  IF YY =  > 80 THEN  RETURN
1910  FOR J = YY + 1 TO YY + B5:TRIAL%(I,J) = C5: NEXT J
1920  RETURN
```

Experiment 2

```
10  DIM STIMSET$(25),TRIAL%(3,160),RESP%(3,160),RT(3,160),SETSIZE(3),SNUM
     BER%(3),BP(6),BN(6)
20  DIM SUM(1),SMSQ(1),MEAN(1,3),S(3),T(4),TEST(24),RESP(24)
30  DIM IMEAN(21),ITEMS(21)
40  FOR I = 768 TO 827: READ X: POKE I,X: NEXT I
50  DATA   162,0,232,224,6,240,9,             189,191,192,157,69,3,76,2,3,
                173,97,192,201,128,176,8,169              ,0,141,68,3,76,4
     3
60  DATA   3,173,98,192,201,128,1              76,234,169,1,141,68,3,162,0,
                232,224,6,240,9,189,191,192,              157,74,3,76,45,3
     ,96
70  HOME : FOR I = 968 TO 990: READ X: POKE I,X: NEXT I
80  DATA  85,1,173,48,192,136,208,5,206,201,3,240,9,202,208,246,174,200,3
     ,76,202,3,96
90 P = 100: DEF  FN [illegible]X) =  INT (X * P + .5) / P
100  PRINT "ITEM R[illegible]ITION  -  2-CHOICE REACTION TIME TASK": PRINT
110  PRINT " EXPER[illegible]T D-9": PRINT : PRINT "PRACTICE TRIALS OCCUR BEFORE
      SESSION "[illegible]T "ONE ONLY."
120 MIN = 450
130 MAX = 3000: PRINT "DO YOU WISH TO CHANGE MAX OF ";MAX;: INPUT S$
140  IF S$ = "N" GOTO 170
150  IF S$     "Y" THEN  GOTO 130
160  INPUT "NEW MAX = ";MAX
170  READ N,SETSIZE(0)
180  DATA  21,160
190  PRINT : PRINT : PRINT "# OF STIMULI= ";N;" # OF TRIALS/SS = ";SETSIZ
     E(0)
200  INPUT "TYPE THE SETSIZE ORDER ";SETSIZE(1),SETSIZE(2),SETSIZE(3)
210  FOR I = 1 TO 3
220  IF SETSIZE(I) = 3 THEN BP(I * 2 - 1) = 1:BP(I * 2) = 3:BN(2 * I - 1)
      = 4:BN(2 * I) = 11
230  IF SETSIZE(I) = 4 THEN BP(I * 2 - 1) = 4:BP(I * 2) = 7:BN(2 * I - 1)
      = 8:BN(2 * I) = 10
240  IF SETSIZE(I) = 5 THEN BP(I * 2 - 1) = 8:BP(I * 2) = 12:BN(2 * I - 1
     ) = 13:BN(2 * I) = 9
250  NEXT I
260  INPUT "TYPE THE SUBJECT'S +VE SETS.";SUBSTIM$(1),SUBSTIM$(2),SUBSTIM
     $(3)
270  PRINT "TYPE THE STIMULUS POOL."
280  FOR I = 1 TO 21: INPUT STIMSET$(I): NEXT I: PRINT
290  FOR J = 1 TO 3
300 X = BP(2 * J - 1)
310  FOR I = X + 1 TO BN(2 * J) + BN(2 * J - 1) - 1: IF STIMSET$(X) = STI
     MSET$(I) THEN  GOSUB 1420: GOSUB 1420: GOTO 1270
320  NEXT I:X = X + 1: IF X < BN(2 * J - 1) + BN(2 * J) - 1 GOTO 310
330  NEXT J
340  PRINT "TYPE SUBJECT NUMBER,SESSION NUMBER,": INPUT "EXPERIMENT NUMBE
     R.";SNUMBER%(1),SNUMBER%(2),SNUMBER%(3): PRINT
350  GOSUB 1750
360  PRINT "YOU ARE READY TO BEGIN THE SESSION.": PRINT "PLACE COVER OVER
      KEYBOARD AND SPACE.": GET S$: HOME
370  VTAB 8: PRINT "SUBJECT # ";SNUMBER%(1); SPC( 2);"SESSION # ";SNUMBER
     %(2); SPC( 2);"EXP # ";SNUMBER%(3): VTAB 11: PRINT "WHEN READY TO BE
     GIN, PRESS SPACE BAR.": GET S$: HOME
380  IF SNUMBER%(2) = 1 THEN  GOSUB 1600
390  HOME
400  FOR J = 1 TO 3
410  POKE  - 16368,0
420  GOSUB 1440
430  VTAB 5: PRINT "     HERE IS THE SET OF LETTERS": PRINT  TAB( 10);"YO
     U ARE TO MEMORIZE."
440  VTAB 8: PRINT  TAB( 5);"COPY THEM DOWN BEFORE CONTINUING."
450  VTAB 14: HTAB 21 - (SETSIZE(J) - 1) * 2: PRINT SUBSTIM$(J)
460  VTAB 20: PRINT  TAB( 6);"WHEN YOU ARE READY TO PROCEED": PRINT  TAB(
```

```
    11);"PRESS THE SPACE BAR": GET S$
470  FOR PAUSE = 1 TO 1000: NEXT PAUSE: HOME : FOR PAUSE = 1 TO 1000: NEXT
     PAUSE
480  FOR I = 1 TO SETSIZE(0):X = TRIAL%(J,I)
490  GOSUB 1340: REM  DISPLAY STIMULUS ITEM
500 RESP% =  PEEK (836): REM   0 FOR BUTTON 0, 1 FOR BUTTON 1
510  GOSUB 1450: REM    GIVE AUDIO  FEEDBACK
520  FOR L = 1 TO 4:T(L) =  PEEK (838 + L): NEXT L: GOSUB 1390:START = TI
     ME
530  FOR L = 1 TO 4:T(L) =  PEEK (843 + L): NEXT L: GOSUB 1390:FINISH = T
     IME
540 T(1) =  PEEK (838):T(2) =  PEEK (843): IF T(1) < > T(2) THEN RESP%(J
     ,I) = 3: REM   CHECK FOR TIME ERROR WITH 1ST CLOCK BIT
550 RT(J,I) =  INT ((FINISH - START) * 1000 + .5): REM   CONVERT TO MSEC
560  FOR PAUSE = 1 TO 1000: NEXT PAUSE
570  NEXT I
580  IF J = 3 GOTO 620
590  VTAB 14: HTAB 8: PRINT "END OF SECTION ";J;" OF THIS SESSION ": PRINT

600  PRINT  TAB( 8);"YOU WILL NOW HAVE A SHORT BREAK."
610  FOR PAUSE = 1 TO 16000: NEXT PAUSE: HOME : NEXT J
620  VTAB 14: HTAB 12: PRINT "END OF SESSION": PRINT  TAB( 5);"YOU MAY NO
     W LEAVE. THANK YOU.": GET S$
630  INPUT "ARE YOU READY TO CALCULATE DATA?";S$
640  IF  LEFT$ (S$,1) < > "Y" GOTO 630
650  HOME : PRINT "SUBJECT # ";SNUMBER%(1);"SESSION # ";SNUMBER%(2);"EXP
     # ";SNUMBER%(3)
660  FOR J = 1 TO 3
670  FOR I = 1 TO SETSIZE(0)
680  IF RT(J,I) > MAX OR RT(J,I) < MIN GOTO 770
690  IF TRIAL%(J,I) < = BP(2 * J) THEN  GOTO 740
700  IF RESP%(J,I) = 0 THEN NERR% = NERR% + 1:ESUM(0) = ESUM(0) + RT(J,I)
     : GOTO 770
710  IF RESP%(J,I) = 3 THEN  GOTO 770
720 SUM(0) = SUM(0) + RT(J,I):SMSQ(0) = SMSQ(0) + RT(J,I) ^ 2:NN% = NN% +
     1: REM   CORRECT - VE RESPONSE
730  GOTO 770
740  IF RESP%(J,I) = 0 THEN PERR% = PERR% + 1:ESUM(1) = ESUM(1) + RT(J,I)
     : GOTO 770
750  IF RESP%(J,I) = 3 THEN  GOTO 770
760 SUM(1) = SUM(1) + RT(J,I):SMSQ(1) = SMSQ(1) + RT(J,I) ^ 2:PP% = PP% +
     1: REM    CORRECT +  VE RESPONSE
770  NEXT I
780  IF NN% < = 1 OR PP% < = 1 THEN  PRINT "THERE ARE TOO FEW TR IALS T
     O CALCULATE ": PRINT "VARIANCE.": GOTO 990
790 MEAN(1,J) = SUM(1) / PP%:MEAN(0,J) = SUM(0) / NN%: IF WW% = 2 GOTO 83
     0
800 PVAR = (SMSQ(1) - (SUM(1) ^ 2 / PP%)) / (PP% - 1):NVAR = (SMSQ(0) - (
     SUM(0) ^ 2 / NN%)) / (NN% - 1)
810 PSTDEV =  SQR (PVAR):NSTDEV =  SQR (NVAR)
820 PM =  FN DP(MEAN(1,J)):NM =  FN DP(MEAN(0,J)):PVAR =  FN DP(PVAR):NVA
     R =  FN DP(NVAR):PSTDEV =  FN DP(PSTDEV):NSTDEV =  FN DP(NSTDEV):SUM
     (1) =  FN DP(SUM(1)):SUM(0) =  FN DP(SUM(0))
830  PRINT "PAGE ";J;"  S.S.= ";SETSIZE(J);" +VE STIMULI ARE ";BP(2 * J -
     1);" TO ";BP(2 * J): PRINT
840  PRINT "+VE"; SPC( 2);"SUMX= ";SUM(1); SPC( 3);"-VE"; TAB( 25);"SUMX=
     ";SUM(0)
850  PRINT  TAB( 9);"N= ";PP%; TAB( 28);"N= ";NN%
860  PRINT  TAB( 6);"MEAN= ";PM; TAB( 25);"MEAN= ";NM
870  IF WW% = 2 THEN  GOTO 900
880  PRINT  TAB( 7);"VAR= ";PVAR; TAB( 26);"VAR= ";NVAR
890  PRINT  TAB( 5);"STDEV= ";PSTDEV; TAB( 24);"STDEV= ";NSTDEV
900  PRINT  TAB( 4);"ERRORS= ";PERR%; TAB( 23);"ERRORS= ";NERR%
910  IF PERR% < > 0 THEN E1 =  FN DP(ESUM(1) / PERR%)
920  IF NERR% < > 0 THEN E0 =  FN DP(ESUM(0) / NERR%)
930  PRINT  TAB( 2);"MEAN ERR= ";E1; TAB( 21);"MEAN ERR= ";E0
```

```
940  PRINT : PRINT
950  PRINT "FOR NEXT SET SIZE PRESS SPACE BAR.": GET S$: PRINT : PRINT
960 PP% = 0:NN% = PP%:PERR% = PP%:NERR% = PP%:SUM(0) = PP%:SUM(1) = PP%:S
     MSQ(0) = PP%:SMSQ(1) = PP%
970 ESUM(0) = 0:ESUM(1) = 0:E1 = 0:E0 = 0
980  GOTO 1010
990  IF NN% = 0 OR PP% = 0 THEN WW% = 1: GOTO 1010
1000 WW% = 2: GOTO 790
1010  NEXT J
1020  IF WW% = 1 GOTO 1230
1030  PRINT "END OF RAW DATA CALCULATIONS"
1040 X = 0:YY = 0: FOR I = 1 TO 3:S(I) = SETSIZE(I): NEXT I
1050  FOR I = 1 TO 0 STEP  - 1
1060  FOR J = 1 TO 3
1070  GOSUB 1490
1080  NEXT J
1090  IF I = 1 THEN  PRINT "+VE  -  LINEAR": PRINT : PRINT
1100  IF I = 0 THEN  PRINT "-VE  -  LINEAR": PRINT : PRINT
1110  GOSUB 1550
1120 X = 0:Y = X:XY = X:XX = X:YY = X: NEXT I
1130  PRINT : PRINT : PRINT "WHEN READY FOR LOG CALCULATIONS,SPACE.": PRINT
     : PRINT
1140  GET S$
1150  FOR I = 1 TO 3:S(I) =  LOG (SETSIZE(I)) /  LOG (2):T(I) =  FN OP(S(
     I)): PRINT "LOG ";SETSIZE(I);"= ";T(I); SPC( 2);: NEXT I: PRINT
1160  PRINT
1170  FOR I = 1 TO 0 STEP  - 1
1180  FOR J = 1 TO 3
1190  GOSUB 1490
1200  NEXT J
1210  IF I = 1 THEN  PRINT "+VE  -  LOG": PRINT : PRINT
1220  IF I = 0 THEN  PRINT "-VE  -  LOG": PRINT : PRINT
1230  GOSUB 1550
1240 X = 0:Y = X:XY = X:XX = X:YY = X: NEXT I
1250  PRINT "END OF SLOPE CALCULATIONS":
1260  GOTO 1280
1270  PRINT "THERE IS AN ERROR IN THE STIMULUS POOL.": PRINT "AN ITEM IS
     REPEATED. INPUT AGAIN.": GOTO 270
1280  PRINT "SAVE RAW DATA. WHEN RECORDER RUNNING,": PRINT "PRESS SPACE B
     AR.": GET S$
1290  STORE SNUMBER%: STORE TRIAL%: STORE RESP%: STORE RT: STORE SETSIZE:
      STORE BP: STORE BN: STORE MEAN:
1300  PRINT "AFTER RECORDING NUMBER FROM TAPE COUNTER": PRINT "HIT SPACE
     BAR.": GET S$
1310  STORE SNUMBER%: STORE TRIAL%: STORE RESP%: STORE RT: STORE SETSIZE:
      STORE BP: STORE BN: STORE MEAN:
1320  PRINT "END OF DATA STORAGE"
1330  END
1340  HOME : HTAB 21: VTAB 14
1350  PRINT "'": FOR PAUSE = 1 TO 1000: NEXT PAUSE
1360  HTAB 21: VTAB 14: PRINT STIMSET$(X)
1370  CALL 768
1380  HOME : RETURN
1390 TENS =  INT (T(4) / 16):UNITS = T(4) - TENS * 16:SEC =  INT (T(3) /
     16):HUNDREDS = T(3) - SEC * 16
1400 TIME = SEC + HUNDREDS / 10 + TENS / 100 + UNITS / 1000 + T(2) * 16 +
     T(1) * 4096
1410  RETURN
1420  POKE 968,85: POKE 969,1: CALL 970
1430  RETURN
1440  GOSUB 1420: FOR PAUSE = 1 TO 20: NEXT PAUSE: GOSUB 1420: RETURN
1450  IF X <  = BP(2 * J) AND RESP% = 1 THEN  GOSUB 1420:RESP%(J,I) = 1: GOTO
     1480
1460  IF X    = BN(2 * J - 1) AND RESP% = 0 THEN  GOSUB 1420:RESP%(J,I) =
     1: GOTO 1480
1470  GOSUB 1440:RESP%(J,I) = 0
```

```
1480  RETURN
1490 XY = MEAN(I,J) * S(J) + XY
1500 Y = MEAN(I,J) + Y
1510 X = S(J) + X
1520 XX = S(J) ^ 2 + XX
1530 YY = MEAN(I,J) ^ 2 + YY
1540  RETURN
1550 BSLOPE = (XY - (X * Y) / 3) / (XX - (X * X) / 3)
1560 A = Y / 3 - BSLOPE * (X / 3)
1570 R2 = ((XY - (X * Y) / 3) ^ 2) / ((XX - (X * X) / 3) * (YY - (Y * Y) /
     3))
1580 R2 =  INT (R2 * 10000 + .5) / 10000:BSLOPE =  FN DP(BSLOPE):A =  FN
     DP(A)
1590  PRINT "R SQUARED= ";R2; SPC( 5);"SLOPE= ";BSLOPE: PRINT "INTERCEPT=
     ";A: PRINT : RETURN
1600  FOR I = 1 TO 24: READ TEST(I),RESP(I): NEXT I
1610  DATA  1,0,2,1,3,1,7,0,4,1,4,1,3,1,7,0,3,1,6,0,3,1,4,1,1,0,2,1,2,1,4
     ,1,5,0,8,0,2,1,9,0,8,0,5,0,6,0,9,0
1620  FOR I = 1 TO 9: READ STIM(I): NEXT I
1630  DATA  5,7,3,8,1,6,4,2,9
1640  VTAB 5: PRINT "      HERE IS THE SET OF NUMBERS": PRINT  TAB( 10);"Y
     OU ARE TO MEMORIZE.": PRINT  TAB( 5);"COPY THEM DOWN BEFORE CONTINUI
     NG."
1650  VTAB 14: HTAB 17: FOR I = 2 TO 4: PRINT STIM(I); SPC( 3);: NEXT I: PRINT

1660  VTAB 20: PRINT  TAB( 6);"WHEN YOU ARE READY TO PROCEED,": PRINT  TAB(
     11);"PRESS THE SPACE BAR.": GET S$
1670  FOR PAUSE = 1 TO 2000: NEXT PAUSE
1680  FOR I = 1 TO 24: HOME : HTAB 21: VTAB 14: PRINT "*": FOR PAUSE = 1 TO
     1000: NEXT PAUSE
1690  HTAB 21: VTAB 14: PRINT STIM(TEST(I)): CALL 768: HOME :
1700 RESP% =  PEEK (836): IF RESP% = RESP(I) THEN  GOSUB 1420: GOTO 1720
1710  GOSUB 1440
1720  FOR PAUSE = 1 TO 1500: NEXT PAUSE
1730  NEXT I
1740  VTAB 10: PRINT  TAB( 10);"ASK ANY QUESTIONS NOW.": VTAB 15: PRINT  TAB(
     5);"WHEN READY TO BEGIN SESSION, SPACE.": GET S$: RETURN
1750  FOR I = 1 TO 3: ON SETSIZE(I) GOTO 1750,1750,1770,1800,1830
1760  REM  S=3
1770 C1 = 1:C2 = 2:C3 = 3:B1 = 40:B2 = 24:B3 = 16: GOSUB 1930
1780  GOTO 1840
1790  REM  S=4
1800 C1 = 4:C2 = 5:C3 = 6:C4 = 7:B1 = 40:B2 = 24:B3 = 8:B4 = 8: GOSUB 193
     0
1810  GOTO 1840
1820  REM  S=5
1830 C1 = 8:C2 = 9:C3 = 10:C4 = 11:C5 = 12:B1 = 40:B2 = 24:B3 = 3:B4 = 5:
     B5 = 3: GOSUB 1930
1840  NEXT I
1850  FOR J = 1 TO 3: FOR I = 81 TO SETSIZE(0) STEP BN(2 * J)
1860  FOR L = 0 TO BN(2 * J) - 1
1870  IF SETSIZE(0) < I + L THEN  GOTO 1890
1880 TRIAL%(J,I + L) = BN(2 * J - 1) + L:
1890  NEXT L: NEXT I
1900  FOR L = 1 TO 3: FOR I = 1 TO SETSIZE(0)
1910 Z =  INT ( RND (1) * SETSIZE(0)) + 1:T = TRIAL%(J,I):TRIAL%(J,I) = T
     RIAL%(J,Z):TRIAL%(J,Z) = T
1920  NEXT I: NEXT L: NEXT J: RETURN
1930  FOR J = 1 TO B1:TRIAL%(I,J) = C1: NEXT J:YY = B1
1940  FOR J = YY + 1 TO YY + B2:TRIAL%(I,J) = C2: NEXT J:YY = YY + B2
1950  FOR J = YY + 1 TO YY + B3:TRIAL%(I,J) = C3: NEXT J:YY = YY + B3
1960  IF YY >  = 80 THEN  RETURN
1970  FOR J = YY + 1 TO YY + B4:TRIAL%(I,J) = C4: NEXT J:YY = YY + B4
1980  IF YY >  = 80 THEN  RETURN
1990  FOR J = YY + 1 TO YY + B5:TRIAL%(I,J) = C5: NEXT J
2000  RETURN
```

Experiment 4 Data Analysis Programme

This programme was primarily concerned with finding the mean RTs for those items whose lag length, from one presentation to the next, was controlled (P=.25 and P=.10). Also, the mean RTs for the remaining positive items and all negative items were found for the lag length intervals 0-4, 5-9, 10-19, 20-29, and 30 or more. As well, variances and standard deviations for the .25 and .10 positive items were calculated for short (0-2) and long (8-10) lag lengths. Linear regression was performed for long and short lags. Mean RTs for first and all subsequent presentations were found for all items individually, as well as the overall mean RT for each item. Errors were also investigated in some depth. See Figure 61 for a more thorough description of the programme.

Experiment 3 Data Analysis Programmes

The two programmes which analyse the data from Experiment 3 act in much the same way as the Experiment 4 programme except that since the lag lengths were not controlled for the unconfounded items, the calculations were done for lag lengths 0-4, 5-9, 10-19, 20-29 and 30 or more for all items, positive and negative. Again, first and subsequent presentations ~~were~~ calculated, variances of the .25 and .05 positives were found, and curve fits were performed for these items. Errors were again examined.

Experiment 2 Data Analysis Programmes

The first programme is a composite of the two used to analyse Experiment 3. In addition, a programme was written to form arrays which were stored on cassette and used in a later programme to obtain 6–day averages of first and subsequent presentation data and lag length data for each item in each set size.

Symbol Table - Experiment 4 Data Analysis Programme

1a) String Variables

L$	-L$="LONG" or "SHORT". Used to print variance and standard deviations of long and short lag langths
S$	-used to await Keyboard response in GET S$

b) Real Variables

A	-temporary storage to indicate .25 probability item in each set size in the error analysis -intercept value obtained from linear regression -index variable of lag length 0, 1, 2, 8, 9, 10
B	-temporary storage to indicate .10 probability item in each set size in the error analysis
B1	-temporary storage to indicate the second .10 item in set size 4 in the error analysis
C	-temporary storage holding the number of times the .10 item(s) occur in each set size in the error analysis
DEN	-the denominator (i.e. the number of occurrences) used to find the average RT at each lag length
FIRST	-mean RT of first occurrences of positive and negative items in each set size
H =0 or 1	used in calculating lags for .25 and .10 items. H=0 for .10 item(s) in each set size. H=1 for .25 item in each set size.
I	-index variable, usually refers to trial I or stimulus item I
II	-index variable
IMEAN	-temporary storage for mean RT of each item in each set size
J	-index variable, usually refers to set size J or block J
K	-index variable
KK	-index variable
L =0 or 1:	0 indicates short lag length, 1 indicates long lag length in the calculation of the variance and standard deviation of .25 and .10 items -also L is used in the error analysis as the trial number counter
LAG	-lag length between two occurrences of a particular item -also temporary storage of the sum of the RTs of an item at different lag lengths
LL	-temporary storage of the sum of the RTs for .10 items in the set size of 4 used to average the long and short lags
LNG	-temporary storage of the mean RTs of the .25 and .10 items at long lag lengths
MAX=2000	response times greater than MAX were excluded from analysis
MIN=150	response times less than MIN were excluded from analysis
ML	-temporary storage of mean RTs for the uncontrolled probability items at lag lengths 0-4, 5-9, 10-19, 20-29 and 30 or more
MRT	-mean RT of errors for a particular item in the error analysis
NO	-temporary storage of the number of subsequent occurrences for all positive or all negative items for each set size

N9	-temporary storage of the number of RTs for the .10 items in the set size of 4 used to average long and short lags
NF	-temporary storage of the number of first occurrences for all positive or all negative items for each set size
OTHERS	-mean RT of subsequent occurrences of positive and negative items for each set size
P	-P=.25, .10, 5 or 6. used to print out variance and standard deviations of .25 and .10 items and for the set size of 4, items 5 and 6 separately -also indicates trial number of a 'subsequent' occurrence
P1	-trial number of a 'previous' occurrence of an item
PCT	-percent errors in the error analysis
R2	-coefficient of determination, r^2, obtained from linear regression
S0	-number of incorrect negative responses
S1	-number of incorrect positive responses
SHRT	-temporary storage of the mean RTs of the .25 and .10 items at short lag lengths
SIGMA	-variance for .25 and .10 items
SLOPE	-slope value obtained from linear regression
STDEV	-standard deviation for .25 and .10 items
X	-sum of the set sizes, used in linear regression
XX	-sum of the squares of the set sizes, used in linear regression -also used to indicate item number
XY	-sum of the products of set size x mean RT, used in linear regression
Y	-sum of the mean RTs of all set sizes, used in linear regression
YY	-sum of the squares of the mean RTs of all set sizes, used in linear regression
Y5	-number of incorrect responses for .10 items in set size 4

2a) Integer Arrays

RESP%(3,160)	-RESP%(J,I)=0 or 1. 0 if the response to trial I in block J was incorrect, 1 if correct
SNUMBER%(3)	-identifies subject: SNUMBER%(I). I=1 indicates subject number, I=2 indicates session number, I=3 indicates experiment number
TRIAL%(3,160)	-stimulus sequences: TRIAL%(J,I). For block J and trial I, indicates which stimulus item is to be presented to the subject

b) Real Arrays

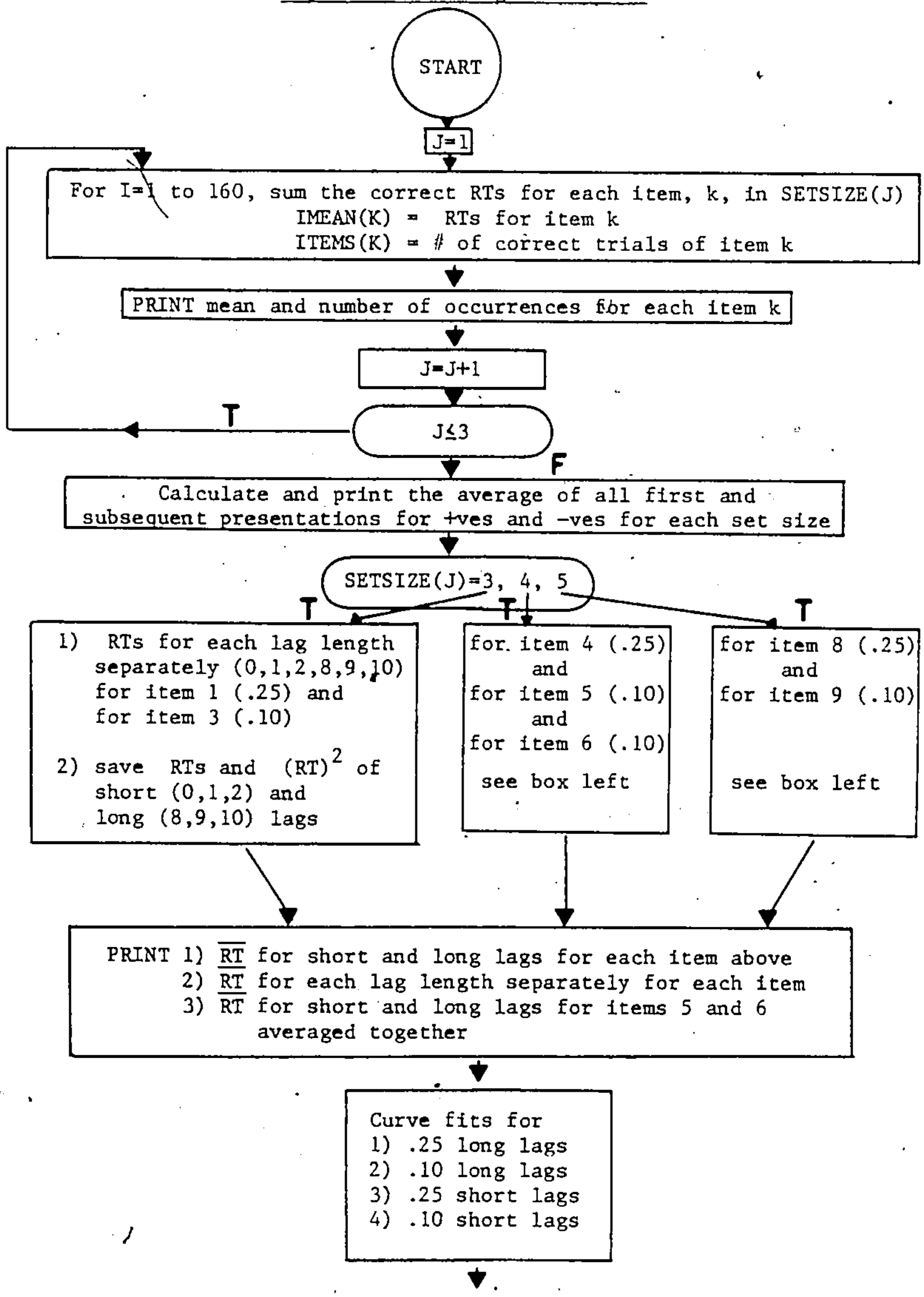
BN(6)	-defines the negative sets by their boundaries: BN(I). I=1,3,5 are the lower boundaries of the first, second, and third negative sets the S will work with. I=2,4,6 indicate how many items are in the respective negative sets. (see Figure 60)

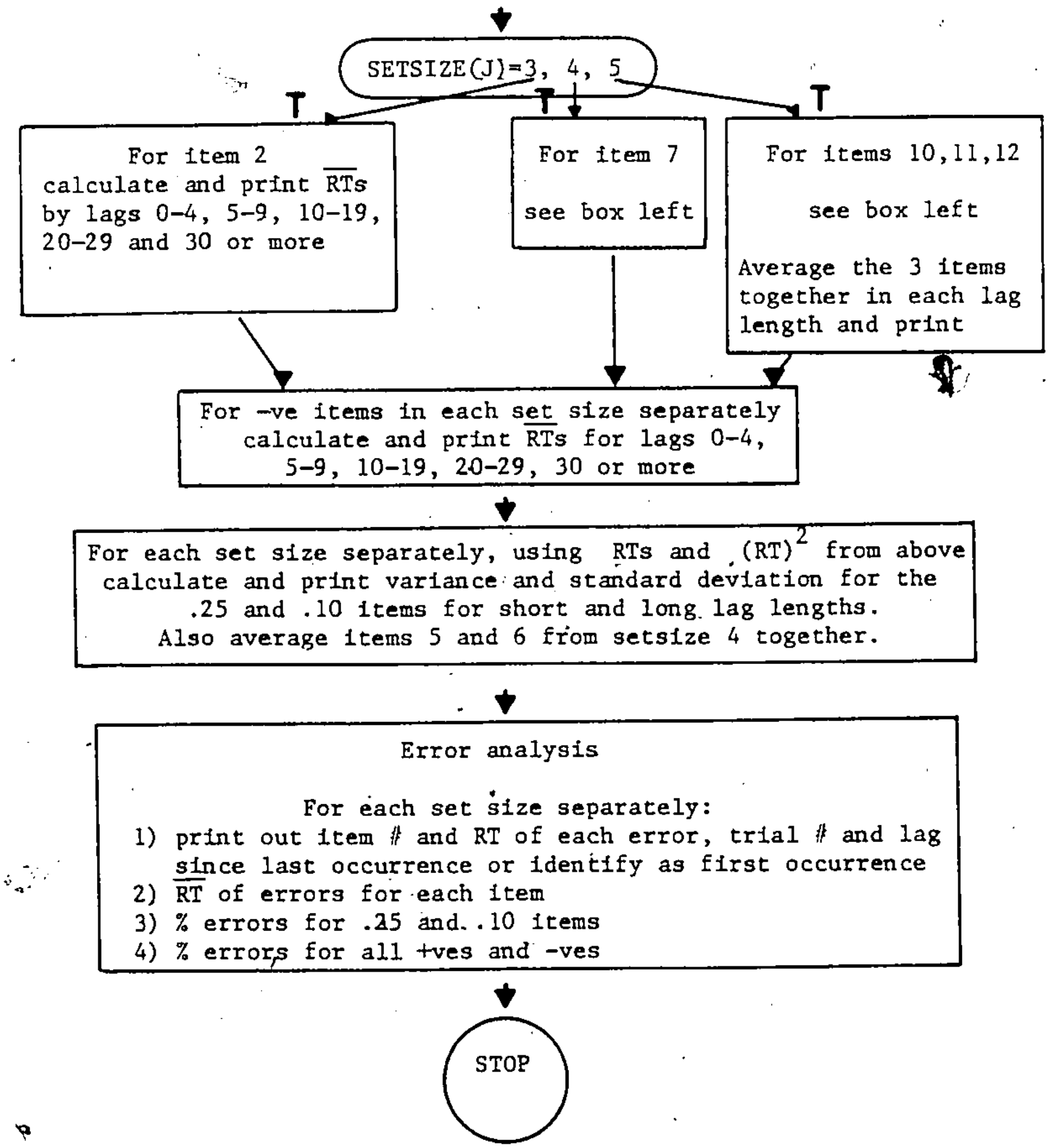
BP(3)	-defines the positive sets by their boundaries: BP(I). I=1,3,5 are the lower boundaries of the first, second, and third positive sets the S will work with. I=2,4,6 indicate the upper bounds of the respective positive sets. (see Figure 60)
DL(5,1)	-the number of correct long lag responses: DL(J,I). J=0,1 and 2 are not used. J=3,4 and 5 for the set sizes 3, 4 and 5. I=0 for the .10 item(s) and I=1 for the .25 item in each set size
DS(5,1)	-the number of correct short lag responses: DS(J,I). J and I assume the same values as in DL(J,I) above
FIRST(3,21)	-RTs of first occurrences: FIRST(J,I). J=1, 2 and 3 for the first, second and third block of trials. For those values of I in the range of 1 to 21 which correspond to stimulus items used in block J, the array contains the RT of the first occurrence for item I if the response was correct.
IMEAN(21)	-sum of the correct RTs of each stimulus item: IMEAN(I). For any block of trials, IMEAN(I) holds the sum of RTs for stimulus I if I was presented in that block. Otherwise IMEAN(I)=0.
ITEMS(21)	-the number of correct responses for each stimulus item: ITEMS(I). This array corresponds to IMEAN(I). The average response for item I is obtained by dividing IMEAN(I) by ITEMS(I).
L(9,10)	-sum of RTs for correct responses at each lag length for controlled probability items: L(I,K). For I= 1, 3, 4, 5, 6, 8 and 9 (controlled items) and K=0, 1, 2, 8, 9, and 10 (controlled lag lengths) the sum of the RTs is found. For all other values of I and K, the array is 0.
L1(4)	-sum of RTs for correct responses at each lag length for uncontrolled probability items: L1(I). I=0 for lag length 0-4. I=1 for lag length 5-9. I=2 for lag length 10-19. I=3 for lag length 20-29. I=4 for lag length 30 or more.
LNG(5,1)	-the mean RT of correct long lag responses: LNG(J,I). See DL(5,1)
M95,1)	-temporary storage of LNG(5,1) and S(5,1) in order to perform linear regression
N(9,10)	-the number of correct responses at each lag length for controlled probability items: N(I,K). see L(9,10) The mean RT for each lag length = L(I,K)/N(I,K)
NO(3,21)	-the number of correct subsequent presentations: NO(J,I). For J=1, 2 and 3 (block of trials) and those values of I in the range of 1 to 21 corresponding to stimulus items used in block J, NO(J,I) contains the number of correct subsequent presentations.
N1(4)	-temporary storage of number of responses at each lag interval. Used to print out data.

N2(4)	- temporary storage used for the set size of 5: N2(I). For the uncontrolled lag items in set size 5, N2(I) contains the sum of the number of correct responses for all three items at each lag length.
N5(1,9)	-number of correct responses at short or long lag lengths for controlled items: N5(I,K). I=0 for short lags and I=1 for long lags. K=1, 3, 4, 5, 6, 8 or 9 (i.e. all .25 and .10 items). Used with X5(1,9) and X7(1,9) to find variances.
NF(3,21)	-number of correct first occurrences: NF(J,I). J indicates block number and I indicates item number. Used with FIRST(3,21).
OTHERS(3,21)	-sum of the RTs of correct subsequent responses: OTHERS(J,I). J indicates block number and I indicates item number. Used with NO(3,21)
RT(3,160)	-response times array: RT(J,I). Response times in msec. to trial I in block J
S(5,1)	-mean RTs of short and long lags S(J,I). For J=3, 4, 5 I=0 contains mean RT of short lags and I=1 contains mean RT of long lags
S2(4)	-temporary storage for the mean RTs in the 5 lag intervals for the set size of 5. See N2(4)
SETSIZE(3)	-set size order array: SETSIZE(J). J=0 holds the number of trials/block which is 160. J=1, 2 and 3 indicate the set size order.
SSIGMA(1)	-sum of the variances of responses to the .10 items in the set size of 4: SSIGMA(I). When I=0, SSIGMA(I) has the variances for short lag responses and I=1 contains variances of long lag responses
STDEV(1)	-standard deviations corresponding to SSIGMA(1)
X5(1,9)	-the sum of the correct mean RTs of short and long lags. see N5(1,9)
X7(1,9)	-the sum of the squares of the correct mean RTs of short and long lags. See N5(1,9).

Figure 61: This figure shows a simplified flow chart of the programme used for the data analysis of Experiment 4.

Experiment 4 - Lag Flow Chart




SETSIZE(J)=3, 4, 5
T
T
T
For item 2 calculate and print RTs by lags 0-4, 5-9, 10-19, 20-29 and 30 or more
For item 7
see box left
For items 10,11,12
see box left
Average the 3 items together in each lag length and print
For -ve items in each set size separately calculate and print RTs for lags 0-4, 5-9, 10-19, 20-29, 30 or more
For each set size separately, using RTs and (RT)2 from above calculate and print variance and standard deviation for the .25 and .10 items for short and long lag lengths. Also average items 5 and 6 from setsize 4 together.
Error analysis
For each set size separately:
1) print out item # and RT of each error, trial # and lag since last occurrence or identify as first occurrence
2) RT of errors for each item
3) % errors for .25 and .10 items
4) % errors for all +ves and -ves
STOP

List of Data Analysis Programmes

Experiment 4 Data Analysis

```
10  DIM TRIAL%(3,160),RT(3,160),IMEAN(21),ITEMS(21),RESP%(3,160),M(5,1),L
     (9,10),N(9,10),S(5,1),LNG(5,1),DS(5,1),DL(5,1)
20  DIM SNUMBER%(3),BP(6),BN(6),SETSIZE(3),N1(4),L1(4),OTHERS(3,21),N0(3,
     21),FIRST(3,21),NF(3,21)
30 MAX = 2000:MIN = 150: DEF  FN OP(X) =  INT (X * 100 + .5) / 100
40  PRINT "   LAG CALCULATIONS FOR D7 "
50  HOME : PRINT "BE SURE THE COMCARD ROUTINE HAS BEEN": PRINT "LOADED IN
     TO LOCATION 300(HEX) .": PRINT
60  PRINT "ENTER ARRAYS OF DATA.  WHEN RECORDER": PRINT "IS RUNNING,SPACE
     .": GET S$
70  RECALL SNUMBER%: RECALL TRIAL%: RECALL RESP%: RECALL RT: RECALL SETSI
     ZE: RECALL BP: RECALL BN
75  CALL 779
80  PRINT "SUBJECT ";SNUMBER%(1);" SESSION ";SNUMBER%(2);" EXP ";SNUMBER%
     (3): PRINT : PRINT : PRINT
90  FOR J = 1 TO 3: FOR I = 1 TO 160
100  IF RESP%(J,I) < > 1 GOTO 140
110  IF RT(J,I) > MAX OR RT(J,I) < MIN GOTO 140
120 IMEAN(TRIAL%(J,I)) = IMEAN(TRIAL%(J,I)) + RT(J,I):ITEMS(TRIAL%(J,I)) =
     ITEMS(TRIAL%(J,I)) + 1
130  REM  IMEAN(N) HOLDS SUM OF RTS FOR ITEM N.  ITEMS(N) HOLDS # OF TRIA
     LS FOR ITEM N.
140  NEXT I
150  PRINT  TAB( 10);"FOR SETSIZE ";SETSIZE(J): PRINT : PRINT : PRINT "
     ITEM"; SPC( 6);" MEAN"; SPC( 8);"N"; SPC( 10);"1ST OCCUR"; SPC( 5);"
     SUBSEQUENT"
160  FOR I = 1 TO 21: IF ITEMS(I) = 0 GOTO 250
170 IMEAN =  FN OP(IMEAN(I) / ITEMS(I))
180  PRINT  SPC( 4);I; SPC( 6);IMEAN; TAB( 8);ITEMS(I); SPC( 12);:
190 XX = I: GOSUB 1120: IF RESP%(J,P1) = 0 THEN  GOTO 230
200  IF MIN > RT(J,P1) OR RT(J,P1) > MAX GOTO 240
210 FIRST(J,I) = RT(J,P1):NF(J,I) = 1:OTHERS(J,I) = IMEAN(I) - RT(J,P1):O
     THERS =  FN OP(OTHERS(J,I) / (ITEMS(I) - 1)):N0(J,I) = ITEMS(I) - 1
220  PRINT RT(J,P1); SPC( 9);OTHERS: GOTO 250
230  PRINT "  1ST OCCUR. WAS AN ERROR.";:OTHERS(J,I) = IMEAN(I):N0(J,I) =
     ITEMS(I): PRINT : GOTO 250
240  PRINT "  1ST OCCUR. WAS OUTSIDE LIMITS."; SPC( 2);RT(J,P1):OTHERS(J,
     I) = IMEAN(I):N0(J,I) = ITEMS(I):
250  NEXT I: PRINT : PRINT
260  FOR I = 1 TO 21:IMEAN(I) = 0:ITEMS(I) = 0: NEXT I: NEXT J
270  PRINT : PRINT :FIRST = 0:OTHERS = 0:N0 = 0:NF = 0: GOSUB 1530: REM
     AVG. OF 1ST PRESENTATIONS AND SUBSEQUENT PRES. FOR ALL +VES AND -VES
     .
280  PRINT : PRINT : PRINT :J = 1
290  ON SETSIZE(J) GOTO 300,300,310,400,490: REM    300 AND 300  ARE DUMM
     Y NUMBERS. 310,400  AND 490 PERFORM LAG CALCULATIONS FOR S=3,4 AND 5
      RESPECTIVELY.
300  REM  S=3.   .25 ITEM=1,.10 ITEM=3
310 XX = 1: GOSUB 1120: REM  FINDS FIRST OCCURRENCE OF ITEM 1. RETURNS TR
     IAL NUMBER AS P1.
320  GOSUB 1140: IF LAG < > - 1 THEN  GOSUB 1180: GOSUB 1820:P1 = P: IF
     P1 < 160 GOTO 320
330  REM  IF LAG =-1 THEN THERE WAS NO NEXT OCCURRENCE OF ITEM. OTHERWISE
     , ADD RT TO THE PROPER LAG BRACKET, AND INCREASE COUNTER FOR THAT BRA
     CKET. IF AT LAST TRIAL (160) THEN ITEM IS FINISHED. OTHERWISE SEARCH
     FOR NEXT OCCURRENCE.
340 XX = 3: GOSUB 1120
350  GOSUB 1140: IF LAG < > - 1 THEN  GOSUB 1180: GOSUB 1820:P1 = P: IF
     P1 < 160 GOTO 350
360 J = J + 1: IF J > 3 GOTO 560
370  REM  IF J=4 THEN ALL SETSIZES HAVE BEEN FINISHED.
380  GOTO 290
390  REM  S=4.   .25 ITEM=4. .10 ITEMS=5 AND 6
400 XX = 4: GOSUB 1120:
```

```
                                - 1 THEN  GOSUB 1130: GOSUB 1820:P1 = P: IF
410  GOSUB 1140: IF LAG
     P1   160 GOTO 410
420 XX = 5: GOSUB 1120
                                - 1 THEN  GOSUB 1180: GOSUB 1820:P1 = P: IF
430  GOSUB 1140: IF LAG
     P1   160 GOTO 430
440 XX = 6: GOSUB 1120
                                - 1 THEN  GOSUB 1180: GOSUB 1320:P1 = P: IF
450  GOSUB 1140: IF LAG
     P1   160 GOTO 450
460 J = J + 1: IF J   3 GOTO 560
470  GOTO 290
480  REM  S=5.  .25 ITEM=8. .10 ITEM=9
490 XX = 8: GOSUB 1120
                                - 1 THEN  GOSUB 1180: GOSUB 1820:P1 = P: IF
500  GOSUB 1140: IF LAG < >
     P1 < 160 GOTO 500
510 XX = 9: GOSUB 1120
                                - 1 THEN  GOSUB 1180: GOSUB 1820:P1 = P: IF
520  GOSUB 1140: IF LAG <
     P1 < 160 GOTO 520
530 J = J + 1: IF J   3 GOTO 560
540  GOTO 290
550  REM  AFTER CALCULATING LAGS FOR EACH SETSIZE FOR EACH .25 AND .10 IT
     EM. PRINT THEM OUT.
                             ITEMS": PRINT : PRINT
560  PRINT  TAB( 10);"+VE LAGS FOR CONTROLLED ITEMS": PRINT : PRINT
570  PRINT  SPC( 5);"0"; SPC( 9);"1"; SPC( 9);"2"; SPC( 18);"8"; SPC( 9);
     "9"; SPC( 9);"10": PRINT : PRINT
580 J = 3:H = 1:XX = 1: PRINT  SPC( 4);"FOR SETSIZE ";J: GOSUB 1220: GOSUB
     1690
590 XX = 3:H = 0: GOSUB 1220: GOSUB 1690: PRINT
600 J = 4:XX = 4:H = 1: PRINT  SPC( 4);"FOR SETSIZE ";J: GOSUB 1220: GOSUB
     1690:XX = 5:H = 0: GOSUB 1220: GOSUB 1690:XX = 6: GOSUB 1220: GOSUB
     1690
610 XX = 5:LAG = 0:DEN = 0: GOSUB 1200:XX = 6: GOSUB 1200:SHRT =  FN DP(L
     AG / DEN):S(J,H) = LAG / DEN:DS(J,H) = DEN:
620 LAG = 0:DEN = 0:XX = 5: GOSUB 1210:XX = 6: GOSUB 1210
630 XX = 5.6:LNG =  FN DP(LAG / DEN):LNG(J,H) = LAG / DEN:DL(J,H) = DEN: GOSUB
     2200: PRINT
640 J = 5:XX = 8:H = 1: PRINT  SPC( 4);"FOR SETSIZE ";J: GOSUB 1220: GOSUB
     1690:XX = 9:H = 0: GOSUB 1220: GOSUB 1690
650  PRINT : PRINT : PRINT
660  PRINT : PRINT : PRINT "     CURVE FIT OF .25 AND .10 ITEMS"
670 XX = 0
680 X = 0:Y = 0: FOR J = 0 TO 1: FOR I = 3 TO 5:M(I,J) = S(I,J): NEXT I: NEXT
     J
690  FOR I = 1 TO 0 STEP  - 1
700  FOR J = 3 TO 5: GOSUB 1270: NEXT J
710  IF I = 1 THEN  PRINT ".25 ITEMS, SHORT LAGS    ";:
720  IF I = 0 THEN  PRINT ".10 ITEMS, SHORT LAGS    ";:
730  GOSUB 1290
740 X = 0:Y = 0:XY = 0:XX = 0:YY = 0: NEXT I
750  FOR J = 0 TO 1: FOR I = 3 TO 5:M(I,J) = LNG(I,J): NEXT I: NEXT J
760  FOR I = 1 TO 0 STEP  - 1
770  FOR J = 3 TO 5: GOSUB 1270: NEXT J
780  IF I = 1 THEN  PRINT ".25 ITEMS, LONG LAGS     ";:
790  IF I = 0 THEN  PRINT ".10 ITEMS, LONG LAGS     ";:
800  GOSUB 1290:X = 0:Y = 0:XX = 0:YY = 0:XY = 0: NEXT I
810  PRINT : PRINT : PRINT :
820  FOR J = 1 TO 3: PRINT "  +VE LAGS FOR S = ";SETSIZE(J): PRINT
830  PRINT "   ITEM"; SPC( 6);"0 TO 4"; SPC( 6);"5 TO 9"; SPC( 6);"10 TO
     19"; SPC( 6);"20 TO 29"; SPC( 5);"30 OR MORE"
840  IF SETSIZE(J) = 3 THEN I = 2: GOSUB 1770: GOTO 870
850  IF SETSIZE(J) = 4 THEN I = 7: GOSUB 1770: GOTO 870
860  FOR I = 10 TO 12: GOSUB 1770: NEXT I: PRINT : PRINT : PRINT "  MEAN
     OF ALL ITEMS FOR EACH LAG LENGTH": PRINT : FOR II = 0 TO 4:N1(II) =
     N2(II):L1(II) = S2(II): NEXT II:I = 0
865  GOSUB 1410
870  FOR KK = 0 TO 4:S2(KK) = 0:N2(KK) = 0: NEXT KK: NEXT J
880  FOR J = 1 TO 3: PRINT  TAB( 6):"-VE LAGS FOR S = ":SETSIZE(J): PRINT
```

```
890  FOR II = 0 TO 4:S2(II) = 0:N2(II) = 0: NEXT II
900  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1: GOSUB 1770: NEXT
     I
910  PRINT : PRINT "MEAN OF ALL ITEMS FOR EACH LAG LENGTH":I = 0: FOR II =
     0 TO 4:N1(II) = N2(II):L1(II) = S2(II): NEXT II: GOSUB 1910
920  PRINT : NEXT J
930  PRINT : PRINT : PRINT  TAB( 10);"VARIANCE AND ST DEV. FOR .25 AND .1
     0 ITEMS."
940  PRINT : PRINT "  SS"; SPC( 3);"PROB"; SPC( 3);"N"; SPC( 4);"VARIANCE
     "; SPC( 5);"ST DEVIATION"
950 J = 3:P = .25:XX = 1:L = 1:L$ = "LONG": GOSUB 1870:L = 0:L$ = "SHORT"
    : GOSUB 1870: PRINT
960 P = .10:XX = 3:L = 1:L$ = "LONG": GOSUB 1870:L = 0:L$ = "SHORT": GOSUB
    1870: PRINT
970 J = 4:P = .25:XX = 4:L = 1:L$ = "LONG": GOSUB 1870:L = 0:L$ = "SHORT"
    : GOSUB 1870: PRINT
980 P = 5:XX = 5:L = 1:L$ = "LONG": GOSUB 1870:SSIGMA(1) = SIGMA:STDEV(1)
    = STDEV:L = 0:L$ = "SHORT": GOSUB 1870:SSIGMA(0) = SIGMA:STDEV(0) =
    STDEV: PRINT
990 P = 6:XX = 6:L = 1:L$ = "LONG": GOSUB 1870:SSIGMA(1) = SSIGMA(1) + SI
    GMA:STDEV(1) = STDEV(1) + STDEV
1000 L = 0:L$ = "SHORT": GOSUB 1870:SSIGMA(0) = SSIGMA(0) + SIGMA:STDEV(0
    ) = STDEV(0) + STDEV
1005  PRINT
1010 SIGMA =  FN DP(SSIGMA(1) / 2):L = 1:L$ = "LONG":STDEV =  FN DP(STDEV
    (1) / 2):P = .10:N5(1,6) = 2: GOSUB 1890:SIGMA =  FN DP(SSIGMA(0) /
    2):STDEV =  FN DP(STDEV(0) / 2):L = 0:L$ = "SHORT":N5(0,6) = 2: GOSUB
    1890: PRINT :
1020 J = 5:P = .25:XX = 8:L = 1:L$ = "LONG": GOSUB 1870:L = 0:L$ = "SHORT
    ": GOSUB 1870: PRINT
1030 P = .10:XX = 9:L = 1:L$ = "LONG": GOSUB 1870:L = 0:L$ = "SHORT": GOSUB
    1870: PRINT : PRINT
1040  PRINT : PRINT : PRINT  TAB( 15);"ERROR ANALYSIS"
1050  FOR J = 1 TO 3
1060  ON SETSIZE(J) GOTO 1070,1070,1070,1080,1090
1070  PRINT "   FOR SETSIZE ";SETSIZE(J):B = 3:B1 = 0:C = 16:A = 1: GOSUB
     1910: GOTO 1100
1080  PRINT "   FOR SETSIZE ";SETSIZE(J):B = 5:B1 = 6:C = 32:A = 4: GOSUB
     1910: GOTO 1100
1090  PRINT "   FOR SETSIZE ";SETSIZE(J):B = 9:B1 = 0:C = 16:A = 8: GOSUB
     1910
1100  NEXT J: PR# 0: PRINT  CHR$ (135): PRINT  CHR$ (135)
1110  END
1120 P1 = 0: FOR II = 1 TO 160: IF TRIAL%(J,II) = XX THEN P1 = II: RETURN

1130  NEXT II
1140  FOR II = P1 + 1 TO 160: IF TRIAL%(J,II) = XX THEN P = II: GOTO 1160

1150  NEXT II:LAG =  - 1: GOTO 1170
1160 LAG = P - P1 - 1
1170  RETURN
1180  IF RESP%(J,P) = 1 AND RT(J,P) <  = MAX AND (RT(J,P) > MIN) THEN L(X
     X,LAG) = L(XX,LAG) + RT(J,P):N(XX,LAG) = N(XX,LAG) + 1
1190  RETURN
1200  FOR I = 0 TO 2:LAG = LAG + L(XX,I):DEN = DEN + N(XX,I): NEXT I: RETURN

1210  FOR I = 8 TO 10:LAG = LAG + L(XX,I):DEN = DEN + N(XX,I): NEXT I: RETURN

1220 LAG = 0:DEN = 0: GOSUB 1200: IF DEN = 0 THEN SHRT = 0:S(J,H) = 0: GOTO
     1240
1230 SHRT =  FN DP(LAG / DEN):S(J,H) = LAG / DEN:DS(J,H) = DEN
1240 LAG = 0:DEN = 0: GOSUB 1210: IF DEN = 0 THEN LNG = 0:LNG(J,H) = 0: GOTO
     1260
1250 LNG =  FN DP(LAG / DEN):LNG(J,H) = LAG / DEN:DL(J,H) = DEN
1260  RETURN
```

```
1270 XY = M(J,I) * J + XY:Y = M(J,I) + Y:X = J + X:XX = J ^ 2 + XX:YY = M
     (J,I) ^ 2 + YY
1280  RETURN
1290 SLOPE = (XY - (X * Y) / 3) / (XX - (X * X) / 3).
1300 A = Y / 3 - SLOPE * (X / 3):R2 = ((XY - (X * Y) / 3) ^ 2) / ((XX - (
     X * X) / 3) * (YY - (Y * Y) / 3))
1310 R2 =  FN DP(R2):SLOPE =  FN DP(SLOPE):A =  FN DP(A)
1320  PRINT "R SQUARED= ";R2; SPC( 5);"SLOPE= ";SLOPE; SPC( 5);"INTERCEPT
     = ";A: PRINT : RETURN
1330  IF RESP%(J,P) = 0 OR RT(J,P) > MAX THEN  RETURN
1340  IF MIN > RT(J,P) THEN  RETURN
1350  IF LAG < 5 THEN L1(0) = L1(0) + RT(J,P):N1(0) = N1(0) + 1
1360  IF 5 <  = LAG AND LAG < 10 THEN L1(1) = L1(1) + RT(J,P):N1(1) = N1(
     1) + 1
1370  IF 10 <  = LAG AND LAG < 20 THEN L1(2) = L1(2) + RT(J,P):N1(2) = N1
     (2) + 1
1380  IF 20 <  = LAG AND LAG < 30 THEN L1(3) = L1(3) + RT(J,P):N1(3) = N1
     (3) + 1
1390  IF 30 <  = LAG THEN L1(4) = L1(4) + RT(J,P):N1(4) = N1(4) + 1
1400  RETURN
1410  PRINT  SPC( 3);I; SPC( 6);
1480  FOR II = 0 TO 4: IF N1(II) > 0 THEN ML =  FN DP(L1(II) / N1(II)): PRINT
     ML; SPC( 9);: GOTO 1510
1500  PRINT  SPC( 12);
1510  NEXT II
1520  PRINT : PRINT  SPC( 14);: FOR II = 0 TO 4: PRINT N1(II); SPC( 13);:
      NEXT II: PRINT : RETURN
1530  PRINT : PRINT "   AVERAGE OF 1ST OCCUR. AND SUBSEQUENT OCCUR."
1540  PRINT : PRINT : PRINT "   SS"; SPC( 3);"SIGN"; SPC( 3);"N"; SPC( 3)
     ;"1ST OCCUR."; SPC( 10);"N"; SPC( 3);"SUBSEQUENT"
1550  FOR J = 1 TO 3
1560  FOR I = BP(2 * J - 1) TO BP(2 * J)
1570 FIRST = FIRST(J,I) + FIRST:NF = NF + NF(J,I):OTHERS = OTHERS + OTHER
     S(J,I):NO = NO + NO(J,I)
1580  NEXT I
1590 OTHERS =  FN DP(OTHERS / NO):FIRST =  FN DP(FIRST / NF)
1600  PRINT : PRINT "   ";SETSIZE(J);"    +VE"; SPC( 4);NF; SPC( 3);FIRST
     ; SPC( 13);NO; SPC( 4);OTHERS
1610 FIRST = 0:NF = 0:OTHERS = 0:NO = 0
1620  FOR I = BN(2 * J - 1) TO BN(2 * J) + BN(2 * J - 1) - 1
1630 FIRST = FIRST(J,I) + FIRST:NF = NF + NF(J,I):OTHERS = OTHERS + OTHER
     S(J,I):NO = NO + NO(J,I)
1640  NEXT I
1650 OTHERS =  FN DP(OTHERS / NO):FIRST =  FN DP(FIRST / NF)
1660  PRINT  TAB( 9);"-VE"; SPC( 4);NF; SPC( 3);FIRST; SPC( 13);NO; SPC(
     4);OTHERS
1670 FIRST = 0:NF = 0:OTHERS = 0:NO = 0: NEXT J
1680  RETURN : REM  HERE THE MEAN OF 1ST OCCUR. OF EACH ITEM AND THE MEAN
      OF SUBSEQUENT OCCUR. ARE FOUND.
1690  PRINT  SPC( 3);"ITEM"; SPC( 2);XX; SPC( 5);SHRT; SPC( 2);"N= ";DS(J
     ,H); SPC( 18);LNG; SPC( 2);"N= ";DL(J,H)
1700 A = 0
1710  FOR I = A TO A + 2: IF N(XX,I) = 0 THEN  GOTO 1730
1720  PRINT  SPC( 5); FN DP(L(XX,I) / N(XX,I));: GOTO 1740
1730  PRINT  SPC( 9);"0"; SPC( 2);:
1740  NEXT I
1750  IF A <  > 8 THEN A = 8: PRINT  SPC( 10);: GOTO 1710
1760  PRINT : PRINT : RETURN
1770  FOR K = 0 TO 4:L1(K) = 0:N1(K) = 0: NEXT K
1780 XX = I: GOSUB 1120
1790  GOSUB 1140: IF LAG <  >  - 1 THEN  GOSUB 1330:P1 = P: IF P1 < 160 THEN
     GOTO 1790
1800  GOSUB 1410: FOR II = 0 TO 4:S2(II) = L1(II) + S2(II):N2(II) = N2(II
     ) + N1(II): NEXT II
1810  RETURN
1820  IF RESP%(J,P) = 0 GOTO 1860
```

```
1830  IF RT(J,P) < MIN OR RT(J,P) > MAX GOTO 1860
1840  IF LAG < 5 THEN X5(0,XX) = X5(0,XX) + RT(J,P):X7(0,XX) = X7(0,XX) +
     RT(J,P) ^ 2:N5(0,XX) = N5(0,XX) + 1
1850  IF LAG > 5 THEN X5(1,XX) = X5(1,XX) + RT(J,P):X7(1,XX) = X7(1,XX) +
     RT(J,P) ^ 2:N5(1,XX) = N5(1,XX) + 1
1860  RETURN
1870  IF N5(L,XX) < 2 THEN  GOTO 1900
1880 SIGMA =  FN DP((X7(L,XX) - X5(L,XX) ^ 2 / N5(L,XX)) / (N5(L,XX) - 1)
     ):STDEV =  FN DP( SQR (SIGMA))
1890  PRINT  SPC( 3);J; SPC( 4);P; SPC( 3);L$; SPC( 3);N5(L,XX); SPC( 4);
     SIGMA; SPC( 5);STDEV
1900  RETURN
1910 L = 0:S1 = 0:S0 = 0: FOR I = 1 TO 21:ITEMS(I) = 0:IMEAN(I) = 0: NEXT
     I
1920 Y5 = 0
1930  FOR I = L + 1 TO 160: IF RESP%(J,I) = 0 GOTO 1950
1940  NEXT I: GOTO 2030
1950 L = I: PRINT "  ERROR AT TRIAL ";L;"     ITEM ";TRIAL%(J,L);"  RT = "
     ;RT(J,L); SPC( 3);
1960 ITEMS(TRIAL%(J,L)) = ITEMS(TRIAL%(J,L)) + 1:IMEAN(TRIAL%(J,L)) = IME
     AN(TRIAL%(J,L)) + RT(J,L)
1970  IF L = 1 GOTO 2000
1980  FOR K = L - 1 TO 1 STEP  - 1: IF TRIAL%(J,K) = TRIAL%(J,L) GOTO 201
     0
1990  NEXT K
2000  PRINT "  ERROR OCCURRED ON 1ST OCCURRENCE ": GOTO 2020
2010 LAG = L - K - 1: PRINT "  LAG SINCE LAST OCCURRENCE = ";LAG
2020  IF L < 160 THEN  GOTO 1930
2030  IF L = 0 THEN  PRINT "  THERE WERE NO ERRORS FOR THIS SETSIZE.": PRINT
     : GOTO 2150
2040  FOR I = 1 TO 21: IF ITEMS(I) = 0 THEN  GOTO 2110
2050 MRT =  FN DP(IMEAN(I) / ITEMS(I)): PRINT : PRINT "  MEAN  RT OF ERRO
     RS FOR ITEM ";I;"  = ";MRT
2060  IF (I = A) THEN PCT =  FN DP(ITEMS(I) / 4 * 10): PRINT "  PCT ERROR
      FOR .25 ITEM = ";PCT: PRINT
2070  IF I = B THEN Y5 = Y5 + ITEMS(I)
2080  IF I = B1 THEN Y5 = Y5 + ITEMS(I)
2090  IF I <  = BP(2 * J) THEN S1 = S1 + ITEMS(I): GOTO 2110
2100 S0 = S0 + ITEMS(I)
2110  NEXT I
2120 PCT =  FN DP(Y5 / C * 100): PRINT "  PCT ERROR FOR .10 ITEMS= ";PCT:
      PRINT
2130  PRINT : PRINT :PCT =  FN DP(S1 / 8 * 10): PRINT "  PCT  ERRORS FOR
     +VE ITEMS = ";PCT;"      # OF ERRORS = ";S1: PRINT
2140 PCT =  FN DP(S0 / 8 * 10): PRINT "  PCT ERRORS FOR -VE ITEMS  = ";PC
     T;"      # OF ERRORS = ";S0: PRINT :
2150  RETURN
2200  PRINT  SPC( 3);"ITEM"; SPC( 2);XX; SPC( 5);SHRT; SPC( 2);"N= ";DS(J
     ,H); SPC( 18);LNG; SPC( 2);"N= ";DL(J,H)
2205 A = 0:LL = 0:N9 = 0
2210  FOR I = A TO A + 2: FOR II = 5 TO 6:LL = LL + L(II,I):N9 = N9 + N(I
     I,I): NEXT II
2220  PRINT  SPC( 5); FN DP(LL / N9);: NEXT I:
2230  IF A <  > 8 THEN A = 8:LL = 0:N9 = 0: GOTO 2210
2240  PRINT : PRINT : RETURN
```

Experiment 3 Data Analysis Programme 1

```
10  DIM TRIAL%(3,160),RESP%(3,160),RT(3,160),SETSIZE(3),SNUMBER%(3),BP(6)
    ,BN(6),IMEAN(21),ITEMS(21),FIRST(3,21),OTHERS(3,21),NF(3,21),N0(3,21
    ).L1(4),N1(4),S2(4),N2(4),SM(4)
20  DIM XM(3,2),X1(4),X2(4),N(4)
30  DEF  FN DP(X) =  INT (X * 100 + .5) / 100:MAX = 2000:MIN = 150
40  PRINT " RECALL RAW DATA.  WHEN RECORDER IS": PRINT " RUNNING,PRESS SP
    ACE BAR.": GET S$
50  RECALL SNUMBER%: RECALL TRIAL%: RECALL RESP%: RECALL RT: RECALL SETSI
    ZE: RECALL BP: RECALL BN
60  CALL 779
70  PRINT "  SUBJECT # ";SNUMBER%(1);"  SESSION # ";SNUMBER%(2);"  EXP #
    ";SNUMBER%(3)
80  GOSUB 280: REM  LAGS OF CORRECT RESPONSES.
90  GOSUB 790: REM  1ST PRESENTATION, OVERALL MEANS AND SUBSEQUENT MEANS
     FOR EACH ITEM
100 FIRST = 0:OTHERS = 0:N0 = 0:NF = 0
110  GOSUB 970: REM  AVG OF 1ST PRES. AND SUBSEQUENT PRES. FOR ALL +VES A
     ND -VES.
120  PRINT : PRINT : PRINT  TAB( 10);"VARIANCE AND ST. DEVIATION FOR .25
     AND .05 ITEMS"
130  PRINT : PRINT "  SS"; SPC( 3);"PROB."; SPC( 3);"N"; SPC( 4);"VARIANC
     E"; SPC( 5);"ST DEVIATION"
140  FOR J = 1 TO 3: ON SETSIZE(J) GOTO 150,150,150,160,170
150 B = 3:B1 = 0:B2 = 0:A = 1: GOSUB 1130: GOTO 180
160 B = 6:B1 = 7:B2 = 0:A = 4: GOSUB 1130: GOTO 180
170 B = 10:B1 = 11:B2 = 12:A = 8: GOSUB 1130
180  NEXT J
190  PRINT : PRINT : PRINT "CURVE FIT OF .25 AND .05 ITEMS.": GOSUB 1470
200  PRINT : PRINT : PRINT : PRINT  TAB( 15);" ERROR ANALYSIS "
210  FOR J = 1 TO 3
220  ON SETSIZE(J) GOTO 230,230,230,240,250
230  PRINT "  FOR SETSIZE  ";SETSIZE(J):B = 3:B1 = 0:B2 = 0:C = 8:A = 1: GOSUB
     1250: GOTO 260
240  PRINT "  FOR SETSIZE  ";SETSIZE(J):B = 6:B1 = 7:B2 = 0:C = 16:A = 4:
      GOSUB 1250: GOTO 260
250  PRINT "  FOR SETSIZE  ";SETSIZE(J):B = 10:B1 = 11:B2 = 12:C = 24:A =
     8: GOSUB 1250
260  NEXT J: PR# 0
270  PRINT  CHR$ (135): END
280  FOR J = 1 TO 3: PRINT "  +VE LAGS FOR S= ";SETSIZE(J): PRINT
300  FOR II = 0 TO 4:S2(II) = 0:N2(II) = 0: NEXT II
310  FOR I = BP(2 * J - 1) TO BP(2 * J): GOSUB 360: NEXT I: GOSUB 440
320  PRINT : PRINT "  -VE LAGS FOR S= ";SETSIZE(J): PRINT
330  FOR II = 0 TO 4:S2(II) = 0:N2(II) = 0: NEXT II
340  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1: GOSUB 360: NEXT
     I: GOSUB 440
350  NEXT J: RETURN
360  FOR K = 0 TO 4:L1(K) = 0:N1(K) = 0: NEXT K
370 XX = I: GOSUB 540
380  GOSUB 560: IF LAG [illegible] - 1 THEN  GOSUB 600:P1 = P: IF P1 [illegible] 160 THEN
      GOTO 380
390  GOSUB 410
400  RETURN
410  FOR II = 0 TO 4
420 S2(II) = L1(II) + S2(II):N2(II) = N2(II) + N1(II)
430  NEXT II: RETURN
440  FOR II = 0 TO 4: IF N2(II) > 0 THEN SM(II) =  FN DP(S2(II) / N2(II))

450  NEXT II
460  PRINT : PRINT : PRINT "  MEAN OF ALL ITEMS FOR EACH LAG LENGTH ": PRINT

470  IF N2(0) > 0 THEN  PRINT  TAB( 13);"0 TO 4"; TAB( 17);SM(0);"  N= ";
     N2(0)
480  IF N2(1) > 0 THEN  PRINT  TAB( 13);"5 TO 9"; TAB( 17);SM(1);"  N= ";
```

```
     N2(1)
490  IF N2(2) > 0 THEN  PRINT  TAB( 13);"10 TO 19"; TAB( 17);SM(2);"  N=
     ";N2(2)
500  IF N2(3) > 0 THEN  PRINT  TAB( 13);"20 TO 29"; TAB( 17);SM(3);"  N=
     ";N2(3)
510  IF N2(4) > 0 THEN  PRINT  TAB( 13);"30 OR MORE"; TAB( 15);SM(4);"  N
     = ";N2(4)
520  REM  THIS ROUTINE FINDS THE AVERAGE OF ALL +VE (-VE) ITEMS AT EACH L
     AG LENGTH.
530  PRINT : PRINT : PRINT : RETURN
540 P1 = 0: FOR II = 1 TO 160: IF TRIAL%(J,II) = XX THEN P1 = II: RETURN

550  NEXT II: REM  THIS ROUTINE FINDS THE 1ST OCCURRENCE OF ITEM XX WHICH
      IS AT TRIAL # P1.
560  FOR II = P1 + 1 TO 160: IF TRIAL%(J,II) = XX THEN P = II: GOTO 580
570  NEXT II:LAG =  - 1: GOTO 590
580 LAG = P - P1 - 1
590  RETURN : REM  THIS ROUTINE ENTERS WITH P1 THE LAST OCCURRENCE OF ITE
     M XX AND FINDS THE NEXT (P). IF IT FINDS P, THE LAG IS CALCULATED. I
     F NOT, LAG =-1.
600  IF RESP%(J,P) = 0 THEN  RETURN
610  IF (RT(J,P) > MAX) OR (RT(J,P) < MIN) THEN  RETURN
620  IF LAG < 5 THEN L1(0) = L1(0) + RT(J,P):N1(0) = N1(0) + 1
630  IF 5 <  = LAG AND LAG < 10 THEN L1(1) = L1(1) + RT(J,P):N1(1) = N1(1
     ) + 1
640  IF 10 <  = LAG AND LAG < 20 THEN L1(2) = L1(2) + RT(J,P):N1(2) = N1(
     2) + 1
650  IF 20 <  = LAG AND LAG < 30 THEN L1(3) = L1(3) + RT(J,P):N1(3) = N1(
     3) + 1
660  IF 30 <  = LAG THEN L1(4) = L1(4) + RT(J,P):N1(4) = N1(4) + 1
670  RETURN : REM  THIS ROUTINE PLACES THE RT OF TRIAL (J,P) INTO THE PRO
     PER LAG BRACKET.
790  FOR J = 1 TO 3: FOR I = 1 TO 160
800  IF RESP%(J,I) <  > 1 GOTO 840
810  IF RT(J,I) > MAX OR RT(J,I) < MIN GOTO 840
820 IMEAN(TRIAL%(J,I)) = IMEAN(TRIAL%(J,I)) + RT(J,I)
830 ITEMS(TRIAL%(J,I)) = ITEMS(TRIAL%(J,I)) + 1
840  NEXT I
850  PRINT  TAB( 10);"FOR SETSIZE ";SETSIZE(J): PRINT : PRINT : PRINT "
     ITEM"; SPC( 6);"MEAN"; SPC( 8);"N"; SPC( 5);"1ST OCCUR."; SPC( 5);"S
     UBSEQUENT"
860  FOR I = 1 TO 21: IF ITEMS(I) = 0 GOTO 950
870 IMEAN =  FN DP(IMEAN(I) / ITEMS(I))
880  PRINT  SPC( 4);I; SPC( 6);IMEAN; TAB( 8);ITEMS(I); SPC( 5);:
890 XX = I: GOSUB 540: IF RESP%(J,P1) = 0 GOTO 930
900  IF MIN > RT(J,P1) OR RT(J,P1) > MAX GOTO 940
910 FIRST(J,I) = RT(J,P1):NF(J,I) = 1:OTHERS(J,I) = IMEAN(I) - RT(J,P1):O
     THERS =  FN DP(OTHERS(J,I) / (ITEMS(I) - 1)):N0(J,I) = ITEMS(I) - 1
920  PRINT RT(J,P1); SPC( 9);OTHERS: PRINT : GOTO 950
930  PRINT "   1ST OCCUR. WAS AN ERROR.":OTHERS(J,I) = IMEAN(I):N0(J,I) =
     ITEMS(I): PRINT : GOTO 950
940  PRINT "   1ST OCCUR. WAS OUTSIDE OF LIMITS"; SPC( 2);RT(J,P1):OTHERS
     (J,I) = IMEAN(I):N0(J,I) = ITEMS(I): PRINT :
950  NEXT I: FOR I = 1 TO 21:IMEAN(I) = 0:ITEMS(I) = 0: NEXT I: NEXT J
960  PRINT : PRINT : PRINT : RETURN
970  PRINT : PRINT "   AVERAGE OF 1ST OCCUR. AND SUBSEQUENT OCCUR."
980  PRINT : PRINT : PRINT "  SS"; SPC( 3);"SIGN"; SPC( 3);"N"; SPC( 3);"
     1ST OCCUR."; SPC( 10);"N"; SPC( 3);"SUBSEQUENT"
990  FOR J = 1 TO 3
1000  FOR I = BP(2 * J - 1) TO BP(2 * J)
1010 FIRST = FIRST(J,I) + FIRST:NF = NF(J,I) + NF:OTHERS = OTHERS + OTHER
     S(J,I):N0 = N0 + N0(J,I)
1020  NEXT I
1030 OTHERS =  FN DP(OTHERS / N0):FIRST =  FN DP(FIRST / NF)
1040  PRINT : PRINT "  ";SETSIZE(J);"     +VE"; SPC( 4);NF; SPC( 3);FIRST
     ; SPC( 13);N0; SPC( 4);OTHERS
```

```
1050 FIRST = 0:NF = 0:OTHERS = 0:N0 = 0
1060  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1
1070 FIRST = FIRST(J,I) + FIRST:NF = NF(J,I) + NF:OTHERS = OTHERS + OTHER
     S(J,I):N0 = N0 + N0(J,I)
1080  NEXT I
1090 OTHERS =  FN DP(OTHERS / N0):FIRST =  FN DP(FIRST / NF)
1100  PRINT  TAB( 9);"-VE"; SPC( 4);NF; SPC( 3);FIRST; SPC( 13);N0; SPC(
     4);OTHERS
1110 FIRST = 0:NF = 0:OTHERS = 0:N0 = 0: NEXT J
1120  RETURN : REM  HERE THE FIRST OCCUR. OF EACH ITEM AND THE MEAN OF SU
     BSEQUENT OCCUR. ARE FOUND.
1130  FOR I = 0 TO 4:X1(I) = 0:X2(I) = 0:N(I) = 0: NEXT I:N = 0:SSIGMA =
     0:SD = 0
1135 N0 = 0
1140  FOR I = 1 TO 160: IF RESP%(J,I) = 0 THEN  GOTO 1180
1150  IF MIN > RT(J,I) OR MAX < RT(J,I) THEN  GOTO 1180
1160  IF (TRIAL%(J,I) = A) THEN X1(1) = X1(1) + RT(J,I):X2(1) = X2(1) + R
     T(J,I) ^ 2:N = N + 1
1170  IF TRIAL%(J,I) = B THEN X1(2) = X1(2) + RT(J,I):N(2) = N(2) + 1:X2(
     2) = X2(2) + RT(J,I) ^ 2
1171  IF TRIAL%(J,I) = B1 THEN X1(3) = X1(3) + RT(J,I):N(3) = N(3) + 1:X2
     (3) = X2(3) + RT(J,I) ^ 2
1172  IF TRIAL%(J,I) = B2 THEN X1(4) = X1(4) + RT(J,I):N(4) = N(4) + 1:X2
     (4) = X2(4) + RT(J,I) ^ 2
1180  NEXT I
1185  IF N   = 1 THEN SIGMA2 = 0:STDEV = 0: GOTO 1200
1190 SIGMA2 = (X2(1) - X1(1) ^ 2 / N) / (N - 1):STDEV =  SQR (SIGMA2):SIG
     MA2 =  FN DP(SIGMA2):STDEV =  FN DP(STDEV)
1200 XM(J,1) = X1(1) / N:
1210  PRINT : PRINT  SPC( 3);SETSIZE(J);"      .25"; SPC( 3);N; SPC( 4);SIG
     MA2; SPC( 5);STDEV
1215  FOR I = 2 TO 4: IF N(I) = 0 GOTO 1225
1220 SIGMA2 =  FN DP((X2(I) - X1(I) ^ 2 / N(I)) / (N(I) - 1)):STDEV =  FN
     DP( SQR (SIGMA2))
1221 XM(J,2) = X1(I) + XM(J,2):N0 = N0 + N(I)
1222  PRINT  TAB( 9);I; SPC( 5);N(I); SPC( 4);SIGMA2; SPC( 5);STDEV
1223 SSIGMA = SSIGMA + SIGMA2:SD = SD + STDEV:N(0) = N(0) + 1
1225  NEXT I
1229 SIGMA2 =  FN DP(SSIGMA / N(0)):STDEV =  FN DP(SD / N(0))
1230  PRINT  TAB( 9);".05"; SPC( 3);N(0); SPC( 4);SIGMA2; SPC( 5);STDEV
1235 XM(J,2) = XM(J,2) / N0
1240  RETURN : REM  HERE THE VARIANCES FOR .25 AND .05 ITEMS FOR EACH SS.
      ARE FOUND.
1250 L = 0:S1 = 0:S0 = 0: FOR I = 1 TO 21:ITEMS(I) = 0:IMEAN(I) = 0: NEXT
     I
1255 YS = 0
1260  FOR I = L + 1 TO 160: IF RESP%(J,I) = 0 GOTO 1280
1270  NEXT I: GOTO 1360
1280 L = I: PRINT "  ERROR AT TRIAL ";L;"     ITEM ";TRIAL%(J,L);"  RT = "
     ;RT(J,L); SPC( 3);
1290 ITEMS(TRIAL%(J,L)) = ITEMS(TRIAL%(J,L)) + 1:IMEAN(TRIAL%(J,L)) = IME
     AN(TRIAL%(J,L)) + RT(J,L)
1300  IF L = 1 GOTO 1330
1310  FOR K = L - 1 TO 1 STEP  - 1: IF TRIAL%(J,K) = TRIAL%(J,L) GOTO 134
     0
1320  NEXT K
1330  PRINT "  ERROR OCCURRED ON 1ST OCCURRENCE ": GOTO 1350
1340 LAG = L - K - 1: PRINT "  LAG SINCE LAST OCCURRENCE = ";LAG
1350  IF L < 160 THEN  GOTO 1260
1360  IF L = 0 THEN  PRINT "  THERE WERE NO ERRORS FOR THIS SETSIZE.": PRINT
     : GOTO 1460
1370  FOR I = 1 TO 21: IF ITEMS(I) = 0 THEN  GOTO 1430
1380 MRT =  FN DP(IMEAN(I) / ITEMS(I)): PRINT : PRINT "  MEAN RT OF ERROR
     S FOR ITEM ";I;"  = ";MRT
1390  IF (I = A) THEN PCT =  FN DP(ITEMS(I) / 4 * 10): PRINT "  PCT ERROR
      FOR .25 ITEM = ";PCT: PRINT
```

```
1400  IF I = B2 THEN Y5 = Y5 + ITEMS(I)
1401  IF I = B1 THEN Y5 = Y5 + ITEMS(I)
1402  IF I = B THEN Y5 = Y5 + ITEM(I)
1410  IF I <  = BP(2 * J) THEN S1 = S1 + ITEMS(I): GOTO 1430
1420 S0 = S0 + ITEMS(I)
1430  NEXT I
1435 PCT =  FN OP(Y5 / C * 100): PRINT "  PCT ERROR FOR .05 ITEMS=  ";PCT
     : PRINT
1440  PRINT : PRINT :PCT =  FN OP(S1 / 8 * 10): PRINT "  PCT ERRORS FOR +
     VE ITEMS = ";PCT;"      # OF ERRORS = ";S1: PRINT
1450 PCT =  FN OP(S0 / 8 * 10): PRINT "  PCT ERRORS FOR -VE ITEMS = ";PCT
     ;"      # OF ERRORS = ";S0: PRINT :
1460  RETURN
1470  FOR I = 1 TO 2:XY = 0:X = 0:Y = 0:XX = 0:YY = 0: IF I = 1 THEN  PRINT
     "   FOR .25 ITEM"
1480  IF I = 2 THEN  PRINT "  FOR .05 ITEM"
1490  FOR J = 1 TO 3
1500 XY = XM(J,I) * SETSIZE(J) + XY
1510 Y = XM(J,I) + Y:X = SETSIZE(J) + X:XX = SETSIZE(J) ^ 2 + XX:YY = XM(
     J,I) ^ 2 + YY
1520  NEXT J
1530 BSLOPE = (XY - (X * Y) / 3) / (XX - (X * X) / 3):A = Y / 3 - BSLOPE *
     (X / 3)
1540 R2 = ((XY - (X * Y) / 3) ^ 2) / ((XX - (X * X) / 3) * (YY - (Y * Y) /
     3))
1550 R2 =  INT (R2 * 10000 + .5) / 10000:BSLOPE =  FN OP(BSLOPE):A =  FN
     OP(A)
1560  PRINT "  R SQUARED= ";R2; SPC( 5);"SLOPE= ";BSLOPE; SPC( 5);"INTERC
     EPT= ";A: NEXT I: RETURN
```

Experiment 3 Data Analysis Programme 2

```
10  DIM STIMSET$(25),TRIAL%(3,160),RESP%(3,160),RT(3,160),SETSIZE(3),SNUM
    BER%(3),BP(6),BN(6)
20  DIM SUM(1),SMSQ(1),MEAN(1,3),S(3),T(4),TEST(24),RESP(24)
25  DIM IMEAN(21),ITEMS(21)
70  DEF  FN DP(X) =  INT (X * 100 + .5) / 100
100 MAX = 3000
140  READ N,SETSIZE(0)
150  DATA  21,160
580  PRINT "RECALL   DATA. WHEN RECORDER RUNNING.": PRINT "PRESS SPACE BA
     R.": GET S$
590  RECALL SNUMBER%: RECALL TRIAL%: RECALL RESP%: RECALL RT: RECALL SETS
     IZE: RECALL BP: RECALL BN:
592  CALL 779
595  PRINT "SUBJECT ";SNUMBER%(1);" SESSION ";SNUMBER%(2);" EXP ";SNUMBER
     R%(3)
1230  GOSUB 1930
1235  GOSUB 2230
1236  PR# 0
1240  END
1930  FOR J = 1 TO 3: PRINT " +VE LAGS FOR S= ";SETSIZE(J): PRINT
1940  FOR I = BP(2 * J - 1) TO BP(2 * J): GOSUB 1980: NEXT I
1950  PRINT : PRINT "-VE LAGS FOR S= ";SETSIZE(J): PRINT
1960  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1: GOSUB 1980:
      NEXT I
1965  NEXT J
1970  RETURN
1980  FOR K = 0 TO 4:L1(K) = 0:N1(K) = 0: NEXT K
1990 XX = I: GOSUB 2030
2000  GOSUB 2050: IF LAG < > - 1 THEN  GOSUB 2090:P1 = P: IF P1 < 160 THEN
      GOTO 2000
2010  GOSUB 2160
2020  RETURN
2030 P1 = 0: FOR II = 1 TO 160: IF TRIAL%(J,II) = XX THEN P1 = II: RETURN

2040  NEXT II
2050  FOR II = P1 + 1 TO 160: IF TRIAL%(J,II) = XX THEN P = II: GOTO 2070

2060  NEXT II:LAG =  - 1: GOTO 2080
2070 LAG = P - P1 - 1
2080  RETURN
2090  IF RESP%(J,P) = 0 THEN  RETURN
2100  IF LAG < 5 THEN L1(0) = L1(0) + RT(J,P):N1(0) = N1(J) + 1
2110  IF 5 < = LAG AND LAG < 10 THEN L1(1) = L1(1) + RT(J,P):N1(1) = N1(
     1) + 1
2120  IF 10 < = LAG AND LAG < 20 THEN L1(2) = L1(2) + RT(J,P):N1(2) = N1
     (2) + 1
2130  IF 20 < = LAG AND LAG < 30 THEN L1(3) = L1(3) + RT(J,P):N1(3) = N1
     (3) + 1
2140  IF 30 < = LAG THEN L1(4) = L1(4) + RT(J,P):N1(4) = N1(4) + 1
2150  RETURN
2160  PRINT "FOR ITEM ";I
2170  IF N1(0) < > 0 THEN  PRINT  TAB( 13);"0 TO 4 "; TAB( 22); FN DP(L1
     (0) / N1(0));"  N= ";N1(0)
2180  IF N1(1) < > 0 THEN  PRINT  TAB( 13);"5 TO 9 "; TAB( 22); FN DP(L1
     (1) / N1(1));"  N= ";N1(1)
2190  IF N1(2) < > 0 THEN  PRINT  TAB( 13);"10 TO 19 "; TAB( 22); FN DP(
     L1(2) / N1(2));"  N = ";N1(2)
2200  IF N1(3) < > 0 THEN  PRINT  TAB( 13);"20 TO 29 "; TAB( 22); FN DP(
     L1(3) / N1(3));"  N = ";N1(3)
2210  IF N1(4) < > 0 THEN  PRINT  TAB( 13);"30 OR MORE "; TAB( 22); FN D
     P(L1(4) / N1(4));"  N = ";N1(4)
2220  PRINT : PRINT : PRINT : RETURN
2230  FOR J = 1 TO 3: FOR I = 1 TO 160
```

```
2240  IF RESP%(J,I) <> 1 GOTO 2270
2250  IF RT(J,I) > MAX GOTO 2270
2260 IMEAN(TRIAL%(J,I)) = IMEAN(TRIAL%(J,I)) + RT(J,I):ITEMS(TRIAL%(J,I))
      = ITEMS(TRIAL%(J,I)) + 1
2270  NEXT I
2280  PRINT  TAB( 10);"FOR SETSIZE ";SETSIZE(J)
2290  FOR I = 1 TO 21: IF ITEMS(I) = 0 GOTO 2320
2300 IMEAN =  FN DP(IMEAN(I) / ITEMS(I))
2310  PRINT "FOR ITEM ";I;" THE MEAN= ";IMEAN;" AND N= ";ITEMS(I)
2320  NEXT I: FOR I = 1 TO 21:IMEAN(I) = 0:ITEMS(I) = 0: NEXT I: NEXT J
2330  PRINT : PRINT : PRINT : RETURN
```

Experiment 2 Data Analysis Programme 1

```
10  DIM TRIAL%(3,160),RESP%(3,160),RT(3,160),SETSIZE(3),SNUMBER%(3),BP(6)
    ,BN(6),IMEAN(21),ITEMS(21),FIRST(3,21),OTHERS(3,21),NF(3,21),N0(3,21
    ),L1(4),N1(4),S2(4),N2(4),SM(4)
20  DIM XM(3,2),X1(2)
30  DEF  FN DP(X) =  INT (X * 100 + .5) / 100:MAX = 3000:MIN = 150
40  PRINT " RECALL RAW DATA.  WHEN RECORDER IS": PRINT " RUNNING,PRESS SP
    ACE BAR.": GET 3$
50  RECALL SNUMBER%: RECALL TRIAL%: RECALL RESP%: RECALL RT: RECALL SETSI
    ZE: RECALL BP: RECALL BN
60  CALL 779
70  PRINT "  SUBJECT # ";SNUMBER%(1);"  SESSION # ";SNUMBER%(2);"  EXP #
    ";SNUMBER%(3)
80  GOSUB 280: REM  LAGS OF CORRECT RESPONSES.
90  GOSUB 790: REM  1ST PRESENTATION, OVERALL MEANS AND SUBSEQUENT MEANS
    FOR EACH ITEM
100 FIRST = 0:OTHERS = 0:N0 = 0:NF = 0
110  GOSUB 970: REM  AVG OF 1ST PRES. AND SUBSEQUENT PRES. FOR ALL +VES A
    ND -VES.
120  PRINT : PRINT : PRINT  TAB( 10);"VARIANCE AND ST. DEVIATION FOR .25
    AND .15 ITEMS"
130  PRINT : PRINT "  SS"; SPC( 3);"PROB."; SPC( 3);"N"; SPC( 4);"VARIANC
    E"; SPC( 5);"ST DEVIATION"
140  FOR J = 1 TO 3: ON SETSIZE(J) GOTO 150,150,150,160,170
150 A = 1:B = 2: GOSUB 1130: GOTO 180
160 A = 4:B = 5: GOSUB 1130: GOTO 180
170 A = 8:B = 9: GOSUB 1130
180  NEXT J
190  PRINT : PRINT : PRINT "     CURVE FIT OF .25 AND .15 ITEMS.": GOSUB
    1470
200  PRINT : PRINT : PRINT : PRINT  TAB( 15);" ERROR ANALYSIS "
210  FOR J = 1 TO 3
220  ON SETSIZE(J) GOTO 230,230,230,240,250
230  PRINT "  FOR SETSIZE  ";SETSIZE(J):A = 1:B = 2: GOSUB 1250: GOTO 260

240  PRINT "  FOR SETSIZE  ";SETSIZE(J):A = 4:B = 5: GOSUB 1250: GOTO 260

250  PRINT "  FOR SETSIZE  ";SETSIZE(J):A = 8:B = 9: GOSUB 1250
260  NEXT J: PR# 0
270  END
280  FOR J = 1 TO 3: PRINT "  +VE LAGS FOR S= ";SETSIZE(J): PRINT
290  PRINT "  ITEM"; SPC( 6);"0 TO 4"; SPC( 6);"5 TO 9"; SPC( 6);"10 TO 1
    9"; SPC( 6);"20 TO 29"; SPC( 6);"30 OR MORE"
300  FOR II = 0 TO 4:S2(II) = 0:N2(II) = 0: NEXT II
310  FOR I = BP(2 * J - 1) TO BP(2 * J): GOSUB 360: NEXT I: GOSUB 440
320  PRINT : PRINT "  -VE LAGS FOR S= ";SETSIZE(J): PRINT
330  FOR II = 0 TO 4:S2(II) = 0:N2(II) = 0: NEXT II
340  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1: GOSUB 360: NEXT
    I: GOSUB 440
350  NEXT J: RETURN
360  FOR K = 0 TO 4:L1(K) = 0:N1(K) = 0: NEXT K
370 XX = I: GOSUB 540
380  GOSUB 560: IF LAG < > - 1 THEN  GOSUB 600:P1 = P: IF P1 < 160 THEN
     GOTO 380
390  GOSUB 680: GOSUB 410
400  RETURN
410  FOR II = 0 TO 4
420 S2(II) = L1(II) + S2(II):N2(II) = N2(II) + N1(II)
430  NEXT II: RETURN
440  FOR II = 0 TO 4: IF N2(II) > 0 THEN SM(II) =  FN DP(S2(II) / N2(II))

450  NEXT II
460  PRINT : PRINT : PRINT "  MEAN OF ALL ITEMS FOR EACH LAG LENGTH ": PRINT

470  IF N2(0) > 0 THEN  PRINT  TAB( 13);"0 TO 4"; TAB( 17);SM(0);"  N= ";
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```
     N2(0)
480  IF N2(1) > 0 THEN  PRINT  TAB( 13);"5 TO 9"; TAB( 17);SM(1);"  N= ";
     N2(1)
490  IF N2(2) > 0 THEN  PRINT  TAB( 13);"10 TO 19"; TAB( 17);SM(2);"  N=
     ";N2(2)
500  IF N2(3) > 0 THEN  PRINT  TAB( 13);"20 TO 29"; TAB( 17);SM(3);"  N=
     ";N2(3)
510  IF N2(4) > 0 THEN  PRINT  TAB( 13);"30 OR MORE"; TAB( 15);SM(4);"  N
     = ";N2(4)
520  REM  THIS ROUTINE FINDS THE AVERAGE OF ALL +VE (-VE) ITEMS AT EACH L
     AG LENGTH.
530  PRINT : PRINT : PRINT : RETURN
540 P1 = 0: FOR II = 1 TO 160: IF TRIAL%(J,II) = XX THEN P1 = II: RETURN

550  NEXT II: REM  THIS ROUTINE FINDS THE 1ST OCCURRENCE OF ITEM XX WHICH
      IS AT TRIAL # P1.
560  FOR II = P1 + 1 TO 160: IF TRIAL%(J,II) = XX THEN P = II: GOTO 580
570  NEXT II:LAG =  - 1: GOTO 590
580 LAG = P - P1 - 1
590  RETURN : REM  THIS ROUTINE ENTERS WITH P1 THE LAST OCCURRENCE OF ITE
     M XX AND FINDS THE NEXT (P). IF IT FINDS P, THE LAG IS CALCULATED. I
     F NOT, LAG =-1.
600  IF RESP%(J,P) = 0 THEN  RETURN
610  IF (RT(J,P) > MAX) OR (RT(J,P) < MIN) THEN  RETURN
620  IF LAG < 5 THEN L1(0) = L1(0) + RT(J,P):N1(0) = N1(0) + 1
630  IF 5 <  = LAG AND LAG < 10 THEN L1(1) = L1(1) + RT(J,P):N1(1) = N1(1
     ) + 1
640  IF 10 <  = LAG AND LAG < 20 THEN L1(2) = L1(2) + RT(J,P):N1(2) = N1(
     2) + 1
650  IF 20 <  = LAG AND LAG < 30 THEN L1(3) = L1(3) + RT(J,P):N1(3) = N1(
     3) + 1
660  IF 30 <  = LAG THEN L1(4) = L1(4) + RT(J,P):N1(4) = N1(4) + 1
670  RETURN : REM  THIS ROUTINE PLACES THE RT OF TRIAL (J,P) INTO THE PRO
     PER LAG BRACKET.
680  PRINT  SPC( 3);I; SPC( 6);
690  IF N1(0) <  > 0 THEN ML =  FN DP(L1(0) / N1(0)): PRINT ML; SPC( 9);:
      GOTO 710
700  PRINT  SPC( 12);
710  IF N1(1) <  > 0 THEN ML =  FN DP(L1(1) / N1(1)): PRINT ML; SPC( 9);:
      GOTO 730
720  PRINT  SPC( 12);
730  IF N1(2) <  > 0 THEN ML =  FN DP(L1(2) / N1(2)): PRINT ML; SPC( 9);:
      GOTO 750
740  PRINT  SPC( 12);
750  IF N1(3) <  > 0 THEN ML =  FN DP(L1(3) / N1(3)): PRINT ML; SPC( 9);:
      GOTO 770
760  PRINT  SPC( 12);
770  IF N1(4) <  > 0 THEN ML =  FN DP(L1(4) / N1(4)): PRINT ML; SPC( 9);:

780  PRINT : PRINT  SPC( 14);: FOR II = 0 TO 4: PRINT N1(II); SPC( 13);: NEXT
     II: PRINT : PRINT : RETURN
790  FOR J = 1 TO 3: FOR I = 1 TO 160
800  IF RESP%(J,I) <  > 1 GOTO 840
810  IF RT(J,I) > MAX OR RT(J,I) < MIN GOTO 840
820 IMEAN(TRIAL%(J,I)) = IMEAN(TRIAL%(J,I)) + RT(J,I)
830 ITEMS(TRIAL%(J,I)) = ITEMS(TRIAL%(J,I)) + 1
840  NEXT I
850  PRINT  TAB( 10);"FOR SETSIZE ";SETSIZE(J): PRINT : PRINT : PRINT "
     ITEM"; SPC( 6);"MEAN"; SPC( 8);"N"; SPC( 5);"1ST OCCUR."; SPC( 5);"S
     UBSEQUENT"
860  FOR I = 1 TO 21: IF ITEMS(I) = 0 GOTO 950
870 IMEAN =  FN DP(IMEAN(I) / ITEMS(I))
880  PRINT  SPC( 4);I; SPC( 6);IMEAN; TAB( 8);ITEMS(I); SPC( 5);:
890 XX = I: GOSUB 540: IF RESP%(J,P1) = 0 GOTO 930
900  IF MIN > RT(J,P1) OR RT(J,P1) > MAX GOTO 940
910 FIRST(J,I) = RT(J,P1):NF(J,I) = 1:OTHERS(J,I) = IMEAN(I) - RT(J,P1):O
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    THERS =  FN DP(OTHERS(J,I) / (ITEMS(I) - 1)):N0(J,I) = ITEMS(I) - 1
920  PRINT RT(J,P1); SPC( 9);OTHERS: PRINT : GOTO 950
930  PRINT "   1ST OCCUR. WAS AN ERROR.":OTHERS(J,I) = IMEAN(I):N0(J,I) =
     ITEMS(I): PRINT : GOTO 950
940  PRINT "   1ST OCCUR. WAS OUTSIDE OF LIMITS"; SPC( 2);RT(J,P1):OTHERS
     (J,I) = IMEAN(I):N0(J,I) = ITEMS(I): PRINT :
950  NEXT I: FOR I = 1 TO 21:IMEAN(I) = 0:ITEMS(I) = 0: NEXT I: NEXT J
960  PRINT : PRINT : PRINT : RETURN
970  PRINT : PRINT "   AVERAGE OF 1ST OCCUR. AND SUBSEQUENT OCCUR."
980  PRINT : PRINT : PRINT "  SS"; SPC( 3);"SIGN"; SPC( 3);"N"; SPC( 3);"
     1ST OCCUR."; SPC( 10);"N"; SPC( 3);"SUBSEQUENT"
990  FOR J = 1 TO 3
1000  FOR I = BP(2 * J - 1) TO BP(2 * J)
1010 FIRST = FIRST(J,I) + FIRST:NF = NF(J,I) + NF:OTHERS = OTHERS + OTHER
     S(J,I):N0 = N0 + N0(J,I)
1020  NEXT I
1030 OTHERS =  FN DP(OTHERS / N0):FIRST =  FN DP(FIRST / NF)
1040  PRINT : PRINT " ";SETSIZE(J);"  +VE"; SPC( 4);NF; SPC( 3);FIRST
     ; SPC( 13);N0; SPC( 4);OTHERS
1050 FIRST = 0:NF = 0:OTHERS = 0:N0 = 0
1060  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1
1070 FIRST = FIRST(J,I) + FIRST:NF = NF(J,I) + NF:OTHERS = OTHERS + OTHER
     S(J,I):N0 = N0 + N0(J,I)
1080  NEXT I
1090 OTHERS =  FN DP(OTHERS / N0):FIRST =  FN DP(FIRST / NF)
1100  PRINT  TAB( 9);"-VE"; SPC( 4);NF; SPC( 3);FIRST; SPC( 13);N0; SPC(
     4);OTHERS
1110 FIRST = 0:NF = 0:OTHERS = 0:N0 = 0: NEXT J
1120  RETURN : REM  HERE THE FIRST OCCUR. OF EACH ITEM AND THE MEAN OF SU
     BSEQUENT OCCUR. ARE FOUND.
1130 X2(1) = 0:X2(2) = 0:X1(1) = 0:X1(2) = 0:N = 0:N0 = 0
1140  FOR I = 1 TO 160: IF RESP%(J,I) = 0 THEN  GOTO 1180
1150  IF MIN > RT(J,I) OR MAX < RT(J,I) THEN  GOTO 1180
1160  IF (TRIAL%(J,I) = A) THEN X1(1) = X1(1) + RT(J,I):X2(1) = X2(1) + R
     T(J,I) ^ 2:N = N + 1
1170  IF TRIAL%(J,I) = B THEN X1(2) = X1(2) + RT(J,I):X2(2) = X2(2) + RT(
     J,I) ^ 2:N0 = N0 + 1
1180  NEXT I
1190 SIGMA2 = (X2(1) - X1(1) ^ 2 / N) / (N - 1):STDEV =  SQR (SIGMA2):SIG
     MA2 =  FN DP(SIGMA2):STDEV =  FN DP(STDEV)
1200 XM(J,1) = X1(1) / N:XM(J,2) = X1(2) / N0
1210  PRINT : PRINT  SPC( 3);SETSIZE(J);"    .25"; SPC( 3);N; SPC( 4);SIG
     MA2; SPC( 5);STDEV
1220 SIGMA2 = (X2(2) - X1(2) ^ 2 / N0) / (N0 - 1):STDEV =  SQR (SIGMA2):S
     IGMA2 =  FN DP(SIGMA2):STDEV =  FN DP(STDEV)
1230  PRINT : PRINT  TAB( 9);".15"; SPC( 3);N0; SPC( 4);SIGMA2; SPC( 5);S
     TDEV
1240  RETURN : REM  HERE THE VARIANCES FOR .25 AND .15 ITEMS FOR EACH SS.
      ARE FOUND.
1250 L = 0:S1 = 0:S0 = 0: FOR I = 1 TO 21:ITEMS(I) = 0:IMEAN(I) = 0: NEXT
     I
1260  FOR I = L + 1 TO 160: IF RESP%(J,I) = 0 GOTO 1280
1270  NEXT I: GOTO 1360
1280 L = I: PRINT "  ERROR AT TRIAL ";L;"    ITEM ";TRIAL%(J,L);"  RT = "
     ;RT(J,L); SPC( 3);
1290 ITEMS(TRIAL%(J,L)) = ITEMS(TRIAL%(J,L)) + 1:IMEAN(TRIAL%(J,L)) = IME
     AN(TRIAL%(J,L)) + RT(J,L)
1300  IF L = 1 GOTO 1330
1310  FOR K = L - 1 TO 1 STEP  - 1: IF TRIAL%(J,K) = TRIAL%(J,L) GOTO 134
     0
1320  NEXT K
1330  PRINT "  ERROR OCCURRED ON 1ST OCCURRENCE ": GOTO 1350
1340 LAG = L - K - 1: PRINT "  LAG SINCE LAST OCCURRENCE = ";LAG
1350  IF L < 160 THEN  GOTO 1260
1360  IF L = 0 THEN  PRINT "  THERE WERE NO ERRORS FOR THIS SETSIZE.": PRINT
     : GOTO 1460
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1370  FOR I = 1 TO 21: IF ITEMS(I) = 0 THEN  GOTO 1430
1380 MRT =  FN DP(IMEAN(I) / ITEMS(I)): PRINT : PRINT "  MEAN RT OF ERROR
     S FOR ITEM ";I;"  = ";MRT
1390  IF (I = A) THEN PCT =  FN DP(ITEMS(I) / 4 * 10): PRINT "  PCT ERROR
      FOR .25 ITEM = ";PCT: PRINT
1400  IF I = B THEN PCT =  FN DP(ITEMS(I) / 24 * 100): PRINT "  PCT ERROR
      FOR .15 ITEM = ";PCT: PRINT
1410  IF I <  = BP(2 * J) THEN S1 = S1 + ITEMS(I): GOTO 1430
1420 S0 = S0 + ITEMS(I)
1430  NEXT I
1440  PRINT : PRINT :PCT =  FN DP(S1 / 8 * 10): PRINT "  PCT ERRORS FOR +
     VE ITEMS = ";PCT;"      # OF ERRORS = ";S1: PRINT
1450 PCT =  FN DP(S0 / 8 * 10): PRINT "  PCT ERRORS FOR -VE ITEMS = ";PCT
     ;"      # OF ERRORS = ";S0: PRINT :
1460  RETURN
1470  FOR I = 1 TO 2:XY = 0:X = 0:Y = 0:XX = 0:YY = 0: IF I = 1 THEN  PRINT
     "    FOR .25 ITEM"
1480  IF I = 2 THEN  PRINT "    FOR .15 ITEM"
1490  FOR J = 1 TO 3
1500 XY = XM(J,I) * SETSIZE(J) + XY
1510 Y = XM(J,I) + Y:X = SETSIZE(J) + X:XX = SETSIZE(J) ^ 2 + XX:YY = XM(
     J,I) ^ 2 + YY
1520  NEXT J
1530 BSLOPE = (XY - (X * Y) / 3) / (XX - (X * X) / 3):A = Y / 3 - BSLOPE *
     (X / 3)
1540 R2 = ((XY - (X * Y) / 3) ^ 2) / ((XX - (X * X) / 3) * (YY - (Y * Y) /
     3))
1550 R2 =  INT (R2 * 10000 + .5) / 10000:BSLOPE =  FN DP(BSLOPE):A =  FN
     DP(A)
1560  PRINT "  R SQUARED= ";R2; SPC( 5);"SLOPE= ";BSLOPE; SPC( 5);"INTERC
     EPT= ";A: NEXT I: RETURN
```

Experiment 2 Data Analysis Programme 2

```
10  DIM TRIAL%(3,160),RESP%(3,160),RT(3,160),SETSIZE(3),SNUMBER(3
    ),BP(6),BN(6),IMEAN(21),ITEMS(21),FIRST(3,21),OTHERS(3,21),N
    F(3,21),NO(3,21),L1(4),N1(4),S2(4),N2(4),SM(4)
20  DIM XM(3,2),X1(4),LL(3,21,4),N8(3,21,4),LJ(3,21,2),N7(3,21,2)

30  DEF  FN DP(X) =  INT (X * 100 + .5) / 100:MAX = 3000:MIN = 15
    0
40  PRINT " RECALL RAW DATA:  WHEN RECORDER IS": PRINT " RUNNING.
    PRESS SPACE BAR.": GET S$
50  RECALL SNUMBER: RECALL TRIAL%: RECALL RESP%: RECALL RT: RECALL
    SETSIZE: RECALL BP: RECALL BN
70  PRINT "  SUBJECT # ";SNUMBER(1);"  SESSION # ";SNUMBER(2);"
    EXP # ";SNUMBER(3)
80  GOSUB 280: REM  LAGS OF CORRECT RESPONSES
90  GOSUB 790: REM  1ST PRESENTATION, OVERALL MEANS AND SUBSEQUEN
    T MEANS FOR EACH ITEM
100 FIRST = 0:OTHERS = 0:NO = 0:NF = 0
120  GOTO 270
270  PRINT  CHR$ (135): PRINT  CHR$ (135): GOSUB 1570: END
280  FOR J = 1 TO 3: PRINT "  +VE LAGS FOR S# ";SETSIZE(J): PRINT

300  FOR II = 0 TO 4:S2(II) = 0:N2(II) = 0: NEXT II
310  FOR I = BP(2 * J - 1) TO BP(2 * J): GOSUB 360: NEXT I: GOSUB
    440
320  PRINT : PRINT "  -VE LAGS FOR S# ";SETSIZE(J): PRINT
330  FOR II = 0 TO 4:S2(II) = 0:N2(II) = 0: NEXT II
340  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1: GOSUB
    360: NEXT I: GOSUB 440
350  NEXT J: RETURN
360  FOR K = 0 TO 4:L1(K) = 0:N1(K) = 0: NEXT K
370 XX = I: GOSUB 540
380  GOSUB 560: IF LAG <  > - 1 THEN  GOSUB 600:P1 = P: IF P1 <
    160 THEN  GOTO 380
390  GOSUB 410
400  RETURN
410  FOR II = 0 TO 4
420 S2(II) = L1(II) + S2(II):N2(II) = N2(II) + N1(II):LL(J,XX,II)
     = L1(II):N8(J,XX,II) = N1(II)
430  NEXT II: RETURN
440  RETURN
540 P1 = 0: FOR II = 1 TO 160: IF TRIAL%(J,II) = XX THEN P1 = II:
     RETURN
550  NEXT II: REM . THIS ROUTINE FINDS THE 1ST OCCURRENCE OF ITEM
    XX WHICH IS AT TRIAL # P1.
560  FOR II = P1 + 1 TO 160: IF TRIAL%(J,II) = XX THEN P = II: GOTO
    580
570  NEXT II:LAG =  - 1: GOTO 590
580 LAG = P - P1 - 1
590  RETURN : REM . THIS ROUTINE ENTERS WITH P1 THE LAST OCCURRENC
    E OF ITEM XX AND FINDS THE NEXT (P). IF IT FINDS P, THE LAG
    IS CALCULATED. IF NOT, LAG =-1.
600  IF RESP%(J,P) = 0 THEN  RETURN
610  IF (RT(J,P) > MAX) OR (RT(J,P) < MIN) THEN  RETURN
620  IF LAG < 5 THEN L1(0) = L1(0) + RT(J,P):N1(0) = N1(0) + 1
630  IF 5 <  = LAG AND LAG < 10 THEN L1(1) = L1(1) + RT(J,P):N1(1
    ) = N1(1) + 1
640  IF 10 <  = LAG AND LAG < 20 THEN L1(2) = L1(2) + RT(J,P):N1(
    2) = N1(2) + 1
650  IF 20 <  = LAG AND LAG < 30 THEN L1(3) = L1(3) + RT(J,P):N1(
    3) = N1(3) + 1
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```
660  IF 30 < = LAG THEN L1(4) = L1(4) + RT(J,P):N1(4) = N1(4) +
     1
670  RETURN : REM  THIS ROUTINE PLACES THE RT OF TRIAL (J,P) INTO
      THE PROPER LAG BRACKET.
790  FOR J = 1 TO 3: FOR I = 1 TO 160
800  IF RESP%(J,I) <  > 1 GOTO 840
810  IF RT(J,I) > MAX OR RT(J,I) < MIN GOTO 840
820 IMEAN(TRIAL%(J,I)) = IMEAN(TRIAL%(J,I)) + RT(J,I)
830 ITEMS(TRIAL%(J,I)) = ITEMS(TRIAL%(J,I)) + 1
840  NEXT I
850  PRINT  TAB( 10);"FOR SETSIZE ";SETSIZE(J): PRINT : PRINT : PRINT
     "  ITEM"; SPC( 6);"MEAN"; SPC( 8);"N"; SPC( 5);"1ST OCCUR.";
      SPC( 5);"SUBSEQUENT"
860  FOR I = 1 TO 21: IF ITEMS(I) = 0 GOTO 955
870 IMEAN =  FN DP(IMEAN(I) / ITEMS(I))
890 XX = I: GOSUB 540: IF RESP%(J,P1) = 0 GOTO 930
900  IF MIN > RT(J,P1) OR RT(J,P1) > MAX GOTO 940
910 FIRST(J,I) = RT(J,P1):NF(J,I) = 1:OTHERS(J,I) = IMEAN(I) - RT
     (J,P1):OTHERS =  FN DP(OTHERS(J,I) / (ITEMS(I) - 1)):NO(J,I)
      = ITEMS(I) - 1
920  PRINT RT(J,P1); SPC( 9);OTHERS: PRINT : GOTO 950
930  PRINT "    1ST OCCUR. WAS AN ERROR.":OTHERS(J,I) = IMEAN(I):N
     O(J,I) = ITEMS(I): PRINT : GOTO 950
940  PRINT "    1ST OCCUR. WAS OUTSIDE OF LIMITS"; SPC( 2);RT(J,P1
     ):OTHERS(J,I) = IMEAN(I):NO(J,I) = ITEMS(I): PRINT :
950 LJ(J,I,0) = IMEAN(I):LJ(J,I,1) = FIRST(J,I):LJ(J,I,2) = OTHER
     S(J,I):N7(J,I,0) = ITEMS(I):N7(J,I,1) = NF(J,I):N7(J,I,2) =
     NO(J,I)
955  NEXT I: FOR I = 1 TO 21:IMEAN(I) = 0:ITEMS(I) = 0: NEXT I: NEXT
     J
960  PRINT : PRINT : PRINT : RETURN
970  PRINT : PRINT "    AVERAGE OF 1ST OCCUR. AND SUBSEQUENT OCCUR
     ."
980  PRINT : PRINT : PRINT "  SS"; SPC( 3);"SIGN"; SPC( 3);"N"; SPC(
     3);"1ST OCCUR."; SPC( 10);"N"; SPC( 3);"SUBSEQUENT"
990  FOR J = 1 TO 3
1000  FOR I = BP(2 * J - 1) TO BP(2 * J)
1010 FIRST = FIRST(J,I) + FIRST:NF = NF(J,I) + NF:OTHERS = OTHERS
      + OTHERS(J,I):NO = NO + NO(J,I)
1020  NEXT I
1030 OTHERS =  FN DP(OTHERS / NO):FIRST =  FN DP(FIRST / NF)
1040  PRINT : PRINT "  ";SETSIZE(J);"     +VE": SPC( 4);NF; SPC(
     3);FIRST; SPC( 13);NO; SPC( 4);OTHERS
1050 FIRST = 0:NF = 0:OTHERS = 0:NO = 0
1060  FOR I = BN(2 * J - 1) TO BN(2 * J - 1) + BN(2 * J) - 1
1070 FIRST = FIRST(J,I) + FIRST:NF = NF(J,I) + NF:OTHERS = OTHERS
      + OTHERS(J,I):NO = NO + NO(J,I)
1080  NEXT I
1090 OTHERS =  FN DP(OTHERS / NO):FIRST =  FN DP(FIRST / NF)
1100  PRINT  TAB( 9);"-VE"; SPC( 4);NF; SPC( 3);FIRST; SPC( 13);N
     O; SPC( 4);OTHERS
1110 FIRST = 0:NF = 0:OTHERS = 0:NO = 0: NEXT J
1120  RETURN : REM  HERE THE FIRST OCCUR. OF EACH ITEM AND THE ME
     AN OF SUBSEQUENT OCCUR. ARE FOUND.
1130  PRINT " STORE ARRAYS. WHEN RECORDER RUNNING.": PRINT " SPAC
     E.": GET S$: STORE SNUMBER: STORE SETSIZE: STORE LL: STORE N
     8: STORE LJ: STORE N7: GET S$: STORE SNUMBER: STORE SETSIZE:
      STORE LL: STORE N8: STORE LJ: STORE N7: RETURN
```

Experiment 2 Data Analysis Programme 3

```
10   DIM SNUMBER(3),SETSIZE(3),LAG(3,21,4),N1(3,21,4),[illegible]AN(3,21,2),ITEMS(
      3,21,2),SLAG(3,21,4),NLAG(3,21,4),SMEAN(3,21,2),NITEMS(3,21,2),LLAG(
      4),N(4)
20   GOSUB 1000
30   DEF  FN DP(X) =  INT (X * 100 + .5) / 100
40   FOR Z = 1 TO 6: PRINT " WHEN RECORDER RUNNING, SPACE. Z= ";Z: GET S$:

50   RECALL SNUMBER: RECALL SETSIZE: RECALL LAG: RECALL N1: RECALL IMEAN: RECALL

ITEMS
60   FOR J = 1 TO 3: ON SETSIZE(J) GOTO 100,100,70,80,90
70  X = 1: GOSUB 1050: GOTO 100
80  X = 2: GOSUB 1050: GOTO 100
90  X = 3: GOSUB 1050
100  NEXT J: NEXT Z
110  CALL 779
120  GOSUB 1000: PRINT  TAB( 20);"SUBJECT # ";SNUMBER(1)
130 J = 1:A = 1:B = 3: PRINT "  +VE LAGS FOR S=3 ": GOSUB 1080: REM  THIS
      PRINTS MEAN LAGS OF EACH ITEM IN A SET.
140  GOSUB 1200: REM   THIS PRINTS  MEAN LAGS OF ALL ITEMS IN A SET
150 A = 4:B = 14: PRINT "  -VE LAGS FOR S=3 ": GOSUB 1080: GOSUB 1200
160 A = 4:B = 7:J = 2: PRINT "  +VE LAGS FOR S=4 ": GOSUB 1080: GOSUB 120
     0
170 A = 8:B = 17: PRINT "  -VE LAGS FOR S=4 ": GOSUB 1080: GOSUB 1200
180 J = 3:A = 8:B = 12: PRINT "  +VE LAGS FOR S=5 ": GOSUB 1080: GOSUB 12
     00
190 A = 13:B = 21: PRINT "  -VE LAGS FOR S=5": GOSUB 1080: GOSUB 1200
200 J = 1:A = 1:B = 14: GOSUB 1250: REM  1ST PRESENTATION,OVERALL MEANS A
     ND SUBSEQUENT PRESENTATIONS
210 J = 2:A = 4:B = 17: GOSUB 1250
220 J = 3:A = 8:B = 21: GOSUB 1250
230  PRINT : PRINT "  AVERAGE OF 1ST OCCURANCE AND SUBSEQUENT OCCURANCES
     ": PRINT
240  PRINT "  SS"; SPC( 3);"SIGN"; SPC( 3);"N"; SPC( 3);"1ST OCCUR"; SPC(
     10);"N"; SPC( 3);"SUBSEQUENT"
250 J = 1:A = 1:B = 3:SIGN$ = "+VE": GOSUB 1300:A = 4:B = 14:SIGN$ = "-VE
     ": GOSUB 1300
260 J = 2:A = 4:B = 7:SIGN$ = "+VE": GOSUB 1300:A = 8:B = 17:SIGN$ = "-VE
     ": GOSUB 1300
270 J = 3:A = 8:B = 12:SIGN$ = "+VE": GOSUB 1300:A = 13:B = 21:SIGN$ = "-
     VE": GOSUB 1300
280  PR# 0: END
1000  PRINT "   EXP 3-2   AVERAGE OF INDIVIDUAL ITEMS DATA OVER 6 DAYS.":
      RETURN
1050  FOR I = 1 TO 21: FOR K = 0 TO 4:SLAG(X,I,K) = LAG(J,I,K) + SLAG(X,I
     ,K):NLAG(X,I,K) = N1(J,I,K) + NLAG(X,I,K): NEXT K
1060  FOR K = 0 TO 2:SMEAN(X,I,K) = IMEAN(J,I,K) + SMEAN(X,I,K):NITEMS(X,
     I,K) = ITEMS(J,I,K) + NITEMS(X,I,K): NEXT K
1070  NEXT I: RETURN
1080  PRINT : PRINT "  ITEM"; SPC( 6);"0 TO 4"; SPC( 6);"5 TO 9"; SPC( 6)
     ;"10 TO 19"; SPC( 6);"20 TO 29"; SPC( 6);"30 OR MORE": PRINT
1090  FOR I = A TO B
1100  FO[illegible]0 TO 4: IF NLAG(J,I,K) < > 0 THEN LLAG(K) =  FN DP(SLAG(J,
     I,K[illegible](J,I,K))
1120  [illegible]
1130  P[illegible]( 3);I; SPC( 6);
1140  FOR[illegible]0 TO 4: IF NLAG(J,I,K) [illegible] 0 THEN  PRINT LLAG(K); SPC( 9);
```

```
      : GOTO 1160
1150  PRINT  SPC( 15);
1160  NEXT K
1170  PRINT  SPC( 14);: FOR K = 0 TO 4: PRINT NLAG(J,I,K); SPC( 14);: NEXT
      K: PRINT
1180  NEXT I: RETURN
1200  FOR K = 0 TO 4:N(K) = 0:LLAG(K) = 0: NEXT K: FOR K = 0 TO 4: FOR I =
      A TO B:LLAG(K) = LLAG(K) + SLAG(J,I,K):N(K) = N(K) + NLAG(J,I,K): NEXT
      I: NEXT K
1210  PRINT "          MEAN OF ALL ITEMS AT EACH LAG LENGTH": PRINT
1220  PRINT  SPC( 11);: FOR K = 0 TO 4: IF N(K) < > 0 THEN LLAG =  FN OP
      (LLAG(K) / N(K)): PRINT LLAG; SPC( 9);: GOTO 1240
1230  PRINT  SPC( 15);
1240  NEXT K: PRINT  SPC( 14);: FOR K = 0 TO 4: PRINT N(K); SPC( 14);: NEXT
      K: PRINT : RETURN
1250  PRINT  TAB( 10);"FOR SETSIZE ";J + 2: PRINT : PRINT "  ITEM"; SPC(
      6);"MEAN"; SPC( 8);"N"; SPC( 5);"1ST OCCUR"; SPC( 5);"SUBSEQUENT"; SPC(
      5);"N SUB"
1260  FOR I = A TO B:MEAN =  FN OP(SMEAN(J,I,0) / NITEMS(J,I,0)): PRINT  SPC(
      4);I; SPC( 6);MEAN; SPC( 8);NITEMS(J,I,0); SPC( 5);:
1270 MEAN =  FN OP(SMEAN(J,I,1) / NITEMS(J,I,1)): PRINT MEAN; SPC( 9);
1280 MEAN =  FN OP(SMEAN(J,I,2) / NITEMS(J,I,2)): PRINT MEAN; SPC( 7);NIT
      EMS(J,I,2)
1290  NEXT I: PRINT : PRINT : RETURN
1300 FIRST = 0:N = 0:SUB = 0:N1 = 0: FOR I = A TO B:FIRST = FIRST + SMEAN
      (J,I,1):N = N + NITEMS(J,I,1):SUB = SUB + SMEAN(J,I,2):N1 = N1 + NIT
      EMS(J,I,2): NEXT I
1310 FIRST =  FN OP(FIRST / N):SUB =  FN OP(SUB / N1)
1320  PRINT "  ";J + 2; SPC( 3);SIGN$; SPC( 4);N; SPC( 3);FIRST; SPC( 13)
      ;N1; SPC( 3);SUB
1330  RETURN
```

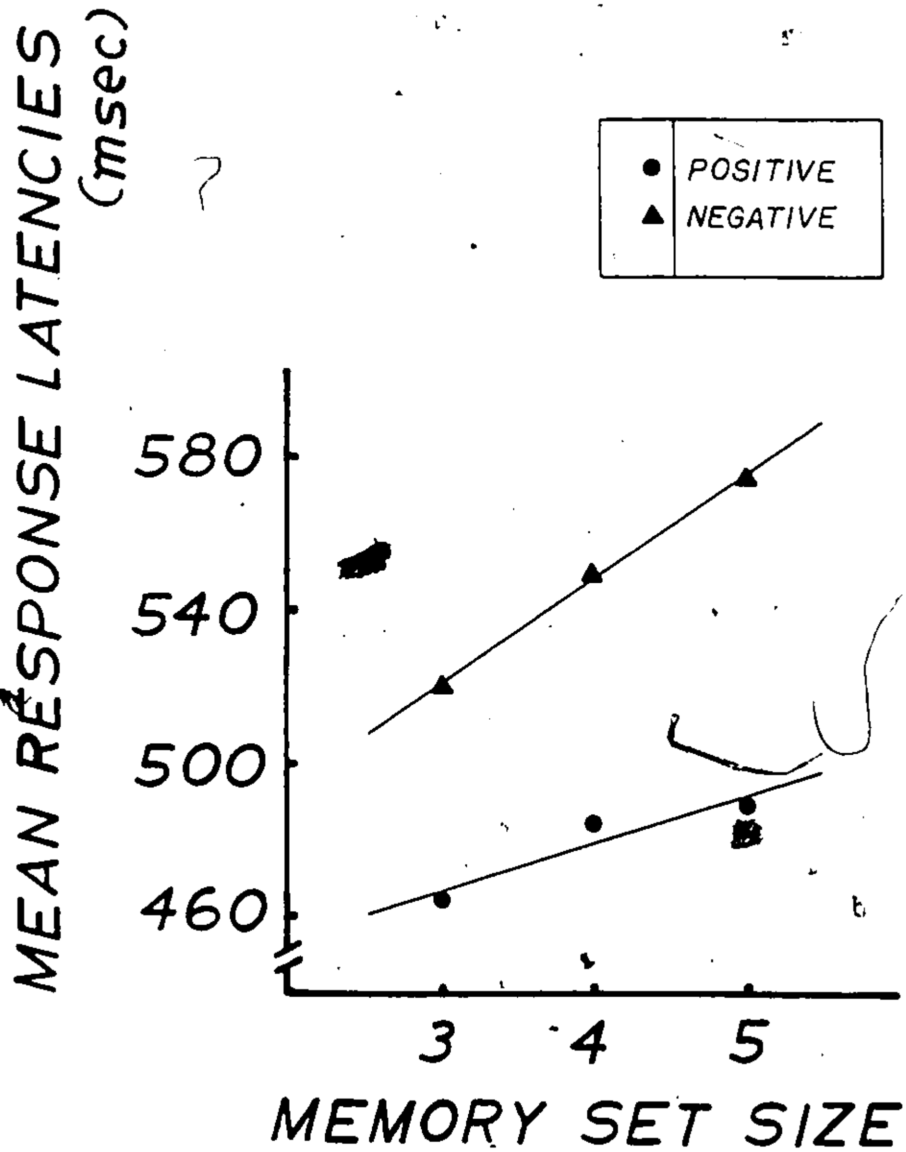
APPENDIX 5

A Replication of Experiment 2 Using the Tachistoscope

Appendix 5 provides the data and corresponding analysis obtained from 12 naive volunteer subjects who participated in an item recognition task identical to that reported for Experiment 2. In contrast to Experiment 2, however, the trial events, (similar to those described on page 41, Experiment 1), were executed using a Scientific 3-Field Tachistoscope.

The findings reported here, verify those findings obtained in Experiment 2 where the Apple II computer initiated the trial events; neither the slope values nor the intercept values obtained from positive .25 and from positive .15 item recognition functions differed significantly.

Figure 62: Mean response latencies are plotted against positive set size for all six days, for negative and positive responses separately over all 12 subjects.



Positive and Negative Mean RTs

Table 55: Individual subjects' mean response latencies for positive and for negative responses are shown summarized over the six days of the experiment for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

POSITIVE mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	441.02	454.33	441.24	.11	445.09	.0002
2	460.69	496.07	482.22	10.77	436.60	.3646
3	403.50	419.44	412.53	4.52	393.76	.3190
4	435.75	440.51	446.77	5.51	418.97	.9939
5	467.04	483.26	499.12	16.04	418.98	1.0000
6	531.15	555.40	565.66	17.26	481.72	.9481
7	382.61	406.98	396.19	6.79	368.10	.3092
8	415.21	441.13	441.52	13.16	380.00	.7611
9	515.14	541.92	564.01	24.44	442.62	.9969
10	508.91	505.72	533.54	12.31	466.80	.6543
11	528.14	556.93	539.01	5.43	519.62	.1398
12	479.55	511.25	546.77	33.61	378.08	.9989
x	464.06	484.42	489.05	12.50	429.20	.8833

NEGATIVE mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	514.74	546.22	561.48	23.37	447.33	.9614
2	508.37	553.29	558.39	25.01	439.98	.8256
3	445.06	477.87	517.62	36.28	335.06	.9970
4	481.50	465.71	505.61	12.06	436.05	.3599
5	494.30	519.25	557.83	31.77	396.73	.9849
6	577.91	606.31	630.01	26.05	500.54	.9973
7	467.84	504.57	487.64	9.90	447.08	.2900
8	464.14	503.98	511.39	23.63	398.67	.8643
9	600.84	625.08	629.28	14.22	561.52	.8580
10	554.87	557.66	630.29	37.71	430.10	.7800
11	592.96	634.73	662.48	34.76	491.02	.9866
12	542.78	597.81	636.62	46.92	404.72	.9901
x	520.45	549.38	574.06	26.81	440.74	.9979

Analysis of Variance

performed on positive and negative mean response latencies for each set size

within variables: w(1): positive vs negative mean RTs
w(2): set size

Findings: w(1): $F(1,11)=171.694$, $p=.0001$
w(2): $F(2,22)=34.350$, $p=.0001$
w(1,2): $F(2,22)=13.535$, $p=.0003$

Analysis of Variance

performed on positive and negative slopes

within variable: w(1): positive vs negative slopes

Finding: w(1): $F(1,11)=17.232$, $p=.0019$

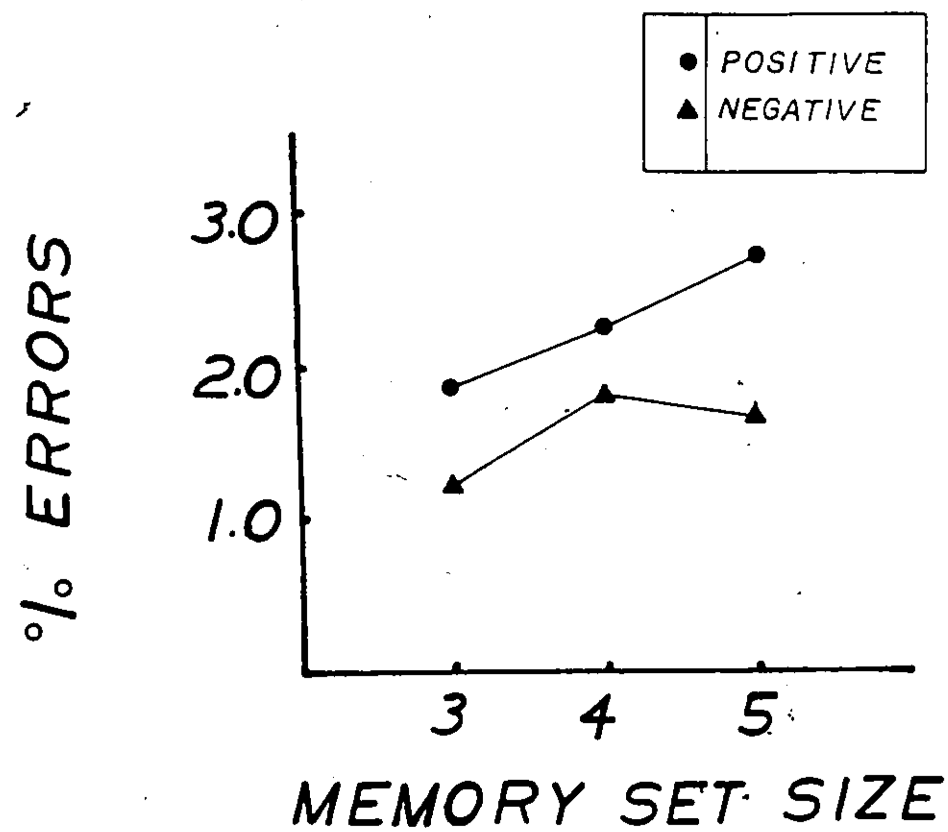
Analysis of Variance

performed on positive and negative intercepts

within variable: w(1): positive vs negative intercepts

Finding: w(1): $F(1,11)=.660$, $p=.5611$

Figure 63: Mean percent errors are plotted against positive set size over the six days of the experiment for positive and negative trials separately for all 12 subjects.



Positive and Negative Percent Errors

Table 16: Individual subjects' mean percent errors for positive and negative responses are shown summarized over the six days of the experiment for each set size separately.

POSITIVE % ERRORS

S#	s=3	s=4	s=5
1	0.67	0.33	1.00
2	0.67	2.66	2.33
3	5.33	4.00	3.67
4	6.00	3.33	5.00
5	0.67	2.66	4.67
6	1.33	0.67	1.67
7	1.33	4.67	2.00
8	1.00	1.67	1.33
9	2.00	2.67	2.33
10	0.67	0.33	0.67
11	1.33	2.33	2.00
12	1.00	1.67	6.00
x	1.84	2.25	2.72

NEGATIVE % ERRORS

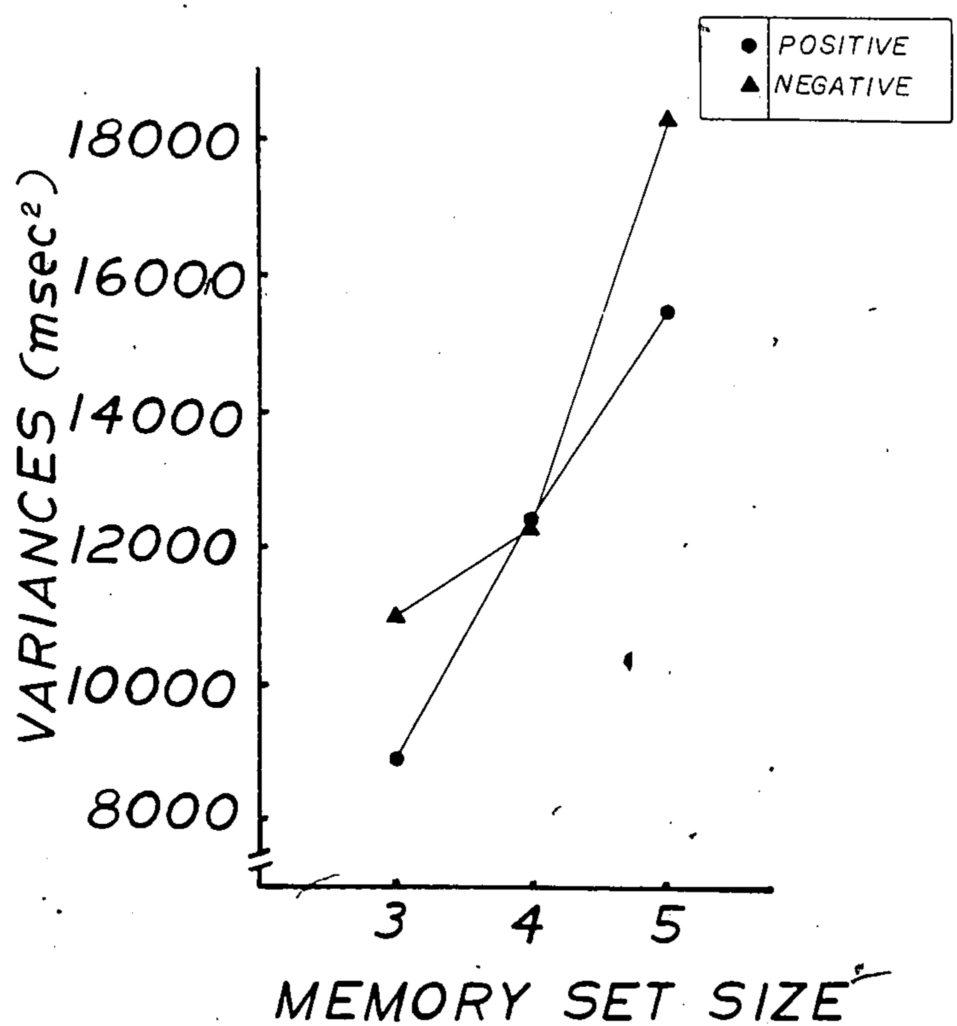
S#	s=3	s=4	s=5
1	1.33	1.67	2.00
2	0.67	0.67	1.67
3	1.67	3.00	1.33
4	2.66	2.33	2.33
5	2.33	3.67	4.67
6	0.00	0.67	1.33
7	3.00	5.33	4.33
8	0.00	0.33	0.33
9	1.33	1.67	0.67
10	0.00	0.00	0.33
11	0.00	1.00	0.67
12	1.33	1.33	0.33
x	1.19	1.81	1.67

Analysis of Variance

within variables: w(1): positive vs negative percent errors
w(2): set size

Findings: w(1): $F(1,11)=3.707$, $p=.0778$
w(2): $F(2,22)=2.605$, $p=.0950$
w(1,2): $F(2,22)=.799$, $p=.5337$

Figure 64: Mean response variances are plotted against positive set size for positive and negative responses separately for all 12 subjects over all six days.



Positive and Negative Variances

Table 57: Individual subjects' mean variance scores for positive and negative responses are shown summarized over the six days of the experiment for each set size separately.

POSITIVE VARIANCES

S#	s=3	s=4	s=5
1	5708.91	8240.50	11015.09
2	6941.89	6996.84	6526.42
3	8766.52	10844.83	11037.94
4	10123.13	18341.92	12772.15
5	4308.17	6436.18	8688.78
6	8309.26	17423.79	13889.83
7	10298.18	9965.46	15513.23
8	5193.12	7099.30	11452.49
9	8913.27	13564.14	23464.55
10	8671.48	10258.19	12198.29
11	19740.92	28444.20	28671.99
12	10105.40	11386.18	30718.23
x	8923.36	12416.80	15495.75

NEGATIVE VARIANCES

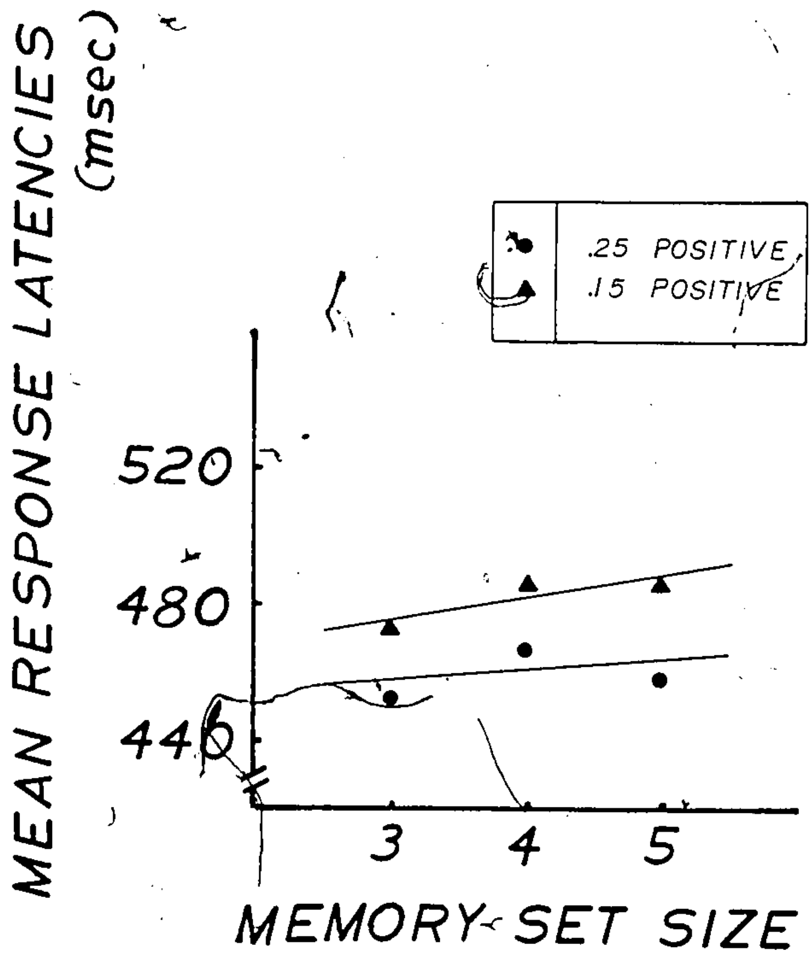
S#	s=3	s=4	s=5
1	7115.26	12662.71	16710.78
2	10203.18	9592.48	11867.37
3	4651.90	7256.41	12542.98
4	12634.04	12656.87	29737.87
5	5629.65	7629.90	8536.76
6	13485.87	16165.96	25370.54
7	8111.56	13672.54	13631.44
8	6059.05	8799.84	8458.60
9	17553.17	14258.11	18653.57
10	8026.31	6359.58	16251.51
11	26908.01	23565.89	37933.02
12	12360.08	15345.70	19404.73
x	11061.51	12330.50	18258.27

Analysis of Variance

within variables: w(1): positive vs negative variances
w(2): set size

Findings: w(1): $F(1,11)=4.843$, $p=.0480$
w(2): $F(2,22)=35.024$, $p=.0001$
w(1,2): $F(2,22)=.801$, $p=.5336$

Figure 65: Mean response latencies are plotted against positive set size for all six days for .25 and .15 positive responses for all 12 subjects. Least squares best fitting straight lines are drawn through each set of data.



Positive .25 and .15 Mean RTs

Table 58: Individual subjects' mean response latencies for the positive .25 and .15 items are shown summarized over the six days of the experiment for each set size separately. Also shown are the corresponding slopes, intercepts and coefficients of determination for each set of data.

POSITIVE .25 mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	431.23	450.65	421.40	−4.92	454.09	.1090
2	458.03	477.54	475.98	8.98	434.62	.6853
3	392.17	418.88	376.67	−7.75	426.91	.1317
4	427.76	439.50	426.03	−0.87	434.56	.0139
5	464.31	458.34	464.00	−0.16	462.84	.0021
6	535.92	542.03	537.39	0.74	535.51	.0531
7	363.47	399.25	362.90	−0.28	376.35	.0002
8	397.32	420.76	415.12	8.90	375.47	.5292
9	501.32	503.99	519.61	9.15	471.73	.8568
10	493.73	485.61	496.03	1.15	487.19	.0441
11	515.10	526.65	492.85	−11.13	556.03	.4193
12	454.17	477.41	503.58	24.71	379.57	.9988
x	452.88	466.72	457.62	2.38	449.59	.1135

POSITIVE .15 mRTs

S#	s=3	s=4	s=5	linear slope	intercept	r^2
1	453.44	427.38	419.07	−17.19	502.04	.9184
2	451.03	503.68	462.14	5.56	450.06	.0401
3	425.03	405.34	419.72	−2.66	427.32	.0679
4	444.27	444.77	436.99	−3.64	456.57	.6987
5	472.17	504.25	495.52	11.68	443.95	.4955
6	515.91	564.38	538.84	11.47	493.85	.2236
7	405.15	379.55	407.89	1.37	392.05	.0077
8	420.94	455.50	440.19	9.62	400.38	.3089
9	526.15	565.09	572.08	22.97	462.25	.8759
10	504.27	497.25	541.01	18.37	440.70	.6110
11	542.59	557.19	550.05	3.73	535.02	.2610
12	514.22	521.56	548.53	17.16	459.48	.9016
x	472.93	485.50	486.01	6.54	455.32	.7792

Analysis of Variance

performed on the mean response latencies of positive .15 and .25 items for set sizes 3, 4 and 5 as averaged over the six days of the experiment

within variables: w(1): .15 vs .25 mean RTs
w(2): set size

Findings: w(1): F(1,11)=20.689, p=.0011
w(2): F(2,22)=4.017, p=.0318
w(1,2): F(2,22)=.753, p=.5132

Analysis of Variance

performed on slopes obtained from the .15 and .25 positive linear item recognition functions

within variable: w(1): .25 vs .15 slopes

Finding: w(1): F(1,11)=2.258, p=.1585

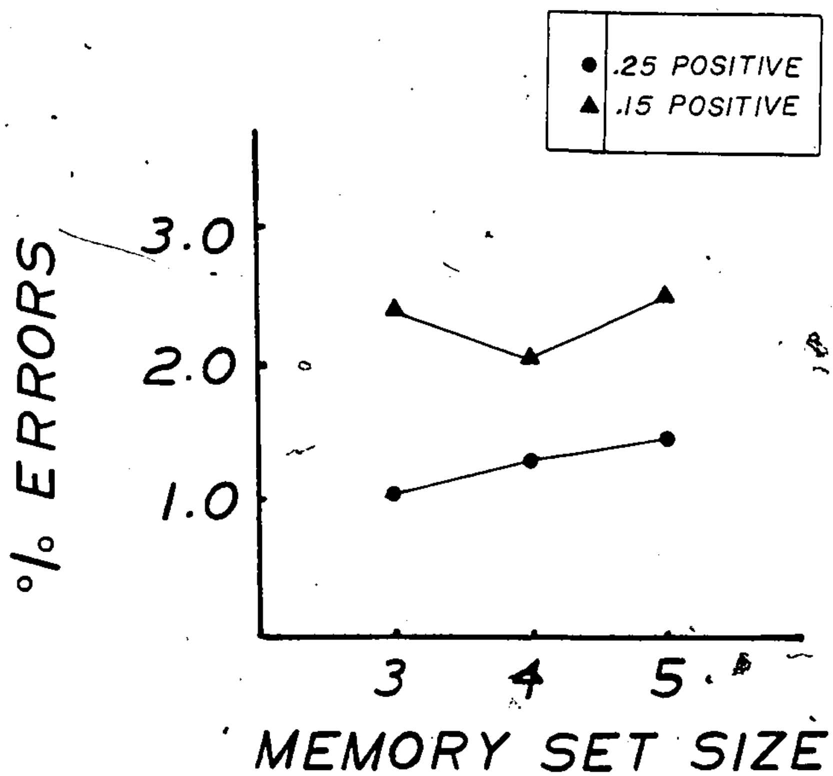
Analysis of Variance

performed on the intercepts obtained from the .15 and .25 positive linear item recognition functions

within variable: w(1): .15 vs .25 intercepts

Finding: w(1): F(1,11)=.296, p=.6027

Figure 66: Percent errors are plotted against positive set size as averaged over all six days and over all 12 subjects for .25 and .15 positive responses, separately.



Positive .25 and .15 Percent Errors

Table 59: Individual subjects' positive .25 and .15 mean percent errors are shown summarized over the six days of the experiment for each set size separately.

POSITIVE .25 % ERRORS

S#	s=3	s=4	s=5
1	0.00	0.67	1.33
2	0.67	0.00	0.00
3	3.33	3.33	1.33
4	3.33	2.67	2.00
5	0.00	0.00	2.00
6	0.00	0.67	2.00
7	1.33	4.00	0.67
8	0.67	0.67	1.33
9	0.67	1.33	1.33
10	0.00	0.00	0.00
11	2.00	2.00	2.00
12	0.67	0.00	3.33
x	1.06	1.28	1.44

POSITIVE .15 % ERRORS

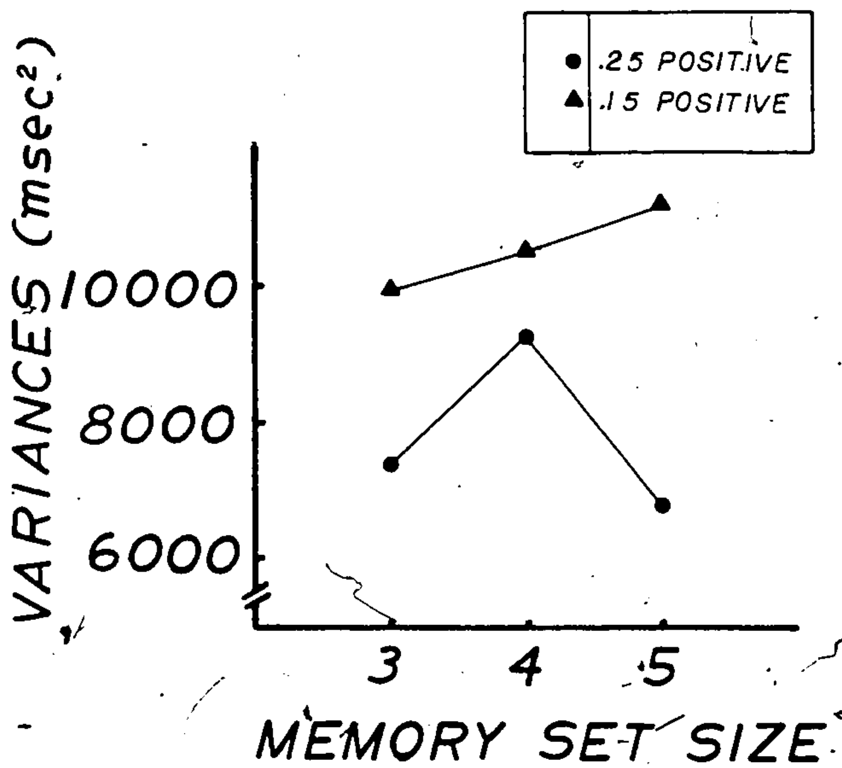
S#	s=3	s=4	s=5
1	2.22	0.00	0.00
2	1.00	5.56	1.00
3	5.56	3.33	3.33
4	5.56	3.33	7.78
5	2.22	3.33	4.44
6	2.22	0.00	1.00
7	2.22	1.11	0.00
8	0.00	0.00	1.11
9	4.44	2.22	3.33
10	2.22	1.11	2.22
11	1.11	2.22	3.33
12	0.00	2.22	2.22
x	2.40	2.04	2.48

Analysis of Variance

within variables: w(1): .25 vs .15 percent errors
w(2): set size

Findings: w(1): F(1,11)=7.543, p=.0182
w(2): F(2,22)=.388, p=.6877
w(1,2): F(2,22)=.339, p=.7203

Figure 67: Response variances for positive .25 and .15 trials are plotted against set size as averaged over all six days and over all 12 subjects.



Positive .25 and .15 Variances

Table 60: Individual subjects' response variances for positive .25 and .15 trials are shown summarized over the six days of the experiment for each set size separately.

POSITIVE .25 VARIANCES

S#	s=3	s=4	s=5
1	5873.77	7307.75	4770.79
2	6496.03	3707.61	3915.89
3	8288.39	12008.18	3614.09
4	10253.90	19801.30	7158.62
5	4095.13	3441.05	3029.88
6	8929.15	19067.45	5583.06
7	10310.34	7568.99	6292.59
8	3674.80	4327.39	5429.53
9	7202.35	7669.89	8876.87
10	7168.59	5637.55	3735.88
11	12379.70	14858.78	17974.75
12	4102.75	5719.68	10887.98
x	7397.91	9259.64	6772.50

POSITIVE .15 VARIANCES

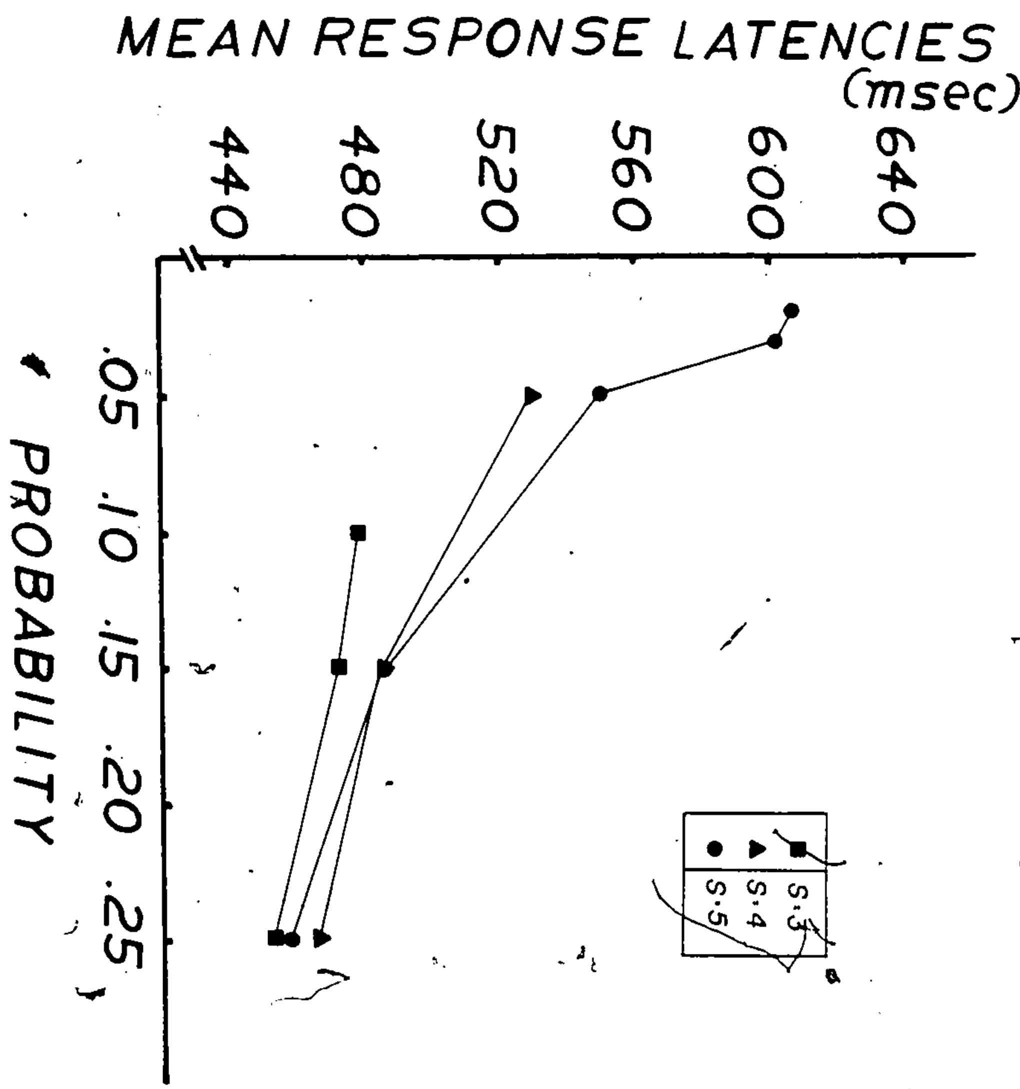
S#	s=3	s=4	s=5
1	5466.09	4572.91	7437.76
2	4893.23	5539.70	3554.10
3	6946.63	4469.87	4603.83
4	10445.04	8754.78	6025.64
5	4571.19	6030.33	5016.13
6	5682.53	10116.77	7616.67
7	8624.93	5382.24	17894.95
8	5389.49	8460.13	9613.91
9	11234.32	10879.71	23876.56
10	5880.94	6111.22	7531.95
11	31782.16	46158.55	25889.11
12	18516.62	9734.43	16040.36
x	9952.77	10517.56	11258.42

Analysis of Variance

within variables: w(1): .25 vs .15 positive variances
w(2): set size

Findings: w(1): F(1,11)=2.183, p=.1651
w(2): F(2,22)=.541, p=.5948
w(1,2): F(2,22)=.996, p=.6128

Figure 68: Mean response latencies of the individual positive items is plotted against probability for each set size separately as averaged over the six days of the experiment.


MEAN RESPONSE LATENCIES (msec)
440
480
520
560
600
640
PROBABILITY
.05
.10
.15
.20
.25
S:3
S:4
S:5

Mean RTs of Each Individual Positive Item

Table 61: Mean RTs of each individual positive item are shown summarized for each set size and for each subject separately as calculated over the six days of the experiment.

s=3

S#	.25	.15	.10
1	431.23	453.44	448.43
2	458.03	451.03	481.48
3	392.17	425.03	394.95
4	427.76	444.27	442.68
5	464.31	472.17	466.02
6	535.92	515.91	542.84
7	363.47	405.15	395.78
8	397.32	420.94	451.78
9	501.32	526.15	533.06
10	493.73	504.27	551.35
11	515.10	542.59	536.78
12	454.17	514.22	490.81
x	452.88	472.93	478.00

s=4

S#	.25	.15	.05*	.05	.05
1	450.65	427.38	505.99	493.57	518.41
2	477.54	503.68	534.46	544.52	524.39
3	418.88	405.34	444.02	467.73	420.30
4	439.50	444.77	436.10	410.30	461.90
5	458.34	504.25	515.16	505.10	525.22
6	542.03	564.38	576.19	584.21	568.17
7	399.25	379.55	473.37	474.57	472.16
8	420.76	455.50	472.07	450.39	493.75
9	503.99	565.09	603.06	610.81	595.30
10	485.61	497.25	568.77	594.13	543.40
11	526.65	557.19	633.55	648.66	618.44
12	477.41	521.56	583.62	530.38	636.86
x	466.72	485.50	528.87	526.20	531.53

* weighted average of the two .05 items

s=5

S#	.25	.15	.05	.03	.02
1	421.40	419.07	502.10	504.34	597.00
2	475.98	462.14	515.58	569.71	515.73
3	376.67	419.72	481.88	517.94	500.10
4	426.03	436.99	541.69	483.75	531.60
5	464.00	495.52	572.37	615.31	652.40
6	537.39	538.84	651.43	681.83	725.91
7	362.90	407.89	445.64	492.65	480.30
8	415.12	440.19	495.27	531.17	516.00
9	519.61	572.08	593.90	724.69	758.75
10	496.03	541.01	563.47	649.94	710.58
11	492.85	550.05	587.50	719.28	650.83
12	503.58	548.53	639.31	735.07	650.33
x	457.62	486.01	549.18	602.14	607.46

Analyses of Variance
performed on the mean RTs of each individual probability in each set size separately

s=3

within variable: w(1): P(.25) vs P(.15) vs P(.10)
Finding: w(1): $F(2,22)=9.430$, $p=.0014$

s=4

within variable: w(1): P(.25) vs P(.15) vs P(.05)*
Finding: w(1): $F(2,22)=24.820$, $p=.0001$

s=5

within variable: w(1): P(.25) vs P(.15) vs P(.05) vs P(.03) vs P(.02)
Finding: w(1): $F(4,44)=50.642$, $p=.0001$

* weighted mean of the two .05 items

APPENDIX 6

The assumptions of the familiarity model were also examined for the data reported in Experiment 2, where P was held constant at .25 and .15 for at least one positive item in each set size. To determine what, if any, shifts of the probability density functions along the familiarity continuum with repetition would be revealed, the slopes of the positive and of the negative item-recognition functions and percent misses and false alarms for initial presentations and for all subsequent tests of the positive and of the negative items were examined separately over all days and subjects. It was found that when probe items were presented for the first time, (1) the positive slope was 30.13 msec./item and the negative slope was 27 msec./item, and (2) subjects missed 6.6% of the positive probed trials and gave 1.4% false alarms. When the slopes and percent errors were examined for subsequent tests of the positive and the negative items, (1) a positive slope of 13 msec./item and a negative slope of 23.19 msec./item were found, and (2) the subjects missed 1.5% of the positive probed trials and gave 1.5% false alarms.

The findings of a substantially large and similar positive-negative slope value on first presentation and that the number of misses exceeded the number of false alarms, indicate that the distributions of the negative and positive probability functions (1) lie very close together, (2) are largely within the boundaries of the criteria, C_0 and C_1, and (3) are positioned more towards the criterion

C_0. The findings of (1) a significant decrease in the negative slope value, (2) a large decrease in the positive slope value (note, for 9 of the 12 subjects there was a substantial decrease in the positive slope value), (3) an equal proportion of misses and false alarms, and (4) a substantial decrease in percent misses on subsequent presentations suggest the positive and negative probability density functions (1) are further apart from one another, (2) that the positive density function is centered more around the criterion C_1, and (3) that there has been a shift of the negative density function more towards the criterion C_0. Thus for initial presentations of the test items, it appears the probability of an exhaustive search exceeds the probability of a fast response for both positive and negative probed trials. However, repetition of the positive and negative items seemed to have influenced the movement of their distributions. Here, it appears repetition of a positive or negative probe item makes it more likely for a fast response to occur than when a positive or negative item is first probed.

It should be noted, though, that the positive slope value was significantly lower than the negative slope value for subsequent presentations, indicating that repetition had a larger effect on the positive probed items. This, however, was not true of the positive and negative slopes for first presentation. Here, no significant difference was found between the slope values further confirming the notion that for first presentation, the positive and the negative probability density functions lie close together.

The finding of a consistent decrease in slope across subjects for the positive and negative probed trials also corresponds nicely with the response latency data: for both sets of items, separately, mean response latencies significantly decrease with subsequent presentation as would be expected if subjects are not as often exhaustively searching the memory list.

As in Experiment 3, a more striking effect of repeated presentations on mean RTs was found when the frequently occurring .25 positive item in each set size was examined separately. Here, the slope of the .25 positive response function for initial presentation (i.e. 33.84 msec./item) was much larger than the slope of the .25 positive response function on subsequent tests (i.e. 8.56 msec./item) and the number of misses on initial presentation (7.4%) exceeded the number of misses on subsequent trials (1.5%). Although the decrease in slope with repetition was not significant, this change was quite reliable for individual subjects. With the exception of two subjects, there was quite a dramatic decline in the .25 positive slope for subsequent presentation. The slope data also correspond nicely with the response latencies obtained for first and for subsequent presentation of the .25 probed items: a significant decrease in response latency was observed with repetition.

Because of the extreme variability of the data for first presentation, the findings for the frequently occurring .15 positive items for first presentation should be taken with a grain of salt. In contrast to the findings reported for the positive and for the .25 positive probe items described above and the findings reported for the positive and for the .25 positive items in Experiment 4, the slope of the .15 positive response function for initial presentation (i.e. -20.11 msec./item) was much smaller than the slope of the .15 positive response function on subsequent tests (i.e. 8.25 msec./item). This finding, though, was not significant. The data were, however, consistent with the positive data and the frequently probed positive data reported, in that (1) the .15 positive mean response latencies for subsequent presentation were significantly lower than the .15 positive mean response latencies for first presentation, and (2) the number of misses on initial presentation (4.17%) exceeded the number of misses on subsequent trials (1.25%). These latter two findings and the further finding of a nonsignificant slope difference between the .25 and .15 positive probed trials for first presentation and a non-significant slope difference between the .25 and .15 positive probed trials for subsequent presentations can be taken to imply that repetition of .15 positive probe items resulted in a shift in their probability density functions towards the criterion C_1. While it can be thought that the .15 items are probed frequently, the decrease in response latency for these items was not as great as the decrease in response latency observed for the positive .25 items. No difference in response latencies for first presentation was noted for these two sets of items. Thus, it appears repetition had a more significant effect on response latencies for the more frequently occurring .25 positive items.

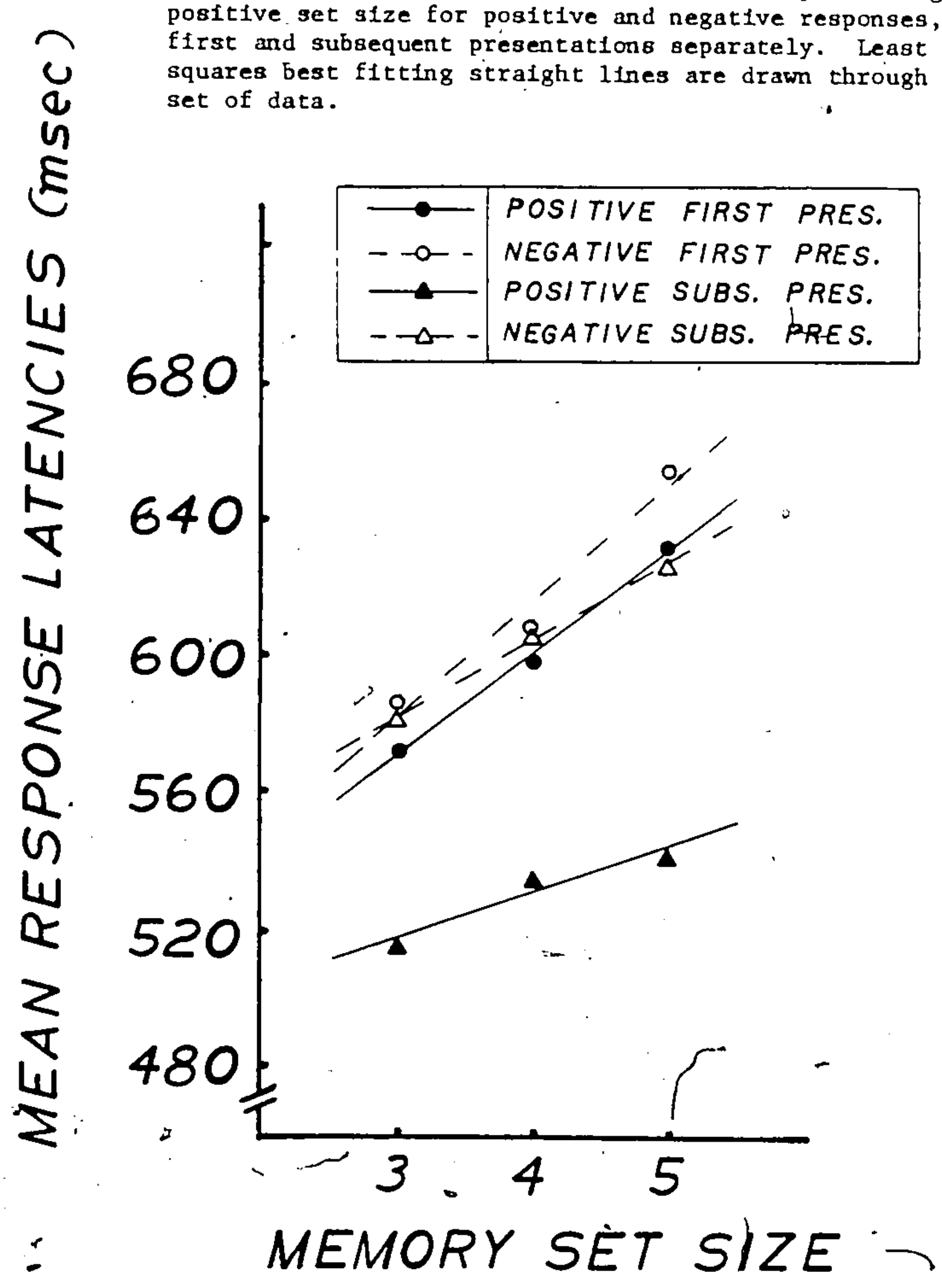
In terms of the familiarity model, the findings of Experiment 2 and also Experiment 3 suggest that frequent repetition of a positive probe item will result in shifts of the probability density function along the familiarity continuum (i.e. an increase in familiarity).

The findings also revealed that the .25 positive and the .15 positive probability density functions changed similarly with repetition, suggesting that both items can be considered as frequently occurring items. This, then, can account for the nonsignificant s by P interaction which was found.

In contrast to Experiment 2, in Experiment 3 a significant interaction between s and P was obtained where the probabilities .25 and .05 were held constant across each set size. For these items, the probability density functions did not seem to change similarly with repetition. Given the .25 positive items were probed many more times than the .05 positive items, it would be expected that the probability functions would not be influenced in the same way.

Included in Appendix 6 are summaries of the individual subjects' data for Experiment 2 and Experiment 3 and summaries of the various analyses of variance which were performed.

Figure 69: Mean response latencies averaged over all 12 subjects and over all six days of Experiment 2 are shown plotted against positive set size for positive and negative responses, for first and subsequent presentations separately. Least squares best fitting straight lines are drawn through each set of data.



Mean RTs for First and Subsequent Presentations

Table 62: Individual subjects' mean response latencies for first and for subsequent presentations of positive and negative items are shown summarized over the six days of Experiment 2 for each set size separately.

POSITIVE ITEMS

S#	1st Presentation s=3	1st Presentation s=4	1st Presentation s=5	Subsequent Presentation s=3	Subsequent Presentation s=4	Subsequent Presentation s=5
1	426.39	533.27	494.04	401.78	413.36	439.90
2	497.11	517.96	584.23	456.38	471.27	478.54
3	539.67	580.52	634.11	539.85	575.20	572.49
4	734.83	709.00	848.14	581.73	600.65	624.92
5	657.00	626.29	792.34	553.00	581.89	598.58
6	525.94	586.75	638.46	488.18	484.77	499.34
7	470.82	526.00	516.62	436.22	451.82	474.60
8	785.06	854.09	801.19	694.62	716.55	722.93
9	477.67	536.52	572.87	438.81	467.90	462.[illegible]4
10	716.83	635.58	617.43	603.58	603.39	617.05
11	494.06	561.44	564.48	488.19	523.76	493.57
12	550.82	522.17	535.29	486.02	517.79	510.31
x	573.02	599.13	633.27	514.03	534.03	541.23

NEGATIVE ITEMS

S#	1st Presentation s=3	1st Presentation s=4	1st Presentation s=5	Subsequent Presentation s=3	Subsequent Presentation s=4	Subsequent Presentation s=5
1	493.01	514.75	560.17	492.17	504.40	534.34
2	547.46	535.38	590.65	522.82	543.45	554.58
3	614.27	640.23	695.25	604.89	646.13	669.06
4	704.05	696.78	795.08	663.25	696.26	772.92
5	609.30	626.70	706.26	603.58	623.61	660.47
6	592.55	607.38	664.43	577.31	603.87	629.54
7	499.10	523.24	566.23	494.52	508.12	519.78
8	700.13	739.43	805.94	720.74	723.94	774.91
9	524.52	555.12	611.06	515.35	545.81	557.53
10	684.45	699.98	672.41	662.15	677.64	689.36
11	513.63	573.67	596.18	548.64	607.99	570.35
12	551.05	596.03	595.69	563.94	591.56	593.17
x	586.13	609.06	654.95	580.78	606.07	627.17

Analysis of Variance

performed on positive mean response latencies for first presentation and subsequent presentations

within variables: w(1): first presentation vs subsequent presentation
w(2): set size

Findings: w(1): $F(1,11)=39.107$, $p=.0002$
w(2): $F(2,22)=10.111$, $p=.0010$
w(1,2): $F(2,22)=1.957$, $p=.1636$

Analysis of Variance

performed on negative mean response latencies for first presentation and subsequent presentations

within variables: w(1): first presentation vs subsequent presentation
w(2): set size

Findings: w(1): $F(1,11)=14.217$, $p=.0033$
w(2): $F(2,22)=37.785$, $p=.0001$
w(1,2): $F(2,22)=6.855$, $p=.0051$

Slopes for First and Subsequent Presentations

Table 63: Individual subjects' slopes for first presentation and subsequent presentations of positive and negative items are shown summarized over the six days of Experiment 2.

POSITIVE SLOPES

S#	1st Presentation	Subsequent Presentation
1	33.83	19.06
2	43.56	11.08
3	47.22	16.32
4	56.66	21.60
5	67.67	22.79
6	56.26	5.58
7	22.90	19.19*
8	8.07	14.16*
9	47.60	11.87*
10	-49.70	6.74*
11	35.21	2.69*
12	-7.77	12.15*
x	30.13	13.60

NEGATIVE SLOPES

S#	1st Presentation	Subsequent Presentation
1	33.58	21.09
2	21.60	15.88
3	40.49	32.09
4	45.52	54.84
5	48.48	28.45
6	35.94	26.12
7	33.57	12.63
8	52.91	27.09
9	43.27	21.09
10	-6.02	13.61
11	41.28	10.86
12	22.32	14.62
x	34.41	23.19

* data trend is opposite that predicted by the familiarity model

Analysis of Variance

performed on positive slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentations

Finding: w(1): $F(1,11)=3.358$, $p=.0913$

Analysis of Variance

performed on negative slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentations

Finding: w(1): $F(1,11)=7.212$, $p=.0203$

Analysis of Variance

performed on the positive and negative slopes for first presentations only

within variable: w(1): positive vs negative

Finding: w(1): $F(1,11)=.391$, $p=.5505$

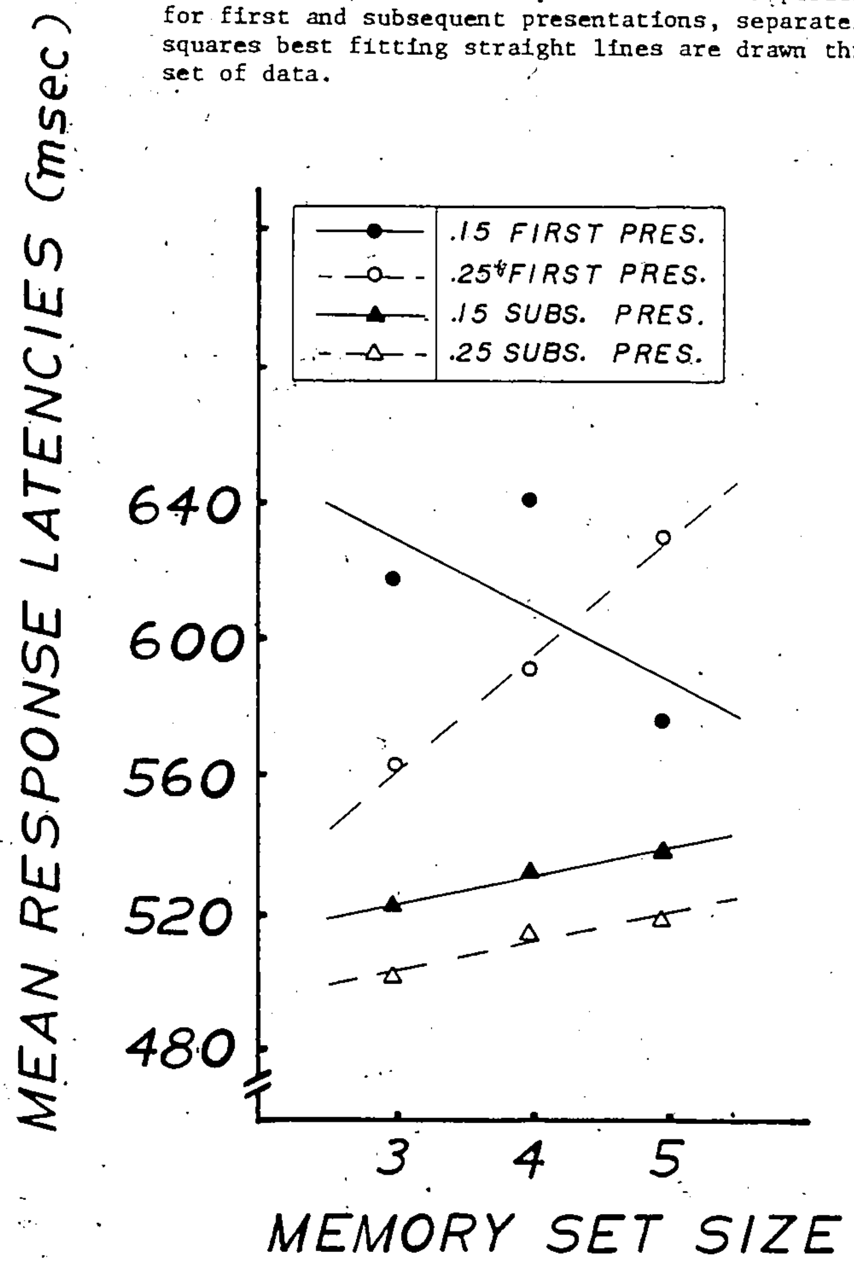
Analysis of Variance

performed on the positive and negative slopes for subsequent presentations only

within variable: w(1): positive vs negative

Finding: w(1): $F(1,11)=10.612$, $p=.0076$

Figure 70: Mean response latencies averaged over all 12 subjects and over all six days of Experiment 2 are shown plotted against positive set size for .25 positive and .15 positive responses for first and subsequent presentations, separately. Least squares best fitting straight lines are drawn through each set of data.



.25 and .15 Positive Mean RTs for 1st and Subsequent Presentations

Table 64: Individual subjects' .25 positive mean response latencies and .15 positive mean response latencies for first and for subsequent presentations are shown summarized over the six days of Experiment 2 for each set size separately.

.25 RESPONSES

	1st Presentation			Subsequent Presentation		
S#	s=3	s=4	s=5	s=3	s=4	s=5
1	478.67	466.33	588.33	400.14	395.51	421.80
2	454.50	523.67	508.80	441.22	456.13	451.71
3	557.33	559.17	626.17	513.47	535.92	543.61
4	645.50	780.83	1015.00	551.85	558.66	591.29
5	772.50	618.67	532.40	541.12	564.30	576.80
6	506.83	550.40	590.60	477.17	473.56	479.03
7	519.80	449.60	565.50	437.45	445.25	457.07
8	663.40	876.67	821.17	691.61	707.77	689.47
9	433.67	514.83	545.33	428.52	452.22	444.12
10	793.50	604.50	546.67	589.12	594.63	605.94
11	444.00	642.00	663.80	468.06	490.50	470.65
12	486.40	517.50	564.40	474.10	490.08	487.66
x	563.01	592.01	630.68	501.15	513.71	518.26

.15 RESPONSES

S#	s=3	s=4	s=5	s=3	s=4	s=5
1	415.50	572.20	452.83	393.46	408.68	448.19
2	556.17	550.67	444.33	470.38	476.49	484.35
3	571.83	687.20	532.00	572.55	580.38	566.05
4	857.33	785.50	665.17	610.20	607.07	618.45
5	587.67	627.50	891.33	562.59	580.45	595.10
6	592.40	586.33	602.17	501.96	475.49	491.36
7	481.67	566.33	492.17	427.68	444.50	475.19
8	997.83	1017.50	760.60	683.66	712.21	713.42
9	542.17	610.00	558.00	446.36	468.79	453.32
10	737.00	637.00	558.00	614.33	592.62	620.02
11	500.33	528.00	447.00	494.71	515.74	485.71
12	571.17	537.20	524.83	489.04	535.71	513.79
x	617.59	642.12	577.37	522.24	533.18	538.75

Analysis of Variance

performed on .25 positive mean response latencies for first presentation and subsequent presentation

within variables: w(1): 1st presentation vs subsequent presentation
w(2): set size

Findings: w(1): $F(1,11)=27.203$, $p=.0005$
w(2): $F(2,22)=2.351$, $p=.1172$
w(1,2): $F(2,22)=.926$, $p=.5863$

Analysis of Variance

performed on .15 positive mean response latencies for first presentation and subsequent presentation

within variables: w(1): 1st presentation vs subsequent presentation
w(2): set size

Findings: w(1): $F(1,11)=18.429$, $p=.0016$
w(2): $F(2,22)=1.403$, $p=.2663$
w(1,2): $F(2,22)=2.549$, $p=.0995$

Analysis of Variance

performed on .25 positive and .15 positive mean response latencies for first presentation only

within variables: w(1): .25 mean RTs vs .15 mean RTs
w(2): set size

Findings: w(1): $F(1,11)=.993$, $p=.6579$
w(2): $F(2,22)=.793$, $p=.5311$
w(1,2): $F(2,22)=2.187$, $p=.1345$

Analysis of Variance

performed on .25 positive and .15 positive mean response latencies for subsequent presentations only

within variables: w(1): .25 mean RTs vs .15 mean RTs
w(2): set size

Findings: w(1): $F(1,11)=28.438$, $p=.0004$
w(2): $F(2,22)=7.880$, $p=.0029$

.25 and .15 Slopes for 1st and Subsequent Presentation

Table 65: Individual subjects' .25 positive and .15 positive slopes for first presentation and for subsequent presentation of these target items are shown summarized over the six days of Experiment 2.

.25 SLOPES

S#	1st Presentation	Subsequent Presentation
1	54.83	10.83
2	27.15	5.25
3	34.42	15.07
4	184.75	19.72*
5	-120.05	17.84
6	41.89	0.93
7	22.85	9.81
8	78.89	-1.07
9	55.83	7.80*
10	-123.42	8.41
11	109.90	1.30
12	39.00	6.78
x	33.84	8.56

.15 SLOPES

S#	1st Presentation	Subsequent Presentation
1	18.67	27.37
2	-55.92	6.99
3	-19.92	-3.20
4	-96.08	4.13
5	151.83	16.26
6	4.89	-5.30
7	5.25	23.76
8	-118.62	14.88
9	7.92	3.48
10	-89.50	2.85
11	-26.67	-4.50
12	-23.17	12.38
x	-20.11	8.25

* data trend is opposite that predicted by the familiarity model

Analysis of Variance

performed on .25 positive slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentations

Finding: w(1): $F(1,11)=1.027$, $p=.3342$

Analysis of Variance

performed on the .15 positive slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentations

Finding: w(1): $F(1,11)=2.057$, $p=.1770$

Analysis of Variance

performed on .25 and .15 positive slopes for first presentation only

within variable: w(1): .25 slopes vs .15 slopes

Finding: w(1): $F(1,11)=1.963$, $p=.1866$

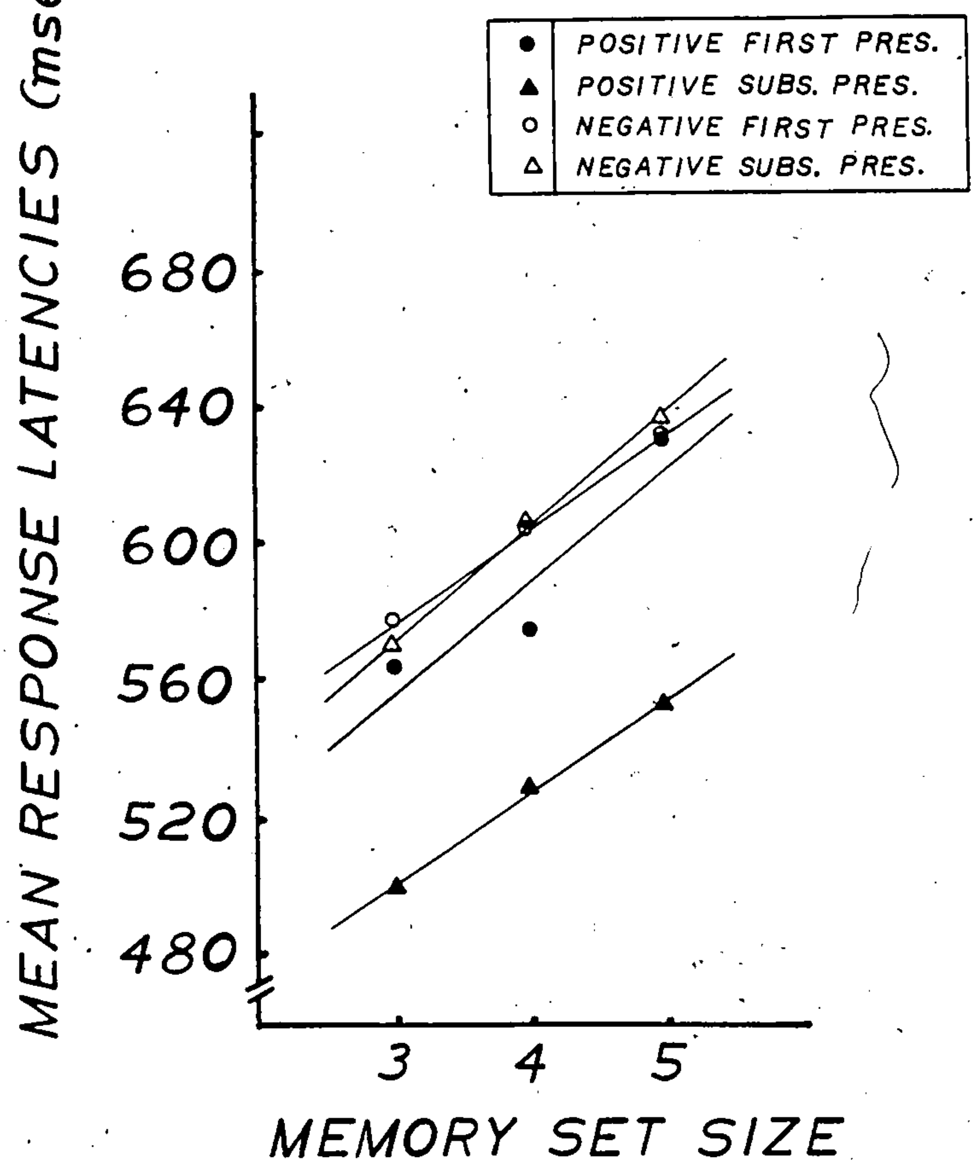
Analysis of Variance

performed on .25 and .15 positive slopes for subsequent presentations only

within variable: w(1): .25 slopes vs .15 slopes

Finding: w(1): $F(1,11)=.008$, $p=.9277$

Figure 71: Mean response latencies for first and subsequent presentations of positive and negative items are plotted against positive set size. Least squares best fitting straight lines are drawn through each set of data in Experiment 3.



Mean RTs for First and Subsequent Presentations

Table 66: Individual subjects' mean response latencies for first and for subsequent presentations of positive and negative items are shown summarized over the six days of Experiment 3 for each set size separately.

POSITIVE ITEMS

	1st Presentation			Subsequent Presentation		
S#	s=3	s=4	s=5	s=3	s=4	s=5
1	654.93	676.15	632.62	546.86	556.82	574.27
2	441.43	444.14	486.76	413.06	434.23	450.30
3	706.00	691.00	717.39	685.53	764.42	739.46
4	591.41	602.10	640.04	509.72	534.88	554.03
5	453.00	458.45	524.56	424.58	446.77	481.79
6	585.56	637.67	748.76	516.71	528.12	567.60
7	461.73	458.32	532.64	425.40	444.95	451.54
8	511.87	466.82	573.48	438.63	451.58	480.66
9	533.12	541.09	615.89	477.57	537.24	539.98
10	581.29	598.45	742.37	501.52	511.51	599.63
11	506.67	506.52	555.68	449.76	458.09	488.60
12	746.73	818.16	796.39	614.66	683.95	713.67
x	564.48	574.91	630.55	500.33	529.38	553.46

NEGATIVE ITEMS

S#	1st s=3	1st s=4	1st s=5	Subsequent s=3	Subsequent s=4	Subsequent s=5
1	561.04	579.94	628.77	564.13	573.03	598.19
2	470.22	494.05	518.10	467.32	484.57	526.41
3	665.58	750.00	691.33	743.09	855.15	851.07
4	608.86	700.49	618.10	596.84	583.77	626.20
5	495.64	513.47	544.69	482.75	497.69	543.91
6	639.41	635.55	688.30	586.77	611.92	632.73
7	478.23	480.97	518.15	484.97	505.99	530.93
8	533.91	520.03	575.88	524.71	538.38	587.51
9	579.25	680.45	712.89	579.60	655.28	665.36
10	635.33	613.46	720.13	615.16	638.99	702.45
11	540.63	548.54	592.81	514.32	523.47	555.32
12	728.45	734.73	780.04	695.94	813.47	829.13
x	578.05	604.31	632.43	571.30	606.81	637.43

Analysis of Variance

performed on positive mean response latencies for first presentation and subsequent presentations

within variables: w(1): first presentation vs subsequent presentation
w(2): set size

Findings: w(1): $F(1,11)=25.411$, $p=.0006$
w(2): $F(2,22)=23.439$, $p=.0001$
w(1,2): $F(2,22)=3.215$, $p=.0583$

Analysis of Variance

performed on negative mean response latencies for first presentation and subsequent presentations

within variables: w(1): first presentation vs subsequent presentation
w(2): set size

Findings: w(1): $F(1,11)= 0.00$, $p=1.00$
w(2): $F(2,22)=24.401$, $p=.0001$
w(1,2): $F(2,22)=.443$, $p=.6530$

Slopes for First and Subsequent Presentations

Table 67: Individual subjects' slopes for first presentation and subsequent presentations of positive and negative items are shown summarized over the six days of Experiment 3.

POSITIVE SLOPES

S#	1st Presentation	Subsequent Presentation
1	-11.15	13.71*
2	22.67	18.62
3	5.70	26.97*
4	24.32	22.16
5	35.79	28.61
6	81.61	25.45
7	35.46	13.07
8	30.81	21.02
9	41.39	31.21
10	80.55	49.06
11	24.51	19.42
12	24.84	49.51*
x̄	33.04	26.57

NEGATIVE SLOPES

S#	1st Presentation	Subsequent Presentation
1	33.87	17.03
2	23.94	29.55
3	12.88	53.99
4	4.62	14.68
5	24.53	30.58
6	24.45	22.98
7	19.96	22.98
8	20.99	31.40
9	66.82	42.88
10	42.40	43.65
11	26.09	20.50
12	25.80	66.60
x̄	27.20	33.07

* data trend is opposite that predicted by the familiarity model

Analysis of Variance

performed on positive slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentation

Finding: w(1); F(1,11)=.904, p=.6354

Analysis of Variance

performed on negative slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentations

Finding: w(1): F(1,11)=1.105, p=.3167

Analysis of Variance

performed on the positive and negative slopes for first presentations only

within variable: w(1): positive vs negative

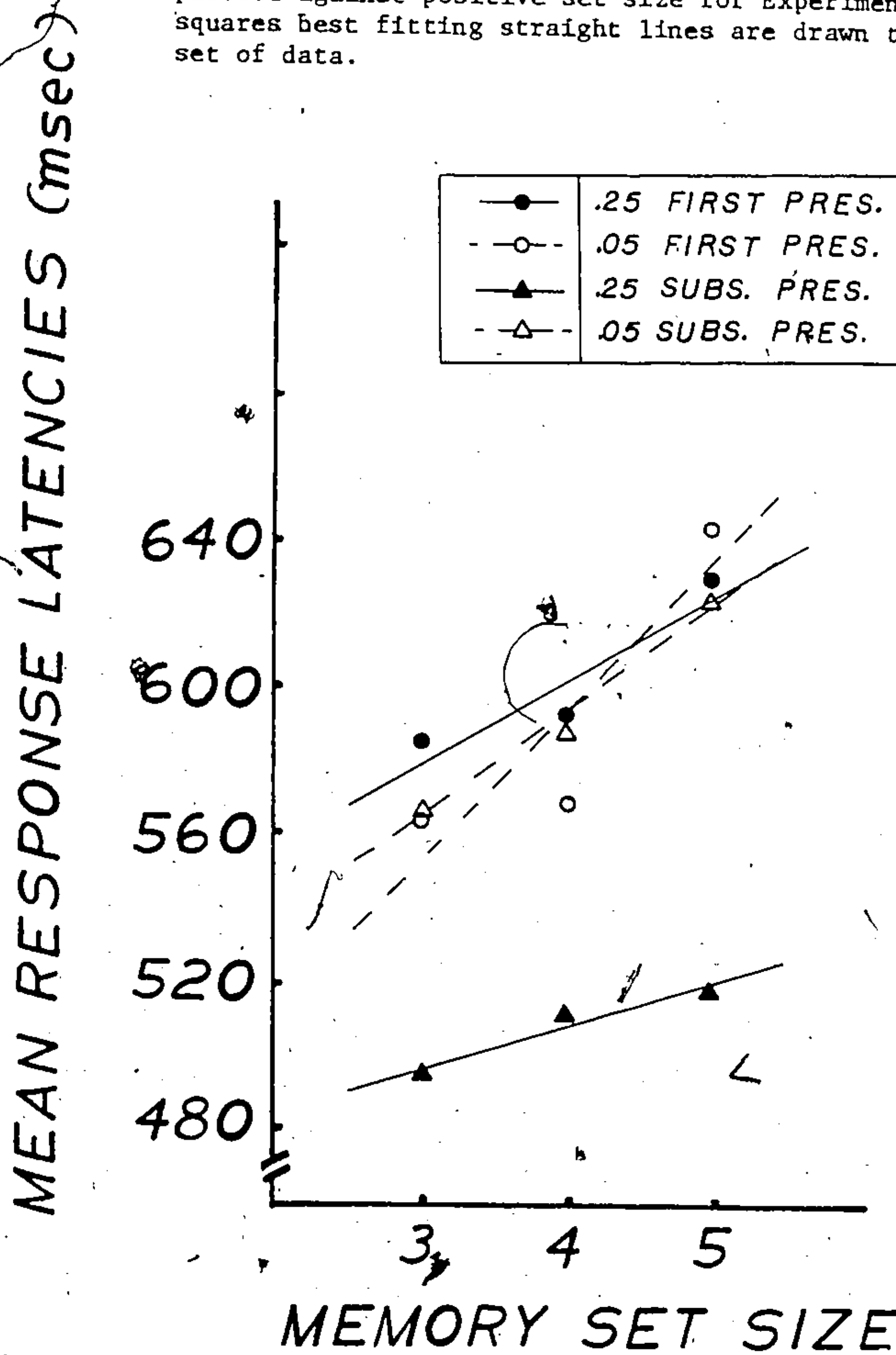
Finding: w(1): F(1,11)=.571, p=.5287

Analysis of Variance

performed on the positive and negative slopes for subsequent presentations only

within variable: w(1): F(1,11)=5.146, p=.0425

Figure 72: Mean response latencies for first and subsequent presentation of .25 positive and .05 positive items are plotted against positive set size for Experiment 3. Least squares best fitting straight lines are drawn through each set of data.



.25 and .05 Positive Mean RTs for 1st and Subsequent Presentations

Table 68: Individual subjects' .25 positive mean response latencies and .05 positive mean response latencies for first and for subsequent presentations are shown summarized over the six days of Experiment 3 for each set size separately.

.25 RESPONSES

	1st Presentation			Subsequent Presentation		
S#	s=3	s=4	s=5	s=3	s=4	s=5
1	801.00	849.00	648.60	544.72	540.16	549.78
2	457.25	448.40	538.67	417.22	432.06	409.70
3	661.83	638.80	782.80	661.56	721.14	693.72
4	673.60	456.40	611.67	508.77	511.51	525.31
5	431.80	473.60	500.33	416.41	420.56	451.44
6	626.83	578.67	945.67	508.69	503.26	542.18
7	479.00	487.40	450.20	426.36	437.30	421.96
8	508.00	412.00	500.40	432.55	433.84	440.65
9	429.17	457.00	690.50	475.06	517.87	502.25
10	560.83	641.00	712.00	493.67	492.09	535.32
11	470.33	569.83	550.50	442.90	441.23	455.60
12	914.40	1092.40	633.20	594.66	679.06	676.52
x	584.50	592.04	630.38	493.55	510.84	517.04

.05 RESPONSES

S#	s=3	s=4	s=5	s=3	s=4	s=5
1	549.60	635.10	647.46	590.58	597.63	632.16
2	421.00	448.58	478.00	460.65	463.99	518.14
3	721.00	744.78	734.71	752.50	893.03	863.41
4	604.67	631.44	665.20	600.00	623.77	620.51
5	414.00	423.33	538.44	459.23	482.89	511.46
6	536.67	695.42	743.59	536.74	609.62	627.27
7	395.40	455.82	549.55	484.95	476.51	497.79
8	528.50	513.40	587.14	483.88	505.96	548.73
9	621.00	575.91	604.89	608.83	575.68	608.51
10	718.00	566.00	754.56	647.42	587.42	720.28
11	552.83	463.00	534.69	471.71	524.25	550.54
12	689.00	651.75	874.29	709.60	711.98	776.92
x	562.64	567.04	642.71	567.17	587.73	622.98

Analysis of Variance

performed on .25 positive mean response latencies for first presentation and subsequent presentation

within variables: w(1): 1st presentation vs subsequent presentation
w(2): set size

Findings: w(1): F(1,11)=16.934, p=.002
w(2): F(2,22)=1.021, p=.3784
w(1,2): F(2,22)=.238, p=.7929

Analysis of Variance

performed on .05 positive mean response latencies for first presentation and subsequent presentation

within variables: w(1): 1st presentation vs subsequent presentation
w(2): set size

Findings: w(1): F(1,11)=.024, p=.873
w(2): F(2,22)=12.416, p=.0004
w(1,2): F(2,22)=2.044, p=.1519

Analysis of Variance

performed on the .25 positive mean response latencies for first presentation and on the .05 positive mean response latencies for first presentation and for subsequent presentations

within variables: w(1): .25 1st presentation vs .05 1st presentation vs .05 subsequent presentation
w(2) set size

Findings: w(1): F(2,22)=.175, p=.8413
w(2): F(2,22)=8.782, p=.0019
w(1,2): F(4,44)=.268, p=.8964

Analysis of Variance

performed on the .25 and .05 positive mean response latencies for subsequent presentations only

within variables: w(1): .25 mean RTs vs .05 mean RTs
w(2): set size

```
Findings:  w(1):   F(1,11)=90.41, p=.0001
           w(2):   F(2,22)=12.52, p=.0004
         w(1,2):   F(2,22)=4.12, p=.0295
```

.25 and .05 Slopes for 1st and Subsequent Presentations

Table 69: Individual subjects' .25 positive and .05 positive slopes for first presentation and for subsequent presentation of these target items are shown summarized over the six days of Experiment 3.

.25 SLOPES

S#	1st Presentation	Subsequent Presentation
1	-76.20	2.53*
2	40.71	-3.76
3	60.49	16.08
4	-30.97	8.27*
5	34.27	17.52
6	159.42	16.75
7	-14.40	-2.20*
8	-3.80	4.05*
9	130.67	13.60
10	75.59	20.83
11	40.09	6.35
12	-140.60	40.93*
x	22.94	11.75

.05 SLOPES

S#	1st Presentation	Subsequent Presentation
1	48.93	20.79
2	28.50	28.75
3	6.86	55.46
4	30.27	10.26
5	62.22	26.12
6	103.46	45.27
7	77.08	6.42
8	29.32	32.43
9	-8.06	-0.16
10	18.28	36.43
11	-9.27	39.42
12	92.65	33.66
x	40.04	27.90

* data trend is opposite that predicted by the familiarity model

Analysis of Variance

performed on .25 positive slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentations

Finding: w(1): $F(1,11)=.202$, $p=.6647$

Analysis of Variance

performed on .05 positive slopes for first presentation and subsequent presentations

within variable: w(1): 1st presentation vs subsequent presentations

Finding: w(1): $F(1,11)=1.098$, $p=.3183$

Analysis of Variance

performed on .25 positive slopes for 1st presentation and on .05 positive slopes for 1st presentation and subsequent presentations

within variable: w(1): .25 1st presentation vs .05 1st presentation vs .05 subsequent presentations

Finding: w(1): $F(2,22)=0.3$, $p=.7475$

Analysis of Variance

performed on .25 and .05 positive slopes for subsequent presentations only

within variable: w(1): .25 slopes vs .05 slopes

Finding: w(1): $F(1,11)=10.913$, $p=.0070$

APPENDIX 7

Appendix 7 provides a summary of the slopes and mean response latencies obtained for the lag lengths of 0-4, 5-9, 10-19, 20-29, and 30 or more for Experiment 2 and Experiment 3. A detailed analysis of the data is also shown.

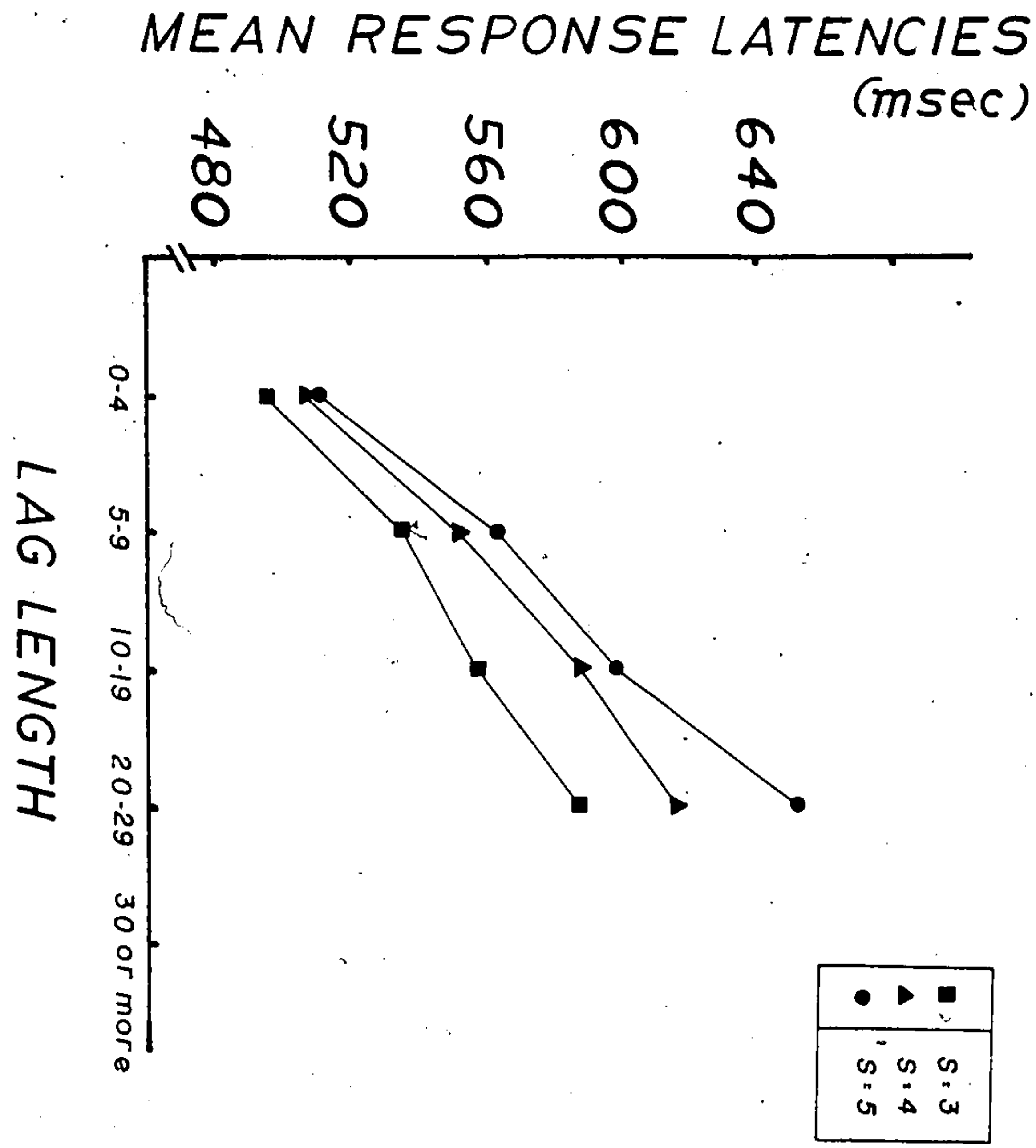
Particular attention should also be given to the tables summarizing the average number of trials which contributed to each lag interval for each subject and for each set size, separately, on each day. It should be noted that for some probed items, few trials contributed to the calculation of slope and response latency for various lag length intervals. Here, the data were much more variable than the data examined at intervals where a large number of trials contributed to the calculations.

The Average Number of Trials for Each Lag Interval

Table 70: The average number of trials contributing to each lag interval each day for each subject is shown for positive items in each set size in Experiment 2 and Experiment 3.

	memory set size	LAG INTERVAL 0-4	5-9	10-19	20-29	30 or more
positive	3	48	17	10	2-3	
	4	47	15	10	3-4	
	5	46	13	8	3-4	
.25 positive	3,4,5	30	7	1-2	.25	
.15 positive (Experiment 2)	3,4,5	14	5	4	1	
.05 positive (Experiment 3)	3,4,5	.67	1	2	2	1-1.33

Figure 73: Positive mean response latencies for uncontrolled lag length items as averaged over 12 subjects and six days of Experiment 2, are shown plotted against lag length for each set size separately.


MEAN RESPONSE LATENCIES (msec)
480
520
560
600
640
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S:3
S:4
S:5

Mean RTs for Each Lag Interval

Table 71: Individual subjects' mean response latencies for positive trials are shown summarized over the six days of Experiment 2 for each set size separately, for each lag interval.

s=3

S#	0-4	5-9	10-19	20-29
1	397.09	411.14	401.56	455.88
2	436.54	490.16	490.57	484.88
3	506.67	583.18	606.06	614.38
4	559.36	608.20	615.91	686.70
5	530.82	582.89	597.04	684.25
6	463.71	509.49	558.91	583.25
7	433.18	442.27	430.49	480.33
8	676.91	713.88	729.46	769.00
9	430.38	440.77	529.33	517.42
10	582.86	630.65	643.08	651.85
11	466.38	510.45	544.58	592.78
12	467.61	501.08	544.79	532.75
x	495.96	535.35	557.65	587.79

s=4

S#	0-4	5-9	10-19	20-29
1	393.08	416.00	444.45	565.44
2	447.16	500.78	514.65	521.15
3	543.04	566.55	663.14	726.10
4	550.27	648.71	721.08	644.17
5	559.73	594.66	648.57	627.20
6	462.05	500.62	538.78	513.93
7	436.77	456.99	468.00	498.59
8	695.44	747.59	736.97	726.22
9	451.57	480.51	550.30	663.85
10	579.84	624.29	657.12	660.55
11	491.63	544.32	576.49	695.63
12	490.40	550.11	551.02	570.82
x	508.42	552.59	589.21	617.80

s=5

S#	0-4	5-9	10-19	20-29
1	418.28	452.97	478.80	522.27
2	448.40	489.95	546.08	537.67
3	536.69	596.20	602.71	631.50
4	588.31	616.77	709.31	775.84
5	564.63	620.07	652.43	677.50
6	464.40	527.03	564.75	604.17
7	455.16	489.45	493.38	548.13
8	692.21	730.78	763.66	857.50
9	435.73	574.09	636.79	798.86
10	591.75	627.48	659.32	688.53
11	461.77	513.30	549.85	635.24
12	489.17	526.42	532.39	542.44
x	512.21	563.71	599.12	651.64

Analyses of Variance
performed on the positive mean response latencies for each lag interval in each set size

s=3
within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): $F(3,33)=38.602$, $p=.0001$

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): $F(3,33)=19.625$, $p=.0001$

s=5
within variable: lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): $F(3,33)=31.952$, $p=.0001$

Positive Slopes for Each Lag Interval

Table 72: Individual subjects' positive slopes for each lag interval are shown summarized over the six days of Experiment 2.

POSITIVE SLOPES

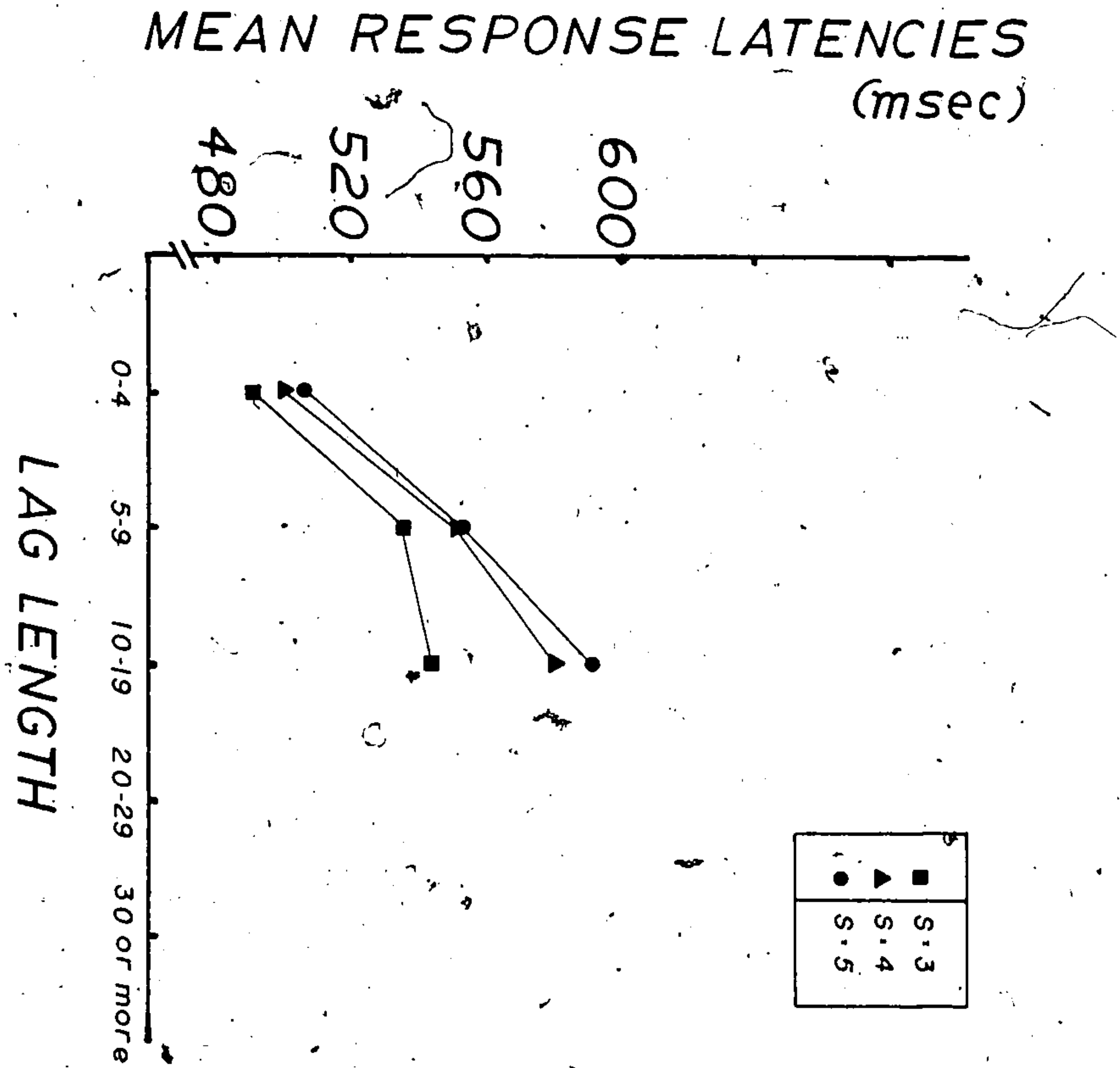
S#	0-4	5-9	10-19	20-29
1	10.60	20.92	38.62	33.20
2	5.93	-0.11	27.76	26.40
3	15.01	6.51	-1.68	8.65*
4	14.48	4.29	46.70	44.57
5	16.91	18.59	27.70	-3.38*
6	0.35	8.77	2.92	10.46
7	10.99	23.59	31.45	33.90
8	7.65	8.45	17.10	44.25
9	2.68	66.66	53.73	140.72
10	4.45	-1.59	8.12	18.34
11	-2.31	1.43	2.64	21.23
12	10.78	12.67	-6.20	4.85*
x	8.12	14.18	20.74	31.92

Analysis of Variance
performed on the positive slopes for each lag interval

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): $F(3,33)=3.691$, $p=.0211$

* data trend is opposite that predicted by the familiarity model

Figure 74: Mean response latencies for .25 positive items, averaged over the six days of Experiment 2 are shown plotted as a function of the lag lengths 0-4, 5-9 and 10-19 for each set size separately.


MEAN RESPONSE LATENCIES
(msec)
600
560
520
480
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S-3
S-4
S-5

.25 Mean RTs for Each Lag Interval

Table 73: Individual subjects' .25 positive mean response latencies are shown summarized over the six days of Experiment 2 for each set size separately, for each lag interval.

s=3

S#	0-4	5-9	10-19	20-29
1	396.46	422.07	378.55	
2	429.57	484.11	447.71	
3	490.93	570.48	611.62	
4	542.69	578.10	607.27	
5	529.73	595.43	565.25	445.00
6	464.98	517.83	556.60	558.00
7	433.99	447.02	455.13	412.00
8	678.67	759.32	656.86	
9	426.94	426.93	576.91	
10	574.42	644.45	599.22	642.50
11	458.97	483.53	542.00	
12	462.02	508.87	540.31	396.00
x	490.78	536.51	544.79	

s=4

S#	0-4	5-9	10-19	20-29
1	386.69	418.92	438.37	390.00
2	440.75	507.60	549.43	
3	527.58	563.70	567.78	
4	529.43	649.00	774.44	385.00
5	553.65	594.24	632.75	
6	462.20	511.00	519.38	
7	439.59	464.12	485.55	414.00
8	695.82	756.66	718.15	
9	443.62	485.04	443.14	595.00
10	574.75	636.64	761.50	760.00
11	477.61	546.06	514.91	
12	480.34	509.76	577.09	
x	501.00	553.56	581.87	

s=5

S#	0-4	5-9	10-19	20-29
1	412.37	451.10	474.67	
2	441.18	473.80	522.42	
3	522.98	607.78	612.09	535.00
4	583.44	572.88	695.14	888.00
5	557.89	612.34	770.88	
6	466.43	519.67	557.15	546.00
7	448.41	487.91	501.33	
8	683.59	707.47	703.31	866.00
9	435.09	544.70	587.36	738.00
10	589.78	644.69	709.00	
11	460.37	517.52	451.30	380.00
12	481.27	508.33	529.67	468.00
x	506.90	554.02	592.86	

Analyses of Variance
performed on the positive .25 mean response latencies for each lag interval in each set size

s=3

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)=7.832$, $p=.0030$

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)=13.693$, $p=.0003$

s=5

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)=17.001$, $p=.0001$

.25 Positive Slopes for Each Lag Interval

Table 74: Individual subjects' .25 positive slopes for each lag interval are shown summarized over the six days of Experiment 2.

.25 POSITIVE SLOPES

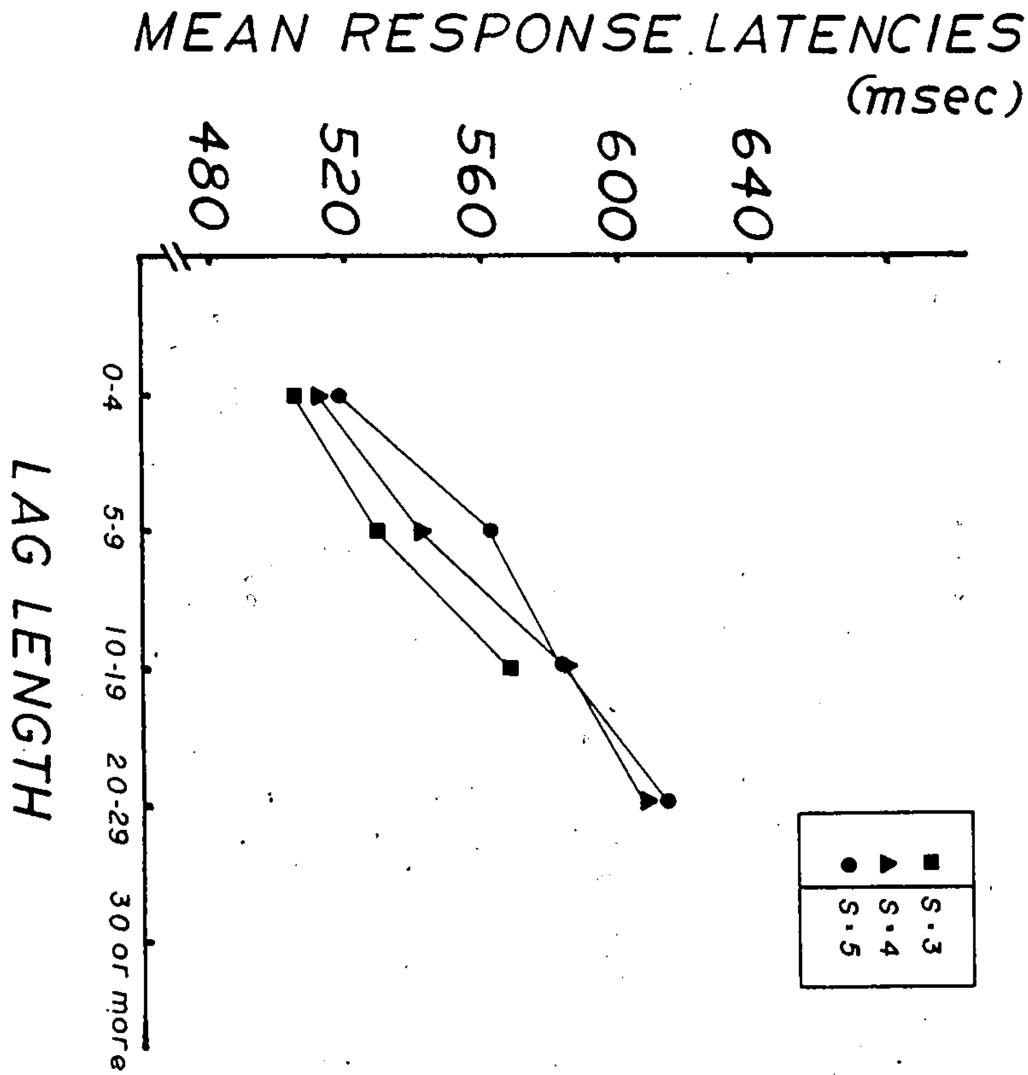
S#	0–9	10–19
1	9.23	48.06
2	3.42	37.36
3	16.30	0.24*
4	16.34	43.94
5	14.85	102.82
6	−0.20	0.28
7	8.87	23.10
8	−3.01	23.23
9	12.53	5.23*
10	6.31	54.89
11	4.40	−45.35*
12	8.08	−5.32*
x	8.09	24.04

Analysis of Variance
performed on the positive .25 slopes for each lag interval

within variable: w(1): lag intervals 0-9 vs 10 -19

Finding: w(1): $F(1,11)=2.343$, $p=.1515$

Figure 75: Mean response latencies for .15 positive items, averaged over the six days of Experiment 2 are shown plotted as a function of the lag lengths 0-4, 5-9, 10-19 and 20-29 for each set size separately.


MEAN RESPONSE LATENCIES (msec)
480
520
560
600
640
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S-3
S-4
S-5

.15 Mean RTs for Each Lag Interval

Table 75: Individual subjects' .15 positive mean response latencies are shown summarized over the six days of Experiment 2 for each set size separately, for each lag interval.

s=3

S#	0–4	5–9	10–19	20–29	30–
1	392.23	384.24	415.13	450.25	278.00
2	445.60	490.97	507.03		
3	531.83	609.02	628.30		536.00
4	600.40	621.87	626.00	585.67	770.00
5	539.44	580.64	613.28	626.00	
6	459.84	521.69	596.53	750.00	811.00
7	421.31	436.50	427.58	516.00	
8	685.43	655.92	720.68	607.00	
9	439.53	448.25	536.06	627.00	
10	598.11	603.45	673.52	678.50	
11	474.63	508.63	536.54	501.67	
12	468.32	497.86	542.25	513.00	
x	504.72	529.92	568.58		

s=4

S#	0–4	5–9	10–19	20–29	30–
1	404.47	395.87	442.75	347.00	361.00
2	454.08	492.07	516.09	549.40	
3	548.92	577.40	677.19	744.67	
4	578.71	629.35	644.90	721.33	813.50
5	559.72	586.34	664.44	555.25	520.00
6	454.48	483.50	525.36	529.67	560.00
7	429.45	453.20	468.60	492.20	
8	699.05	715.33	754.63	683.67	
9	449.36	503.44	593.50	724.00	395.00
10	583.43	562.67	631.65	688.00	857.50
11	487.73	539.21	559.00	686.80	478.00
12	510.85	582.84	549.58	598.40	
x	513.35	543.44	585.64	610.03	569.29

s=5

S#	0–4	5–9	10–19	20–29	30–
1	416.62	458.44	514.06	613.50	515.00
2	457.10	509.69	530.32	545.00	
3	557.62	551.00	619.48	576.25	
4	598.41	632.86	659.57	571.00	786.00
5	578.27	624.42	585.86	604.17	886.00
6	463.30	525.83	537.25	585.50	
7	468.16	479.23	478.74	533.40	
8	693.18	744.93	717.00	795.78	
9	432.39	591.83	637.50	537.75	707.00
10	601.53	604.90	655.72	876.50	
11	467.06	490.52	560.57	569.00	
12	498.30	542.48	514.30	575.00	
x	519.33	563.01	584.20	615.24	

Analyses of Variance
performed on the .15 positive mean response latencies for each lag interval in each set size

s=3

within variable: w(1): lag intervals 0–4 vs 5–9 vs 10–19
Finding: w(1): F(2,22)=23.591, p=.0001

s=4

within variable: w(1): lag intervals 0–4 vs 5–9 vs 10–19 vs 20–29
Finding: w(1): F(3,33)=10.139, p=.0002

s=5

within variable: w(1): lag intervals 0–4 vs 5–9 vs 10–19 vs 20–29
Finding: w(1): F(3,33)=8.242, p=.0005

.15 Positive Slopes for Each Lag Interval

Table 76: Individual subjects' positive .15 slopes for each lag interval are shown summarized over the six days of Experiment 2.

.15 POSITIVE SLOPES

S#	0-4	5-9	10-19	20-29
1	12.20	37.10	49.47	81.63
2	5.75	9.36	11.65	
3	12.90	-29.01	-4.41	*
4	-1.00	5.50	16.79	
5	19.42	21.89	-13.71	-10.92*
6	1.73	2.07	-29.64	-82.25*
7	23.43	21.37	25.58	8.70*
8	3.88	44.51	-1.84	94.38
9	-3.57	71.79	50.72	-44.63
10	1.71	0.73	-8.90	99.00
11	-3.79	-9.06	12.02	33.67
12	14.99	22.31	-13.98	31.00
x	7.30	16.55	7.81	

Analysis of Variance
performed on the positive .15 slopes for each lag interval

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)=.897$, $p=.5748$

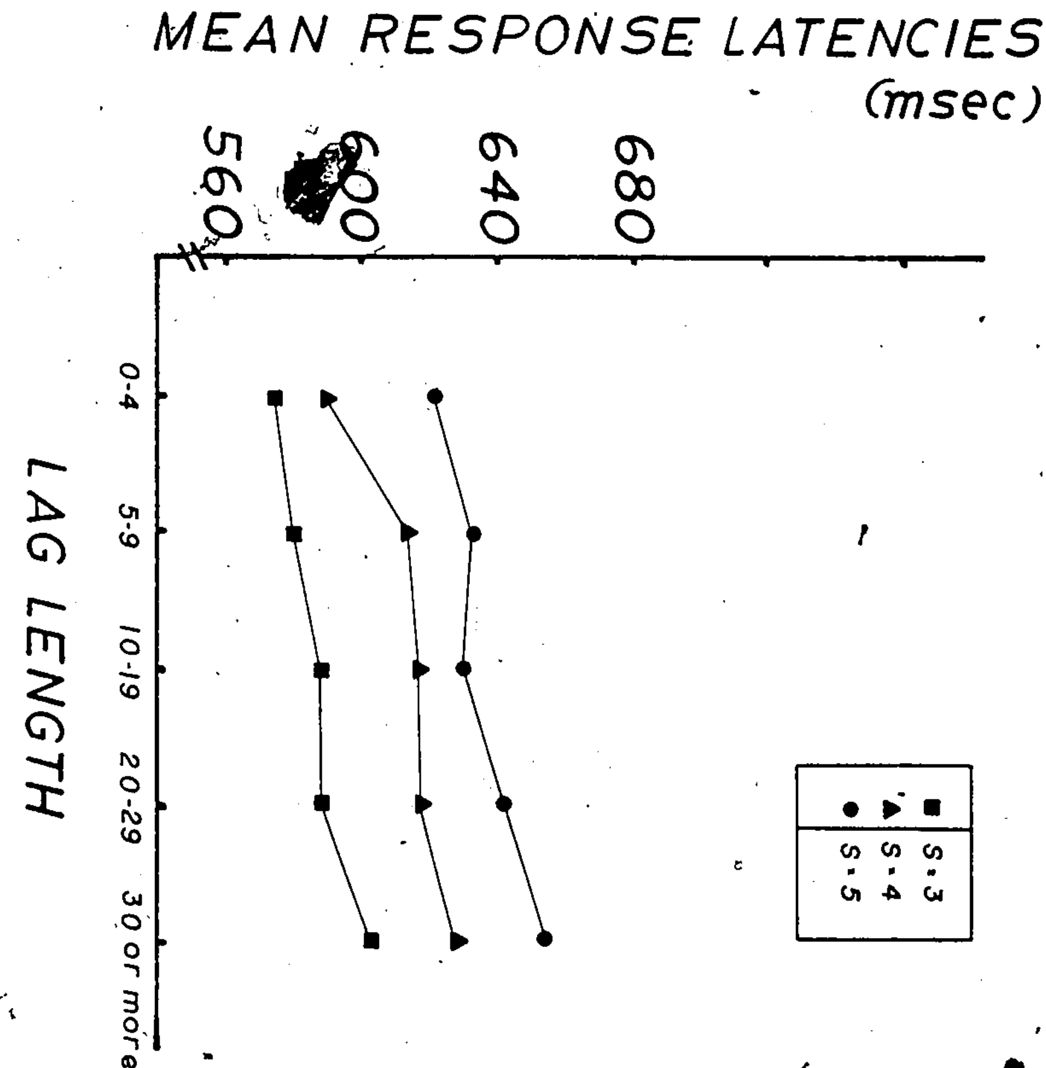
* data trend is opposite that predicted by the familiarity model

The Average Number of Trials for Each Lag Interval

Table 77: The average number of trials contributing to each lag interval each day for each subject is shown for negative items in each set size in Experiment 2.

	LAG INTERVAL				
memory set size	0–4	5–9	10–19	20–29	30–
3	13–18	9–13	14–19	9–12	10–16
4	15–18	10–15	14–19	8–12	10–13
5	14–19	11–15	16–20	9–10	9–12

Figure 76: Mean response latencies for negative items, averaged over the six days of Experiment 2, are shown plotted as a function of the lag lengths 0-4, 5-9, 10-19, 20-29 and 30 or more for each set size separately.


MEAN RESPONSE LATENCIES
(msec)
560
600
640
680
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S-3
S-4
S-5

Negative Mean RTs for Each Lag Interval

Table 78: Individual subjects' mean response latencies for negative trials are shown summarized over the six days of Experiment 2 for each set size separately, for each lag interval.

s=3

S#	0-4	5-9	10-19	20-29	30-
1	486.52	493.51	494.10	478.22	504.31
2	504.51	522.80	528.88	517.76	540.22
3	614.62	607.98	603.35	586.19	611.23
4	689.29	658.82	664.59	663.44	639.47
5	609.86	593.89	594.03	612.98	608.10
6	561.42	579.46	572.89	589.32	587.69
7	479.99	478.63	492.25	509.28	510.29
8	727.36	702.70	702.39	706.47	752.11
9	514.74	559.12	617.11	581.22	660.57
10	631.42	651.62	674.88	654.56	697.87
11	519.68	555.91	550.70	573.83	554.51
12	558.54	561.42	556.20	580.51	566.07
x	574.83	580.49	587.61	587.82	602.70

s=4

S#	0-4	5-9	10-19	20-29	30-
1	498.69	507.62	503.60	504.35	509.52
2	532.62	542.39	560.02	568.00	517.49
3	622.85	646.89	646.59	659.65	666.69
4	708.12	661.81	717.59	680.96	691.72
5	621.38	605.40	640.90	618.19	626.23
6	574.63	591.38	613.91	619.80	623.43
7	501.41	502.86	504.14	522.88	515.91
8	715.06	749.35	725.26	693.43	736.70
9	526.09	635.41	612.66	701.72	719.25
10	665.63	688.83	667.24	660.47	707.64
11	546.61	647.45	626.25	595.77	640.11
12	571.87	597.71	592.66	602.45	598.83
x	590.41	614.76	617.57	618.97	629.46

s=5

S#	0-4	5-9	10-19	20-29	30-
1	516.02	546.65	546.94	507.98	549.55
2	566.85	558.10	542.04	556.20	550.52
3	667.53	622.70	688.30	673.70	698.09
4	801.26	752.04	776.70	828.31	710.42
5	650.25	655.85	667.83	646.52	687.46
6	612.26	642.33	601.11	640.72	674.25
7	516.09	511.16	517.51	523.48	535.78
8	780.24	758.50	756.39	768.48	823.23
9	548.14	720.96	669.87	660.31	696.33
10	668.94	663.50	664.42	709.92	774.47
11	574.70	578.39	545.31	596.46	566.46
12	576.78	598.52	596.63	602.11	599.03
x	623.26	634.06	631.09	642.85	655.47

Analyses of Variance
performed on the negative mean response latencies for each lag interval in each set size

s=3

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): $F(4,44)=3.198$, $p=.0214$

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): $F(4,44)=3.416$, $p=.0161$

s=5

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): $F(4,44)=1.887$, $p=.1288$

Negative Slopes for Each Lag Interval

Table 79: Individual subjects' negative slopes for each lag interval are shown summarized over the six days of Experiment 2.

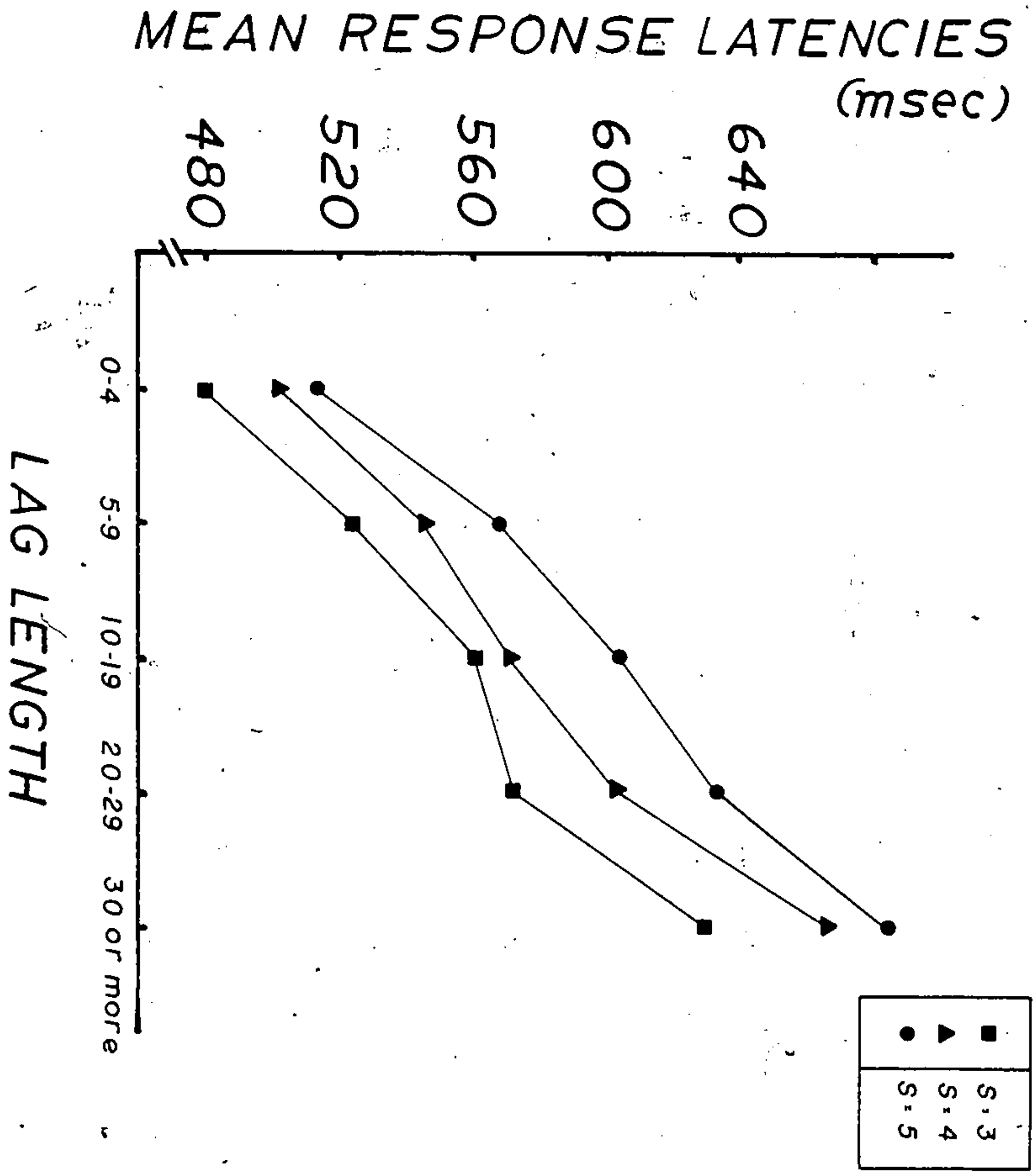
NEGATIVE SLOPES

S#	0-4	5-9	10-19	20-29	30-
1	14.75	26.57	26.42	14.88	22.62
2	31.17	17.65	6.58	19.22	5.15
3	26.46	7.36	42.48	43.76	43.43
4	55.99	46.61	56.06	82.44	35.48
5	20.20	30.98	36.90	16.77	39.68
6	25.42	31.44	14.11	25.70	43.28
7	18.05	16.27	12.63	7.10	12.75
8	26.44	27.90	27.00	31.01	35.56
9	16.70	80.92	26.38	39.55	17.88
10	18.76	5.94	-5.23	27.68	38.30
11	27.51	11.24	-2.70	11.32	5.98
12	9.12	18.55	20.22	10.80	16.48
$\bar{x}$	24.21	26.79	21.74	27.52	26.38

Analysis of Variance
performed on the negative slopes for each lag interval

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): F(4,44)=.360, p=.8364

Figure 77 : Mean response latencies for positive items, averaged over the six days of Experiment 3, are shown plotted as a function of the lag lengths 0-4, 5-9, 10-19, 20-29 and 30 or more for each set size separately.


MEAN RESPONSE LATENCIES (msec)
480
520
560
600
640
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S-3
S-4
S-5

Positive Mean RTs for Each Lag Interval

Table 80: Individual subjects' mean response latencies for positive trials are shown summarized over the six days of Experiment 3 for each set size separately, for each lag length.

s=3

S#	0–4	5–9	10–19	20–29	30–
1	522.96	552.91	602.57	553.00	664.00
2	398.14	428.77	483.13	426.00	516.45
3	657.23	723.19	777.76	815.88	859.25
4	491.56	533.28	550.89	615.33	639.60
5	409.62	446.95	473.37	471.43	458.00
6	504.93	539.07	559.08	512.06	545.80
7	416.14	430.13	473.70	501.00	477.43
8	426.49	453.82	480.84	496.58	544.00
9	448.66	514.37	577.20	660.50	575.33
10	470.97	526.01	604.61	685.73	790.80
11	442.88	451.80	485.97	481.89	520.33
12	573.46	695.67	678.21	653.08	982.00
x	480.25	524.66	562.28	572.71	631.08

s=4

S#	0–4	5–9	10–19	20–29	30–
1	519.78	576.72	597.12	588.26	751.18
2	423.93	422.38	464.92	573.43	456.92
3	724.82	770.55	846.06	846.50	1057.25
4	508.74	547.49	580.55	568.11	708.06
5	426.86	468.34	477.15	482.00	538.10
6	501.10	540.54	561.50	619.74	674.53
7	427.25	459.04	472.49	516.47	495.67
8	425.15	481.85	498.43	542.06	507.61
9	510.28	556.82	570.41	698.12	615.57
10	477.94	530.60	565.22	590.07	753.17
11	438.14	477.66	474.90	559.29	565.27
12	643.69	726.17	770.84	672.19	887.58
x	502.31	546.51	573.30	604.69	667.58

s=5

S#	0-4	5-9	10-19	20-29	30-
1	543.96	593.33	603.85	533.35	695.21
2	426.21	473.06	493.04	496.43	478.21
3	662.15	756.97	856.38	964.39	946.33
4	522.59	553.15	586.36	684.52	649.17
5	454.54	519.78	506.52	548.76	537.87
6	535.54	565.55	596.03	604.06	784.21
7	428.73	460.76	478.84	527.52	527.00
8	444.40	499.67	536.04	532.23	625.27
9	500.38	549.39	596.45	603.37	683.46
10	540.43	599.00	687.56	779.47	784.65
11	451.17	490.43	557.11	550.72	608.81
12	656.26	770.39	767.77	777.19	927.33
x	513.86	569.29	605.49	633.50	687.29

Analyses of Variance
performed on the positive mean response latencies for each lag interval in each set size

s=3

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): F(4,44)=14.246, p=.0001

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): F(4,44)= 21.121, p=.0001

s =5

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): F(4,44)=27.023, p=.0001

Positive Slopes for Each Lag Interval

Table 81: Individual subjects' positive slopes for each lag interval are shown summarized over the six days of Experiment 3.

POSITIVE SLOPES

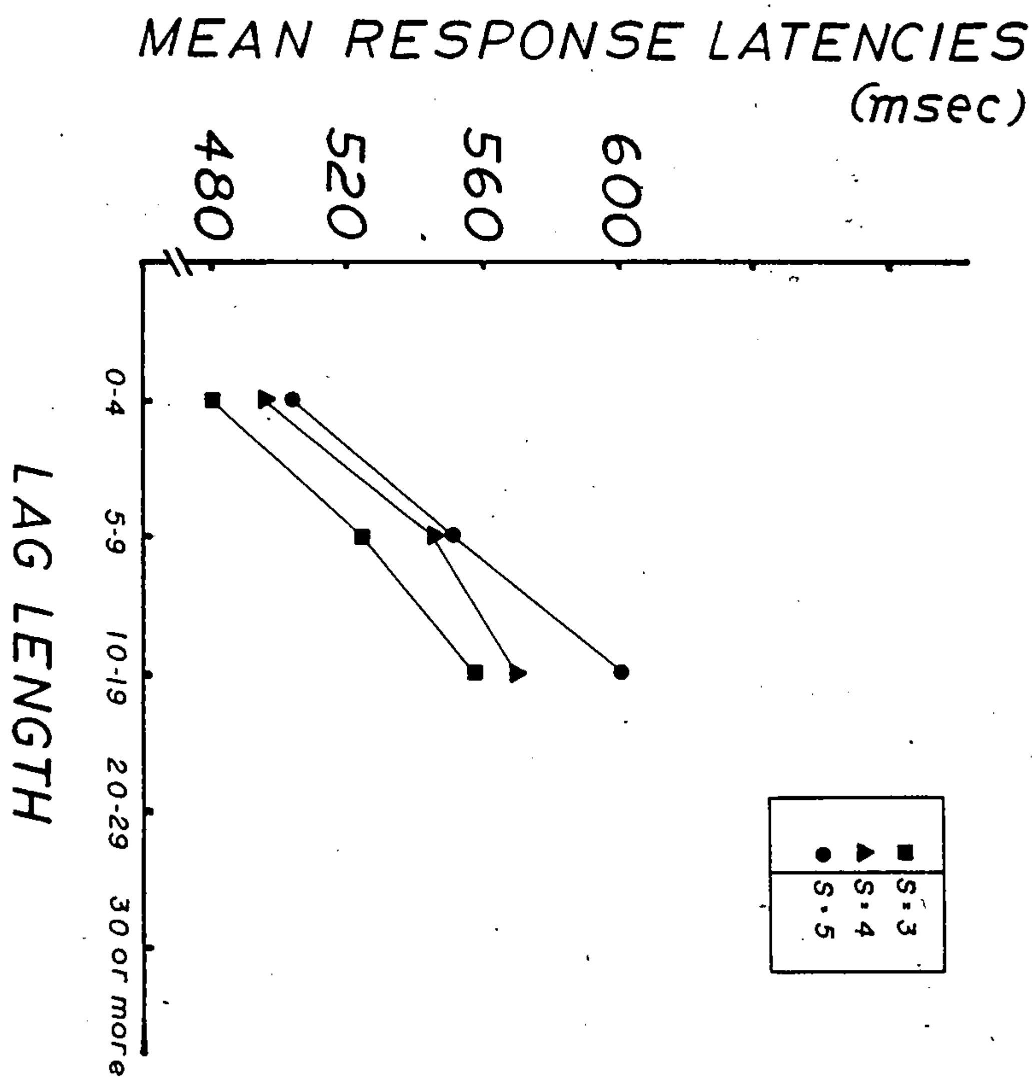
S#	0-4	5-9	10-19	20-29
1	10.50	20.21	0.64	-9.83
2	14.04	22.14	4.96	35.22
3	2.47	16.89	39.30	74.25
4	15.52	9.93	17.74	34.59
5	22.46	36.42	16.58	38.67
6	15.31	13.25	18.48	46.01
7	6.30	15.32	2.57	13.26
8	8.95	22.93	27.60	17.83
9	25.87	17.51	9.63	-28.57
10	34.74	36.50	41.47	46.88
11	4.14	19.32	35.57	34.42
12	41.40	37.36	44.78	62.06
x	16.81	22.32	21.61	30.40

Analysis of Variance
performed on the positive slopes for each lag interval

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29

Finding: w(1): F(3,33)=1.722, p=.1804

Figure 78: Mean response latencies for .25 positive items, averaged over the six days of Experiment 3, are shown plotted against lag length for each set size separately.


MEAN RESPONSE LATENCIES
(msec)
480
520
560
600
0-4
5-9
10-19
20-29
30 or more
LAG LENGTH
S = 3
S = 4
S = 5

.25 Mean RTs for Each Lag Interval

Table 82: Individual subjects' .25 positive mean response latencies are shown summarized over the six days of Experiment 3 for each set size separately, for each lag interval.

s=3

S#	0–4	5–9	10–19
1	532.54	547.83	635.00
2	406.84	422.73	543.69
3	651.70	696.59	689.90
4	499.18	552.97	542.75
5	406.14	430.65	495.60
6	498.83	535.41	555.78
7	418.69	454.29	423.14
8	428.86	432.81	474.27
9	457.80	519.13	559.63
10	475.70	530.35	630.36
11	437.06	456.89	477.93
12	563.75	715.33	662.86
x	481.42	524.58	557.58

s=4

S#	0–4	5–9	10–19
1	514.69	584.29	620.17
2	426.14	436.00	488.06
3	703.16	773.75	807.46
4	501.74	525.07	593.57
5	410.54	449.81	456.00
6	501.22	493.66	560.08
7	427.76	472.92	471.18
8	421.60	461.25	498.20
9	507.01	556.28	520.54
10	482.73	514.96	544.00
11	431.29	477.67	434.43
12	638.15	801.00	856.71
x	497.17	545.56	570.87

s=5

S#	0-4	5-9	10-19
1	537.68	573.27	577.17
2	404.20	418.75	474.25
3	662.35	739.27	1055.56
4	516.14	549.55	590.11
5	444.59	489.78	418.70
6	533.80	557.54	594.59
7	416.88	423.93	484.90
8	427.15	476.75	530.57
9	484.77	532.84	673.90
10	514.15	628.42	613.50
11	446.63	478.39	514.00
12	653.90	760.89	693.78
x	503.52	552.45	601.75

Analyses of Variance
performed on the .25 positive mean response latencies for each lag interval in each set size

s=3

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)=16.510$, $p=.0001$

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)=16.128$, $p=.0001$

s=5

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)= 7.659$, $p=.0033$

.25 Positive Slopes for Each Lag Interval

Table 83: Individual subjects' .25 positive slopes for each lag interval are shown summarized over the six days of Experiment 3.

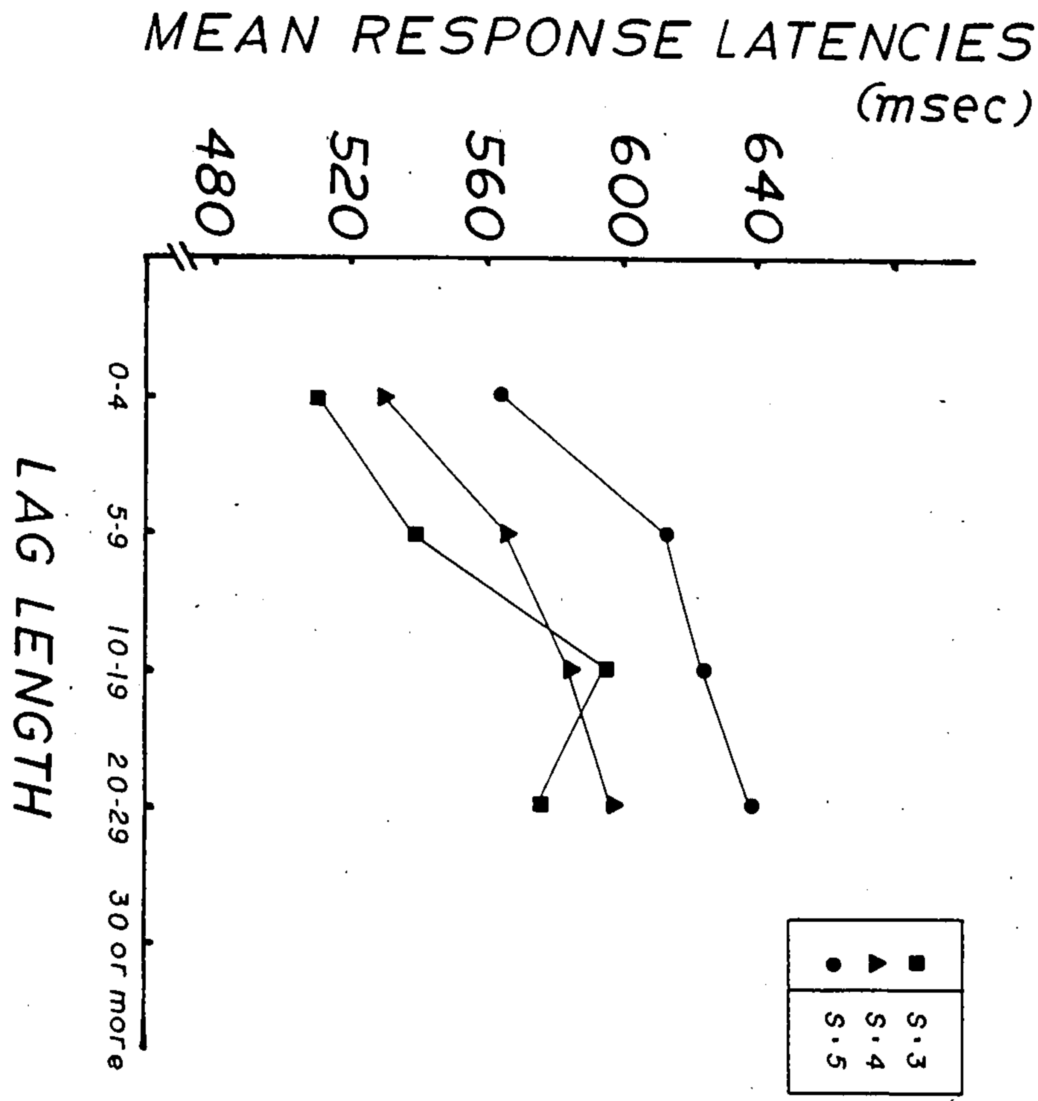
.25 POSITIVE SLOPES

S#	0-4	5-9	10-19
1	2.57	12.72	-28.92
2	-1.32	-1.99	-34.72
3	5.33	21.34	182.83
4	8.48	-1.71	23.68
5	19.23	29.57	-38.45
6	17.49	11.07	19.41
7	-0.91	-15.18	30.88
8	-0.86	21.97	28.15
9	13.49	6.86	57.14
10	19.23	49.04	-8.43
11	4.79	10.75	18.04
12	45.08	22.78	15.46
x	11.05	13.93	22.09

Analysis of Variance
performed on the .25 positive slopes for each lag interval

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,22)=.304$, $p=.7451$

Figure 79 : Mean response latencies for .05 positive items, averaged over the six days of Experiment 3, are shown plotted as a function of lag length for each set size separately.


MEAN RESPONSE LATENCIES
(msec)
480
520
560
600
640
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S·3
S·4
S·5

.05 Mean RTs for Each Lag Interval

Table 84: Individual subjects' .05 positive mean response latencies are shown summarized over the six days of Experiment 3 for each set size separately, for each lag interval.

s=3

S#	0-4	5-9	10-19	20-29
1	480.71	522.67	617.58	553.00
2	414.11	475.43	452.29	396.50
3	649.36	722.00	798.55	811.71
4	616.20	528.00	609.82	588.43
5	410.89	568.33	441.25	525.20
6	528.25	590.50	547.83	508.50
7	445.22	440.29	540.50	503.67
8	433.00	450.29	556.00	469.78
9	524.75	582.00	673.45	734.67
10	542.50	467.80	752.00	656.33
11	465.29	424.29	477.83	483.38
12	606.14	693.27	688.09	681.00
x	509.70	538.74	596.22	576.01

s=4

S#	0-4	5-9	10-19	20-29
1	531.31	533.57	602.26	596.43
2	433.75	425.54	474.28	576.33
3	871.57	808.50	884.74	755.50
4	563.24	669.94	612.59	532.50
5	460.41	476.31	480.41	480.60
6	539.25	610.11	608.06	611.88
7	424.08	448.86	468.41	528.06
8	449.78	508.56	537.06	532.23
9	509.87	523.63	557.67	701.09
10	466.81	592.78	567.78	612.09
11	488.95	524.62	510.71	575.00
12	626.38	684.63	729.24	669.65
x	530.45	567.25	586.10	597.61

s=5

S#	0-4	5-9	10-19	20-29
1	586.17	629.43	640.11	527.92
2	510.00	564.08	506.45	510.69
3	708.16	894.76	865.69	989.00
4	589.41	607.67	592.25	672.25
5	461.28	495.88	520.15	565.40
6	576.62	572.78	624.50	597.70
7	453.22	526.94	486.41	541.36
8	484.27	558.74	550.57	542.59
9	586.92	571.38	596.64	596.11
10	642.87	631.53	771.84	774.22
11	496.45	511.52	578.62	565.04
12	673.74	797.63	767.16	785.60
x	564.09	613.53	625.03	638.99

Analyses of Variance
performed on the .05 positive mean response latencies for each lag interval in each set size

s=3

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): F(3,33)=5.998, p=.0025

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): F(3,33)=4.953, p=.0062

s=5

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): F(3,33)=6.361, p=.0019

.05 Positive Slopes for Each Lag Interval

Table 85 : Individual subjects' .05 positive slopes for each lag interval are shown summarized over the six days of Experiment 3.

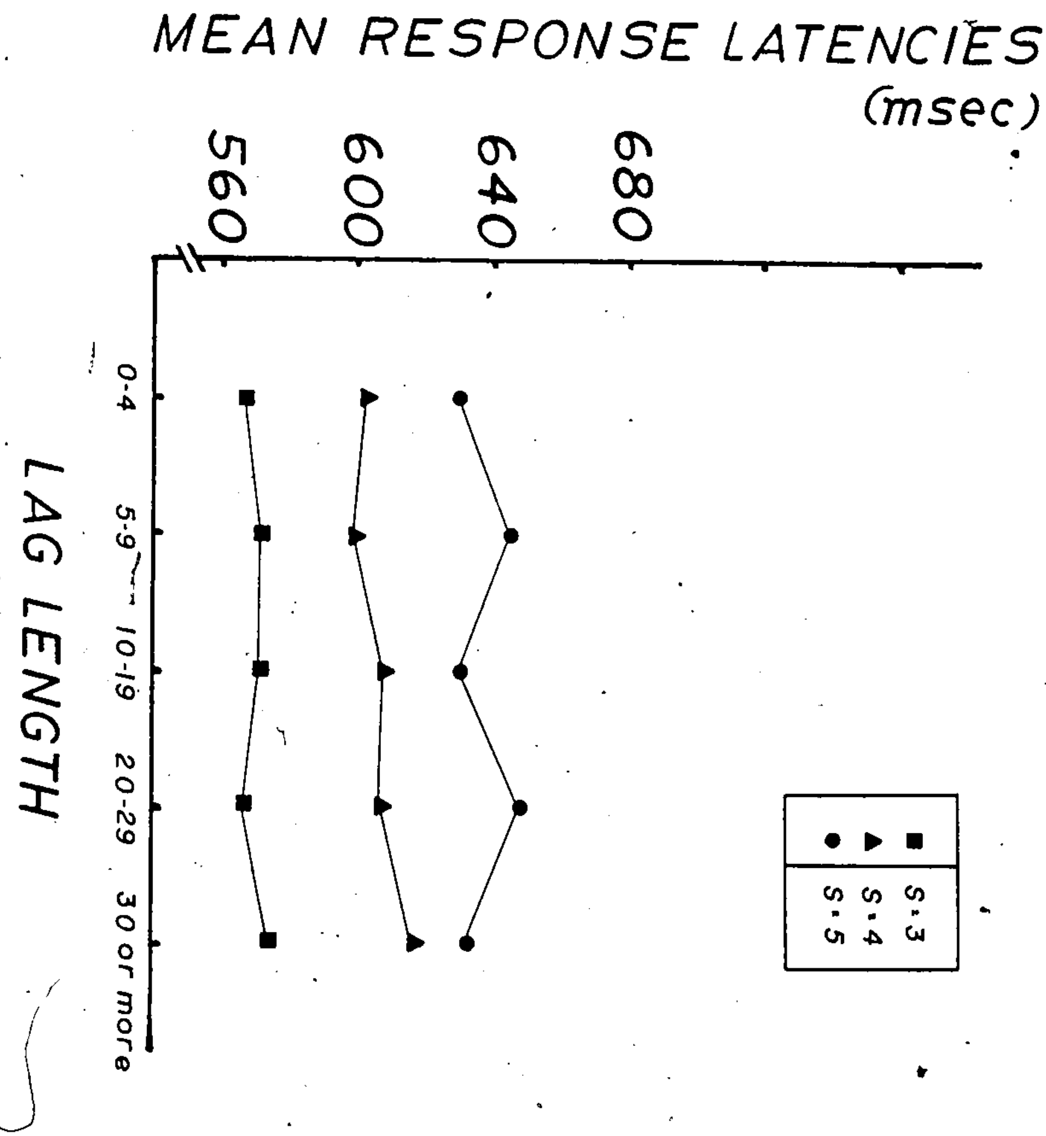
.05 POSITIVE SLOPES

S#	0-4	5-9	10-19	20-29
1	52.73	53.38	11.27	-12.54
2	47.95	44.33	27.08	57.10
3	29.40	86.38	33.57	88.65
4	-13.40	39.84	-8.79	41.91
5	25.20	-36.23	39.45	20.10
6	24.19	-8.86	38.59	44.60
7	4.00	43.33	-27.05	18.85
8	25.64	54.23	-2.72	36.41
9	31.09	-5.31	-38.41	-69.28
10	50.19	81.87	9.92	58.95
11	15.58	43.62	50.40	40.83
12	33.80	52.18	39.54	52.30
x	27.20	37.39	14.41	31.49

Analysis of Variance
performed on the .05 positive slopes for each lag interval

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): $F(3,33)=1.529$, $p=.2242$

Figure 80: Mean response latencies for negative items, averaged over the six days of Experiment 3, are shown plotted as a function of lag length for each set size separately.


MEAN RESPONSE LATENCIES (msec)
560
600
640
680
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S·3
S·4
S·5

Negative Mean RTs for Each Lag Interval

Table 86: Individual subjects' negative mean response latencies are shown summarized over the six days of Experiment 3 for each set size separately, for each lag interval.

s=3

S#	0-4	5-9	10-19	20-29	30-
1	554.19	569.09	556.35	565.41	560.46
2	469.95	459.42	465.88	473.86	468.45
3	718.42	738.70	768.77	706.55	759.93
4	577.65	580.14	614.17	593.94	612.08
5	493.28	499.27	469.14	485.11	474.19
6	579.44	579.03	586.91	587.51	599.22
7	502.92	472.97	478.05	489.16	481.54
8	519.50	524.14	516.55	539.40	528.19
9	567.73	601.53	565.75	576.83	594.26
10	622.59	616.45	609.60	601.37	625.00
11	523.92	511.84	512.57	507.14	512.90
12	677.34	711.39	721.43	680.74	685.79
x	567.24	572.00	572.10	567.25	575.17

s=4

S#	0-4	5-9	10-19	20-29	30-
1	571.32	543.00	555.65	579.25	594.42
2	501.62	478.43	469.50	472.48	497.49
3	855.70	805.86	889.84	849.45	854.67
4	569.68	581.77	581.26	629.71	573.10
5	512.05	483.17	502.42	510.41	482.81
6	596.93	617.78	609.19	606.05	635.90
7	502.00	513.14	503.79	503.29	509.06
8	520.33	540.11	535.35	545.33	559.55
9	654.24	661.34	668.34	639.51	647.62
10	637.17	626.35	639.24	631.18	661.18
11	527.79	522.67	519.71	519.83	526.75
12	787.40	821.58	832.93	814.88	883.21
x	603.02	599.60	608.94	608.45	618.81

s=5

S#	0-4	5-9	10-19	20-29	30-
1	590.54	596.58	588.83	580.57	587.68
2	518.58	543.40	502.41	558.95	533.92
3	886.52	854.71	856.96	835.21	792.48
4	648.17	647.24	606.38	614.69	610.74
5	541.34	534.89	547.10	526.50	569.36
6	613.07	635.57	637.02	651.72	638.81
7	525.40	535.51	515.43	553.39	541.39
8	578.75	583.72	584.55	574.73	619.51
9	651.30	660.30	654.51	698.79	676.47
10	658.45	715.94	711.42	777.51	681.63
11	544.75	545.06	556.79	584.81	556.54
12	798.84	904.14	813.05	829.30	803.63
x	629.64	646.42	631.20	648.85	634.35

Analyses of Variance
performed on the negative mean response latencies for each lag interval in each set size

s=3

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): F(4,44)=.730, p=.5788

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): F(4,44)=1.913, p=.1242

s=5

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): F(4,44)=1.561, p=.2007

Negative Slopes for Each Lag Interval

Table 87: Individual subjects' negative slopes for each lag interval are shown summarized over the six days of Experiment 3.

NEGATIVE SLOPES

S#	0-4	5-9	10-19	20-29	30-
1	18.18	13.75	16.24	7.58	13.61
2	24.32	41.99	18.27	42.55	32.74
3	84.05	58.01	44.10	64.33	16.28
4	35.26	33.55	-3.90	10.39	-0.67
5	24.03	17.81	38.98	20.70	47.59
6	16.82	28.27	25.06	32.11	19.80
7	11.24	31.27	18.69	32.12	29.93
8	29.63	29.79	34.00	17.67	45.66
9	41.79	29.39	44.38	60.98	41.11
10	17.93	49.75	50.91	88.07	28.32
11	10.42	16.61	22.11	38.84	21.82
12	60.75	96.38	45.81	74.28	58.92
x	31.20	37.21	29.55	40.80	29.59

Analysis of Variance
performed on the negative slopes for each lag interval

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more

Finding: w(1): $F(4,44)=1.346$, $p=.2672$

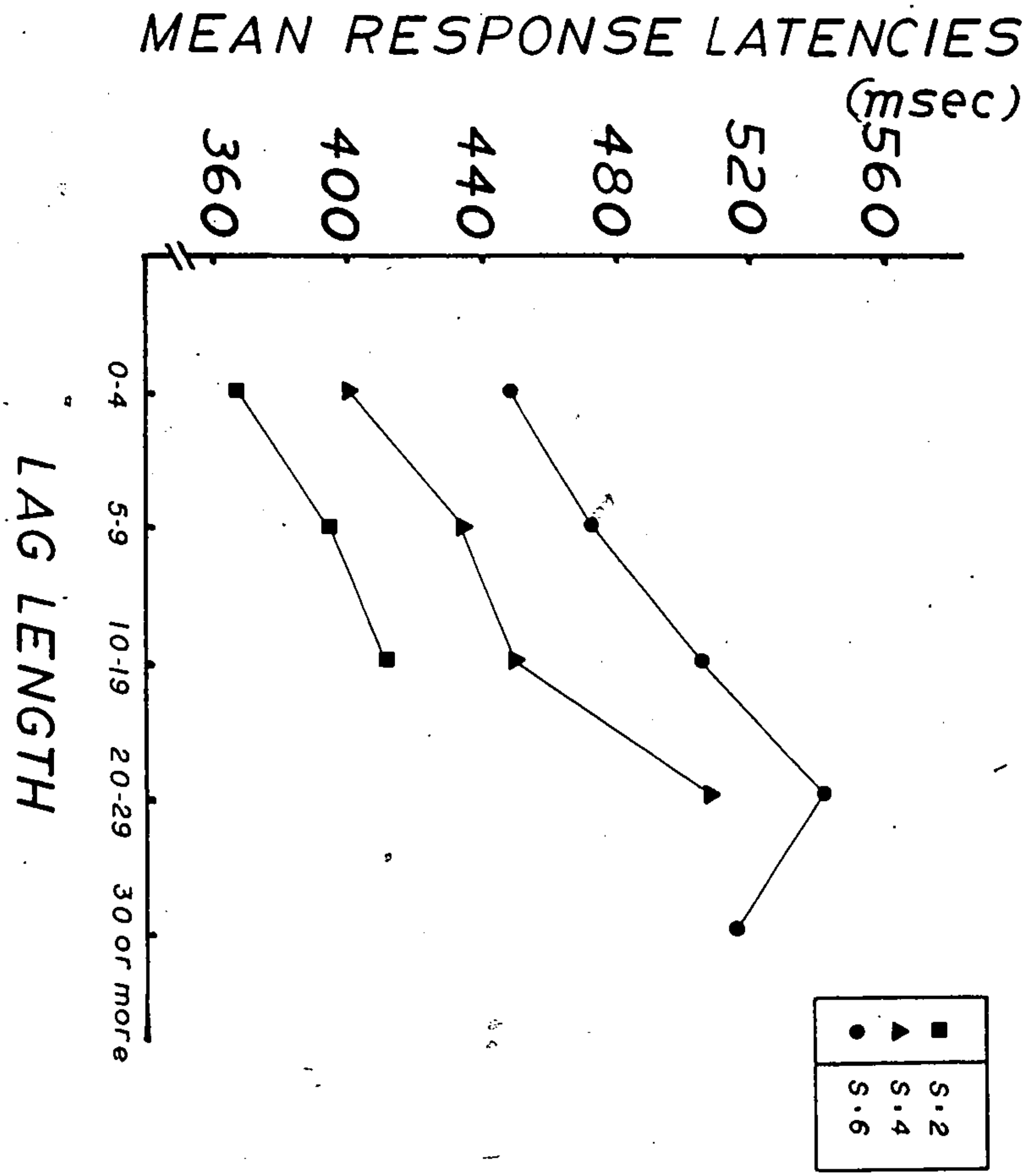
The Average Number of Trials for Each Lag Interval

Table 88: The average number of trials contributing to each lag interval each day for each subject is shown for positive items in each set size for the experiment in Appendix 3.

LAG INTERVAL

memory set size	0–4	5–9	10–19	20–29
2	25–27	5–7	1–2	0
4	15–17	7–8	5–7	1–1.67
6	8–9	7–9	8–12	3

Figure 81: Mean response latencies for positive items, averaged over the 24 days of the experiment in Appendix 3, are shown plotted as a function of lag length for each set size separately.


MEAN RESPONSE LATENCIES (msec)
360
400
440
480
520
560
LAG LENGTH
0-4
5-9
10-19
20-29
30 or more
S·2
S·4
S·6

Positive Mean RTs for Each Lag Interval

Table 89: Individual subjects' positive mean response latencies are shown summarized over the 24 days of the experiment in Appendix 3 for each set size separately, for each lag interval.

s=2

S#	0-4	5-9	10-19	20-29	30-
1	373.51	378.63	358.00		
2	420.17	469.69	499.55	540.00	
3	346.01	363.47	465.33		
4	338.71	386.93	409.67		
5	374.06	397.13	387.90	454.50	
6	352.30	372.97	349.60		
x	367.46	394.80	411.68		

s=4

S#	0-4	5-9	10-19	20-29	30-
1	398.17	428.98	418.19	409.30	507.50
2	456.60	502.76	519.62	554.43	418.00
3	410.76	430.57	445.28	585.83	732.00
4	351.28	423.68	414.64	539.63	
5	408.29	429.15	454.11	463.57	620.00
6	379.57	395.57	446.35	496.40	482.00
x	400.78	435.12	449.70	508.19	

s=6

S#	0-4	5-9	10-19	20-29	30-
1	472.24	483.63	522.11	508.68	589.00
2	466.23	497.46	556.87	604.89	436.00
3	457.87	460.06	495.79	527.33	504.00
4	399.70	430.22	446.53	487.22	489.00
5	454.93	490.55	504.77	489.60	526.67
6	445.94	475.37	509.31	636.29	551.00
x	449.49	472.88	505.90	542.34	515.95

Analyses of Variance
performed on positive mean response latencies for each lag interval in each set size

s=2

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,10)=3.318$, $p=.0776$

s=4

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29
Finding: w(1): $F(3,15)=10.521$, $p=.0008$

s=6

within variable: w(1): lag intervals 0-4 vs 5-9 vs 10-19 vs 20-29 vs 30 or more
Finding: w(1): $F(4,20)=5.471$, $p=.0041$

Positive Slopes for Each Lag Interval

Table 9a Individual subjects' positive slopes for each lag interval are shown summarized over the 24 days of the experiment in Appendix 3.

POSITIVE SLOPES

S#	0-4	5-9	10-19
1	24.68	26.25	41.03
2	11.52	6.94	14.33
3	27.97	24.15	7.62
4	15.25	10.82	9.22
5	20.22	23.36	29.22
6	23.41	25.60	39.93
x	20.51	19.52	23.56

Analysis of Variance
performed on the positive slopes for each lag interval

within variable: lag intervals 0-4 vs 5-9 vs 10-19
Finding: w(1): $F(2,10)=.448$, $p=.6555$

APPENDIX 8

Appendix 8 provides a summary of the positive percent error and standard deviation scores obtained from positive and from negative trials for each memory set size and for each subject averaged over the six days of Experiment 4. Group error rates were maintained at a low level and were 1.8%, 1.8% and 2.9% for the memory set sizes 3, 4 and 5 respectively. In Appendix 8, mean percent errors are also shown plotted against positive set size over the six days for positive and negative trials separately over all six subjects. An analysis of variance was performed on percent errors where the within variables were positive-negative percent errors and set size. The findings were typical of those previously reported. Both main effects were significant: positive percent errors were significantly greater than negative percent errors [$F(1,5)=9.36$, $p=.028$] ; and percent positive and negative errors increased significantly as set size increased [$F(2,10)=9.36$, $p=.0054$].

An analysis of variance was also performed on the standard deviation scores where the within variables were positive-negative trials and set size. Only the main effect of set size was significant: positive and negative variances increased significantly as set size increased [$F(2,10)=14.86$, $p=.0013$] . The standard deviation scores are shown plotted against positive set size over the six days for positive and negative trials separately over all six subjects.

Also provided in Appendix 8 for the individu[al] subjects are the

.25 and the .10 positive mean response latencies for each short lag (i.e. lag lengths of 0, 1 and 2) and for each long lag (i.e. lag lengths of 8, 9 and 10) interval for each set size separately.

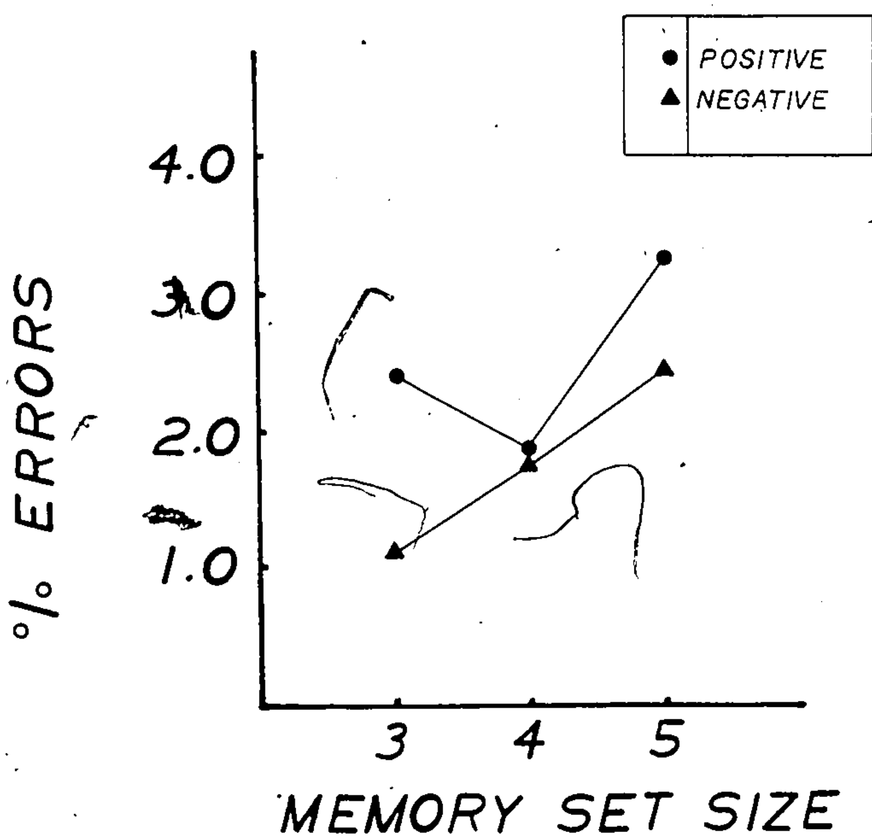
An analysis of variance was performed on the .25 positive mean response latencies where the within variables were lag lengths, 0, 1 and 2, and set size. Only the main effect of lag length was significant [F(2,10)=6.07, p=.0186] ; mean responses were found to increase significantly as lag length increased (i.e. 457, 466, 478 msec. for the lag lengths of 0, 1 and 2, respectively). An analysis of variance was also performed on the .25 positive mean RTs where the within variables were lag lengths, 8, 9 and 10, and set size. Here, neither of the two main effects nor the interaction was significant.

Similar analyses of variance were performed on the .10 positive mean response latencies where the within variables were (A) lag lengths, 0, 1 and 2, and set size; and (B) lag lengths, 8, 9 and 10, and set size. Only in the case where the .10 positive mean RTs were examined for the lag lengths of 0, 1 and 2 over set size, was a significant main effect of set size observed [F(2,10)=3.99, p=.0525]. While mean RTs for the lag lengths, 0, 1 and 2 combined, were found to significantly increase as set size increased, it is obvious that this was a result of set size 5. For the set size 5, an average RT of 506 msec. for the lag lengths 0, 1 and 2 was obtained; whereas, the mean RTs for the set sizes 3 and 4 were 471 and 471 msec., respectively.

The [illegible] error scores and standard deviation scores of the individual subjects for the .25 and .10 positive items, for short lags and for long lags and for each set size separately are also included.

It was found that neither the standard deviation scores nor the percent error scores consistently increased with set size increases when the .25 and .10 positive percent errors and standard deviation scores for short lags and for long lags were analyzed separately. However, it should be noted from the summary of the analyses included, that for both the .25 positive and the .10 positive items, a long lag length interval resulted in significantly higher standard deviation scores and (although not significant) higher percent error scores than when lag length was short.

Figure 82: Mean percent errors are plotted against positive set size over the six days of Experiment 4 for positive and negative trials separately.



Percent Errors

Table 91: Individual subjects' mean percent errors for positive and negative responses are shown summarized over the six days of Experiment 4 for each set size separately.

POSITIVE % ERRORS

S#	s=3	s=4	s=5
1	2.71	1.46	3.54
2	2.71	1.88	3.13
3	1.04	.83	2.29
4	4.17	2.71	2.71
5	1.67	2.08	3.33
6	2.08	2.08	4.58
x	2.40	1.84	3.26

NEGATIVE % ERRORS

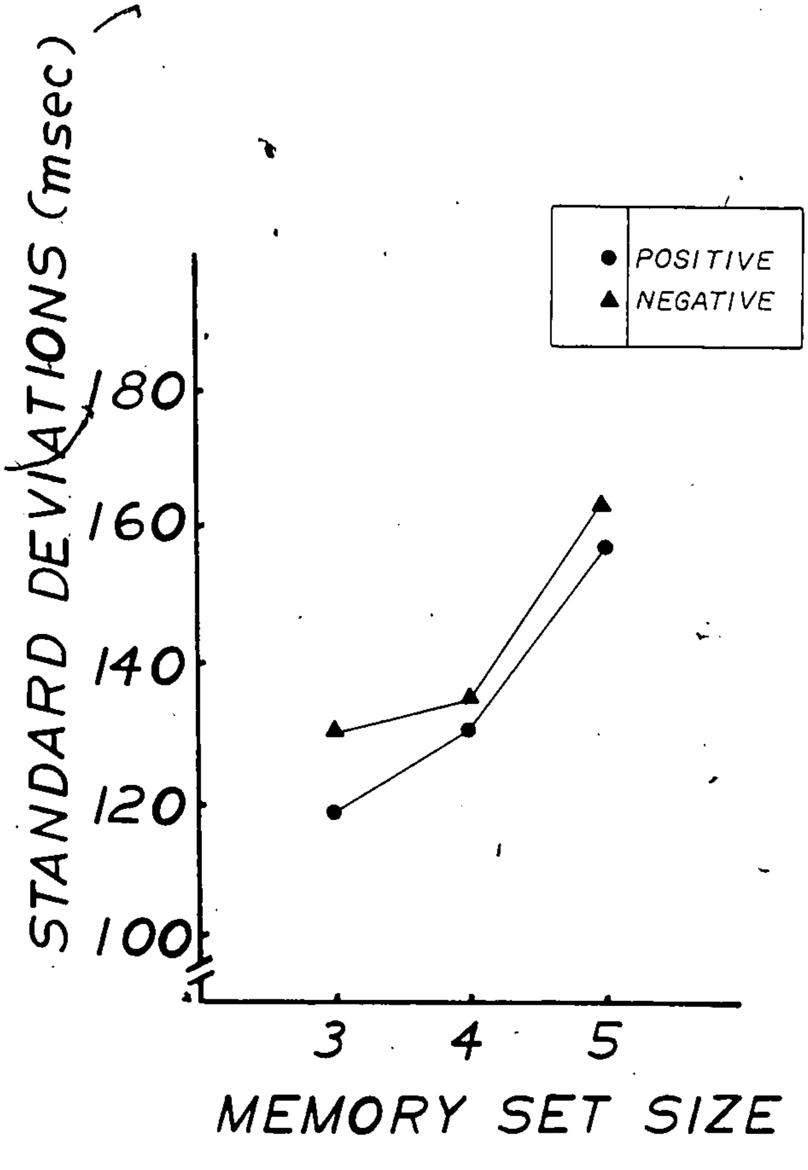
1	.83	1.46	1.88
2	1.46	2.50	2.92
3	.42	.83	.42
4	1.88	2.50	2.92
5	1.04	1.88	4.58
6	1.04	1.25	2.08
x	1.11	1.74	2.47

Analysis of Variance
performed on positive and negative percent errors

within variables: w(1): positive vs negative percent errors
w(2): set size

Findings: w(1): $F(1,5)=9.356$, $p=.0280$
w(2): $F(2,10)=9.358$, $p=.0054$
w(1,2): $F(2,10)=2.451$, $p=.1352$

Figure 83: Mean response standard deviations are plotted against positive set size for positive and negative responses separately for all six subjects over the six days of Experiment 4.



Positive and Negative Standard Deviations

Table 92: Individual subjects' mean standard deviation scores for positive and negative responses are shown summarized over the six days of Experiment 4 for each set size separately.

POSITIVE STANDARD DEVIATIONS

S#	s=3	s=4	s=5
1	142.45	157.61	226.31
2	146.03	162.52	207.91
3	114.41	128.30	136.49
4	98.40	107.90	118.95
5	69.85	75.03	94.07
6	138.93	149.92	155.90
x	118.35	130.21	156.61

NEGATIVE STANDARD DEVIATIONS

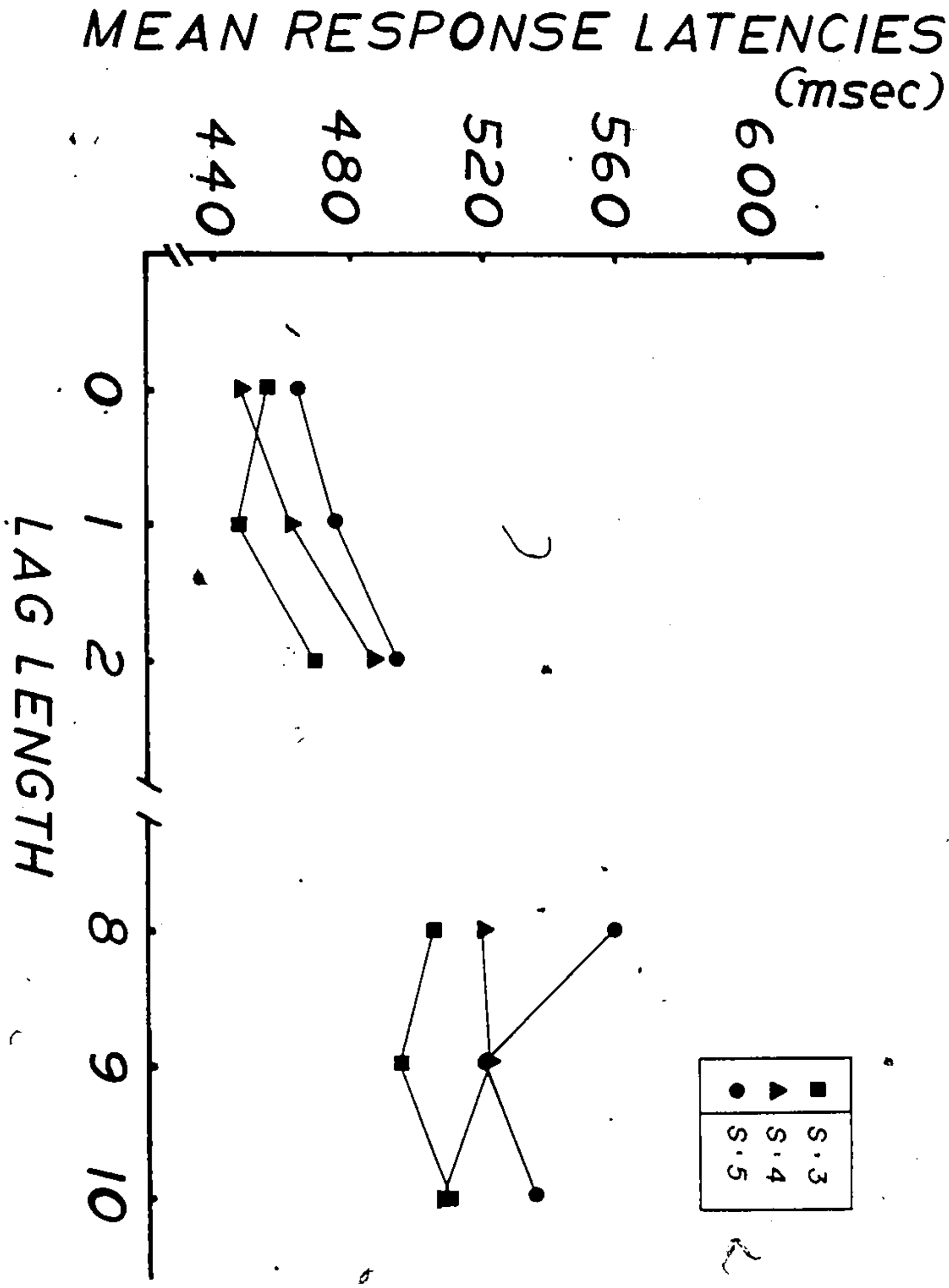
S#	s=3	s=4	s=5
1	150.33	133.57	205.38
2	224.41	232.32	236.83
3	106.71	125.28	149.56
4	94.28	100.06	106.16
5	68.88	69.53	95.17
6	133.11	150.59	186.32
x	129.62	135.23	163.24

Analysis of Variance
performed on the positive and negative standard deviation scores

within variables: w(1): positive vs negative standard deviations
w(2): set size

Findings: w(1): $F(1,5)=.510$, $p=.5112$
w(2): $F(2,10)=14.862$, $p=.0013$
w(1,2): $F(2,10)=.216$, $p=.8107$

Figure 84: Positive .25 mean response latencies for each short lag and for each long lag interval are shown plotted as a function of lag length for each set size separately, as averaged over the six days of Experiment 4.


MEAN RESPONSE LATENCIES
(msec)
440
480
520
560
600
0
1
2
8
9
10
LAG LENGTH
S·3
S·4
S·5

.25 Mean RTs for Each Lag Interval

Table 93: Individual subjects' .25 positive mean response latencies for each short lag and for each long lag interval are shown summarized over the six days of Experiment 4 for each set size separately.

.25 ITEM, S=3

S#	lag =0	lag =1	lag =2	lag =8	lag =9	lag =10
1	469.50	478.47	506.31	542.43	547.99	590.75
2	533.57	554.18	598.15	609.80	613.13	575.39
3	502.44	479.29	489.26	502.18	509.04	559.13
4	406.08	388.19	412.51	469.20	409.86	426.76
5	349.28	326.51	328.31	369.88	369.89	389.60
6	467.74	456.39	485.13	535.11	527.71	517.40
x	454.77	447.17	469.95	504.77	496.27	509.84

.25 ITEM, S=4

S#	lag =0	lag =1	lag =2	lag =8	lag =9	lag =10
1	411.95	430.18	455.22	514.88	486.92	506.93
2	512.68	588.36	628.68	633.99	611.68	603.35
3	497.43	500.56	502.58	555.65	585.38	551.75
4	422.36	401.16	433.05	440.45	432.75	463.68
5	361.42	357.35	367.66	371.14	409.13	373.40
6	480.02	497.58	538.56	605.29	607.75	555.86
x	447.64	462.53	487.63	520.23	522.27	509.16

.25 ITEM, S=5

S#	lag =0	lag =1	lag =2	lag =8	lag =9	lag =10
1	477.32	496.98	565.89	640.29	549.50	572.12
2	545.25	555.43	571.53	644.74	614.54	628.58
3	506.88	523.93	536.26	600.39	553.17	568.96
4	409.61	424.72	414.82	462.15	426.67	506.63
5	363.70	351.78	378.54	403.21	393.51	429.17
6	484.30	501.07	494.95	601.24	591.49	513.29
x	464.51	475.65	493.67	558.67	521.48	536.46

Analysis of Variance

performed on the .25 mean response latencies for lag lengths of 0, 1 and 2

within variables: w(1): set size
w(2): lag length 0, 1 and 2

Findings: w(1): $F(2,10)=1.540$, $p=.2608$
w(2): $F(2,10)=6.068$, $p=.0186$
w(1,2): $F(4,20)=1.335$, $p=.2910$

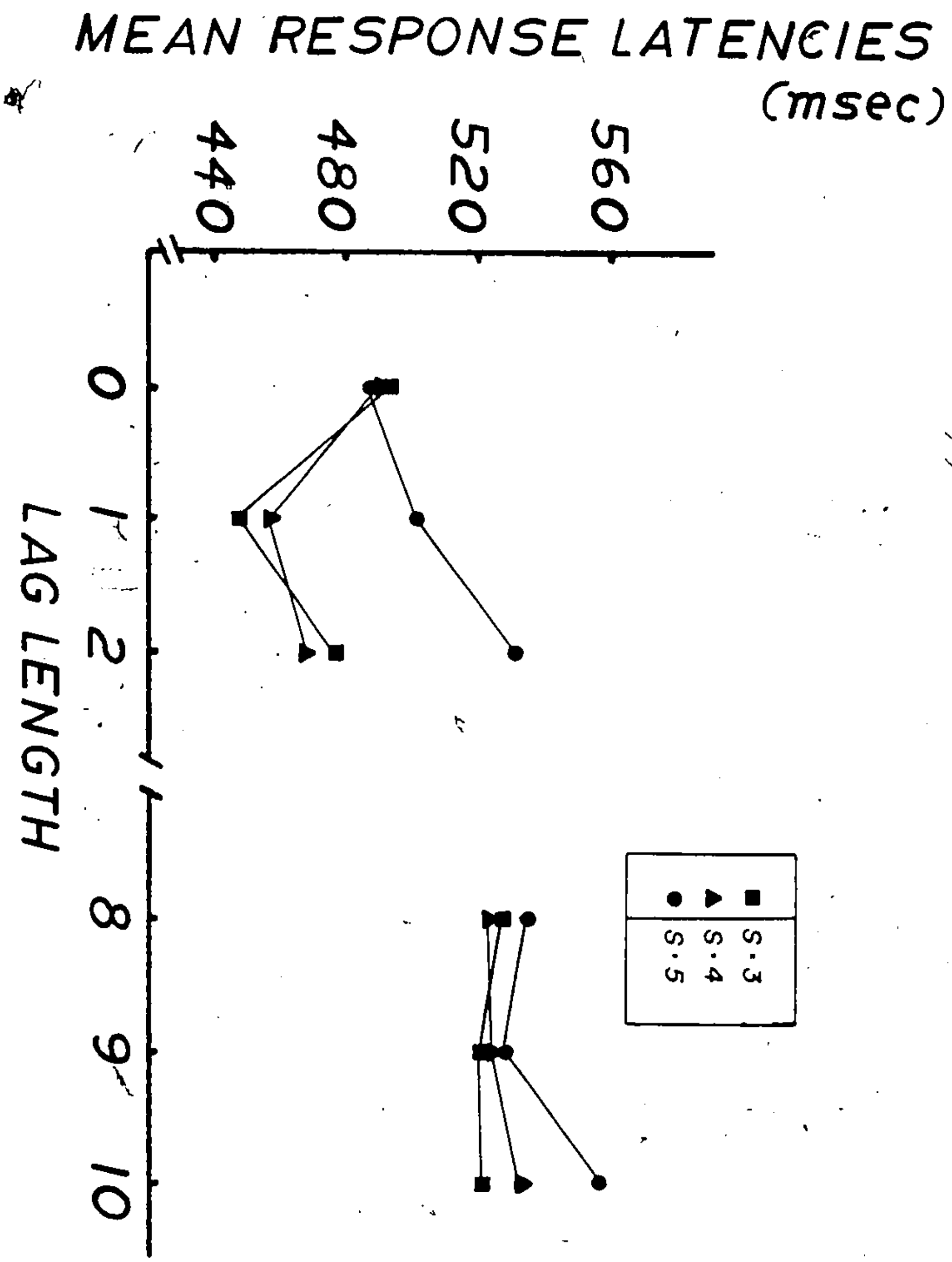
Analysis of Variance

performed on the .25 mean response latencies for lag lengths of 8, 9 and 10

within variables: w(1): set size
w(2): lag length 8, 9 and 10

Findings: w(1): $F(2,10)=3.875$, $p=.0560$
w(2): $F(2,10)=.98$, $p=.5891$
w(1,2): $F(4,20)=1.621$, $p=.2073$

Figure 85: Positive .10 mean response latencies for each short lag and for each long lag interval are shown plotted as a function of lag length for each set size separately, as averaged over the six days of Experiment 4.


MEAN RESPONSE LATENCIES
(msec)
440
480
520
560
0
1
2
8
9
10
LAG LENGTH
S-3
S-4
S-5

.10 Mean RTs for Each Lag Interval

Table 94 Individual subjects' .10 positive mean response latencies for each short lag and for each long lag interval are shown summarized over the six days of Experiment 4 for each set size separately.

.10 ITEM, S=3

S#	lag =0	lag =1	lag =2	lag =8	lag =9	lag =10
1	572.40	412.58	440.00	547.28	508.43	520.47
2	597.92	570.58	634.58	660.89	645.51	696.22
3	467.08	525.33	472.10	555.78	576.17	541.01
4	437.25	391.58	399.83	459.22	472.85	467.72
5	401.25	339.75	390.58	402.07	407.43	408.85
6	476.92	441.08	517.00	538.33	510.60	491.14
x	492.14	446.82	475.68	527.26	520.17	520.90

.10 ITEM, S=4*

S#	lag =0	lag =1	lag =2	lag =8	lag =9	lag =10
1	477.54	484.28	456.50	531.88	528.97	521.03
2	575.92	521.34	565.94	620.38	609.82	662.67
3	511.84	498.46	520.17	569.74	565.37	567.00
4	465.84	397.46	406.41	452.97	492.80	479.29
5	383.13	360.58	371.45	388.25	392.48	387.12
6	527.84	471.63	483.89	576.62	542.50	579.21
x	490.35	455.63	467.39	523.31	521.99	532.72

.10 ITEM, S=5

S#	lag =0	lag =1	lag =2	lag =8	lag =9	lag =10
1	439.08	513.50	592.25	598.83	544.32	619.35
2	530.17	567.75	649.58	620.15	630.74	593.81
3	562.83	510.58	491.42	537.89	518.15	550.74
4	463.42	431.00	417.17	461.46	440.03	519.15
5	387.42	375.00	404.42	426.04	424.50	460.26
6	538.25	605.92	635.67	618.75	609.35	594.46
x	486.86	500.63	531.75	534.85	527.85	556.30

* weighted average of the two .10 items

Analysis of Variance

performed on the .10 mean response latencies for lag lengths of 0, 1 and 2

within variables: w(1): set size
w(2): lag lengths 0, 1 and 2

Findings: w(1): F(2,10)=3.99, p=.0525
w(2): F(2,10)=2.779, p=.1088
w(1,2): F(4,20)=1.534, p=.2300

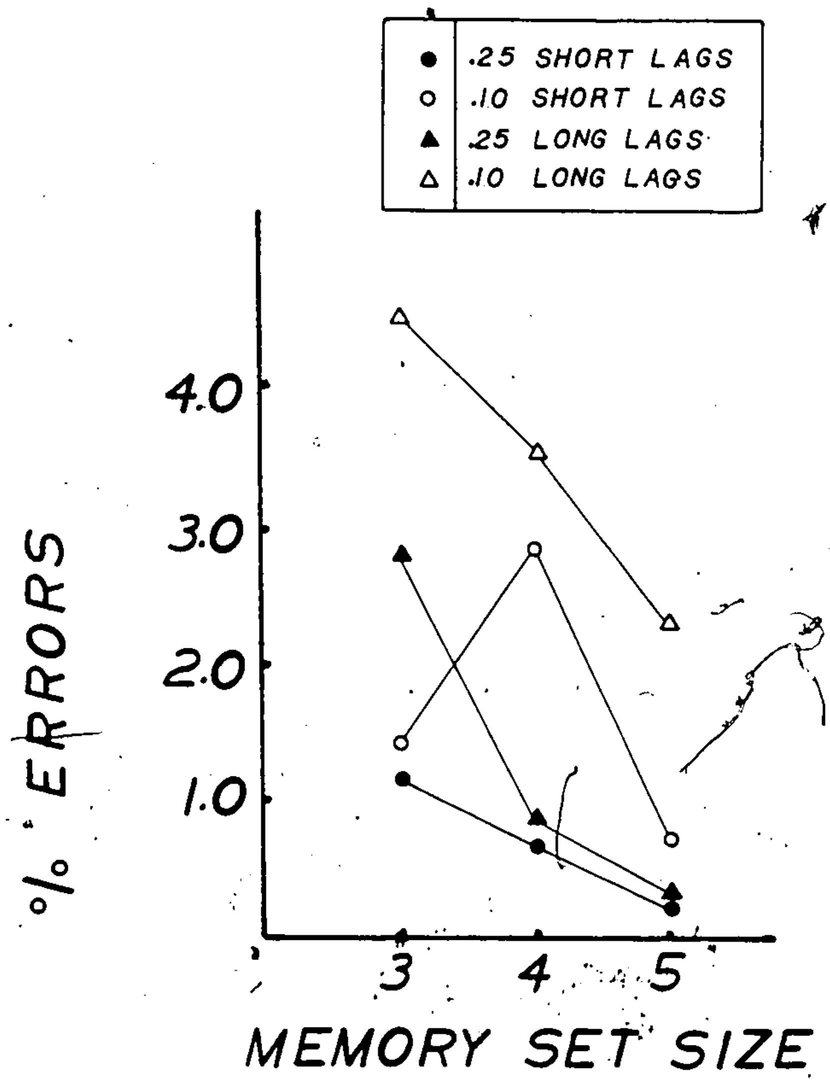
Analysis of Variance

performed on the .10 mean response latencies for lag lengths of 8, 9 and 10

within variables: w(1): set size
w(2): lag lengths 8, 9 and 10

Findings: w(1): F(2,10)=.78, p=.5123
w(2): F(2,10)=2.14, p=.1680
w(1,2): F(4,20)=.76, p=.5640

Figure 86: Positive .25 and .10 percent errors for long and short lags are shown plotted against positive set size for Experiment 4.



.25 and .10 Positive Percent Errors

Table 95: Individual subjects' .25 and .10 positive percent errors are shown summarized for long and short lag intervals over the six days of Experiment 4 for each set size separately.

% ERRORS, .25 ITEMS

	Short Lags			Long Lags		
S#	s=3	s=4	s=5	s=3	s=4	s=5
1	1.72	.00	.00	1.67	.00	1.67
2	1.72	.57	.57	.00	.00	.00
3	.00	.00	.00	3.33	.00	.00
4	2.30	1.15	.00	8.33	1.67	.00
5	.57	.57	.00	1.67	1.67	.00
6	.57	1.72	.57	1.67	1.67	.00
x	1.15	.67	.19	2.78	.84	.28

% ERRORS, .10 ITEMS

S#	s=3	s=4*	s=5	s=3	s=4*	s=5
1	4.17	8.33	.00	1.52	4.55	1.52
2	.00	.00	.00	6.06	3.03	1.52
3	4.17	.00	.00	3.03	.00	.00
4	.00	4.17	.00	7.58	4.55	4.55
5	.00	.00	4.17	3.03	4.55	1.52
6	.00	4.17	.00	6.06	4.55	4.55
x	1.39	2.78	.70	4.55	3.54	2.28

* average of two .10 items

Analysis of Variance
performed on the percent errors of the .25 positive items for short and long lag intervals

within variables: w(1): short vs long lags
w(2): set size

Findings: w(1): $F(1,5)=2.201$, $p=.1969$
w(2): $F(2,10)=4.266$, $p=.0451$
w(1,2): $F(2,10)=1.763$, $p=.2202$

Analysis of Variance
performed on the percent errors of the .10 positive items for short and long lag intervals

within variables. w(1): short vs long lags
w(2): set size

Findings: w(1): $F(1,5)=3.513$, $p=.1184$
w(2): $F(2,10)=2.168$, $p=.1643$
w(1,2): $F(2,10)=1.091$, $p=.3742$

Analysis of Variance
performed on the percent errors of the .25 and .10 positive items for short lag intervals

within variables: w(1): .25 short lags vs .10 short lags
w(2): set size

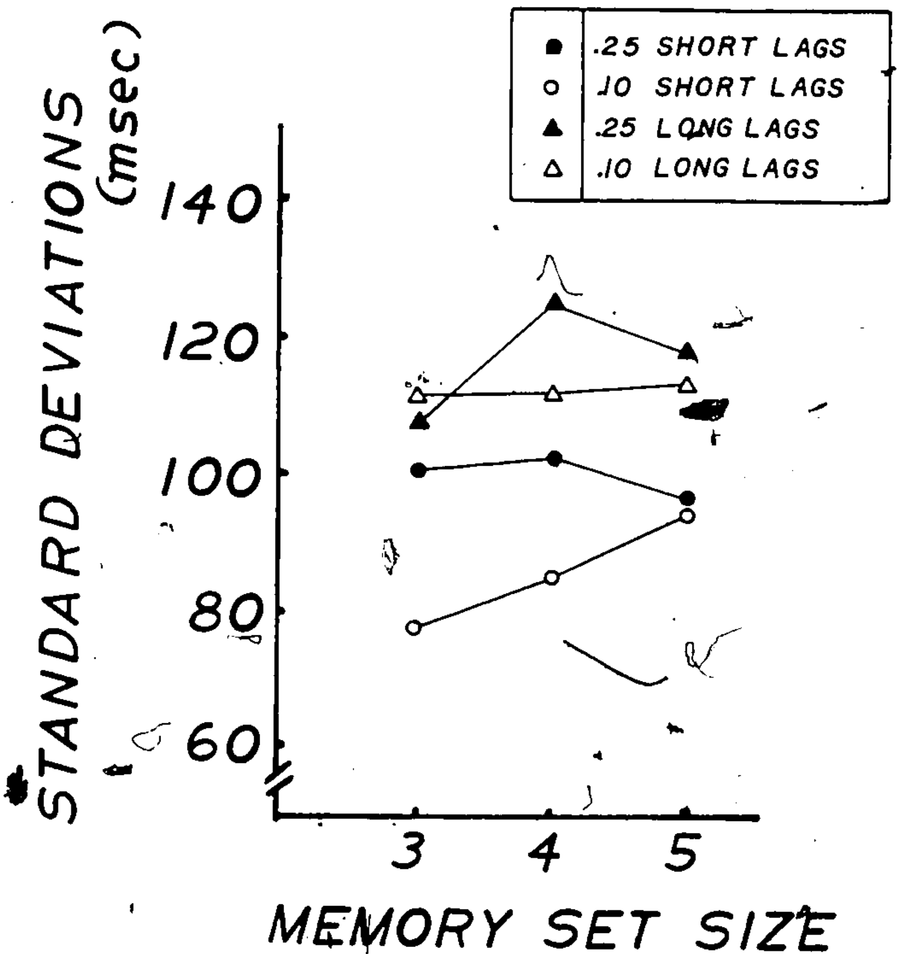
Findings: w(1): $F(1,5)=2.353$, $p=.1845$
w(2): $F(2,10)=1.432$, $p=.2838$
w(1,2): $F(2,10)=.849$, $p=.5405$

Analysis of Variance
performed on the percent errors of the .25 and .10 positive items for long lag intervals

within variables: w(1): .25 long lags vs .10 long lags
w(2): set size

Findings: w(1): $F(1,5)=12.94$, $p=.0159$
w(2): $F(2,10)=5.686$, $p=.0222$
w(1,2): $F(2,10)=.352$, $p=.7151$

Figure 87 : Positive .25 and .10 standard deviation scores for long and short lags are shown plotted against positive set size for Experiment 4.



.25 and .10 Positive Standard Deviations

Table 96: Individual subjects' .25 and .10 positive standard deviation scores are shown summarized for long and short lag intervals over the six days of Experiment 4 for each set size separately.

STANDARD DEVIATIONS, .25 ITEMS

	Short Lags			Long Lags		
S#	s=3	s=4	s=5	s=3	s=4	s=5
1	140.80	94.18	140.07	162.50	146.77	158.91
2	114.15	149.89	141.51	112.46	137.85	146.02
3	111.55	84.66	85.08	76.67	133.89	105.15
4	78.90	84.83	72.91	84.91	116.10	96.88
5	51.26	70.24	54.24	76.93	57.85	73.71
6	106.31	131.27	87.50	133.58	161.35	131.33
x	100.50	102.51	96.89	107.84	125.64	118.67

STANDARD DEVIATIONS, .10 ITEMS

S#	s=3	s=4*	s=5	s=3	s=4*	s=5
1	100.80	111.61	151.18	110.24	115.36	151.20
2	110.08	116.18	96.00	150.63	147.64	143.48
3	58.43	68.73	67.81	130.15	98.59	111.24
4	54.97	70.42	68.02	80.82	110.13	110.16
5	49.96	44.78	53.47	75.15	56.16	67.44
6	91.36	95.85	128.47	124.56	141.40	95.24
x	77.60	84.60	94.16	111.93	111.55	113.13

* average of two .10 items

Analysis of Variance
performed on the standard deviations of the .25 positive items for short and long lag intervals

within variables; w(1): short vs long lags
w(2): set size

Findings: w(1): F(1,5)=9.499, p=.0273
w(2): F(2,10)=.758, p=.5028
w(1,2): F(2,10)=.937, p=.5738

Analysis of Variance
performed on the standard deviations of the .10 positive items for short and long lag intervals

within variables: w(1): short vs long lags
w(2): set size

Findings: w(1): F(1,5)=14.779, p=.0125
w(2): F(2,10)=.779, p=.5116
w(1,2): F(2,10)=.836, p=.5354

Analysis of Variance
performed on the standard deviations of the .25 and .10 positive items for short lag intervals

within variables: w(1): .25 short lags vs .10 short lags
w(2): set size

Findings: w(1): F(1,5)=9.702, p=.0263
w(2): F(2,10)=.525, p=.6112
w(1,2): F(2,10)=1.074, p=.3795

Analysis of Variance
performed on the standard deviations of the .25 and .10 positive items for long lag intervals

within variables: w(1): .25 long lags vs .10 long lags
w(2): set size

Findings: w(1): F(1,5)=.522, p=.5067
w(2): F(2,10)=.715, p=.5160
w(1,2): F(2,10)=.913, p=.5652

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