Organization & Memory

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Data from a series of experiments are reported in support of the context hypothesis developed in this thesis: recall and recognition are affected by the context in which items are perceived and the effects on recognition are most appropriately determined through reaction time (RT) measures as opposed to accuracy measures alone. Data are also reported which demonstrate instructional effects on recognition.

The major independent variables manipulated were mode of presentation (simultaneous or serial), list structure (blocked or random) and practice (one trial or three trials). In addition, both a nested hierarchy and a categorized list paradigm were used as well as a paradigm involving the use of adjective modifiers. The data reported were consistent with the context hypothesis in that, generally, RTs were faster with a serial presentation and with a random list structure, and performance improved with practice. The effect of instructions was to attenuate recall and, especially, recognition effects.

Two major approaches were compared with the context hypothesis and results discussed in those terms; the effective presentation time hypothesis and the dual-process approach. Neither was as effective in explaining the obtained results as the context hypothesis.

The mechanisms involved in the context hypothesis were proposed as being an encoding specificity-variability process affecting encoding and an Atkinson/Juola search and decision process affecting retrieval. Nothing in the data contraindicated these processes.

The context hypothesis is falsifiable, as was demonstrated in the final experiment reported, and is in a stage of development. This thesis reports the beginning phases of this development.

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CHAPTER 1

Recall and recognition are the two most basic and frequently used tests of retention in verbal learning. Recall requires the reproduction of a set of previously learned material, generally in the absence of specific cues. Recognition requires the making of a judgment as to whether or not a presented stimulus item was part of the learned set of items, or judging which of two or more stimuli were in the set of learned material. Most commonly the to-be-learned material consists of words, but may also be sentences, nonsense syllables, letters, or other verbal material.

Currently there is some controversy as to whether or not recall and recognition involve the same underlying processes, one side of the controversy maintains that the underlying processes are the same while the other maintains that recall and recognition are qualitatively different. Postman, Jenkins & Postman (1948) maintain that recall and recognition are alternative tests of retention and that observed differences in performance between these measures are the result of threshold differences. The dual-process approach, as proposed by Kintsch (1968, 1970) for example, asserts that recall and recognition are qualitatively different; recall involving a search and a decision process while recognition involves only a decision process. The internal representation of an item in memory is regarded as directly accessible and any decision as to its membership in the specified set is made purely on the basis of a strength or familiarity criterion, in recognition. In recall the item must first be located and then a decision made on the basis of its strength or familiarity.

Mandler (1969) holds a position between these two opposing schools of thought in that he proposes a system in which items in a recognition task are directly accessed but if the strength criterion is not sufficient for a decision to be made the subject then searches his memory set of the learned items and makes a decision based on the presence or absence of the item from that set.

This distinction between uni-process and dual-process theories of recall and recognition is important to the development of the hypothesis which is at the core of this thesis and which will be developed later in this chapter.

Retrieval from memory is conceived of as a search and decision process, at least for recall, and this view is accepted by most contemporary psychologists (Bower, 1972; Shepard, 1966; Tulving, 1968; Yntema & Trask, 1963), and in fact has a very long history.

The search concept of memory was central to Aristotle's definition of recollection (retrieval or remembering). Recollection was a process of searching the contents of the mind to locate a particular memory. Furthermore, the search did not start from any arbitrary point in memory. A person trying to recollect would choose a 'relevant' place in memory from which to begin the search and, more or less systematically, would begin to examine the contents of his memory. The following quote serves to illustrate this point:

> "And thus whenever someone wishes to recollect, he will do the following. He will seek to get a starting point for a <u>change</u> after which will

> be the change in question. And this is why recollections occur quickest and best from a starting point. For as things are related to each other in succession so also are the changes." (from Sorabjii, 1972, p. 55)

Aristotle also explains why it is that sometimes one can remember something and at other times cannot remember the same item, even though the memory exists for the person:

> "...the reason why one sometimes remembers and sometimes does not, starting from the same starting point, is that it is possible to move to more than one point from the same starting point." (from Sorabjii, 1972, p.56)

Also, it should be noted that Aristotle proposed at least two kinds of recollective processes; one in which we start with an image of the thing (item) and only after passing through a series of associated images, i.e., searching, do we manage to refer the image to the thing, secondly, we may start by passing through a series of associated images and reach the image of the thing at the end of the process when we recollect. These two recollective processes are, essentially, recognition and recall, respectively. Both processes are regarded as involving a search component and are thus very much like a uni-modal model of recognition and recall.

An implication of the Aristotelian model of memory is that memory is structured. It is assumed that starting points can be found which are relevant for the memory search required and that this search can be directed along appropriate lines, usually. Additionally, memory was regarded as a function of the three laws of association; contiguity, similarity, and contrast. These relationships formed the basis for the structure of memory and were instrumental in terms of the directing of the search process, from choice of an appropriate starting point to following a line of association.

The Aristotelian conceptualization of memory was the dominant one for almost two thousand years and was the basis for the theories of memory and knowledge developed by the British empiricists. Other conceptualizations of memory did exist during this two thousand year period but they were, for the most part concerned with what Yates (1966) called the 'art of memory' or mnemotechnics, and were regarded as a part of the then important art of rhetoric. Basically, this was applied memory theory since the art of memory consisted in the application of various techniques to assist recall of material. The most famous technique was the architectural place mnemonic attributed to Simonides (ca. 500 B.C.) and described by Cicero (ca. 100 B.C.) and Quintillian (ca. 65 A.D.), and detailed in the Ad Herennium. This technique was based securely on the principles of organization such as associating ideas or topics with parts of a house and then, in the mind, walking through the house and retrieving the ideas or topics in the order of the 'walk', i.e., in the order in which the associated retrieval cues are found. This technique is very similar to the "one is a bun, two is a shoe, ..." mnemonic described by Miller, Galanter & Pribram (1960). In the terms of Miller, Galanter & Pribram the architectural place mnemonic would be an example of a 'plan'.

Albertus Magnus (ca. 1250) and his student, Thomas Aquinas, integrated the Aristotelian theory of memory with the techniques from the Ad Herennium to produce a theory of memory which was essentially Aristotelian, but was more detailed and elaborate. This theory, as most of the others before it, emphasized the organizational aspects of memory and memorizing and the structure of memory.

Rene Descartes (ca. 1630) proposed a somewhat different view of memory from that of the Aristotelian tradition. Descartes viewed memory as a reductive process in that one could, according to Descartes, reduce memories to their causes or simplest elements and from these elements one could later derive the specific memories.

> "This would be done through the reduction of things to their causes. ...When one understands the causes all vanished images can easily be found again in the brain through the impression of the cause. This is the true art of memory ..." (Descartes, <u>in</u> Yates, 1969, pg. 360).

This is similar to the approach taken by Miller (1956) when he introduced his concept of 'chunking'. This also is an approach to memory which implies a structural component.

While the effect of Descartes on modern science is great indeed, his effect on the development of theories of memory has not been as great. More influential were the British empiricists. The British empiricists disagreed with Descartes over the doctrine of innate ideas and followed a line of theorizing more like the traditional Aristotelian. The effect of the British empiricists has been great indeed and the associative tradition begun by Aristotle and enhanced by the British empiricists has dominated psychology for many years.

In brief, the position of the British empiricists was that knowledge was the direct result of sensory experience or reflection upon sensory experience and the laws which regulated knowledge were associative laws. Hobbes (1651) regarded reason as the dominant factor in guiding man's behaviour and the lawful succession of ideas was seen as responsible for all thought and action. This lawful succession of ideas was described in terms of the Aristotelian law of association by contiguity. John Locke (1700) attacked the Cartesian concept of innate ideas, as had Hobbes, and proposed that all knowledge comes as a result of sensory experience or reflection on sensory experience. He resurrected the Aristotelian notion of the 'tabula rasa' or blank slate which characterized the mind of the infant and upon which experience wrote. Locke pointed out that ideas were combined in experience according to the laws of association by contiguity and by similarity. Others in the British empiricist tradition expanded upon and elaborated these concepts, for example; James Mill, John Stuart Mill, Alexander Bain, and Herbert Spencer. These associationist ideas have dominated psychological, as opposed to philosophical, approaches to memory that have been developed in the past 100 years.

A more nearly contemporary psychologist who viewed recall as a search process was William James. His view of memory search was very similar to that proposed by Aristotle and is described by James as follows:

> "In short, we make search in our memory for a forgotten idea, just as we rummage our house for a lost object. In both cases we visit what seems to be the most probable <u>neighbourhoods</u> of that which we miss. We turn over the things under which, or within which or alongside of which it may possibly be; and if it lies near them it soon

> comes to view." (James, 1890, p. 654, Vol. 1, Dover edition)

The association of ideas was gradually replaced in psychology by the concept of association between stimuli and responses and by the development of a viewpoint which emphasized the importance of behaviour, per se. Behaviourists such as J. B. Watson regarded psychology as:

> "... that division of natural sciences which takes human behaviour - the doings and sayings, both unlearned and learned, of people as its subject matter." (in Marx & Hillix, 1963, p. 139)

The rise of Behaviourism effectively sounded the death knell for concepts such as memory search and for a cognitive approach to psychology in general. Behaviourism took a position of extreme objectivity; only observable behaviour which could be measured was to be considered. Any events which were unobservable and unmeasurable had no place in the science of Psychology since they could not be scientifically studied.

One psychologist who maintained a cognitive point of view during this period of Behaviourism was F. C. Bartlett. Bartlett (1932) viewed memory as a reconstructive process in which material was learned by a reductive process, similar to chunking as proposed by Miller (1956), and recalled at a later date by reconstructing it from the 'schema' (chunks). This approach also has elements similar to plans as proposed by Miller, Galanter & Pribram (1960). Bartlett's view is also very similar to that proposed by Descartes (1630). It must be pointed out that, in fact, Bartlett's schema might have an overall structure and also, chunks are really only a special case of schema.

Bartlett investigated very complex memory tasks such as memory for faces, stories, and so on. The formation of schema is the reductive process involved in learning the material and may be described as a process of abstraction since it is a process of condensing information without necessarily making a kind of shorthand, rather, a precis is used as a schema. Bartlett regarded a schema as an active organization of past reactions or experiences and stated that whenever there is any order or regularity of behaviour, a particular response was possible only because the schema had been related to similar responses made in the past. These similar responses are regarded as having been serially organized but they operate as a whole, a 'unitary mass', rather than as unitary items in a sequence. According to Bartlett (1932):

> "Remembering is not the re-excitation of innumerable fixed, lifeless, fragmentary traces. It is an imaginative reconstruction built out of the relation of our attitude towards a whole active mass of organized past reactions or experiences, and to a little outstanding detail which commonly appears in image or in language form. It is thus hardly ever exact, even in the most rudimentary cases of rote recapitulation, and it is not at all important that it should be so." (p. 213)

The contemporary interest in the organization of memory and the development of an organizational approach to the study of memory appears to stem from a study by Bousfield & Sedgewick (1944) which investigated the characteristics of sequences of associative responses. They observed that subjects tended to emit responses in clusters of related items. The problem of quantification of this phenomenon was the primary one which stood in the way of pursuing this approach further. This was the same problem which faced psychologists who wished to counter the Behaviourist point of view. Bousfield (1953) developed a method for the quantification of "clustering", as he called it. A cluster was defined by Bousfield as "a sequence of associates having an essential relationship between its members" (Bousfield, 1953). The quantification mentioned is an estimation of the degree to which subjects tend to cluster items from presented categories, in excess of chance clustering, given that the items were presented in random order. The essence of this measure and its interpretation was an associative one. Since the development of this measure several other measures of clustering or organization have also been developed. Shuell (1969) has presented a review and comparison of many of the measures developed as of that time.

ORGANIZATION AS EXPERIMENTER-DEFINED CLUSTERS

The term usually applied to organization which is measured as a function of the experimenter-defined clusters is "category clustering". Typically (see Bousfield, 1953) a list of items is presented in which a number of categories are represented with a number of exemplars in each category. The measure of organization is some function of the number of 'repetitions' observed in recall, a repetition being the consecutive recall of any two items from the same category.

The degree of clustering evidenced by this measure is dependent upon the subject discovering <u>and</u> using the experimenter-defined category membership relationships inherent in the list. To the extent that the subject does not discover or use these category relationships in recall the measure will tend to underestimate the actual level of organization which might be present. In any case, the experimenter can never be certain that the relationships observed are the same as those used by the subject.

Some measures of category clustering depend upon an assumption of equal availability of items for recall and this is not a realistic assumption as indicated by the work of Tulving & Pearlstone (1966). However, in some situations such a measure may be the only one which is feasible, even with the drawbacks indicated, e.g., in single recall-trial experiments.

CLUSTERS AND CHUNKS

Miller (1956) developed what has come to be known as the "unitization hypothesis". This is an account of the way in which the apparently limited capacity of immediate memory could be overcome. This limited capacity was determined to be on the order of 7±2 items (words, numbers, letters, ...). Subjects in memory experiments overcome this limitation, according to Miller, by a process of 'chunking' in which items are grouped on some basis of similarity, into chunks and these chunks are encoded. In recall the chunk is recovered and decoded to yield the items it contains. This proposal is very similar to the system proposed by Bartlett (1932) as well as by Descartes in his "Rules for the Direction of the Mind" in which he proposed that the effect of repetition was to permit the organization of many separate parts into one unit (cited by Miller, 1956, p. 3).

The limit of immediate memory has been regarded as 7±2 chunks instead of 7±2 individual items. The content of a chunk is determined by rules, e.g., redundancy, category membership, transformational rules, and others (Miller, 1958). It thus is evident that items are placed into chunks on the basis of their similarity along one or more dimensions, and the basis of judging similarity is a function of the rules used.

Clusters are merely one kind of chunk, a chunk for which the apparent rule is that of category membership. If it is accepted that various bases exist for grouping, it then becomes obvious that at least one of the drawbacks to measures of clustering is that the only acceptable basis for this measure is category membership. A subject may produce a highly organized recall protocol on a basis other than this rule, resulting in a unrealistically low clustering score.

ORGANIZATION AS SUBJECT-DEFINED CLUSTERS

Tulving (1962) developed a measure of organization which did not depend upon the experimenter-determined basis of the organization inherent in the list. This measure was called "subjective organization" (SO) since the basis of the organization was determined by the individual subject. The measure is derived from information theory and is a type of redundancy measure. One drawback of this measure is that it requires a multitrial acquisition procedure since the measure requires information gathered over two or more trials. The major import of this form of organization approach is that it emphasizes the control of the subject over the way in which the presented information is processed for storage and eventual recall.

ORGANIZATION AND RECALL

The issue of the relationship between organization and recall is independent of the nature of the measure used to quantify the organization. However, this is not necessarily a desirable state of affairs. If a theory of organization and a measure of organization were more congruent then the evidence for the theory would be more relevant. At the present time, this aspect of organization is decidedly underdeveloped. It is not the purpose of this thesis to devise and implement new measures of organization, but it is of some importance to the development of the experimental work that the problems of measurement in organization theory be alluded to, and the separation between (for most cases) measurement and theory be stated.

Some authors regard organization as a prerequisite for recall. Mandler (1967), Tulving (1962, 1968), and by implication, Miller (1956) all regard organization as a necessary condition for recall. On the other side, Carterette & Coleman (1963) have suggested that organization is a function of recall since increments in subjective organization were found to follow increments in recall. This is a decidedly minority view.

Any of the models of memory which are based on organization concepts support the view that recall is a function of organization (Johnson, 1972; Kintsch, 1970). The position adopted in this thesis is that a form of organization is essential for recall, and also has an effect on recognition. However, the measures of organization currently available are not completely adequate to expose the level of organization which may in fact be present. This is a matter which will be dealt with in more detail later in this thesis.

TYPES OF ORGANIZATION

Models of memory with an organizational basis may be divided into three classes: (1) hierarchical models, (2) context models, and (3) associative network models. These classifications refer to relatively broad classes and not to mutually exclusive theoretical positions. The types of organization referred to are a function of the properties of the data base rather than a function of the properties of any 'system' of memory. That is, the term 'structure of memory' has been used, in the past, to refer to the memory system as comprised of sensory memory, short-term memory, etc. (for example, see Atkinson & Shiffrin, 1968). In this thesis the term structure refers to a systematic organization of words or word-attributes and verbal knowledge in general.

Shepard (1966) regards learning and recall as organization and search processes respectively. This position is central to contemporary organization theories regardless of the specific way in which the functioning of the organization process is viewed. Shepard also demonstrates a cognitive view of man in that he regards man as "... an active agent with a definite, hopefully decipherable, internal structure. The ubiquity of evidence for processes of searching, grouping, and ordering in recent studies suggests to me that these processes represent neither occasional lapses nor epiphenomena of this underlying structure. They represent, I believe, its fundamental modus operandi." (p. 204). This view is reflected in the models of memory structure which will be discussed. It should be borne in mind that there is a high degree of overlap between some of the various models.

(1) HIERARCHICAL MODEL

Mandler (1967), working from Miller's (1956) unitization hypothesis, developed a theory of memory based on principles or organization which was designed to handle the results of word-list learning studies. This model was not intended to handle explanations or predictions from studies using syntactic or sequential material such as language. Mandler proposed a memory structure which was hierarchical and in which words, or word equivalents (logogens - see Morton, 1964) are organized into chunks, with a limit of 5±2 words or units per chunk. These chunks are, if necessary, organized into higher level chunks via a recursive process, the end product of this process being a hierarchy. The limits of the hierarchy in this model are five chunks per level and five levels. An outline of this model is given in Fig. 1-1.

Mandler (1967) relates the hierarchical structure established during the experimental session to the lexical store. He states that in most cases the experimental situation utilizes the subject's knowledge of the existing organization of his lexical store although some new

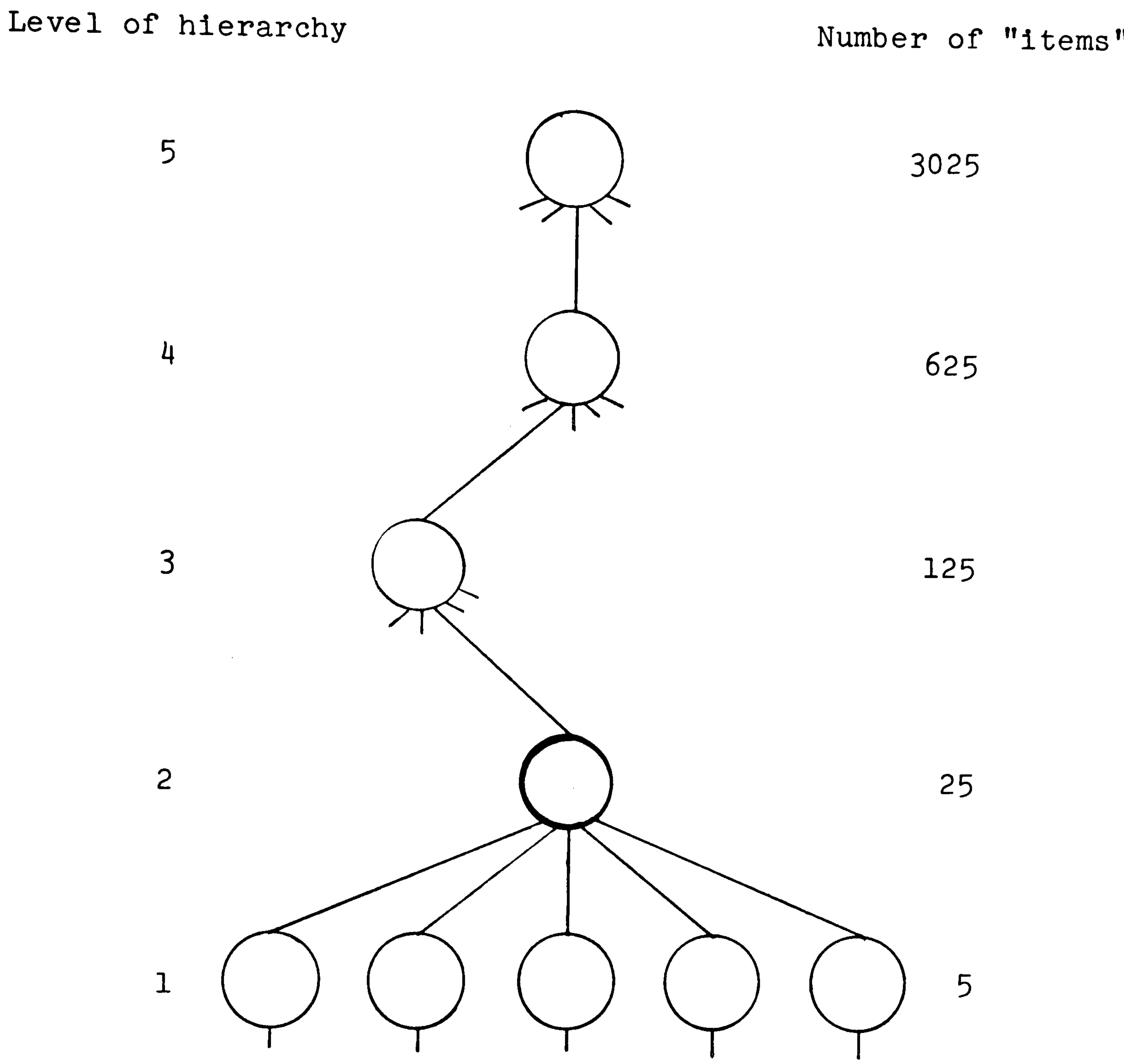


Figure 1-1. Outline of Mandler's (1967) hierarchical model of memory. The levels of the hierarchy are given as well as the number of list items that can be held, in terms of potential retrievability, by each level of the hierarchy. The chunk capacity is regarded as 5±2 items or units.

organization may be used to accommodate unusual words or clusters. This relationship between the situationally determined hierarchy and the organization of lexical store is similar to the relationship between episodic and semantic memory proposed by Tulving (1972). This relationship is important in the development of the major hypothesis of this thesis.

Mandler (1968) extended the position he had adopted on the relationship between the experimental organization and the organization of the subject's lexical store when he formally stated the assumption that permanent memory for words and their attributes is also stored as a hierarchy. In addition to words forming part of a hierarchy Mandler (1968) also makes the assumption that words are independently categorized in terms of their features.

In the hierarchical system the fact that words are part of one hierarchy does not preclude them from being, at the same time, parts of other hierarchies, particularly in the lexical store. Mandler uses the term "lexical store" to refer to a memory store which is analogous to a combined dictionary and thesaurus which contains information about the denotative and connotative definitions of words as well as information about the inter-relationships, both formal and idiosyncratic between words. The formal inter-relationships would be those of, for example, category membership, while the idiosyncratic inter-relationships would be those particular to the experience of the individual subject both before and during the experimental episode.

An assumption made by Mandler (1967) which is most pertinent to this thesis is that of the transcience of the experimentally formed hierarchies. Mandler assumes that these hierarchies probably outlive the experimental situation by only minutes, or perhaps hours. A similar assumption is made by Feigenbaum (1970) in the development of his concept of "acquisition memory" in his EPAM model. This acquisition memory is also hierarchically organized and the nature of the hierarchy is determined as a function of the perceived experimental situation, i.e., by the task demand characteristics, instructions, environment, and similar variables. An implication of the transcience assumption is that the experimentally established transient structures may have an effect on the performance of subsequent tasks which use the same verbal material but for which the task demand characteristics differ.

Mandler (1967) makes the point that the meaning of a word is a function of the position of the word within the hierarchy, and this apparently means both the experimentally established hierarchy and the hierarchy which exists in the lexical store. The hierarchy in this case may be thought of in terms of 'context' and a restatement of this point in terms of context would be that the meaning of a word is a function of the context (semantic) in which it is perceived to occur and which leads to its placement in a particular location within the hierarchy. Throughout this thesis the term context shall refer to semantic context unless otherwise indicated.

There is some experimental evidence to support the concept of context effects as mentioned above. Light &

Carter-Sobell (1970) demonstrated that the effect of altering semantic context between acquisition and recognition testing resulted in an impairment of recognition performance in terms of accuracy of recognition. Furthermore, the encoding specificity principle (Thomson & Tulving, 1970) leads to the same prediction from the statement that a cue is only effective in promoting retrieval of an item if it has been encoded with that item at the time of input or acquisition. Thus, one might expect that if the transient hierarchy were established for one set of task demands it might not contain appropriate information to facilitate the performance of a different task; i.e., if the hierarchy were established to meet recall demands it might not support recognition task demands based on the same material.

Johnson (1970) conceives of memory structures in terms of hierarchies and also bases his model of memory on the groundwork of Miller's (1956) unitization hypothesis. In terms of structural detail Johnson's (1970) model and Mandler's (1967, 1968) models are essentially the same. However, Johnson specifies the recoding (chunking) and the decoding (retrieval) processes in greater detail than does Mandler and Johnson does not make any assumptions regarding either the transcience of the heirarchies or the importance of perceived context for the determination of the word meanings.

(2) CONTEXT MODEL

Kintsch (1970) proposed a 'marker theory' of memory. This theory is similar to those produced by some psycholinguists, e.g., Katz & Fodor, (1963). In this section some reference will also be made to psycholinguistic models although the focus of such models is not the focus of this thesis. There are many points of similarity, conceptually, between theories such as Kintsch's marker model of memory and Katz & Fodor's model of a semantic theory.

In Kintsch's (1970) model each word presented in a memory experiment is encoded as a list of markers. There are three classes of markers identified by Kintsch; sensory, phonemic, and semantic. Of the three classes of marker that is regarded as most important is the semantic marker. A summary of Kintsch's model is contained in the following quote:

> "The model proposed is a marker theory of memory. Each word is encoded as a list of markers. A marker, at least in the case of semantic markers ... is in general another word. Thus far, the model is an associative network: each entry in memory consists of a list of references to other entries. However, different types of markers will be distinguished. In this sense the model is no longer an associative network, but it contains different kinds of relationships of which associative relations are one." (Kintsch, 1970, p. 352)

According to Kintsch, meaning provides the most important principle of organization in memory and the meaning of a word is defined by its relationships with other words. A word has no meaning by itself, but meaning in the system is given entirely by context. "A formal unit is meaningful because it can be located somewhere in a semantic field." (Kintsch, 1970, p. 354). The concept of a semantic field provides one way for approaching a definition of meaning as a function of the way an item is entered into and stored in memory - as a list of pointers to other words or features. It should be noted that in this model Kintsch points out that only <u>relevant</u> semantic markers are used to encode word meanings. The implication of this argument is that the relevance of a semantic marker is determined by the perceived context of the word, both semantic and environmental, although only the semantic marker is of importance in the model at this stage.

Norman & Rumelhart (1970) proposed a model of memory in which context is assigned a major role. In this model, however, context is a rather vague concept since Norman & Rumelhart are not specific as to what exactly they consider context to be. It would appear that context in this model includes the environment (experimental situation) as well as the semantic context in which an item occurs.

The flow of information through this model is from a sensory register which acts as a feature extractor and which leads to a 'naming' response based on a comparison of the extracted features with 'lexical' entries in the internal dictionary. The output of this naming dictionary is represented as an ordered list of attributes which are formed into a 'memory vector' which then contains the name of the stimulus item. Each item or attribute in the memory vector has attached to it information about the context in which it has occurred. Retrieval is regarded as a reconstructive process. The following quote makes clear the processes of the model involved in recalling and in recognizing:

> "In recall we assume that we are given the contextual information, and that we use that to try to recreate the individual attributes. In recognition we are given the attributes and we try to recover the contextual information. We talk as if we store,

> remember, and retrieve individual attributes. Actually, we operate only on their links and associations." (Norman & Rumelhart, 1970, p. 27)

Norman & Rumelhart make two major assumptions about memory in their model; the first is that memory is content-addressable permitting the retrieval of attributes without a lengthy search process, and the second is that contextual information can be retrieved in the same way.

(3) ASSOCIATIVE NET MODEL

The models so far discussed can be demonstrated to be, in actual fact, associative network models. However, Bower (1972), Anderson (1972), and Anderson & Bower (1973) have proposed models which they have explicitly named as associative network models of memory and in which the memory storage format is a network of associations.

Anderson (1972) views the 'data base' of a person's memory as "... a complex associative network and our model for free recall consists of operations for marking subgraphs of that associative network." (p. 320) It should be noted at this point that a hierarchy would be one possible subgraph.

The term 'association' is used as a generic name for a large class of different types of relations between items rather than specifying a single type or class of relationship. Anderson produced a computer simulation of this model of memory which he called FRAN and in which the memory structure consisted of a network of labelled associations between words, and the associations were of an all-or-none nature, i.e., there were no gradations of associative strength. The form of an association was <A<B>R>>, i.e., A has the relation R to B, where R may be any one of many possible, but specified, relations.

During acquisition three processes occur; (1) the tagging of words, (2) the discovery and tagging of associative pathways between list words, and (3) the updating of 'good' recall starters in what was called an ENTRYSET. In recall the words which exist in short-term store are recalled first and then access is made to ENTRYSET and the words stored there are obtained. These words in ENTRYSET serve also as cues for the recall of additional list words, i.e., the ENTRYSET is a list of words which are tagged, during acquisition as good starting points and cues for recall.

Since all words are represented as a subgraph, of which short-term store and ENTRYSET are a part, then a search proceeds in a depth-first manner. This means that a particular branch of the subgraph will be searched, from top to bottom, to exhaustion before any other branches are searched.

A further point of interest in the FRAN model is that each word recalled is marked as having been recalled, and temporary failures of the marker may account for the fact that some subjects will repeat a previously recalled item. When no further list words can be reached from a starting point in ENTRYSET the next starting point is accessed and the retrieval process repeated until all the accessible starting points have been searched and all the accessible nodes from each starting point have been examined. In addition, it is assumed that a recall trial also serves as an additional acquisition trial.

Anderson & Bower (1973) presented a model of human associative memory which they called HAM. This model was a more sophisticated and elaborate version of FRAN. Associations, per se, were replaced by a propositional basis <u>for</u> associations. The input and output systems of FRAN were replaced with more complex systems, but the rationale for FRAN and HAM, at the base level, remained the same.

In HAM, Anderson & Bower evolved a model more akin to some of the models proposed by psycholinguists than had heretofore been presented. The notion of a propositional basis for associations was more like the propositional basis of language structure found in, for example, Katz & Fodor (1963).

A further class of models, some of which have been briefly mentioned, are those drawn from linguistics and psycholinguistics. While there are many points of similarity between such models and those presented in this chapter, the basic premises differ. Linguistic models are primarily concerned with the ways in which language exists and functions in communication. Sentences tend to the prime focus in these areas whereas, for the purposes of this thesis the major manipulandum consists of words and their interrelationships. Bransford & Franks (1971), Katz & Fodor (1963), and Chomsky (1965) have all developed theories which are of relevance to the study of organization in memory and which are also relevant to the points made so far in this thesis. However, since their main thrust goes considerably beyond that of this thesis they are not reported in additional detail, except to note their contribution to the study of organization or structure in semantics and related areas.

Katz & Fodor (1963) have been mentioned frequently and it is perhaps relevant to present an example of at least a portion of their theory as it applies to the concerns mentioned to this point. Fig. 1-2 presents an illustration of the dictionary entry for the word 'bachelor' in the Katz & Fodor (1963) model. A dictionary entry is characterized as a hierarchically organized complex of grammatical markers, semantic markers, distinguishers, and selection restrictions.

"Bachelor" is marked as a noun (grammatical marker), and may be 'human' or 'animal' (semantic markers), and which may be a 'male' who has (a) never married (b) is a young knight, (c) has the lowest academic degree, or (d) is a young fur seal without a mate during the breeding time (distinguishers).

The similarity between an approach as exemplified above and those mentioned previously in this thesis is obvious. Also, it is clear that the implications of such a model for memory are similar to those previously mentioned as, for example, Kintsch. A model such as that presented here is a good example of a structured lexical entry.

MECHANIZMS OF ORGANIZATION

(1) RETRIEVAL PLANS: Tulving (1968) viewed organization as something which occurred as the end result of a retrieval plan. Tulving's position was that during learning the subject establishes a retrieval plan and the subsequent organization is a function of the particular retrieval plan

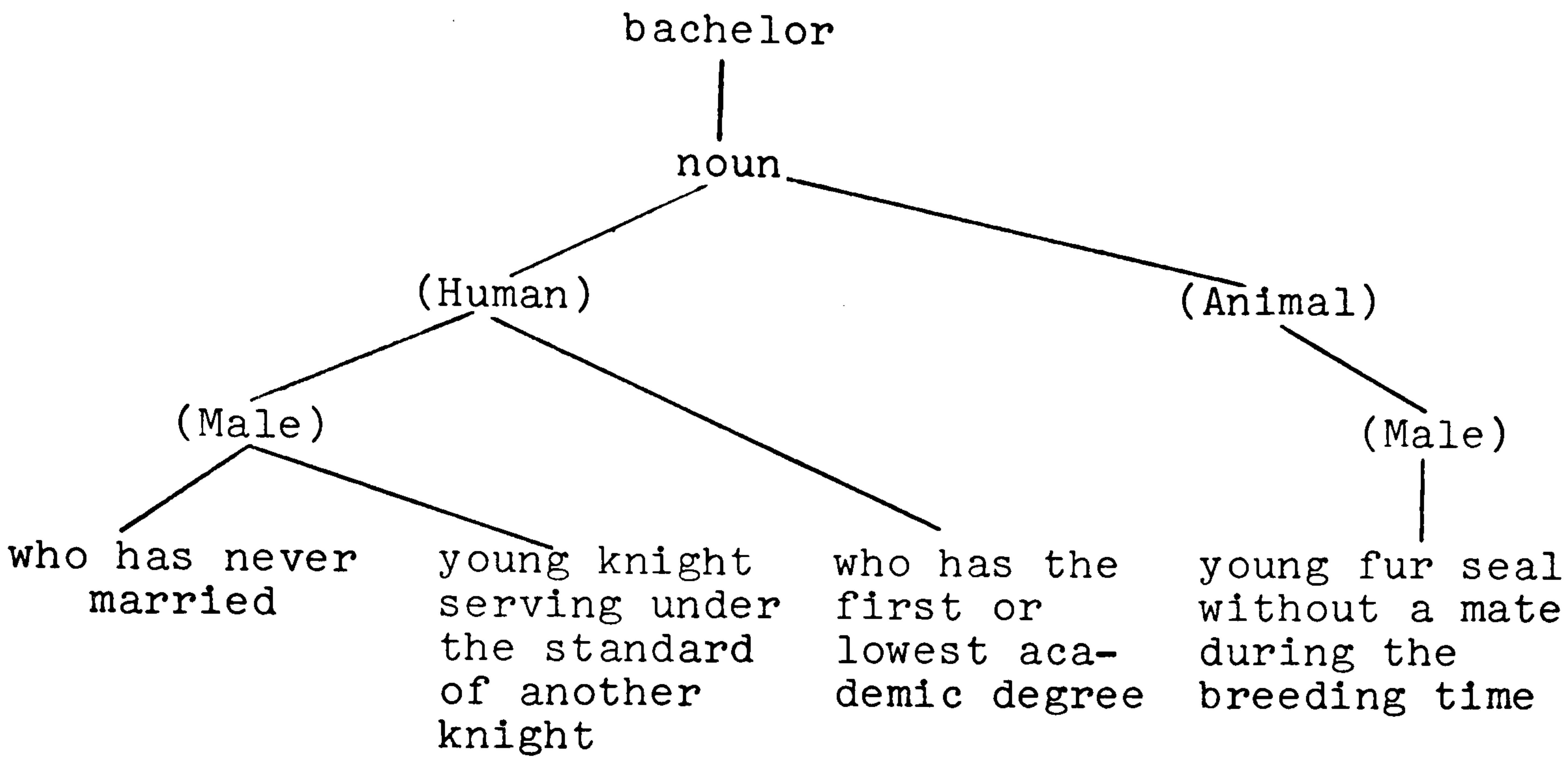


Figure 1-2. An illustration of the structure of a lexical representation for the word 'bachelor' based on the theory of Katz & Fodor (1963).

devised. The specific nature of the retrieval plan is dependent upon the requirements of the task, as perceived by the subject, and upon the relationships which are perceived as extant between the items of the word list. Also, the strategy adopted by the subject in performance of the task will directly affect the retrieval plan.

In many ways the position adopted by Tulving (1968) is similar to that of Atkinson & Shiffrin (1968) as presented in their control process theory of memory. Examples of some of the control processes would be selection (an attentional process), rehearsal, the establishment of response or decision criteria, among others.

Since organization is, according to Tulving (1968) a function of a retrieval plan which is, in turn, a function of the task demands, it then follows that if one were to perform two tasks in succession, using the same verbal material and having different task demands for the two tasks, only the first set of which was known to the subjects, then any memory structure established under this situation would not likely be appropriate for performance of the second task. One would expect to obtain transfer effects in this situation which would be a function of the differences in the demand characteristics of the tasks and the information coded relevantly for both tasks. This is essentially the same position reached by Mandler (1967, 1968) through a consideration of the experimentally derived memory structure as a transient thing, the general structure of which was hierarchical and the detailed structure of which was a function of the demands of the task.

Bower (1972) proposed the existence of an "executive monitor" in the memory system. This monitor performed two tasks. First, the executive monitor attempted to find a function or relation between what was known and new material which was to be learned, and secondly, if such a function was found it was then used, together with supporting material, to generate the new material. That is, the executive monitor searches for functions or relations during retrieval in order to generate the list items which were learned. Others who have postulated systems similar to an executive monitor are Miller, Galanter & Pribram (1960), Neisser (1966), and Anderson & Bower (1973). In its most basic form an executive monitor is a system which assists in the establishment of a retrieval plan during acquisition.

Bower (1972) distinguished between four types of retrieval plans. These plans were based on rules and were thus functions of the operation of the executive monitor. The four types of retrieval plans were: (1) generative rules, (2) pegword systems, (3) hierarchical systems, and (4) associative chaining.

A generative rule is a concept characterizing a subset of an entire population of items. For example, category membership could be a generative rule and could be used to assist in the chunking of items during acquisition and in the subsequent decoding of the chunks during output. The type of system appropriate to the use of this kind of rule would be one like Kintsch's (1970) dual-process system. In this system, members of the relevant category would be generated by the rule and then checked against the occurrence information associated with that item. A decision would be made on the basis of the occurrence information as to whether or not the item obtained was a list item.

Pegword systems generally require the existence of previously learned specific items with which the newly learned items could be associated, for example, the "one is a bun is a ..., two is a shoe is a ... " system which was mentioned earlier in this chapter. In this system retrieval is facilitated by the retrieval of the pegword and consequently its associated item from the new list. Another source of pegwords could be category labels, which Tulving & Pearlstone (1966) have shown can function as very powerful retrieval cues. Bower (1972) states that:

> "... the implicit category cueing which subjects often use as a retrieval plan is not very far removed from the generative rule and the pure pegword retrieval systems. The categories are like concepts that characterize the word-list in obvious ways and they can be used for generating pieces of that list; and the subject's implicit cueing of his recall by his discovered and remembered categories has all the features of a self-made pegword system." (p. 115)

The third retrieval plan distinguished was the hierarchical system. A list of semantic categories is regarded as a first-order retrieval plan but if the list of these categories is very long then one has the problem of remembering the semantic categories. Mandler (1967, 1968) has shown that subjects can use a hierarchical plan for retrieval, beginning at the top node and unpacking the hierarchy in a downward direction by a recursive process of decoding. Bower, Clark, Lesgold & Winzenz (1969) have also demonstrated that a hierarchical structure can be very powerful in facilitating free recall performance and recognition performance.

The fourth retrieval plan distinguished by Bower (1972) was the associative chaining plan. Bower argues that this plan is characteristic of the plans used by <u>most</u> subjects in memory experiments. The basis of the associative retrieval plan is the determination of relationships (associative) between items during acquisition and the marking of these relationships. The process is regarded as a continuously ongoing one which operates during both recall and acquisition trials. According to Bower (1972) a subject using this strategy establishes a few 'starters' or 'entry points' from which to begin his recall. These entry points are items which serve as good cues to aid the retrieval of further list items and they are, by implication, easily memorable in their own right. This notion of entry points is a basic property of both the HAM and FRAN models of memory as discussed earlier.

(2) <u>ENCODING SPECIFICITY AND VARIABILITY</u>: Johnson (1970) stated that; "Two responses are identical only in so far as they are the same in terms of both their content and the organization imposed on that content." (p.225). Tulving (1972) stated that the encoding specificity principle "emphasizes the importance of encoding events at the time of input as the primary determinant of storage format and retrievability of information in the episodic system." (p. 392). Martin (1968) proposed a somewhat different principle when he proposed the encoding variability hypothesis, postulating that the same nominal stimulus may be

encoded in a variety of ways on a variety of occasions. This hypothesis is very similar to the "replica theory of memory" proposed by Bernbach (1969), as well as being in agreement with multicomponent trace theories such as those proposed by Bower (1967), Wickens (1970), and Underwood (1969). The concept of encoding variability and its relation to encoding specificity is particularly important for this thesis as is the approach that words are encoded by their attributes.

According to Bernbach's (1969) replica theory, whenever an item is presented or rehearsed for a long enough period for it to be processed by the perceptual system an internal representation of the item is produced and is stored in memory. This representation is called a replica. These replicas need not be identical and, in fact, are not likely to be absolutely identical. Although an item may be encoded in may possible ways it is only encoded one way at a time, i.e., any individual encoding is highly specific. In this way the encoding specificity principle and the encoding variability hypothesis may be regarded as subprocesses of a single encoding principle, namely that an item is encoded with respect to its perceived environment (physical and semantic). This environment may change and any encodings will reflect this change, whether the change is real or perceived.

(3) INTERACTION OF DIFFERENT TYPES OF MEMORY: Tulving (1972) distinguished two kinds of memory, episodic and semantic. Episodic and semantic memory are regarded as two systems that receive information from other systems, such

as the perceptual system, that retain aspects of this information, and that transmit aspects of this information to other systems, such as the response system, when necessary.

> "Episodic memory receives and stores information about temporally dated episodes or events, and temporal-spatial relations among these events. ...While the specific form in which perceptual input is registered into episodic memory can at times be strongly influenced by information in semantic memory - we refer to the phenomenon as encoding - it is also possible for the episodic system to operate relatively independently of the semantic system." (p. 395-386)

Episodic memory is idiosyncratic and contains a record of experience. The typical laboratory experiment constitutes an entry into episodic memory.

> "...semantic memory is the memory necessary for the use of language. It is a mental thesaurus, organized knowledge a person possesses about words, their meaning and referents, about relations among them, and algorithms for the manipulation of these symbols, concepts and relations. Semantic memory does not register perceptible properties of inputs, but rather cognitive referents of input signals." (p. 386)

An output from semantic memory can be entered into the episodic memory and also information can be transmitted from, and most likely is, episodic memory to semantic memory, or to the output system, or both. In terms of the kinds of models previously presented in this chapter semantic memory may be regarded as a data base, a storehouse of information which may be called upon by episodic memory. It is the semantic system which contains the attributes of words and also contains information about the relationships between words. The episodic system contains information about past experiences and often, it is likely, some of this information has become a part of semantic memory.

ORGANIZATION AND RECOGNITION

The dual-process theory ascribed to Kintsch (1970) maintains that organization has no effect on recognition since organization affects retrieval and there is no retrieval component to a recognition task. In recognition the presented items are directly accessed and checked for occurrence information. There is a good deal of recent evidence which contradicts this position.

Mandler (1972) stated that: "Recognition requires both occurrence information and organization information, though there may be different emphases in different situations." (p. 141). Mandler, Pearlstone & Koopmans (1969) found that recognition performance was a function of the degree of organization of a list of words with organization measured in terms of the number of categories used in a sorting task. Recognition in this case was measured by both Hit Rate (HR) and d'. A positive correlation was obtained between recognition performance and the number of categories into which the subject sorted words with some degree of consistency. It should be noted that the subjects in this experiment were only permitted to use between two and seven categories, thus the task was not a free sorting task but was a limited sort.

Mandler (1972) reported a study in which the degree of opportunity for organization was varied along with the type of filler or distractor item, and the level of occurrence information. Mandler found that discriminability between list words and distractors, as measured by d', decreased as organization decreased and that semantic confusions in the recognition task increased as organization decreased. Mandler concluded that organization does affect recognition performance and also that both occurrence and organization information are used by the subjects in recognition tasks. Mandler also reported evidence which strongly suggested that subject's assign occurrence information at recall as well as at input and he interprets this as providing additional support for the idea that organization has an effect on recognition performance. The argument was that presumably an item is recalled only if is is retrieved and retrieval is a function of organization, hence an occurrence tag placed at time of recall is, in a sense, dependent upon organization. The basis for this line of argument is that recalled words are recognized better than are non-recalled words. It therefore appears reasonable to conclude that occurrence information is assigned at time of recall as well as during acquisition.

Mandler (1972) stated the evidence for the case that organization affects recognition performance as follows: first, as organization increases there is an increasing discriminability of old from new items and a decreasing tendency to confuse conceptually related items; second, specific occurrence tags are unaffected by the degree of organization. In addition, it appears that processes which occur during recall are more important in determining recognition of an item than mere presentation of the item, and the effect of organization factors increases with time. The latter notion is supported by the fact that recognition performance was superior for subjects with high degrees of organization after a two week period had passed since acquisition of the items.

Kintsch (1968, 1970, 1972) regards occurrence information as the sole determinant of recognition performance. However, this is not the actual situation which is supported by most available evidence. According to Mandler (1972); "... occurrence tags preempt the recognition process when items are relatively unorganized and recent, but with increasing organization as well as with older and weaker tags, organizational processes tend to dominate." (p. 162-163)

Additional evidence which supports the position that organization affects recognition performance comes from studies concerned with the effects of changed semantic context on recognition. While these studies do not in an unequivocal manner demonstrate organization processes operating in recognition tasks it is difficult to see how an occurrence tag point of view adequately deals with the results obtained from studies such as those conducted by Light & Carter-Sobell (1970), and Tulving & Thomson (1971). Kintsch (1972) modified his position slightly and, while still not regarding organization as having any significant effect on recognition performance, he proposed that recognition involved pattern matching while recall involved pattern completion. This formulation appears to be able to handle context effects and is also amenable to an interpretation based in organization terms. A pattern can be thought of as an organized system of components and a single item might be able to exist with various different patterns, depending on the specific coding employed. Bernbach's (1970) model presents a mechanism for the existense of different patterns for essentially the same item, as do most multicomponent models of memory. If this is the case then the nature of the organization of the pattern might determine the 'recognizability' of an item. In the sense in which the word pattern is used here it may refer to a grouping or associating of inter-related items as well as to a grouping of attributes which act to define a word and which might be affected by contextual information. In other words, it appears that Kintsch and other dual-process theorists are unwilling to accept that organization might have an effect on recognition and that retrieval processes might be involved in recognition as they are in recall, but not necessarily in the same way. It is a central point of this thesis that recall and recognition both involve, to some extent, retrieval processes and are thus affected by organizational variables. The reason for the emphasis placed on Kintsch is that he is currently among the foremost of the dual-process theorists and he has stated his position quite clearly.

COMPARISON AND LIMITATIONS OF CURRENT POSITIONS

According to Norman (1973) in order to represent the meaningful component of memory properly we need a richly inter-connected network structure but this structure can be described in many different ways depending on the theoretical bias of the experimenter. A richly inter-connected network structure may be described as labelled digraphs, lists, formulas in the predicate calculus, or as hierarchies, but all of these can be derived from an associative network in which there are various kinds of associations extant. For example, associations based on category membership, shared attributes, syntagmatic relationships, formal relationships, functional relationships, phonemic and graphemic similarity, are all types of possible relationships which may be derived from information available in an associative network. One can establish directed paths from one item to another or others on several bases and by applying a recursive operation one can derive hierarchical structures from associative networks. Thus, apart from the particular biases of the experimenters, all the models discussed so far can be regarded as being based on richly connected networks of associations or relationships, at least in terms of the data base or semantic memory.

When we examine a hierarchical model such as Mandler's (1967) model it is clear that this is basically a model of short-term memory and the proposal that the data base is hierarchical can be viewed as the result of recursive operations applied to an associative network. It would appear reasonable, and parsimonious, to assume that semantic memory is best represented as a richly interconnected associative network and that hierarchical and other structures are merely special cases within this structural framework. Also, the work of Kiss (1973) illustrates the potential richness of the associative network.

Tulving (1968) regarded organization as a process of establishing a retrieval plan or plans during acquisition. The hierarchical models proposed by Mandler (1967, 1968) and by Johnson (1970) are concerned with possible and plausible retrieval plans which are based on the concept of 'chunking' and then 'superchunking' or forming higher level chunks which subsume the lower level chunks. Bower (1972) mentioned four possible retrieval plans and regards associative chaining as the plan most commonly used by subjects in memory experiments. It is possible that this says more about the nature of the experiments than about the essentialness of this plan. An important point to note however is that the plans are under the control of the subject. This concept is one which has been elaborated and developed into a theory of memory by Atkinson & Shiffrin (1968).

It is clear that the models presented to this point are not mutually exclusive on objective grounds, rather the emphases of the models are somewhat different, one concentrating on hierarchical structures, another concentrating on propositional relations, and so on. A basic assumption of this thesis, based on the preceding discussion, is that the various types of models illustrated are not fundamentally different and that all may be regarded as having a richly interconnected network or associations as a data base.

According to Norman (1973) there are three basic principles underlying learning memory structure:

> "If three basic principles are used in learning memory structure, then many of the simple hierarchical structures studied in recent years by psychologists interested in the organization of memory emerge. The three principles would seem to be:
> 1. No forgetting or erasure: once information is entered within the network, it stays.
> 2. Generalization: the process by which information common to a number of nodes can be added to higher level nodes.

3. Discrimination: the process by which one node is subdivided into two, each with a set of features that discriminate them from one another and with common features remaining on a higher level node." (p. 354)

There are several limitations apparent in each of the types of model presented but the major limitation, from the point of view of this thesis, is that none of the models, as presented, can handle the change of semantic context effect in recognition. None of the models can adequately handle the relationship between free recall and recognition and in a more general sense none of the models can give a response to an object or description of an object. This last limitation is of more concern to psycholinguists than to the issues addressed in this thesis.

Anderson & Bower (1973) state that their model, in its present form, cannot handle the change of semantic context effect on recognition performance. No provision is made for context information to be encoded and utilized in a manner pertinent to this effect. However, as an aside to this thesis, it might be possible that with only minor modifications a component could be incorporated into this model which would permit the handling of the change of semantic context effect and not alter the rest of the model.

Mandler (1972) presents data which are consistent with the proposal that organization has an effect on recognition but he makes no provision for differential task-demand effects nor, in any direct manner, for subject-controlled strategy effects. Mandler's model also, in its present form, cannot handle the change of semantic context effect. Light & Carter-Sobell (1970) while presenting an explanation of the change of semantic context effect do not present a model which will account for the effect within a more general framework.

It is clear that none of the models presented to this point can handle the change of semantic context effect in recognition, and this effect constitutes the core area of this thesis. Any model purporting to represent memory processes should be able to handle this effect as well as recall and other recognition effects.

CONTEXT HYPOTHESIS

Light & Carter-Sobell (1970) concluded that any particular word might be represented in semantic memory in a number of different ways, each different way corresponding to a somewhat different interpretation of the word. If a word is encoded with respect to a particular interpretation and later the word is accessed there exists a likelihood that the encoded representation might not be the one which is accessed. A contention of this thesis is that semantic context has an effect on this likelihood and that this effect is reflected in recognition performance.

A bare outline schematic of the structure and flow of information through memory during acquisition is presented in Fig. 1-3. This outline does not indicate the control processes which operate during acquisition. When an item is input to the system it first enters a sensory register at which time features are extracted (phonemic and graphemic, for example) and this feature list is passed to semantic memory where a comparison is made and a 'name' is obtained along with a set of attributes appropriate to that

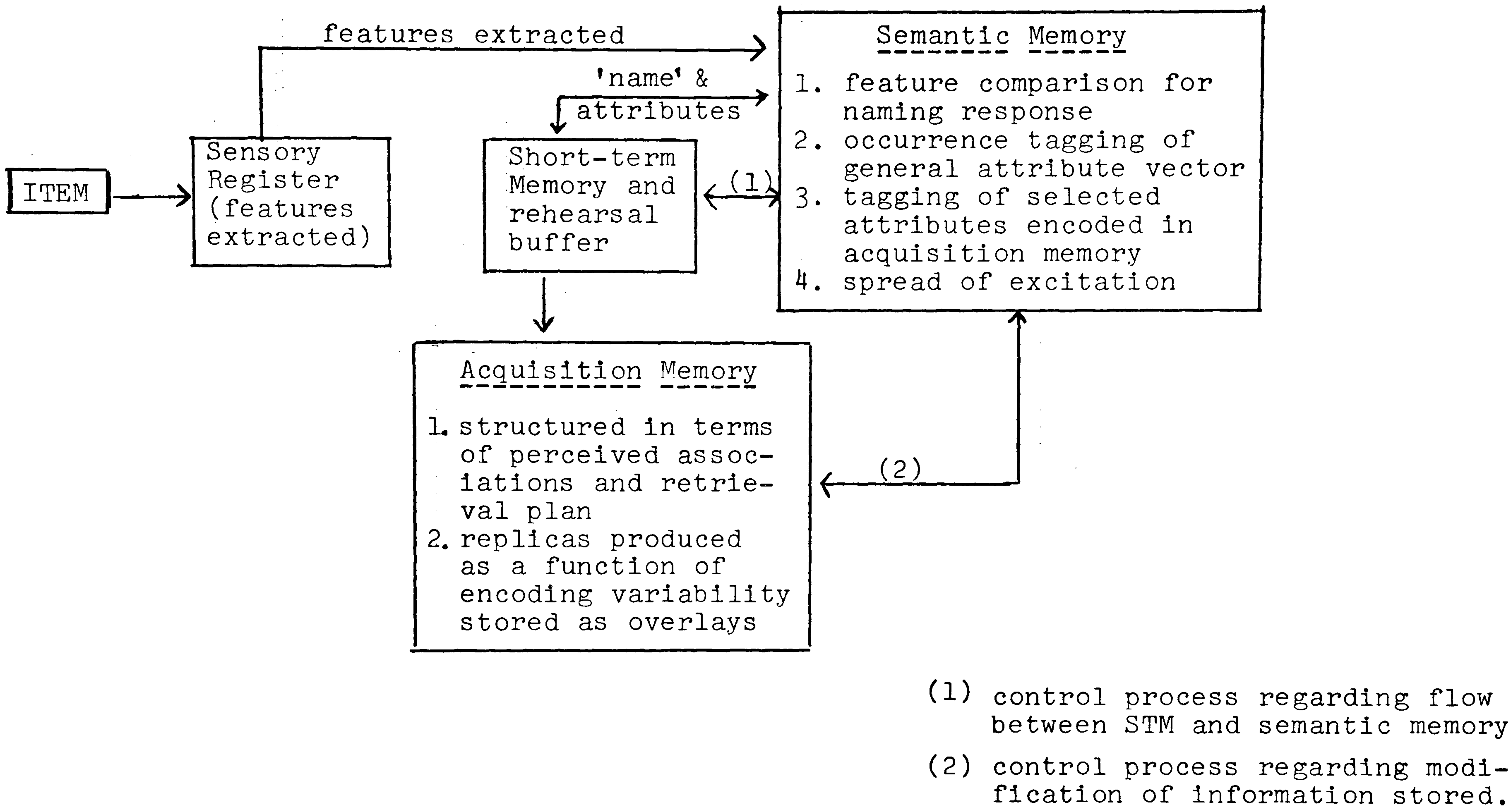


Figure 1-3. A general schematic illustrating the flow of information through the memory system and some of the components of various parts of the system.

name. The 'name' is passed to short-term memory as a general attribute vector and is maintained in STM via the rehearsal buffer. As other items enter the system the same process is repeated but as they enter STM they are compared to the contents of STM and attributes from the general vectors are selected to represent the interpretation of the item considered most relevant to the needs of the situation. These needs and the relevance check are control processes and are under the control of the subject. The modified attribute vectors are passed to acquisition memory in which the storage format is determined in terms of a retrieval plan. This retrieval plan develops as a function of the perceived task requirements and in conjunction with the perceived inter-relationships between the items in the to-be-learned set. The general attribute vector is tagged in semantic memory for occurrence the first time it is passed back and the attribute vector encoded in acquisition memory is also tagged for occurrence in semantic memory as having been entered into the acquisition memory. This process continues throughout the presentation of the list and for as long as the subject can or will rehearse the items.

Attribute selection and rehearsal are regarded as control processes under the control of the subject. Any particular encoding is highly specific, reflecting a particular interpretation and accompanied by a specific attribute vector. However, on each presentation and on each rehearsal these specific attribute vectors may differ to some degree from each other. This process reflects the change in information as new relationships are uncovered by the subject and as the subject's strategy changes and other variables, e.g., attention, also vary. This essentially reflects encoding variability. The degree of difference in the encodings is a function of the amount of variability in possible interpretations which exists in the learning set. Semantic context operates on this factor; as semantic context is constrained the level of encoding variability decreases, and vice versa. Also, replicas are encoded as overlays, i.e., a second item is not encoded but information is added to or deleted from the previous encoding.

In recall, the usual process would involve output of the contents of STM, most likely beginning with the rehearsal buffer, followed by output of the contents of acquisition memory. The form of the output from acquisition memory follows the structure imposed in this memory as a function of the retrieval plan established. As each item in acquisition memory is accessed for recall a strength check is applied. If the item meets the strength criterion it is output, else semantic memory is accessed and the strength associated with the item in that store is checked. If the item meets this criterion it is output otherwise the search is continued for an item to output or until the criterion of when to stop recall has been met.

Allowance must be made for the occasional recall of non-presented items. It is assumed that when items are accessed in semantic memory there is some spread of excitation throughout the associative network from the accessed nodes (see Meyer & Schvaneveldt, 1971). In such a situation one can expect occasional intrusive errors. Also, an occurrence tag may fail on occasion and this would account for the repetition of an already recalled item. Tulving & Pearlstone (1966) have demonstrated that while all items in a learned list might be available, not all are accessible at all times. However, both types of errors tend to be rare.

Atkinson & Juola (1972) presented a model of recognition memory which utilized two criteria, C_n and C_o. In this model the subject was presumed to access a representation of a recognition test item directly. When the item had been accessed the subject checked its familiarity value. If the value was less than C_n, the subject immediately responded 'new' or if the value was greater than C_o, the subject immediately responded 'old'. If the value were intermediate to these criteria the subject searched the memory set of the learned items and made a response based on the outcome of this search. This is essentially the model of the recognition <u>process</u> used in this thesis and is illustrated in Fig. 1-4.

The effect of semantic context on recognition is to constrain the tagging of representative interpretations in semantic memory. These particular interpretations are tagged only when they have been transferred from acquisition memory and hence reflect the contents of acquisition memory. As encoding variability decreases as the result of increase in level of constraint on semantic context information the number of interpretations encoded and tagged in semantic memory decreases. The effect of this is to decrease the

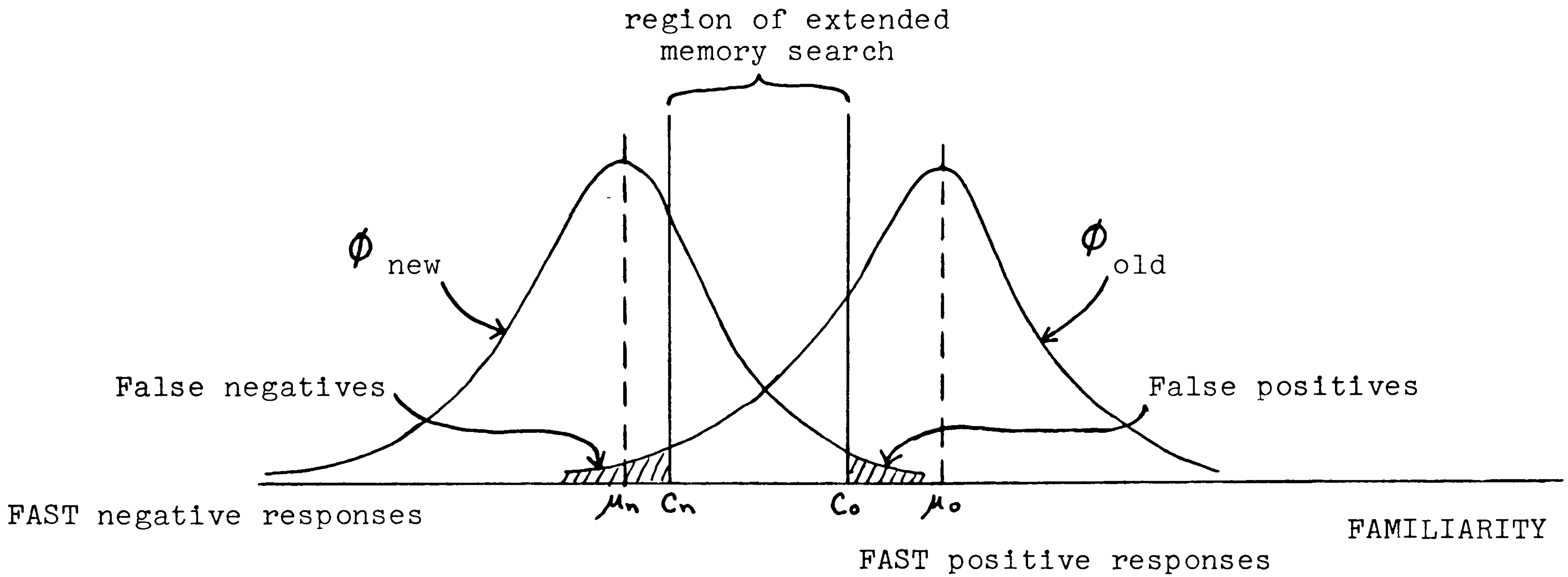


Figure 1-4. Representation of recognition processes as proposed by Atkinson & Juola (1972)

likelihood that a tagged interpretation will be accessed during a recognition test. Recognition accuracy might not be affected by such a process, particularly since recognition performance differences may be obscured by ceiling effects, but recognition latencies should be sensitive to this process. The more frequently a search operation has to take place the longer should the overall reaction times be. This is the most general prediction of the context hypothesis. More specific predictions will be made and investigated in the following chapters.

CHAPTER 2

The purpose of this chapter is to present the results of some experiments which were designed to test implications of the context hypothesis developed in the previous chapter. The background and the rationale for the use of the paradigms chosen will be discussed and the results obtained will be discussed in terms of the context hypothesis as well as in terms of possible alternative hypotheses.

The paradigms used for all the experiments of this thesis were variants of the "blocked versus random" presentation paradigm using categorized lists. In a blocked (BLS) presentation the subject receives the list items in an organized manner, generally in terms of their category membership, i.e., all the items from the first category, then all the items from the second category, and so on through the entire list of items. In a random (RLS) presentation the order of the list is independent of their category membership and is random. Categorized lists are constructed by creating a list of categories and then choosing a number of exemplars for each category, these exemplars then form the list of to-be-learned items.

Two other factors which were varied in these experiments were mode of presentation; items were presented sequentially, one at a time (Ser) or items were presented simultaneously (Sim), also, the subjects received either a single trial for acquisition or three trials for acquisition. After each trial a free recall was obtained for each subject.

Kintsch (1968) used a blocked - random presentation with categorized lists and tested for the effects of organization on recognition performance. It should be noted that in this case, as in most studies using categorized lists, the organization deemed acceptable was experimenter-determined. Organization was assessed in terms of the degree to which the subject reproduced the organization inherent in the list, as determined by the experimenter. Kintsch reported no effect of organization on recognition performance. This study has been criticized on the grounds that Kintsch confounded his testing procedure with the word-frequency of the list items and distractor items. D'Agostino (1969), in a replication of Kintsch's (1968) experiment but with better controls, found an effect of organization of recognition performance such that recognition was better in the blocked condition than in the random condition, although the effect was a small one. Recognition was defined by D'Agostino as the difference between the number of items correctly recognized and the number of errors. The possibility has been pointed out in the preceding chapter that accuracy measures of recognition may not be sensitive enough to in fact discriminate differences due to organizational factors; they may be maximally sensitive to "strength" factors such as conditions of practice.

Bower, Clark, Lesgold & Winzenz (1969) argued that the manipulation of structure information via the blocked - random paradigm was, at best, a weak manipulation and that the weakness of this manipulation had resulted in some ambiguity in the various results reported in the literature, as witness the differences between the Kintsch (1968) and the D'Agostino (1969) results. To overcome this inherent weakness in the technique Bower, et. al. (1969) developed a technique in which a categorized list was created consisting of nested categories arranged in a hierarchical fashion, as illustrated in Fig. 2-1 . The labels form part of the to-be-learned list as well as the exemplars of the categories and subcategories.

Bower, et. al. (1969) presented a series of these categories to subjects in either a blocked or a random form. The results of these studies indicated that the paradigm produced an extremely powerful effect of blocking on free recall as well as an effect of blocking on recognition. In both cases the effect was such that performance in the blocked condition was superior to performance in the random condition. In the recognition task there was a higher hit rate and fewer false alarms in the blocked condition than in the random condition.

A word sorting task is another technique which has been used in the study of organization effects on recognition and which bears further mention. Mandler, Pearlstone & Koopmans (1969) used such a technique and reported significant effects of organization on recognition performance as well as the more standard finding of a facilitative effect of organization on free recall. In addition, Mandler (1972) presented evidence indicating that performance effects were such that recognition effects remained potent over time for high levels of organization but fell off quickly for low levels of organization. These results were interpreted as indicating that subjects used both occurrence

ANIMAL

WILD		DOMESTIC	
HUNTER	PREY	PET	FARM
LION	SQUIRREL	HAMSTER	BULL
TIGER	DEER	PIGEON	DONKEY
FOX	ZEBRA	CAT	SHEEP

<u>Fig. 2-1.</u> Nested hierarchy for superordinate ANIMAL and for a blocked presentation.

and organization information for encoding purposes but as organization increased the dependence on occurrence information decreased. In terms of the context hypothesis this could be restated as that when organization increases the level of encoding variability decreases with replicas becoming more and more similar. A measure of performance efficiency would be sensitive to this occurrence while a measure of power would not be, e.g., reaction times (RT).

In a pilot study which investigated the effects of type of items on recognition performance it was observed that subjects tended to respond very quickly to some items and less quickly to others. No RTs were obtained in this study and the differences observed appeared to be independent of the type of item per se. More importantly, it appeared to be the organization of which the items were a part which determined whether they would be responded to quickly or slowly. This observation was consistent with results of organization effects on recognition reported in the literature.

If a subject has relatively limitless time in which to make a recognition response he is able to peruse his memory at will and his performance will generally be very high. Along with this, it will be impossible to assess if any searching at all was performed of the memory set. A typical recognition test involves presenting a single item and asking the subject whether or not it appeared in the list of to-be-learned items. The accuracy with which the subject can do this may reflect the effects of occurrence information and not the effects of organization information since this effect is one which would alter the process of deciding to respond 'old' or 'new' and not the decision itself.

If the 'meaning' of a word is dependent upon the semantic context in which it is perceived to occur then a word presented in isolation will be in a degraded state of semantic context at least. A word presented in the presence of an inappropriate cue will be in a changed context. In both cases there should be an effect of semantic context. In the situation in which a word is learned in a 'list context' and is later presented in isolation for a recognition test, the probability that an encoded representation will be accessed is a function of the number of possible representations which have been encoded, i.e., encoding variability. Thus, to the extent that the encoding of a word is variable recognition performance will be facilitated since the probability of accessing an encoded representation is assumed to be a function of the number of different replicas which are encoded.

The result of an increase in encoding variability, vis-à-vis an entire list, should be a decrease in average RT for correct responses to 'old' or target items. The opposite would also be predicted, i.e., as encoding variability decreases average RTs increase due to constraints upon the number of different replicas encoded. More specifically, it should be the case that RTs for the RLS condition should be shorter than RTs for the BLS condition. The following experiments were designed to examine the implications of the context hypothesis with respect to the effects of organization on speed of recognition (as measured by RT) as well as on accuracy of recognition and to compare the results obtained through the two approaches.

EXPERIMENT 1: Simultaneous presentation

METHOD

Subjects and Design: The subjects were 24 undergraduates of the University of Stirling who were enrolled in the Part 1 Psychology program. The subjects participated in the experiment in order to fulfill a course requirement.

The design was a 2 x 2 factorial with fixed factors and with six subjects per cell in the design. This was a between-subjects design and subjects were assigned to the treatments on a randomized basis. The dependent variables were the probability of correct recall (Prl), the degree of clustering (Cls), the probability of correct recognition of target items (Prn), a non-parametric index of sensitivity $P(\bar{A})$, and reaction times for correct responses (RT). The independent variables were the list structure (blocked - BLS, or random - RLS), practice (one trial - 1T, or three trials - 3T), and the interactions of these factors.

Apparatus and Materials: The apparatus consisted of a Kodak Carousel projector, a rear-projection screen, a tape recorder, a digital timer (with millisecond resolution), and a data transfer unit to record the RTs on punched paper tape. A pair of response keys labelled 'old' and 'new' were in front of the subject as was a red 'ready' light, the purpose of which was to indicate, at the appropriate time the presentation of an item in the recognition test phase. A photocell was placed in front of the lens of the projector which was equipped with a solenoid operated shutter. When a slide was presented using the project-shutter apparatus the photocell would be illuminated and would activate the timer. When the subject made a response the shutter would close, the RT would be punched on the paper tape and the response would be recorded by the experimenter and finally the next slide would cycle into position for the following trial.

The materials consisted of a hierarchically nested category (animals), an example of which is given in Fig. 2-1. It should be emphasized that the category labels formed a part of the list and were to be learned. The words were typed on a sheet of paper (A4 size) and were presented to the subjects for approximately 60 seconds, i.e., average time available for study was approximately 3 seconds per item. The individual words were photographed and made into transparencies along with a number of distractors. The distractors were from the same categories as the targets and were of approximately the same Thorndike-Lorge frequency and associative frequency. The items were all selected from the Battig & Montague (1969) category norms. The Thorndike-Lorge frequencies ranged from six to AA. There were the same number of distractors as target words.

Procedure: Each subject was told that he was going to take part in two separate experiments and the first one was a free recall experiment. The subjects were told that they would see the list of items for 60 seconds and they would be given 90 seconds for recall immediately following each presentation of the list. The subjects were also told whether they would see the list three times or only once. In addition, in the 3T condition the subjects were told that the order of the words would be the same on each trial. This was done in order to create a situation in which it was assumed that organization and structural information would be maximized. The recall instructions were standard free recall instructions and the subject was asked if he understood the task and if he had any questions. Any questions were answered at that time.

Following the completion of the recall task the subjects were told that the second task was a recognition test of the material they had just learned. The subjects were not told about this task prior to acquisition in order to minimize the likelihood that they would choose to encode the material in a manner specifically designed to aid performance in a recognition test.

The subjects were instructed that they would see a red light. This light would signal them to prepare for the presentation of an item for a recognition decision, it was a "ready" light, and the item followed the onset of this signal by one second. Subjects were told that when the item was presented they were to respond as quickly and as accurately as possible by pressing the button labelled "old" if the item was from the list they had learned, otherwise they were to press the button labelled "new". Within each treatment level one-half the subjects responded "old" with their preferred hand and the remaining responded "old" with their nonpreferred hand. Items remained on the screen until a response was made. The speed _with_ accuracy instructions were stressed and each subject was asked if they understood the task. Any questions were answered at this time.

<u>Predictions</u>: The general finding in the literature is that a blocked presentation facilitates recall as do increases in level of practice and this is the prediction for the recall phase. It is also predicted that clustering will increase with practice and will also be higher in the BLS condition. Since there is controversy in the literature regarding the effects of organization on probability of correctly recognizing list items and it is held that, in this thesis, accuracy measures of recognition are not adequate to determine an effect of organization on recognition it is predicted that the only effect on Prn will be one of practice with Prn being highest in the 3T condition. A similar prediction is made regarding the sensitivity measure $P(\overline{A})$, although there may be a slight effect of organization on this measure. If so, the effect would be such that $P(\overline{A})$ would be higher in the BLS condition since it is assumed that $P(\overline{A})$ mainly reflects occurrence information effects related to target ("old") items. For RT "old" it is predicted that RTs will be fastest in the RLS condition since this is the condition in which encoding variability is greatest and consequently the probability of conducting a search is less than in the BLS condition. Also, recognition is facilitated by increases in occurrence information and this should be reflected by RTs decreasing as practice increases. For RT "new", it is predicted that there will be an effect of practice such that RT "new" is fastest in

the 3T condition. Since the "new" items are not presented they will gain no occurrence information via presentation and they will not be encoded as a function of the list structure. Any organization effect would occur as a function of a spread of activation.

These predictions are for the following experiment only. As the paradigm is changed the predictions will also change at some points to reflect the changes in the paradigms which are hypothesized as having differential effects on the relevant dependent variables.

RESULTS

The data were analyzed by means of appropriate analyses of variance (ANOVAs) for the design employed (See Winer, 1962). A separate ANOVA was performed for each dependent variable.

NOTE: Throughout this thesis the following conventions are used to denote significance levels in ANOVA tables: (*) denotes marginal non-significance; * denotes significance at .05 level; ** denotes significance at .01 level; and *** denotes significance at .001 level. Each of the treatments and interactions have a single degree of freedom associated with it and there are 20 degrees of freedom associated with the error term in this design.

Recall: There was a significant effect of list structure on the probability of correctly recalling an item (Prl) ($F = 7.07$, $p < .025$): Prl was superior in the blocked list structure (BLS) condition, relative to the random list structure (RLS) condition. The difference due to practice was also significant ($F = 25.48$, $p < .001$) with Prl increasing as a function of increasing practice. There is no interaction. The results are summarized in Tables 2-1 (a) and 2-1 (b). Table 2-1 (a) presents the ANOVA summary while the means associated with the treatments presented in Table 2-1 (b). The effects are illustrated in Fig. 2-2 (a).

Organization: Clustering (Cls) was the measure of organization used and was defined as the number of category repetitions observed in recall divided by the number of category repetitions possible, given the number of items recalled. The Cls scores are indicative of the degree to which the subjects discovered and used the organization inherent in the list and do not reflect any alternative organizational strategies, e.g., a seriation strategy. There was a significant effect of list structure on Cls ($F = 203.14$, $p < .001$) with Cls scores being higher in the BLS condition. There was also a significant list structure x practice interaction ($F = 26.28$, $p < .001$): in the BLS condition the effect of increased practice is to increase clustering while in the RLS condition the effect of increased practice was not significant ($t = 0.32$, $p > .05$). The results of the ANOVA are presented in Table 2-2 (a) and the mean Cls scores are presented in Table 2-2 (b). The effects are illustrated in Fig. 2-2(b). The effect of practice is smaller in the RLS condition than in the BLS condition. If the effect of the RLS condition is to facilitate increased encoding variability it would then follow that Cls scores based on the inherent list structure would tend to decrease in the RLS condition, relative to the BLS condition, particularly over trials. Mandler &

Table 2-1 (a): Summary of ANOVA for Prl results, Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.9816	---------	---
Organization (A)	1	0.1320	0.1320	7.07*
Practice (B)	1	0.4759	0.4759	25.48**
A X B	1	0.0001	0.0001	0.005
Error	20	0.3736	0.0137	---

Table 2-1 (b): Mean Prl for treatments in Sim presentation.

	1T	3T	
BLS	0.68	0.97	0.82
RLS	0.54	0.82	0.68
	0.61	0.89	0.75

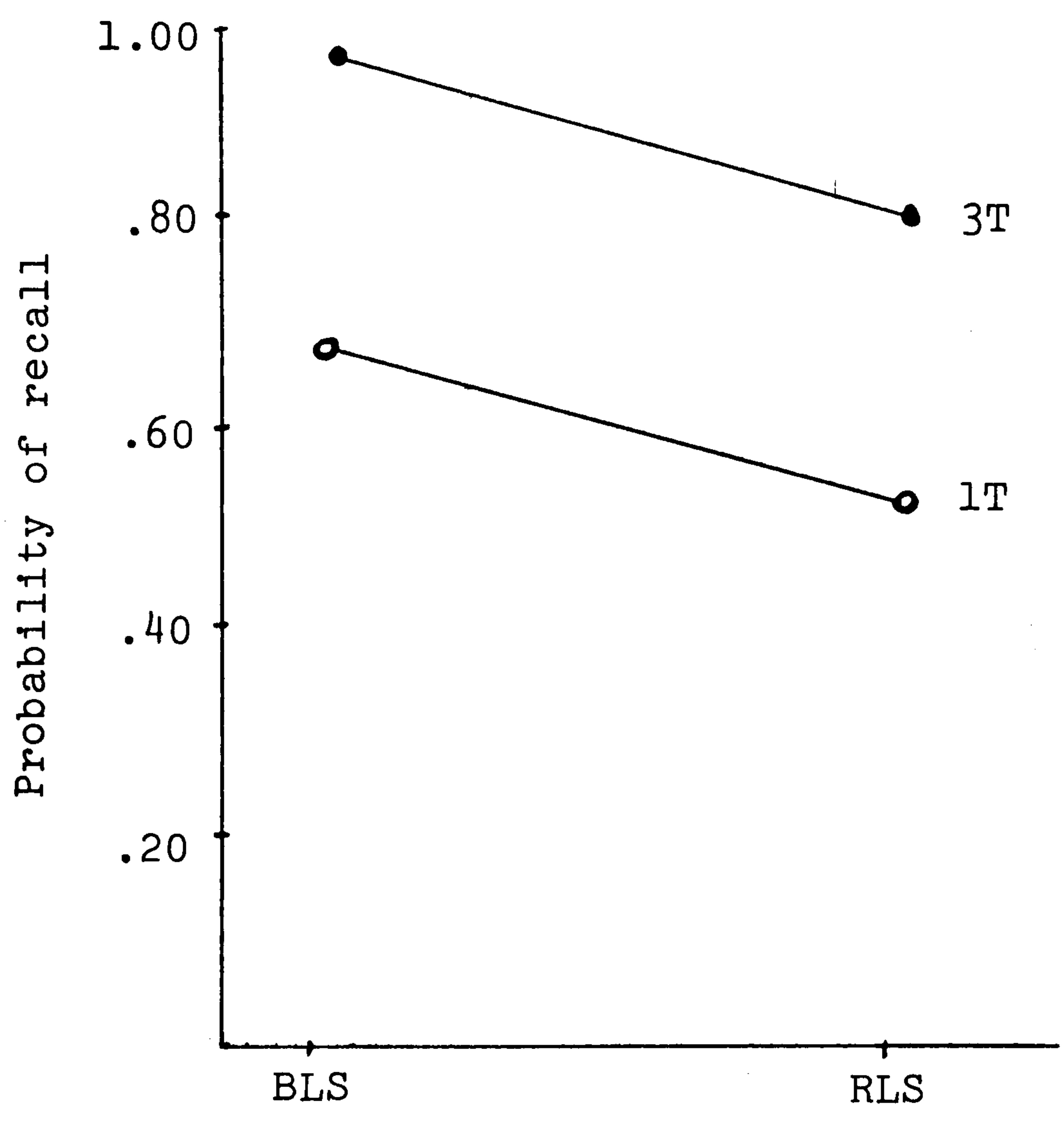


Fig. 2-2 (a). Probability of recall for list structure x practice interaction.

Table 2-2 (a): ANOVA summary table for Cls with Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1.0726	---------	---
Organization (A)	1	0.8664	0.8664	203.14**
Practice (B)	1	0.0088	0.0088	2.07
A x B	1	0.1121	0.1121	26.28**
Error	20	0.0853	0.0043	---

Table 2-2 (b): Mean values of Cls for Sim presentation.

	1T	3T	
BLS	0.57	0.74	0.66
RLS	0.33	0.23	0.28
	0.45	0.49	0.47

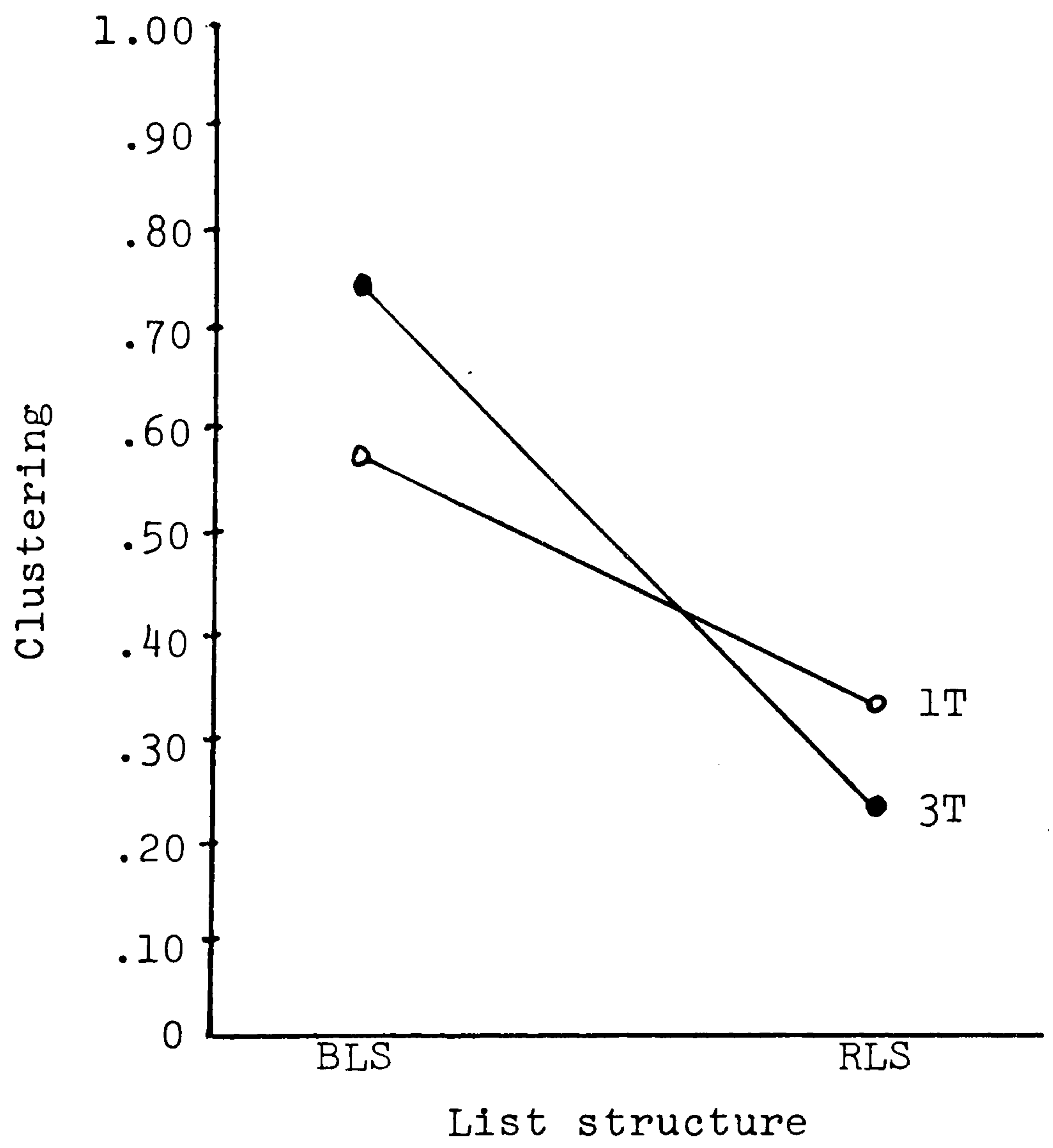


Fig. 2-2(b). Clustering for the list structure x practice interaction.

Dean (1969) reported that in the absence of any obvious organizational strategies subjects adopt a seriation strategy. The results of this would be a lower Cls score in the RLS condition than in the BLS condition.

Recognition: The only significant effect of the experimental treatments on the probability of correctly recognizing an item (Prn) was the effect of practice ($F = 13.66$, $p < .001$): recognition performance improved with an increase in practice. The summary of the ANOVA is presented in Table 2-3 (a) and the mean Prn scores are presented in Table 2-3 (b).

These results are of the sort which have been used in the past as indicating that organization has no effect on recognition performance. The effect of practice is presumed to increase only familiarity in a rather mechanical manner, i.e., the more times an item is presented and rehearsed the greater the strength of the familiarity information and, consequently, the higher the Prn.

$P(\bar{A})$: This measure is a nonparametric measure of sensitivity (discriminability between "old" and "new" items) in the signal detection sense of the word (see McNicol, 1972). This measure is functionally similar to the Hit Rate - False Alarm Rate measures used by, for example, Mandler (1972). There was a significant effect of list structure ($F = 7.87$, $p < .05$): $P(\bar{A})$ was better in the BLS condition. There was also a significant effect of practice ($F = 39.64$, $p < .001$): performance improved as practice increased.

These results support those in the literature which report organizational effects in recognition. The basic

Table 2-3 (a): ANOVA summary for Prn with Sim presentation.

Source	df	Sum of Squares	Mean Squares	F
Total	23	0.1979	--------	---
Organization (A)	1	0.0006	0.0006	0.11
Practice (B)	1	0.0771	0.0771	13.66**
A x B	1	0.0074	0.0074	1.30
Error	20	0.1128	0.0056	---

Table 2-3 (b): Mean values of Prn for Sim presentation.

	1T	3T	
BLS	0.83	0.91	0.87
RLS	0.79	0.94	0.86
	0.81	0.92	0.87

premise is that anything which promotes better learning of items will also support a better level of discrimination between those items and other, non-presented, items. In the present experiment a preferred argument is that the effect of list structure is to constrain encoding and thus limit any spread of activation, particularly that due to the selection of common attributes among items. The greater the specificity of encoding the less the likelihood of selecting attributes common to items which are not presented in the list. In the RLS condition this likelihood is much larger, consequently there is a larger False Alarm Rate, relative to the BLS condition and this leads to a smaller level of $P(\overline{A})$ in the RLS condition. The ANOVA summary is presented in Table 2-4 (a) and the mean levels of $P(\overline{A})$ are presented in Table 2-4 (b).

Reaction time: The results presented for reaction time (RT) measures are based on median RTs computed for each subject and not on mean RTs since there is a strong tendency for the RT distribution to be positively skewed. The average RTs mentioned are the means of the subject median RTs.

There was a significant effect of list structure on RT for "old" items ($F = 4.36$, $p < .05$): RTs were shorter in the RLS condition, as predicted from the context hypothesis. There was also a significant effect of practice on RTs to "old" items ($F = 25.11$, $p < .001$): RTs were faster as practice increased. These results are summarized with the ANOVA summary in Table 2-5 (a) and the average RTs in Table 2-5 (b). The results are illustrated in Fig. 2-3 (a) along with the error rates associated with the experimental

Table 2-4 (a): ANOVA summary table for $P(\bar{A})$ with Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.2457	---------	---
Organization (A)	1	0.0280	0.0280	7.87*
Practice (B)	1	0.1411	0.1411	39.64**
A x B	1	0.0054	0.0054	1.52
Error	20	0.0712	0.0036	---

Table 2-4 (b): Mean values of $P(\bar{A})$ with Sim presentation.

	1T	3T	
BLS	0.85	0.97	0.91
RLS	0.75	0.93	0.84
	0.80	0.95	0.87

Table 2-5 (a): ANOVA summary for RT "old" with Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	2304637.62	---------	---
Organization (A)	1	200385.37	200385.37	4.36*
Practice (B)	1	1154132.04	1154132.04	25.11**
A x B	1	15352.04	15352.04	0.33
Error	20	919241.11	45962.06	---

Table 2-5 (b): Mean RT "old" for Sim presentation.

	1T	3T	
BLS	1515	1127	1321
RLS	1383	894	1138
	1449	1138	1230

treatments. An examination of this figure indicates that there was no apparent speed-accuracy tradeoff since this would be indicated by higher error rates in the fast condition and this is not the case.

There was no effect of list structure on RTs to "new" items ($F < 1$, $p > .05$) but there was an effect of practice ($F = 23.44$, $p < .001$): RTs were faster in the higher level of practice condition (3T). One would not expect an effect of list structure on RTs to "new" items unless those items had accrued sufficient strength for them to be responded to as "old". Since the effect of increased practice is to increase strength of familiarity and it is assumed that spread of activation is a function of increased practice and rehearsal, then one can explain, on a posteriori grounds, the above effect. This is illustrated in Fig. 2-3 (b) and the ANOVA results are presented in Table 2-6 (a) and mean RT "new" in Table 2-6 (b).

The net effect of the above results is support for the context hypothesis. The predictions that RTs for "old" items would be faster in the RLS condition was supported and the results obtained with reference to RTs for "new" items also lends support to the context hypothesis.

It should be noted that the error data for "new" items was not analyzed since there were a number of subjects who made no errors, yielding an error rate of zero, and this makes any analysis difficult, statistically.

DISCUSSION

The results based on accuracy measures along, e.g., Prl and Prn, would indicate that performance on these tasks

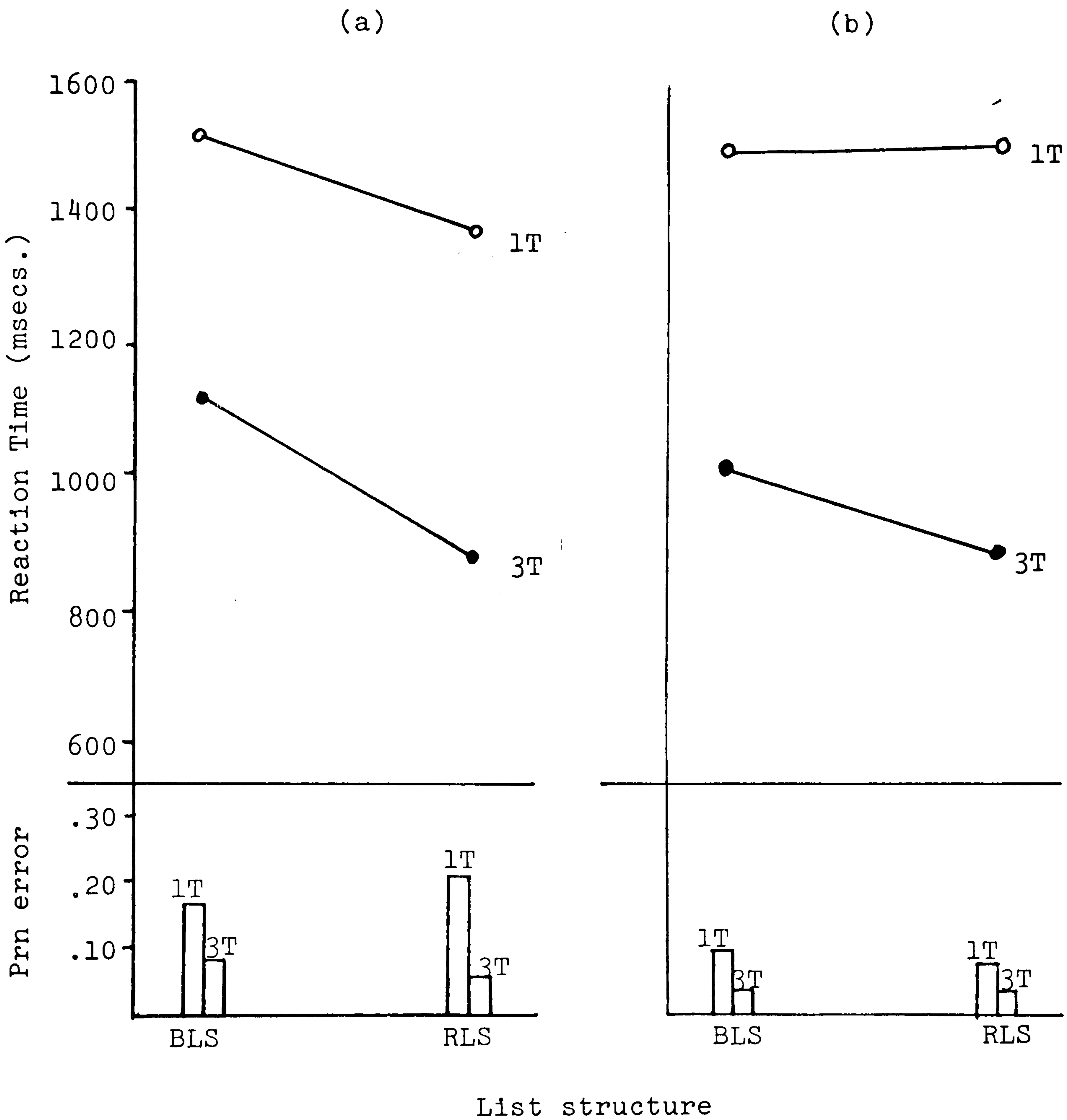


Fig. 2-3 (a) and (b). RT and Prn error for "old" responses for (a) and "new" responses for (b).

Table 2-6 (a): ANOVA summary table for RT "new" for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	3408016.62	---------	---
Organization (A)	1	20126.04	20126.04	
Practice (B)	1	1813350.37	1813350.37	23.44**
A x B	1	27405.04	27405.04	0.35
Error	20	1547135.17	77356.76	---

Table 2-6 (b): Mean RT "new" for Sim presentation.

	1T	3T	
BLS	1501	1019	1260
RLS	1511	894	1202
	1506	956	1231

is a function of occurrence or familiarity information and that organization information is not pertinent. The results of the treatments on sensitivity are generally explained on a strength basis rather than on an organization-search basis such as that embodied in the context hypothesis. An alternative explanation is possible and was presented in the presentation of the results. This will be discussed in greater detail later.

The effects of the experimental treatments on RTs tends to refute the strength approaches to recognition performance and supports an approach based on the concept of searches of memory based on the degree of encoding which occurred during acquisition.

Bower, et. al. (1969a) argued that differences in effective presentation time exist between conditions such as the BLS and RLS conditions of this experiment with the effective presentation time being longer in the BLS condition. According to this hypothesis a random list is supposed to take longer to read, thus the effective presentation time, per item, is less than in the BLS condition which is regarded as being easier to read. The predictions from this hypothesis are that Prl and Cls should be higher in the BLS condition. Also, one would expect better recognition performance in the BLS condition and one would predict that RTs for "old" items would be faster in the BLS condition. In the above experiment it is the case that Prl and Cls scores are higher in the BLS condition, as are the scores on the sensitivity measure, and there was no effect of list structure on Prn. However, RTs for "old" items were longer in the BLS condition. The latter result is that predicted by the context hypothesis and is opposite that predicted by the effective presentation time hypothesis.

If the context hypothesis is correct then anything which increases encoding variability will lead to an increase in the probability of accessing an appropriate encoding during recognition without having to search the memory set. The effect of this is to reduce RTs in those conditions. The effect of a simultaneous presentation would be to maximize the amount of information present in an array of words, particularly in the BLS condition. If, however, the items were presented serially (Ser) then one would expect that each item would receive a relatively large degree of occurrence information, and since each item is presented in isolation one would expect a greater degree of encoding variability overall. The effect of a Ser presentation would be an attenuation of the effects found with a Sim presentation. Also, since the situation is more like that experienced in a recognition test, there would be less change in semantic context between acquisition and test. One would expect little, if any difference in terms of Prn.

Experiment 2: Serial Presentation

This experiment was designed to test the implications of the context hypothesis using a serially presented (Ser) list of items. The design, apparatus, materials and procedure were exactly the same as in Experiment 1, with the following exceptions. A different group of 24 undergraduate students enrolled in Part 1 Psychology at the University of Stirling were used. The order of the items in the BLS condition of this experiment was based on a depth-first reading of the hierarchy. The path from one node was followed to completion before the processing of the next node began, i.e., ANIMAL - DOMESTIC - ... - DONKEY - PET - ... - ZEBRA. The order of presentation for the RLS condition was the same for both Sim and Ser modes of presentation.

Predictions: The predictions derived from the context hypothesis which are specific to this experiment are that recall and clustering will be facilitated by list structure with the best performance occurring in the BLS condition. Recall and clustering will also increase with increases in practice. The predictions dealing with Prn and $P(\bar{A})$ are that the only treatment which will have an effect on Prn is that of practice and this treatment will facilitate $P(\bar{A})$ with performance being better in the 3T condition. Since one of the presumed properties of a Ser mode of presentation is an attenuation of some recognition effects and an overall increase in encoding variability, it is predicted that the effect of list structure on $P(\bar{A})$ will be attenuated. It is expected that RTs to "old" items will be faster in the RLS condition than in the BLS condition although this effect will be attenuated as will the effect of practice on RTs to "old" items.

RESULTS

Recall: There were significant effects of list structure ($F = 10.90$, $p < .005$) and practice ($F = 60.22$, $p < .001$) on Prl with performance being best in the BLS and in the 3T levels of these treatments. These results are typical of those found in the literature and are summarized in the following tables; Table 2-7 (a) contains the ANOVA summary and Table 2-7 (b) presents the mean values of Prl for the treatment conditions.

Table 2-7 (a): ANOVA summary for Prl with Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.4775	---------	---
Organization (A)	1	0.0570	0.0570	10.90**
Practice (B)	1	0.3151	0.3151	60.22**
A x B	1	0.0007	0.0007	0.13
Error	20	0.1047	0.0052	---

Table 2-7 (b): Mean Prl with Ser presentation.

	1T	3T	
BLS	0.72	0.96	0.84
RLS	0.63	0.85	0.74
	0.68	0.90	0.79

Organization: There were significant effects of list structure ($F = 156.37$, $p < .001$) and practice ($F = 24.40$, $p < .001$) on Cls as well as a significant list structure x practice interaction effect ($F = 10.91$, $p < .001$). Clustering (Cls) was higher in the BLS condition and increased as practice increased. Also, the effects of practice were greatest in the BLS condition and in the RLS condition the effect of increased practice was not as great as in the BLS condition. In the previous experiment the effects were similar. These results support an interpretation that encoding variability is increased in the Ser presentation, particularly in the RLS condition of list structure. The results of the ANOVA are presented in Table 2-8 (a) and the mean Cls scores are presented in Table 2-8 (b). The results are illustrated in Fig. 2-4.

Recognition: There was no effect of list structure on Prn ($F < 1$, $p > .05$), nor was the list structure x practice interaction significant ($F < 1$, $p > .05$). There was a significant effect of practice on Prn, as predicted ($F = 28.43$, $p < .001$) with Prn increasing as level of practice increased. These results suggest that occurrence information is sufficient for recognition responses and the effects of practice are not differential with regard to list structure in the Ser mode of presentation, as analyzed.

A summary of the ANOVA is presented in Table 2-9 (a) and the mean values for Prn are presented in Table 2-9 (b).

$P(\bar{A})$: There was no effect of list structure on sensitivity ($F = 1.87$, $p > .05$), nor was there a significant interaction effect ($F < 1$, $p > .05$). There was a significant effect of practice ($F = 56.91$, $p < .001$) with $P(\bar{A})$ being best in the

Table 2-8 (a): ANOVA summary for Cls for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1.7192	---------	---
Organization (A)	1	1.1704	1.1704	156.37**
Practice (B)	1	0.3174	0.3174	42.40**
A x B	1	0.0817	0.0817	10.91**
Error	20	0.1497	0.0075	---

Table 2-8 (b): Mean Cls for Ser presentation.

	1T	3T	
BLS	0.54	0.89	0.71
RLS	0.21	0.33	0.27
	0.38	0.61	0.49

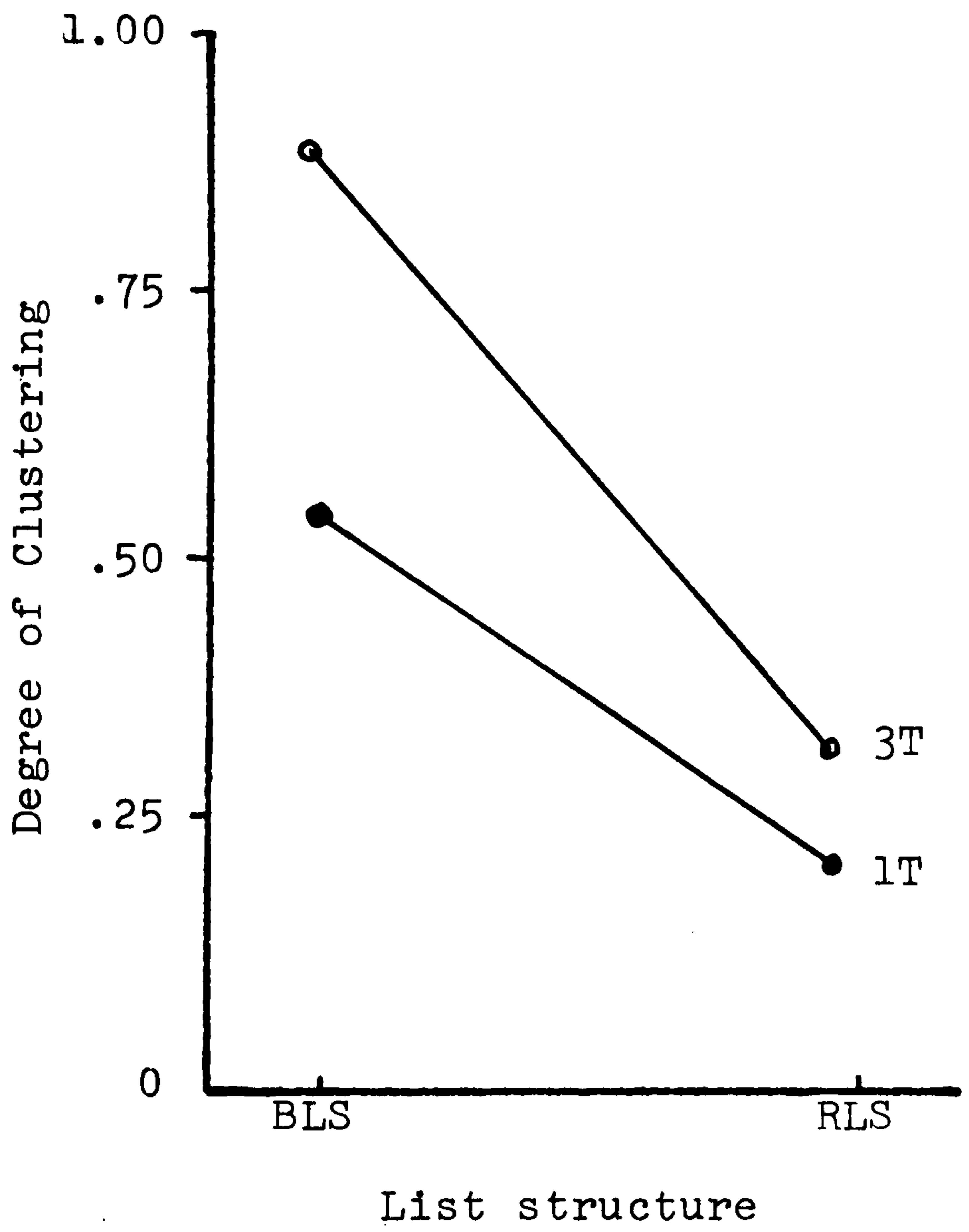


Fig. 2-4. Clustering as a function of the list structure x practice interaction.

Table 2-9 (a): ANOVA summary for Prn "old" for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.2608	---------	---
Organization (A)	1	0.0018	0.0018	0.34
Practice (B)	1	0.1520	0.1520	28.43**
A x B	1	0.0001	0.0001	0.02
Error	20	0.1070	0.0053	---

Table 2-9 (b): Means for Prn "old" for Ser presentation.

	1T	3T	
BLS	0.81	0.97	0.89
RLS	0.82	0.98	0.90
	0.82	0.97	0.90

3T condition of practice. This result is illustrated in Fig. 2-5. The ANOVA summary is presented in Table 2-10 (a) and the mean values of $P(\bar{A})$ are presented in Table 2-10 (b).

Reaction time: As predicted, the effect of list structure on RTs to "old" items was attenuated in this experiment relative to Experiment 1 (Sim presentation) and the differences due to list structure was not significant ($F < 1$, $p > .05$). The effect of practice was not significant ($F = 1.97$, $p > .05$) but the list structure x practice interaction was significant ($F = 6.81$, $p < .025$): the fastest RTs occurred in the RLS-3T condition and this is the condition in which it was expected encoding variability would be highest. These results are illustrated in Fig. 2-6 and the results are presented for the ANOVA in Table 2-11 (a) and the average RTs for "old" items in Table 2-11 (b).

As predicted, there was a significant effect of practice on RT to "new" items ($F = 9.79$, $p < .01$) with RTs being fastest in the 3T condition. The results of the ANOVA are presented in Table 2-12 (a) and the average RTs in Table 2-12 (b).

DISCUSSION

The results of this experiment which are based on accuracy of performance would appear to support a strength approach to recognition memory such as indicated in a dual-process theory such as Kintsch (1968). Recall and organization were facilitated by increases in organization information and this is, as mentioned, a result typically found in the literature. There was, however, no effect of

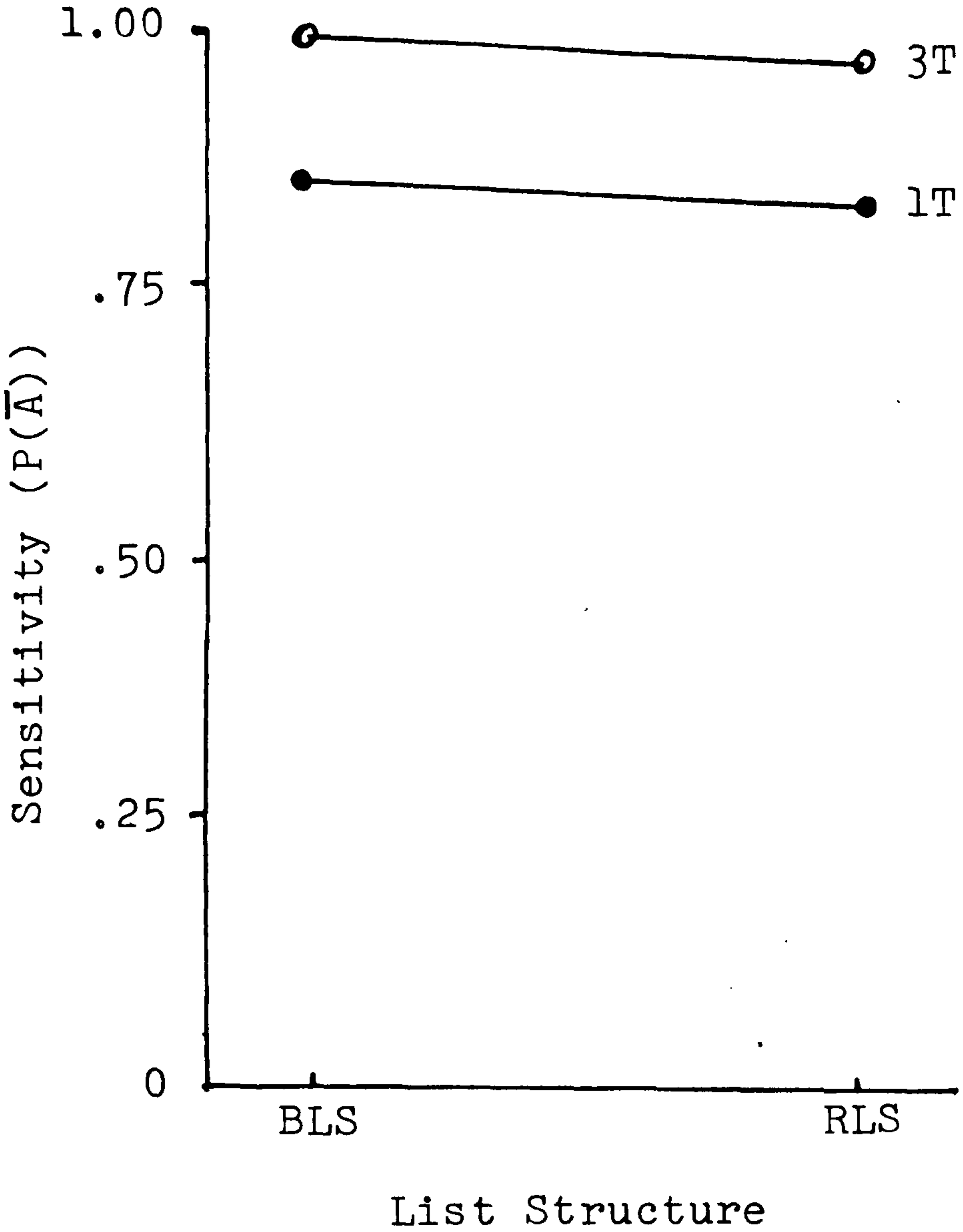


Fig. 2-5. Sensitivity (P(Ā)) as a function of amount of practice for levels of list structure.

Table 2-10 (a): ANOVA summary for $P(\bar{A})$ for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.1687	---------	---
Organization (A)	1	0.0040	0.0040	1.87
Practice (B)	1	0.1218	0.1218	56.91**
A x B	1	0.0001	0.0001	0.05
Error	20	0.0428	0.0021	---

Table 2-10 (b): Mean $P(\bar{A})$ for Ser presentation.

	1T	3T	
BLS	0.84	0.99	0.91
RLS	0.82	0.96	0.89
	0.83	0.97	0.90

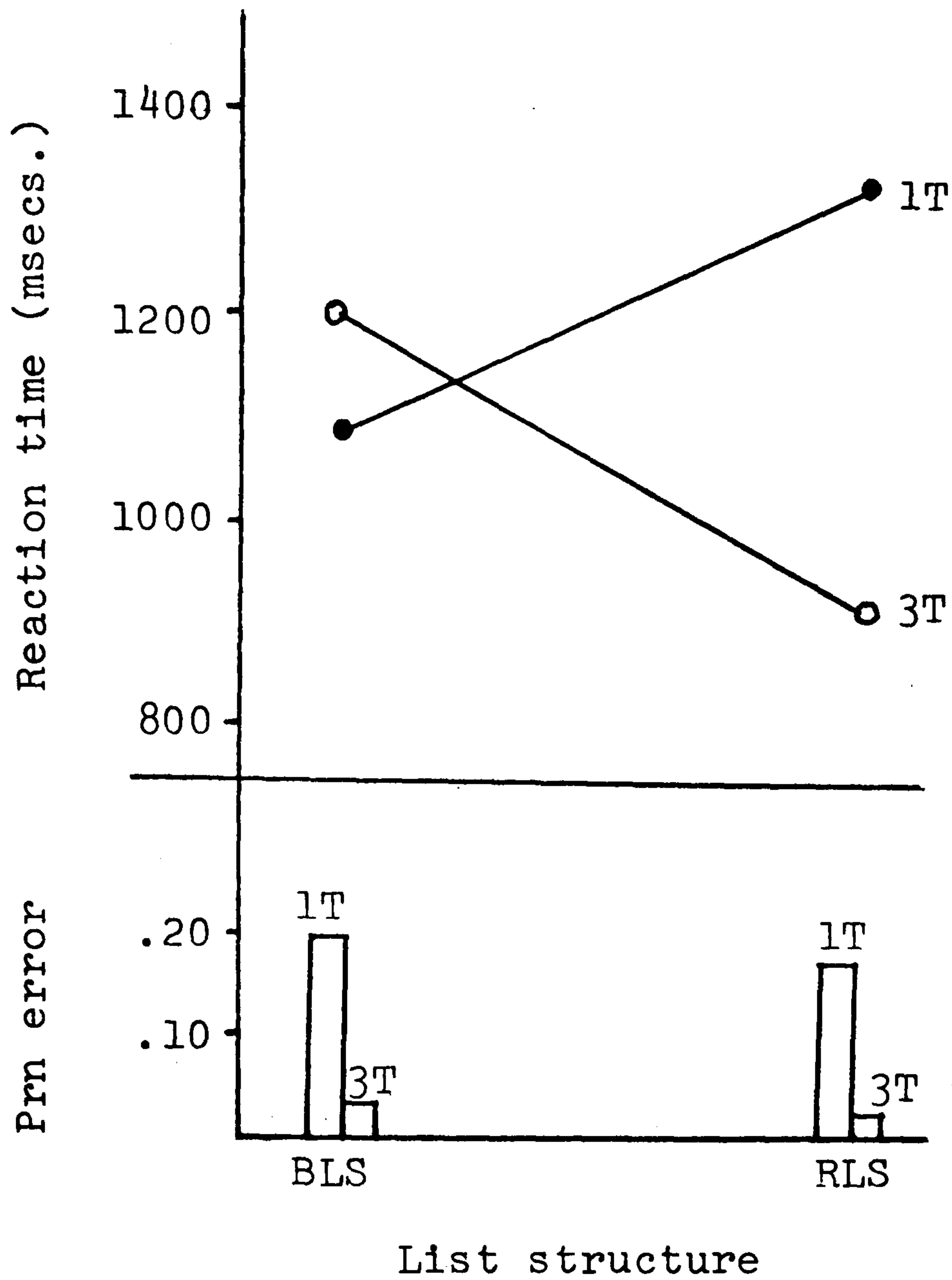


Fig. 2-6. RT and Prn error for "old" responses as a function of the list structure x practice interaction.

Table 2-11 (a): ANOVA summary for RT "old" for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1731595.83	---------	----
Organization (A)	1	4160.66	4160.66	0.07
Practice (B)	1	118441.50	118441.50	1.97
A x B	1	408726.00	408726.00	6.81*
Error		1200267.67	60013.38	----

Table 2-11 (b): Mean RT "old" for Ser presentation.

	1T	3T	
BLS	1080	1200	1140
RLS	1315	913	1114
	1197	1057	1127

Table 2-12 (a): ANOVA summary for RT "new" for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1749768.50	--------	----
Organization (A)	1	5460.17	5460.17	0.09
Practice (B)	1	602300.17	602300.17	9.79*
A x B	1	111248.16	111248.16	1.81
Error	20	1230760.00	61538.00	----

Table 2-12 (b): Mean RT "new" for Ser presentation.

	1T	3T	
BLS	1319	1138	1229
RLS	1485	1032	1259
	1402	1085	1244

list structure on probability of recognizing "old" items, but there was an effect of practice with Prn increasing as practice increased. Similarly, there was only an effect of practice on $P(\bar{A})$. Such results support approaches such as the effective presentation time approach (Bower, et. al., 1969a). The thrust of this position is that recognition is a function of familiarity which is in turn a function of the number of times the item has been processed in memory. It is assumed that items have a longer effective presentation time in the BLS condition than in a RLS condition, the result of which is the accrual of more 'strength' in a BLS condition.

When one examines the results derived from RT measures it becomes apparent that an effective presentation time hypothesis is not adequate, and, in fact, would lead to inaccurate predictions. First, one would predict that an effect of list structure would be present since in this case the effective presentation time is longer, more familiarity strength should accrue and consequently RTs should be faster. In addition, one would predict that this effect should increase over trials. Also, one would predict that RTs in the RLS condition should be long and should become shorter over trials. There is no basis for predicting that list structure and trials should interact however. It was the case that RTs were shorter in the BLS-1T condition relative to the RLS-1T condition, but in the BLS condition the RTs increased over practice while in the RLS condition the RTs decreased over practice. This is the effect one would predict from the context hypothesis.

In the BLS condition the effect of practice is to permit or facilitate the discovery of the inherent organization and would lead to an increase in encoding specificity with a consequent increase in RTs. The opposite is true for the RLS condition in which the effect of practice is to lead to an increase in encoding variability with a consequent decrease in RTs. Thus, comparisons between the context hypothesis and one alternative hypothesis, the effective presentation hypothesis, leads to the conclusion that the context hypothesis is more appropriate and that the predictions derived from it are better supported by the obtained data.

It was stated earlier that the effect of a Ser mode of presentation would be to attenuate the effects of some of the treatments, notably for RT measures. In order to attempt to assess this, the data from Experiments 1 and 2 were combined into a 2 x 2 x 2 factorial design with six subjects per cell and analyses performed for this data set. In this situation mode of presentation is treated as an independent variable.

Predictions: With specific regard to the mode of presentation it is predicted that, for Prl, Cls, Prn, and $P(\bar{A})$ there will be little, if any effect of mode of presentation and any effects would be in the direction of better performance in the Ser condition. The reasoning behind this is that these recognition measures appear to be principally sensitive to changes in familiarity value or strength and not so much to changes which influence the probability of search as a function of encoding variability.

RESULTS

The Fs for all the results in this section are based on one and 40 degrees of freedom unless otherwise stated.

Recall: There were no effects of mode of presentation on Prl ($F = 1.57$, $p > .05$). No other effects involving mode of presentation yielded significant differences in recall. The results of the ANOVA are presented in Table 2-13, and the mean Prl for mode of presentation was: Ser = 0.79; Sim = 0.80.

Organization: There was a significant effect of the mode of presentation x practice interaction ($F = 5.69$, $p < .025$). This effect is illustrated in Fig. 2-7. The results of the ANOVA are presented in Table 2-14.

Recognition: There was no significant effect of mode of presentation ($F < 1$). No other differences involving mode of presentation were significant. The results of the ANOVA are presented in Table 2-15.

$P(\bar{A})$: There was no significant effect of mode of presentation or its interactions. The ANOVA summary is presented in Table 2-16.

Reaction time: The mode of presentation x practice interaction ($F = 4.99$, $p < .05$) was significant. This effect

Table 2-13: ANOVA summary for Prl for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	1.4779	--------	----
Presentation (A)	1	0.0188	0.0188	1.57
Organization (B)	1	0.1813	0.1813	15.16**
Practice (C)	1	0.7829	0.7829	65.48**
A x B	1	0.0078	0.0078	0.65
A x C	1	0.0083	0.0083	0.69
B x C	1	0.0004	0.0004	0.03
A x B x C	1	0.0004	0.0004	0.03
Error	40	0.4782	0.0120	----

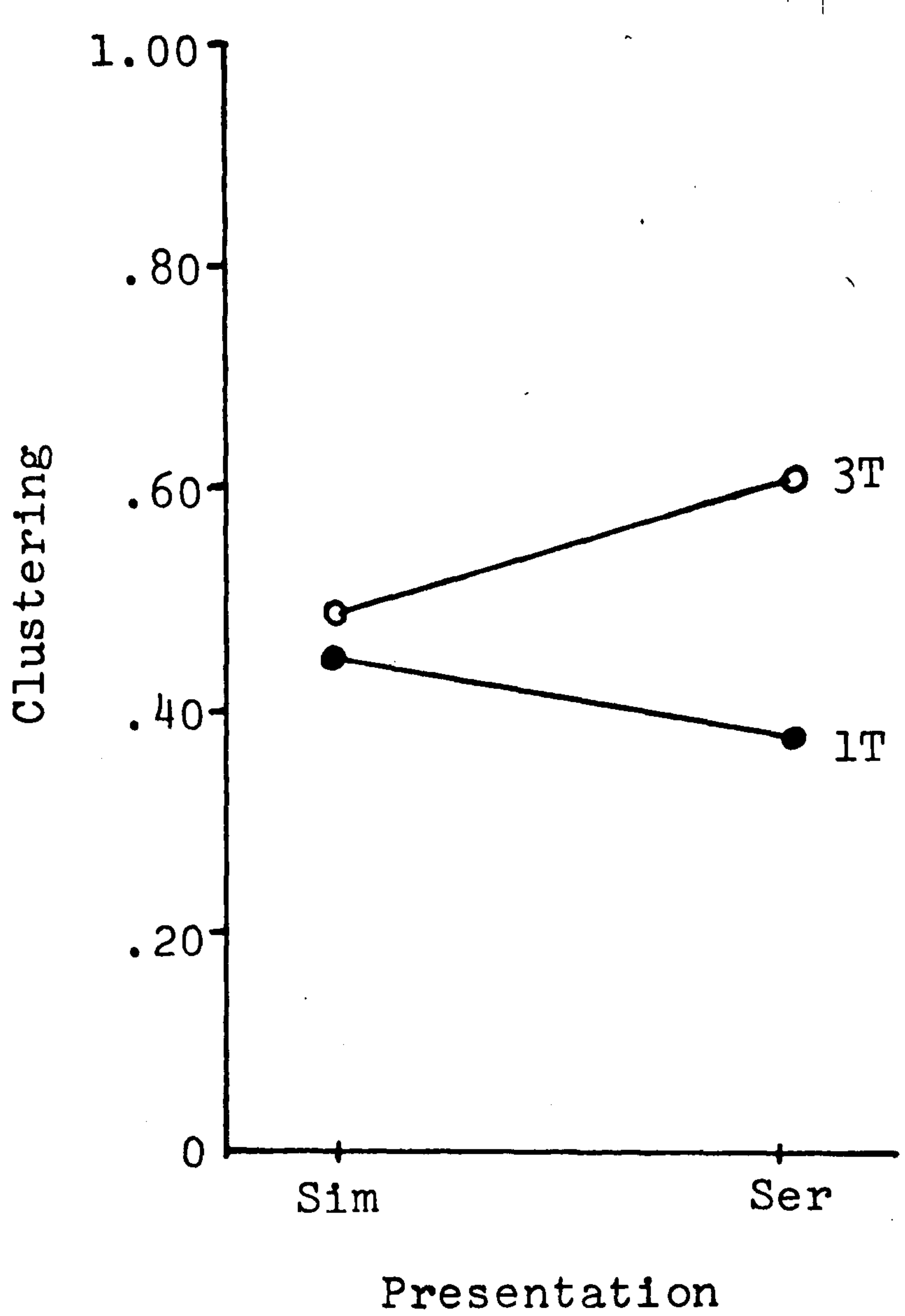


Fig. 2-7. Clustering as a function of mode of presentation x practice interaction.

Table 2-14: ANOVA summary for Cls for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	3.3393	--------	----
Presentation (A)	1	0.0075	0.0075	0.39
Organization (B)	1	2.0254	2.0254	104.54**
Practice (C)	1	0.2160	0.2160	11.15**
A x B	1	0.0114	0.0114	0.59
A x C	1	0.1102	0.1102	5.69*
B x C	1	0.1925	0.1925	9.94**
A x B x C	1	0.0012	0.0012	0.06
Error	40	0.7750	0.0194	----

Table 2-15: ANOVA summary for Prn for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.4692	--------	----
Presentation (A)	1	0.0088	0.0099	1.59
Organization (B)	1	0.0002	0.0002	0.03
Practice (C)	1	0.2228	0.2228	40.21**
A x B	1	0.0023	0.0023	0.41
A x C	1	0.0063	0.0063	1.14
B x C	1	0.0039	0.0039	0.70
A x B x C	1	0.0035	0.0035	0.63
Error	40	0.2216	0.0055	----

Table 2-16: ANOVA summary for $P(\bar{A})$ for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.4242	--------	----
Presentation (A)	1	0.0099	0.0099	3.48
Organization (B)	1	0.0266	0.0266	9.34*
Practice (C)	1	0.2626	0.2626	92.14**
A x B	1	0.0054	0.0054	1.90
A x C	1	0.0004	0.0004	0.12
B x C	1	0.0029	0.0029	1.00
A x B x C	1	0.0026	0.0026	0.90
Error	40	0.1140	0.0028	----

is illustrated in Fig. 2-8. The effects of practice under the Ser mode of presentation was very small while the effect of practice under the Sim mode of presentation was large. In the Ser presentation items are rehearsed in a more discrete fashion and the differences in encoding variability as a function of practice are small. In the Sim presentation the structure of the list is more apparent and the effect of practice is to reduce RTs through a familiarity index.

The contest hypothesis does not ignore familiarity as a parameter of recognition performance it merely assigns it a secondary role after encoding variability-specificity as a determinant of recognition performance as assessed by a RT measure.

The results of the ANOVA are presented in Table 2-17. The ANOVA summary for RTs to "new" items is presented in Table 2-18.

DISCUSSION

The overall analysis indicated that the results as measured by accuracy terms are similar to those obtained in Experiments 1 and 2 and the same discussion applies, for the effects due to list structure, practice and their interaction. The effect of mode of presentation was not significant for any of these independent measures.

The context hypothesis which was developed in the first chapter of the thesis states that the greater the degree of encoding specificity which occurs as a result of contextual (semantic) constraints upon the interpretation of a word in a list, the longer the time taken to decide if the

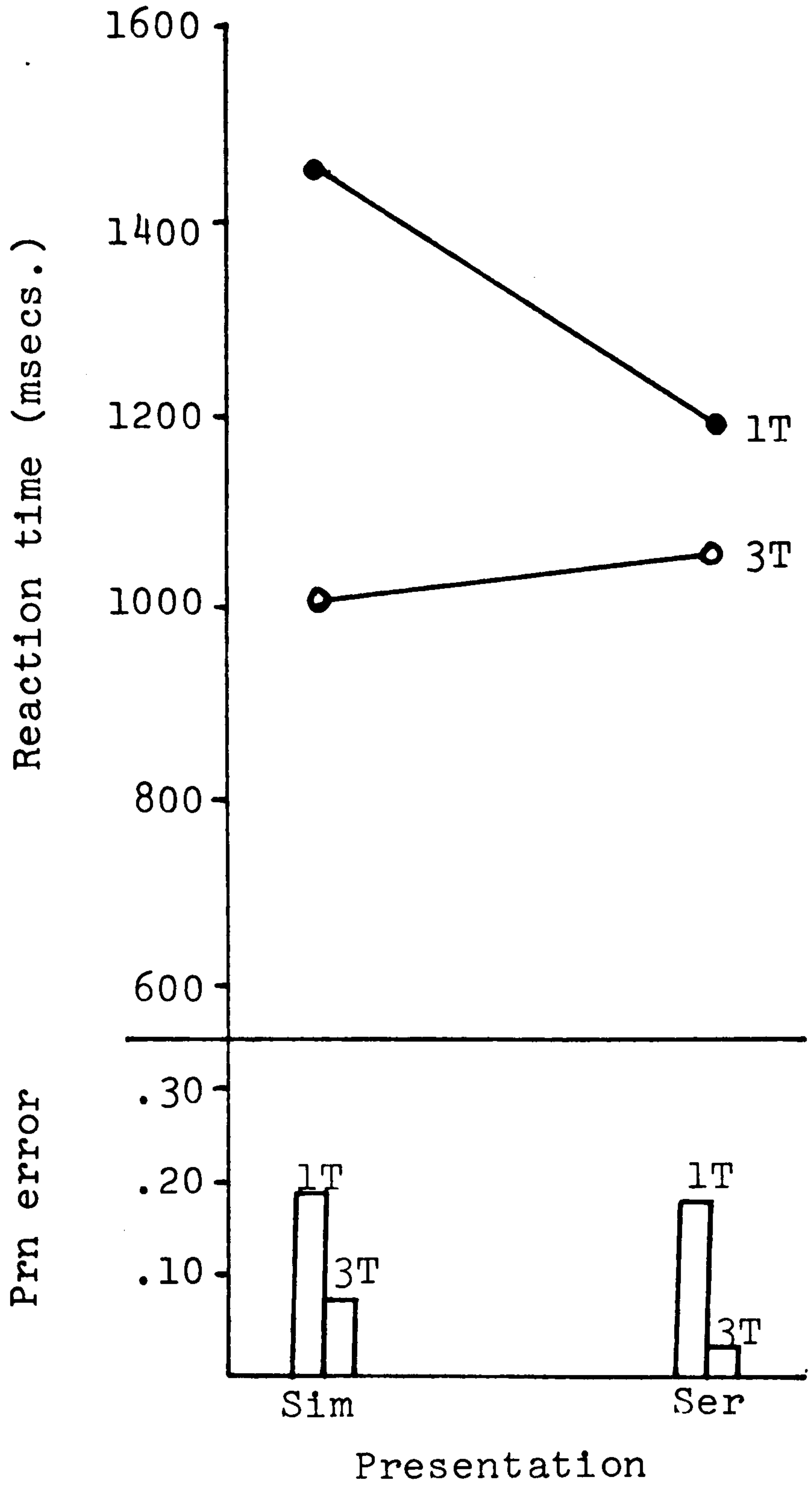


Fig. 2-8. RT responses and Prn error for "old" items for the mode of presentation x practice interaction.

Table 2-17: ANOVA summary for RT "old" for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	4162821.48	--------	----
Presentation (A)	1	126588.02	126588.02	2.37
Organization (B)	1	131147.53	131147.53	2.46
Practice (C)	1	1006012.53	1006012.53	18.85**
A x B	1	73398.51	73398.51	1.38
A x C	1	266561.01	266561.01	4.99*
B x C	1	291252.50	291252.50	5.46*
A x B x C	1	132825.52	132825.52	2.49
Error	40	2135035.83	53375.90	----

Table 2-18: ANOVA summary for RT "new" for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	5359697.81	--------	----
Presentation (A)	1	1912.69	1912.69	0.03
Organization (B)	1	2310.19	2310.19	0.03
Practice (C)	1	2252900.02	2252900.02	32.44**
A x B	1	23276.01	23276.01	0.34
A x C	1	162750.52	162750.52	2.34
B x C	1	124542.18	124542.18	1.79
A x B x C	1	14110.98	14110.98	0.20
Error	40	2777895.17	69447.38	----

presented item in the recognition test is an "old" or a "new" item. The rationale for this stemmed from the proposal by Mandler (1967) that the "meaning" of a word is a function of the position of that word in a hierarchy. Meaning, in terms of its use in this thesis is more akin to interpretation and refers to the "meaning" as defined by the attributes selected to encode it. The effect of increasing structural constraints is to constrain the number, type, or both, of attributes by which a word is encoded. This, in turn, will increase the probability of a search operation being performed to decide if an item is "old" or "new". This leads directly to the prediction that RTs will decrease as encoding specificity decreases.

Although the point has not been emphasized, the items are regarded as being encoded as discrete but related items. In other words, the attributes the items are encoded by are not regarded as being organized into clusters which must be decoded in order to obtain the items, but as links in a network which connect similar interpretations but which do not fuse them. This is illustrated in Fig. 2-9.

When an item is presented in isolation, as in a recognition test, it has a very low level of contextual information associated with it in a semantic manner, and thus is regarded as having a low level of contextual constraint upon its interpretation which is regarded as variable. If a particular item has received some familiarity value, perhaps via a spread of activation process, a subject is likely to verify the item's status by performance of a

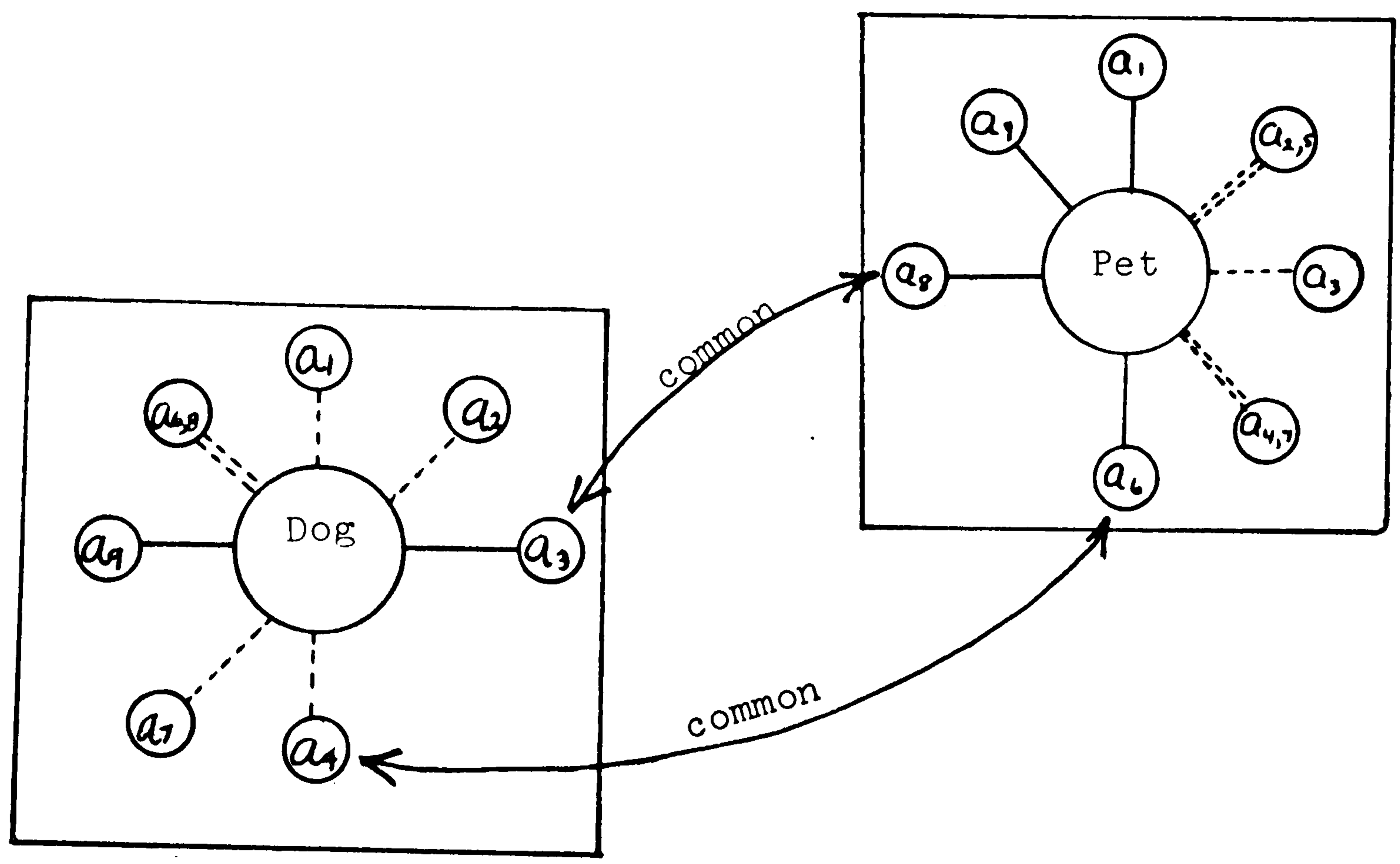


Fig. 2-9. A schematic of the concept of linked items in memory without them being fused into, for example, chunks or opaque containers. The dashed lines (----) represent replica coding overlays, the boxes represent the item and the circles represent the attributes selected for encoding. Some of the attributes would contain information relevant to the learning strategy.

search of the memory set. The effect of this is that it takes time to search memory thus the more searches made, the longer the average RT. The greater the variability of encoding the greater the likelihood that an interpretation which has been encoded will also be accessed for recognition leading to a fast RT. Mode of presentation and list structure are two variables which are regarded as potentially having this sort of effect. The effect of practice is primarily one on familiarity of an item which is also a relevant parameter of recognition performance.

The evidence of the results of the experiments to this point suggests that organization factors interact with familiarity factors, particularly with mode of presentation, since this interaction was not expected. However, it appears that the effects of increased practice on mode of presentation are such that practice has relatively little effect in the Ser condition but a relatively large effect in the Sim condition on RTs to "old" items with the RTs decreasing as practice increases. It is in the Sim condition in which it was expected that the constraints on semantic context would be most powerful.

In the experimental situations reported in the experiments of this chapter the word MONKEY, for example, encoded within the context imposed by the word PET is encoded with reference to a particular and highly specific interpretation while the word MONKEY presented in isolation is in a situation of minimal contextual constraint, i.e., with few contextual cues, and there is likely a degree of uncertainty in a recognition test as to the list membership of the item as a result of the lack of an appropriate cue which specifies the interpretation of the item in a manner identical to or similar to the way in which it was encoded. This uncertainty leads to a decrement in recognition performance as measured by RT but not necessarily in terms of Prn. The reason for this is that the word MONKEY has some familiarity value as a function of its having been presented, at least for some interpretation, and if the subject has learned the word he can recognize it. However, the probability of the subject making a response based on a search of memory is greater in the BLS condition, and to a lesser degree in the Sim condition. RTs should thus tend to be longer in the BLS condition and also, to a lesser degree in the Sim condition although Prn may not reflect these differences at all. If anything, the Prn may be slightly lower in the Sim condition due to the effect of changed semantic context between acquisition and recognition test, as was reported by Light & Carter-Sobell (1970), although this was not a manipulation used by them.

Mandler (1972) proposed that a recall trial acts as an acquisition trial and that items increment familiarity value during recall as well as during acquisition. The fact that RTs for non-recalled items were observed to be somewhat longer, on average, and that the error probability was observed to be somewhat higher lends position to a position such as Mandler's. An item which was processed during acquisition but was not available for recall would have a lower level of familiarity value than one which was processed both during acquisition and recall. The result of the foregoing would be, at least a slight, increase in RTs as well as errors.

A major point demonstrated in the preceding experiments is that accuracy measures are not appropriate for a fuller understanding of underlying processes in recogniton.

One hypothesis which has been proposed as an alternative to the context hypothesis has been the effective presentation time hypothesis. This hypothesis essentially states that effective presentation time is longer in a BLS condition and, presumably, in a Sim condition, the results of which should be a facilitation of recognition in these conditions and a decrease in RTs to "old" items in these conditions. In terms of main effects of treatments such an approach could be used to explain those results in the Ser condition but cannot explain the obtained interaction. In the Ser mode of presentation there is an apparent emphasis on familiarity information which leads to a weakening of the main effect of list structure, while the interaction also resulted in an apparent lessening of the effect of practice, since under one condition the effect of practice is to increase RTs to "old" items while under a second condition the effect of practice is to reduce RTs to "old" items, thus the overall effect of practice is relatively small. Virtually all other pure strength approaches to recognition suffer from the same weaknesses in that they cannot adequately handle the results obtained for the RT measures.

Although the context hypothesis was supported, for the most part, by the results obtained it is the situation that the nested hierarchy paradigm involves a very special and unique method of presentation even though it does fit very nicely into Mandler's (1967) concept of memory structure. It may well be the case that some forms of list structure are best utilized when the presentation is Ser instead of Sim. Most of the work reported in the current literature dealing with the effects of organization variables on recognition has been performed using a categorized list with several categories in which the category names were not a part and in which the various categories were not closely related, as they were in the nested hierarchy paradigm. In the following chapter a series of experiments is presented which were designed to test the implications of the context hypothesis using a more traditional categorized list paradigm while keeping the independent variables identical with those of Experiments 1 and 2.

One of the points raised earlier, although it was orginally raised by Bower, et. al. (1969), was that the results based on standard manipulations of list structure, e.g., categorized lists, subjective organization, etc., have been weak and have contributed to ambiguities in the literature. In addition, it is a proposal of this thesis that it has not been so much the manipulations of organization factors which has led to the ambiguities but that an accuracy type of measure does not adequately or accurately reflect the processes occurring in recognition of verbal material. Recognition is typically a high-performance level process in that recognition produces relatively few errors generally and it is always possible that ceiling effects may mask actual differences. Given the preceding it is clear that accuracy measures may generally not be sensitive enough to detect real, but small, differences. A RT measure is more sensitive in such a situation, particularly since organization could conceivably have either a facilitative effect on recognition or it could produce an impairment of recognition performance. The model proposed in this thesis and based on the context hypothesis will, hopefully, suggest a way in which these points may be resolved. A prior task must however be to test further the implications of the context hypothesis in a situation which is more like those from which previous results reported in the literature have been obtained and this is the purpose of the following chapter.

CHAPTER 3

In the previous chapter it was shown that organization, as manipulated via list structure, had an effect on recognition and on recall performances. High levels of organization facilitated recall and clustering, had no effect on probability of recognition, improved sensitivity mostly, and for the most part resulted in longer RTs to "old" items. Practice had the effect of also facilitating recall and, for the most part, clustering, while also leading to improved probability of recognition and sensitivity as practice increased, and generally faster RTs to "old" items, and faster RTs to "new" items.

The organization was an experimenter-determined one and no measure of subjective organization was made. The recognition task was a simple true - false, i.e., "old" - "new" decision task. In summary, there were effects of organizational factors on RTs to "old" items and these effects did not occur as reliably when accuracy measures were used to assess performance.

The nested hierarchy paradigm used in Experiments 1 and 2 is specialized in at least two ways, as mentioned previously; the superordinate and subordinate category names form a part of the to-be-learned list and second, in the BLS condition, the relationships between the particular items and the appropriate subordinate and superordinate category names are specified.

Mandler & Dean (1969) reported that in the absence of strong organizational cues subjects tended to adopt a seriation strategy in learning a list of words. It is presumed that such a strategy would facilitate the encoding of an item as a discrete item and thus would facilitate the elaboration of encoding variability. Also, to the extent that an item is encoded independently of other items in the list it will be more similar, situationally, to a single item presented for recognition and thus in a state of relatively unchanged semantic context.

It is proposed that one of the factors which has lead to the statement by Bower, et. al. (1969) that the blocked - random manipulation is a weak one in that, in most cases, the list structure supports a confounding of processes which are based on occurrence information (familiarity) and those which are based on organizational processes, for typical categorized lists, e.g., as used by Bousfield (1953).

Experiment 3: Simultaneous presentation

Since, with a categorized list, the category labels are not presented during acquisition or test, then the level of semantic contextual constraint should be somewhat less than with a nested hierarchy list, particularly with a Ser mode of presentation. In the Sim mode of presentation there should be little difference in the BLS condition and the differences for the RLS condition should be smaller as well. This is because of the presumably higher impact of familiarity information in the categorized list situation with no category labels.

METHOD

The method for this experiment is exactly the same as that for Experiment 1 with the following exceptions. A different group of 24 subjects, all enrolled in Part 1 Psychology at the University of Stirling, were used and they participated in order to fulfill a course requirement. The major difference was that the materials used were different. The materials in this experiment consisted of 25 words chosen such that there were five words from each of five different categories. An additional five words were chosen from each category and these were used as distractors in the recognition test. As in Experiments 1 and 2, the words were balanced for Thorndike-Lorge and Associative frequency and were all selected for the Battig & Montague (1969) category norms. The list items and distractors are presented in Fig. 3-1.

The presentation time was approximately three seconds per item, as for Experiments 1 and 2, and the instructions to the subjects were the same, as was the apparatus.

Predictions: The context hypothesis predicts the following: that recall and clustering will be higher in the BLS condition than in the RLS condition and that both will increase with increased practice. Since, it is assumed, familiarity values will be high in all conditions, then the likelihood of ceiling effects is higher, and if they exist, then no interaction effects are predicted in recall or in organization (clustering). There will be little, if any, effect of list structure on probability of recognition of "old" items although recognition will increase as practice increases. Similarly, since familiarity is presumed to be somewhat more potent in this experiment, there should be little, if any, effect of list structure on sensitivity

Target	Distractor
Lilac	Orchid
Tulip	Rose
Aster	Poppy
Daisy	Daffodil
Chrysanthemum	Carnation
Asparagus	Celery
Watermelon	Avocado
Onion	Cauliflower
Beet	Pea
Tomato	Turnip
Limestone	Chalk
Quartz	Marble
Emerald	Ruby
Slate	Granite
Jade	Opal
Grape	Apple
Lemon	Lime
Pear	Peach
Pomegranate	Mango
Plum	Cherry
Lion	Panther
Camel	Beaver
Wolf	Mouse
Horse	Sheep
Cat	Dog

Fig. 3-1: List items (Target) and Distractors used in the experiments of this chapter. The above order is that used in the BLS condition.

although sensitivity should increase as practice increases. For RTs to "old" items it is predicted that RTs should be somewhat faster in the RLS condition although the differences between the RLS and the BLS conditions are not expected to be as great as for Experiment 1. In the RLS condition encoding variability will be greatest and the probability of deciding on the basis of a search of the memory set is correspondingly reduced, relative to the BLS condition. For RTs to "new" items it is predicted that there will be an effect of practice with RTs decreasing as practice increases.

RESULTS

The data were analyzed by means of appropriate ANOVAs for a 2 x 2 factorial between-subject design with six data points per cell of the design. All results are reported for one and 20 degrees of freedom unless otherwise stated.

Recall: There was a significant effect of list structure ($F = 5.41$, $p < .05$) and of practice ($F = 88.09$, $p < .001$) with Pr1 being highest in the BLS and the 3T conditions. These results are as predicted and, as for Experiment 1, are typical of the results found in the current literature. The results of the ANOVA are presented in Table 3-1 (a) and the mean Pr1 values are presented in Table 3-1 (b).

Organization: There were significant effects of list structure ($F = 9.16$, $p < .01$) and of practice ($F = 7.35$, $p < .025$) with Cls being higher in the BLS condition and increasing with increased practice. These are typical results as reported in the literature and as predicted. The results of the ANOVA are presented in Table 3-2 (a) and the mean

Table 3-1 (a): ANOVA summary for Prl for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1.1775	--------	----
Organization (A)	1	0.0561	0.0561	5.41*
Practice (B)	1	0.9126	0.9126	88.09**
A x B	1	0.0017	0.0017	0.16
Error	20	0.2072	0.0104	----

Table 3-1 (b): Mean Prl for Sim presentation.

	1T	3T	
BLS	0.47	0.87	0.67
RLS	0.40	0.77	0.59
	0.49	0.86	0.68

Table 3-2 (a): ANOVA summary for Cls for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	3.0451	--------	----
Organization (A)	1	0.7385	0.7385	9.16*
Practice (B)	1	0.5922	0.5922	7.35*
A x B	1	0.1027	0.1027	1.27
Error	20	1.6117	0.0806	----

Table 3-2 (b): Mean Cls for Sim presentation.

	1T	3T	
BLS	0.54	0.99	0.76
RLS	0.32	0.50	0.41
	0.43	0.74	0.59

Cls scores are presented in Table 3-2 (b). The list structure x practice interaction was not significant ($F = 1.27$, $p > .05$). In both conditions of list structure (BLS and RLS) the effect of practice was to increase clustering.

Recognition: The only difference in Prn was that due to practice ($F = 7.20$, $p < .025$) with Prn increasing as practice increased. This is as predicted and again, could be taken as evidence that organization has no effect on recognition performance. This has been the case in the past for some studies. The results of the ANOVA are presented in Table 3-3 (a) and the mean Prn scores are presented in Table 3-3 (b).

$P(\overline{A})$: There was a significant effect of practice on sensitivity as measured by $P(\overline{A})$ ($F = 34.34$, $p < .001$) with $P(\overline{A})$ increasing with increased practice. This result appears to reflect a process based on familiarity. In Experiment 1 there was an effect of list structure on $P(\overline{A})$ with scores being highest in the BLS condition. Since there is no necessity for a search process to have any effect on sensitivity which is based on a discriminability between "old" and "new" items, it can be tentatively argued that this result is more indicative of familiarity value increments than of organization as it relates to encoding variability and search processes. This argument will be elaborated in Chapter 6. The results of the ANOVA are presented in Table 3-4 (a) and the mean sensitivity scores are presented in Table 3-4 (b).

Thus far it appears that accuracy measures such as Prn

Table 3-3 (a): ANOVA summary for Prn for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.2554	--------	----
Organization (A)	1	0.0081	0.0081	0.91
Practice (B)	1	0.0641	0.0641	7.20*
A x B	1	0.0054	0.0054	0.61
Error	20	0.1779	0.0089	----

Table 3-3 (b): Mean Prn for Sim presentation.

	1T	3T	
BLS	0.74	0.87	0.81
RLS	0.81	0.88	0.84
	0.77	0.88	0.83

Table 3-4 (a): ANOVA summary for $P(\bar{A})$ for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0892	--------	----
Organization (A)	1	0.0035	0.0035	2.26
Practice (B)	1	0.0532	0.0532	34.34**
A x B	1	0.0015	0.0015	0.97
Error	20	0.0310	0.0015	----

Table 3-4 (b): Mean $P(\bar{A})$ for Sim presentation.

	1T	3T	
BLS	0.85	0.96	0.90
RLS	0.89	0.96	0.92
	0.87	0.96	0.91

and $P(\bar{A})$ are not adequate to demonstrate the presence or absence of any effect of organization since neither appears sensitive to search processes. It is a central theme of the context hypothesis that organization has an effect on recognition by biasing towards or away from search processes as a function of encoding variability-specificity. Encoding variability-specificity is regarded as being influenced by organizational factors such as list structure and semantic contextual constraints which are their consequent.

Reaction time: There was a significant effect of list structure on RTs to "old" items ($F = 6.42$, $p < .025$) with RTs being faster in the RLS condition, as predicted by the context hypothesis. In the BLS condition encoding specificity is relatively high and the likelihood of deciding list membership on the basis of the outcome of a search of the memory set is high, relative to the RLS condition. Thus, average RTs tend to be longer in the BLS condition. Such was the case in this experiment and the context hypothesis was supported. The ANOVA summary appears in Table 3-5 (a) and the average RTs to "old" items is presented in Table 3-5 (b). The results are illustrated in Fig. 3-2. It is clear from an examination of this figure that there is no effect of practice ($F < 1$, $p > .05$) nor is there any interaction effect ($F < 1$, $p > .05$). The difference due to practice, while not reaching significance, was in the direction one would expect, i.e., increased practice produced slightly faster RTs to "old" items. This result will be discussed later.

There was a significant effect of practice on RT to

Table 3-5 (a): ANOVA summary for RT "old" for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1298212.50	---------	----
Organization (A)	1	307813.50	307813.50	6.42*
Practice (B)	1	26800.17	26800.17	0.56
A x B	1	4648.16	4648.16	0.10
Error	20	958950.67	47947.53	----

Table 3-5 (b): Mean RT "old" for Sim presentation.

	1T	3T	
BLS	1485	1446	1465
RLS	1286	1191	1239
	1385	1318	1352

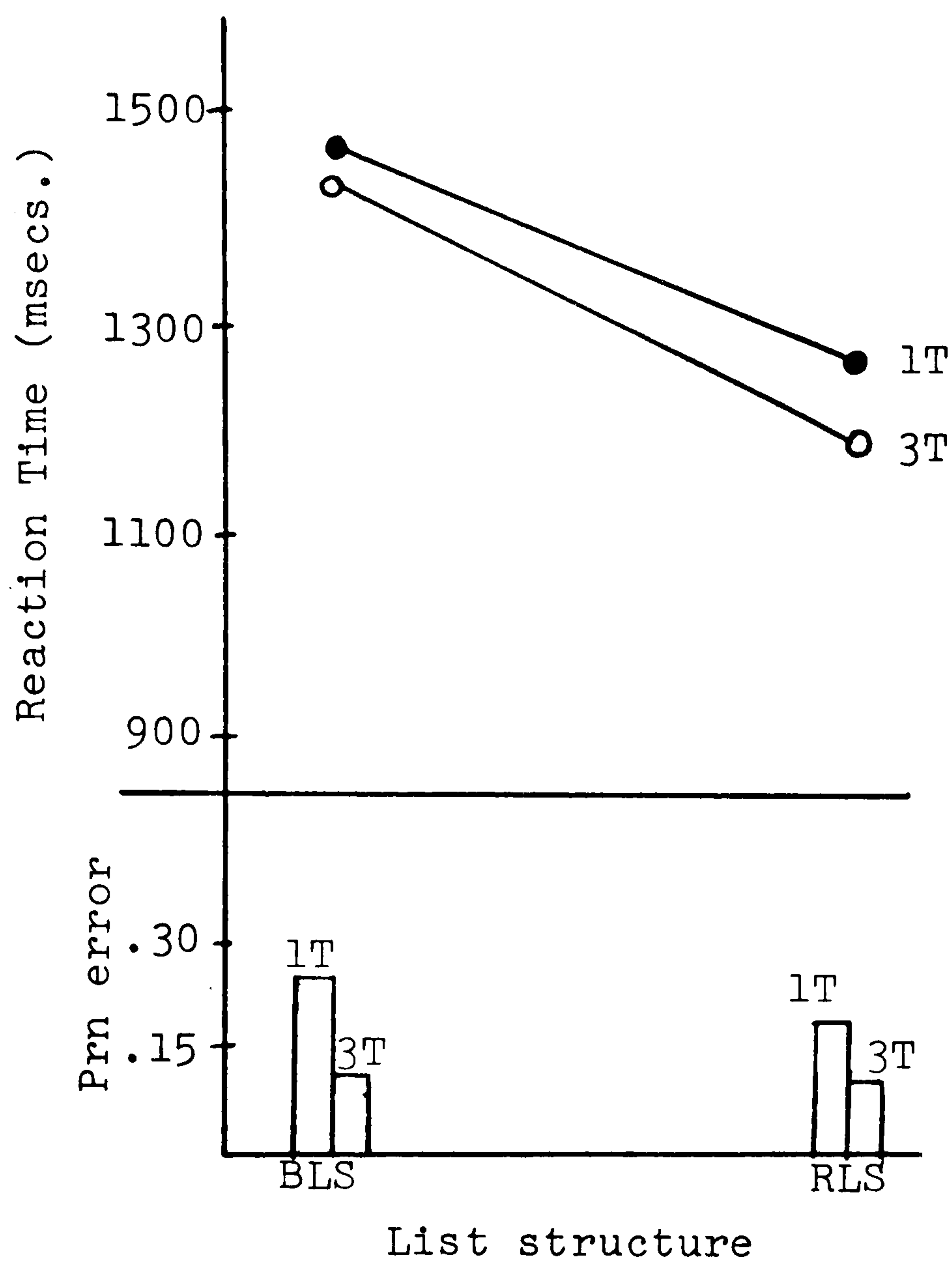


Fig. 3-2. RT and Prn error for "old" responses as a function of list structure for levels of practice.

"new" items ($F = 10.69$, $p < .005$). RTs to "new" items decreased with increasing practice. This is the same result as that found in Experiment 1. A summary of the ANOVA is presented in Table 3-6 (a) and the average RTs to "new" items are presented in Table 3-6 (b).

Note should be taken of the lower portions of Fig. 3-2 which illustrates the probability of an error associated with the experimental treatments. Again, there is no evidence to support the consideration of a speed-accuracy tradeoff.

DISCUSSION

If the argument that the categorized list structure used in this experiment leads to an emphasis on familiarity values, relative to Experiment 1 then one would expect an attenuation of any effects of organization treatments on RTs to "old" items and such was not the case. The fact that recall and clustering were both higher in the BLS condition indicates that some organization has occurred. What is not clear is the basis of the organization beyond that of utilization of the inherent list structure. However, regardless of the basis of the organization effect, it is clear that the contention that occurrence information is emphasized in this experimental list treatment is not upheld. In general, the results are very similar to those obtained in Experiment 1. Accuracy measures are regarded as reflecting mainly effects attributable to familiarity information since the effect of organization on sensitivity is not significant. However, the effect of list structure on RTs to "old" items was significant, as predicted. Approaches based on occurrence

Table 3-6 (a): ANOVA summary for RT "new" for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1092764.00	----------	----
Organization (A)	1	19952.66	19952.66	0.59
Practice (B)	1	360150.00	360150.00	10.69**
A x B	1	38720.66	38720.66	1.15
Error	20	673940.67	673940.67	----

Table 3-6 (b): Mean RT "new" for Sim presentation.

	1T	3T	
BLS	1543	1378	1460
RLS	1565	1240	1403
	1554	1309	1432

information alone do not make such a prediction. Similarly, the effect of practice on RTs to "new" items was significant, as it was in Experiment 1, and this would be expected. If the items used as distractors gain little familiarity value and no organizational information then the only factor which should have an effect would be practice. Practice aids in the discrimination between "old" and "new" items, regardless of the basis of the decision process, i.e., search or non-search.

According to the context hypothesis any recognition decision is based on the familiarity value of an item. However, when an item is accessed for a recognition decision its familiarity value may lie between the criterion points for a rapid "old" or a rapid "new" response. In such a situation a search of the memory set will be performed and a decision made on the outcome of the search. As the number of replicas of an item in the memory set increases so does the probability of accessing an interpretation which has been encoded as a replica and thus has a high enough level of familiarity to warrant a response of "old". Such a process is relatively quick, especially when compared to a search process which would occur when the accessed interpretation has not been encoded although it may share some common attributes with an encoded interpretation of the item. Similarly, some "new" items may share some common attributes with list words from the same category. In this case the probability of an error is quite high, but is confounded with the effects of practice which facilitate discrimination on the basis of strength of familiarity.

Essentially, these results replicate those of Experiment 1 and support the context hypothesis. There were some differences in results between Experiment 1 and this experiment, but they will be discussed later in this chapter. The predictions for a Ser presentation differ somewhat from those for a Sim presentation, particularly with a categorized list as used in this experiment. In a Ser presentation there is a greater similarity to a recognition test situation in which items are presented singly. Also, there is a greater emphasis on the coding of familiarity value for each item, and for each replica. The following experiment was conducted to test the context hypothesis with a categorized list and a Ser mode of presentation.

Experiment 4: Serial presentation

The method and procedure for this experiment were the same as the method and procedure for the previous experiment with the exception that a different group of 24 Part 1 Psychology undergraduates of the University of Stirling were subjects and the items were presented singly in sequence for approximately three seconds per item instead of simultaneously. The instructions were the same except they described a serial presentation instead of a simultaneous presentation.

Predictions: The predictions for recall and clustering are the same as for Experiment 2, namely that recall will be better in the BLS condition and will increase as practice increases. Similarly clustering will be highest in the BLS condition and will increase with practice. However, since it is assumed that the impact of occurrence information will be even stronger in a Ser condition with a categorized list there is not likely to be any interaction effect since the practice effect may be strong enough to swamp the differential list structure effect on clustering. Also, if occurrence information is strongly emphasized by the parameters of the presentation and type of list then Prn may reach ceiling levels and not accurately reflect differences, even those which occur as a result of practice. In Experiment 2 Prn levels were very high and should be even higher in this experiment if the assumptions made about occurrence information are valid.

In a situation such as that presented in this experiment the effective presentation time hypothesis may gain more validity since the bias of the conditions is in a direction which should favor such an approach. However, the context hypothesis would predict that to the extent that encodings are variable average RTs for a list will be fast. If the inherent organization is not obvious then a seriation strategy might be more readily adopted by the subjects. The results of this would be that items in the BLS condition would receive more variable encoding than even in Experiment 2 and would be more equivalent to the encoding found in the RLS condition. The list structure effect will be attenuated in this experiment with the major effect being that of practice, particularly in the RLS condition. Without category names to bias a difference between the BLS and RLS conditions and with an increase in the difficulty of discovering the inherent organization the subjects will tend to encode the list items in more discrete terms and thus the encodings will gain in variability with a consequent reduction of the likelihood of a search between the RLS and BLS conditions.

RESULTS

All results are reported for one and 20 degrees of freedom and the analyses are the same as for the previous experiment.

Recall: There were significant differences due to list structure ($F = 18.41$, $p < .001$) and practice ($F = 76.39$, $p < .001$) with Prl increasing with practice and being highest in the BLS condition, as predicted. The results of the ANOVA are presented in Table 3-7 (a) and the mean Prl scores are presented in Table 3-7 (b). As before, the prediction for recall and for clustering are supported and are similar to those reported in the literature. These results do not enable a distinction to be drawn between the context hypothesis and alternative hypotheses.

Organization: There were significant differences in Cls scores as a result of list structure ($F = 43.17$, $p < .001$) and of practice ($F = 19.22$, $p < .001$) with Cls being highest in the BLS condition and increasing as practice increased. An examination of the recall protocols indicated that the nature of the effect was similar to that obtained in Experiment 2. The results support an interpretation based on a seriation strategy. In the BLS condition seriation and inherent list structure are mutually supportive processes while in the RLS condition seriation would lead to lower Cls scores as it is antagonistic to discovery of the inherent list structure. The effect of practice is to

Table 3-7 (a): ANOVA summary for Prl for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1.2125	--------	----
Organization (A)	1	0.1944	0.1944	18.41**
Practice (B)	1	0.8067	0.8067	76.39**
A x B	1	0.0003	0.0003	0.03
Error	20	0.2112	0.0106	----

Table 3-7 (b): Mean Prl for Ser presentation.

	1T	3T	
BLS	0.59	0.95	0.77
RLS	0.40	0.77	0.59
	0.49	0.86	0.68

support the processes in the BLS and RLS conditions which are assumed to center on the acquisition of information about each item with little reference to its place in the overall structure, although its place is automatically defined in the BLS condition. Clustering is higher, observably, in the BLS condition of this experiment than it was in Experiment 2 and is 'equal' in the RLS condition to that in Experiment 2. This supports the assumption that subjects are adopting a seriation strategy which supports the inherent list structure in the BLS condition but not in the RLS condition. An implication of this is that, relative to Experiment 2, occurrence information is more strongly emphasized by the parameters of the experimental situation and materials. The ANOVA summary is presented in Table 3-8 (a) and the mean Cls scores are presented in Table 3-8 (b).

Recognition: There were no significant treatment effects on Prn, although the effect of practice was marginally nonsignificant ($F = 3.67$, $.10 > p > .05$) with the direction being the same as in Experiment 2, i.e., Prn increases as practice increases. Since it appears that occurrence or familiarity is of prime importance to Prn it appears that any potential effect has been swamped by a ceiling effect. The results of the ANOVA are presented in Table 3-9 (a) and the mean Prn scores are presented in Table 3-9 (b). An examination of the latter table indicates that the differences in Prn are quite small across all conditions, particularly when these Prn scores are compared with those for Experiment 3 (Table 3-3 (b)). These results are mildly

Table 3-8 (a): ANOVA summary for Cls for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	2.1258	---------	----
Organization (A)	1	1.1137	1.1137	43.17**
Practice (B)	1	0.4959	0.4959	19.92**
A x B	1	0.0002	0.0002	0.01
Error	20	0.5160	0.0258	----

Table 3-8 (b): Mean Cls for Ser presentation.

	1T	3T	
BLS	0.69	0.97	0.83
RLS	0.25	0.55	0.40
	0.47	0.76	0.62

Table 3-9 (a): ANOVA summary for Prn for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.1429	--------	----
Organization (A)	1	0.0011	0.0011	0.18
Practice (B)	1	0.0216	0.0216	3.67 (*)
A x B	1	0.0024	0.0024	0.41
Error	20	0.1179	0.0059	----

Table 3-9 (b): Mean Prn for Ser presentation.

	1T	3T	
BLS	0.85	0.93	0.89
RLS	0.88	0.92	0.90
	0.86	0.92	0.89

supportive of the argument that occurrence information is emphasized across conditions in this experiment, relative to previous experiments in this thesis.

P($\bar{A}$): The only significant difference was that due to practice ($F = 14.36$, $p < .005$) with sensitivity increasing as practice increased. This is in keeping with the results of the previous experiments for practice effects on sensitivity. There was an effect of list structure on sensitivity in Experiment 1 and the implications of this effect will be discussed later. The results of the ANOVA are presented in Table 3-10 (a) and the mean P($\bar{A}$) scores are presented in Table 3-10 (b).

Reaction time: There was a significant effect of list structure on RTs for "old" item responses ($F = 8.16$, $p < .01$) and there was an effect of practice with RTs decreasing as practice increased ($F = 47.68$, $p < .001$). In addition, the list structure x practice interaction was significant ($F = 17.33$, $p < .001$) with RTs for "old" items being virtually equivalent over practice for the BLS condition but decreasing as a function of increasing practice in the RLS condition. This effect is illustrated in Fig. 3-3. The effect appears mainly due to a very long RT in the RLS - 1T condition. While it was predicted that the major effect of practice would be in the RLS condition a RT score difference such as that obtained was not expected, the magnitude of the difference being beyond any expectation. The difference is in the direction one would expect if subjects adopt a seriation strategy; although to produce a difference of this magnitude it would appear that the subjects had

Table 3-10 (a): ANOVA summary for $P(\bar{A})$ for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0386	--------	----
Organization (A)	1	0.0003	0.0003	0.24
Practice (B)	1	0.0160	0.0160	14.36**
A x B	1	0.00002	0.00002	0.02
Error	20	0.0223	0.0011	----

Table 3-10 (b): Mean $P(\bar{A})$ for Ser presentation.

	1T	3T	
BLS	0.92	0.98	0.95
RLS	0.92	0.97	0.94
	0.92	0.97	0.95

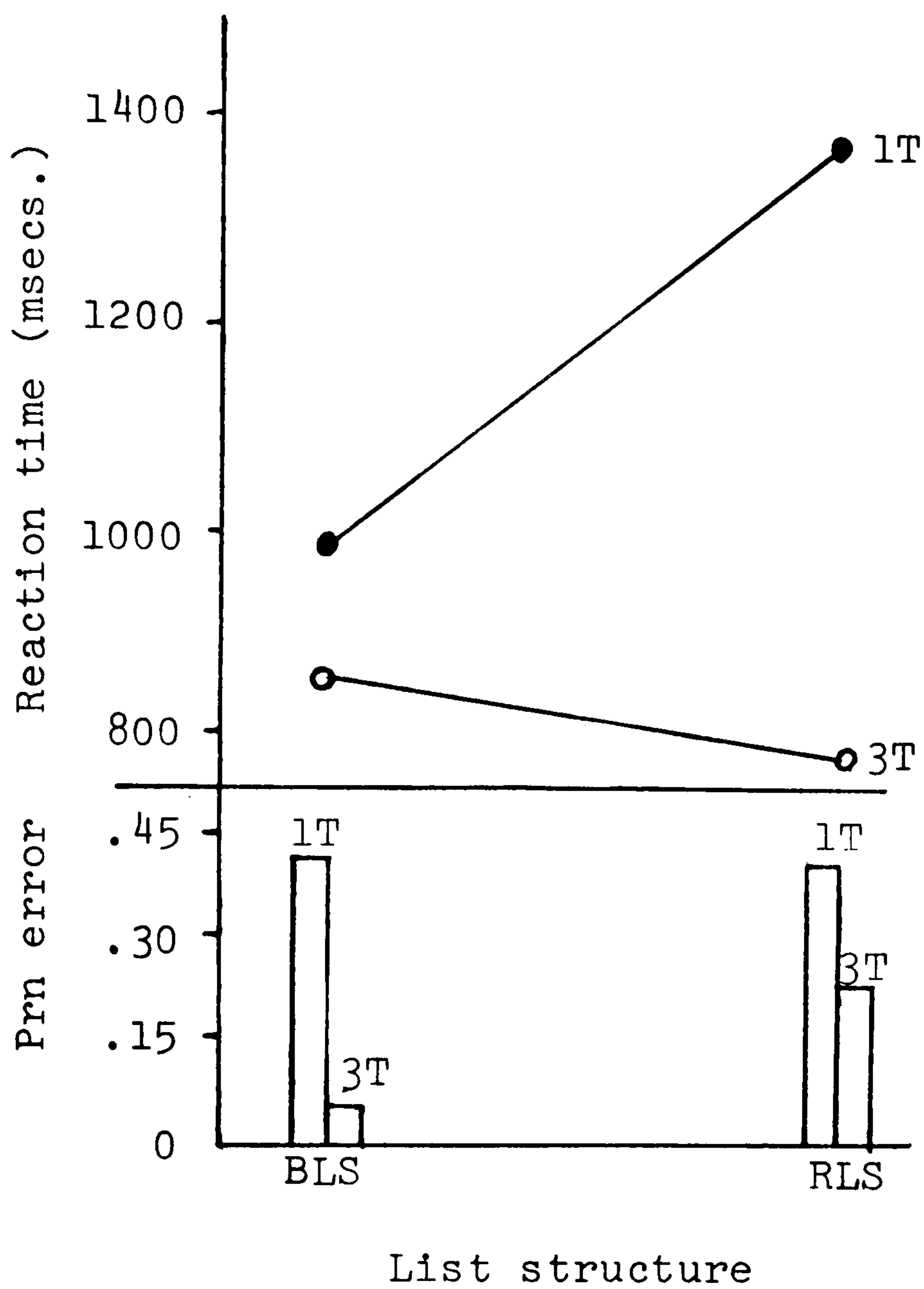


Fig. 3-3. RT and Prn error for "old" responses as a function of the list structure x practice interaction.

encoded very few interpretations (replicas) in the RLS - 1T condition, perhaps being content with rehearsing a single or a limited range of interpretations and concentrating instead on accruing as much occurrence strength as possible. Since interpretations are not supported to the same extent in the RLS condition by the list structure as in the BLS condition, the effect of practice would be to differentially affect encoding variability in the RLS condition, relative to the BLS condition.

There were significant effects of list structure ($F = 4.08$, $p < .05$) and practice ($F = 41.17$, $p < .001$) on RTs to "new" items with RTs being fastest in the BLS condition and decreasing with increased practice. If the assumption that the major effect on RTs to "new" items is that of occurrence strength then one must assume that, in this experiment occurrence information is also a function of list structure. This is another way of stating the previous argument that in the BLS condition seriation and organization are equivalent in the BLS condition, or at least the two kinds of information are mutually supportive, and the likelihood of performing a search is less, for this experiment, for the BLS treatment condition than for the RLS treatment condition. A summary of the ANOVA results for the RTs to "old" items is presented in Table 3-11 (a) and for RTs to "new" items in Table 3-12 (a). The average RT scores for "old" responses are presented in Table 3-11 (b) and for "new" responses in Table 3-12 (b).

DISCUSSION

A seriation strategy coupled with a category rule would be fast with respect to processing items during acquisition.

Table 3-11 (a): ANOVA summary for RT "old" for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1632654.50	---------	----
Organization (A)	1	142912.67	142912.67	8.16*
Practice (B)	1	835520.17	835520.17	47.68**
A x B	1	303749.99	303749.99	17.33**
Error	20	350471.67	17523.58	----

Table 3-11 (b): Mean RT "old" for Ser presentation.

	1T	3T	
BLS	989	841	915
RLS	1368	770	1069
	1178	805	992

Table 3-12 (a): ANOVA summary for RT "new" for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	2463146.62	---------	----
Organization (A)	1	151209.37	151209.37	4.08*
Practice (B)	1	1526617.04	1526617.04	41.17**
A x B	1	43776.04	43776.04	1.18
Error	20	741544.17	37077.21	----

Table 3-12 (b): Mean RT "new" for Ser presentation.

	1T	3T	
BLS	1261	842	1052
RLS	1505	915	1210
	1383	879	1131

In other words, if a subject processed an organized list using a seriation strategy the category rule would facilitate or support the seriation approach and also items would tend to be rehearsed in terms of their position rather than in terms of their semantic context, although this context would be present and, to a degree, likely attended to.

The results of the recall and clustering data are the same as in the previous experiments and are typical of those reported in the literature. These results do not permit a discrimination to be made between the context hypothesis and alternatives such as the effective presentation time hypothesis. The major difference between the results of this experiment and those previous is with regard to the results obtained in terms of RTs for "old" and "new" items. The effective presentation time hypothesis would lead to the prediction that RTs should be fastest in the BLS condition, and that is the case for RTs to "new" items and also for RTs to "old" items. The context hypothesis predicted an attenuation of any effects on RTs and this certainly was the case, but the context hypothesis would not predict a reversal of the effect on the a priori grounds available before this experiment. An a posteriori explanation of the results obtained would be that when a subject adopts a seriation strategy, as it appears subjects in this experiment did, each item is processed with little regard for its semantic context. In this situation semantic context does not impose the limitations on encoding variability in the same way as it did in previous experiments.

The inherent list structure while obvious is not as constrained by category labels and, as a result of this lessening of constraint, encoding is more variable in the BLS condition. In the RLS condition the category relationships are not as obvious and it appears that, while engaged in a seriation strategy, the subject is searching for a basis to organize the list. As a result there would likely be a lower degree of encoding variability, at least for a number of the items, and average RTs for the list are relatively long.

In summary, the results of this experiment present an anomaly for the context hypothesis and, in fact, provide support for an alternative such as the effective presentation time hypothesis which states that a blocked list (BLS) is easier to read, and consequently will receive more rehearsals on a per-item basis and will thus be better learned (as well as likely being more variable in encoding due to the formation of a greater number of replicas).

In order to assess the effects of mode of presentation the data from Experiments 3 and 4 were combined into a 2 x 2 x 2 factorial between-subjects design with six subjects per cell of the design. The context hypothesis leads to the prediction that, for RTs to "old" items, there should be an effect, if any, such that RTs are longer in the Sim condition since semantic constraints are greater in that condition and consequently it would be expected that encoding variability would be greater in the Ser condition. All results are based on one and 40 degrees of freedom, unless otherwise stated.

RESULTS

Recall: The effect of mode of presentation was marginally non-significant ($F = 3.47$, $.10 > p > .05$). No other effects involving mode of presentation were significant. Prl was slightly higher in the Ser condition. The results of the ANOVA are presented in Table 3-13.

Organization: There were no significant differences in Cls as a result of differences in mode of presentation ($F < 1$). The results of the ANOVA are presented in Table 3-14.

Recognition: There was a significant effect of mode of presentation on Prn ($F = 7.58$, $p < .01$) with Prn being higher in the Ser condition. In the Ser condition items are presented in isolation, at least relative to the Sim condition, and it is postulated they are treated as discrete items to a greater degree than in the Sim condition. It has been argued that Prn is principally sensitive to the effects of treatments which have an effect on the level of familiarity values accrued by a list item. This result supports the postulation that Prn is primarily a strength measure. The results of the ANOVA are presented in Table 3-15.

$P(\bar{A})$: Mode of presentation produced significant differences as indicated by the sensitivity measure ($F = 9.76$, $p < .005$) with $P(\bar{A})$ being higher in the Ser condition. It is the Ser condition in which maximum familiarity value would be expected for list items; therefore, discrimination should be better between "old" and "new" items since the process is supported most strongly in the Ser condition. The results of the ANOVA are summarized in Table 3-16.

Table 3-13: ANOVA summary for Pr1 for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	2.4264	--------	----
Presentation (A)	1	0.0363	0.0363	3.47 (*)
Organization (B)	1	0.2296	0.2296	21.95**
Practice (C)	1	1.7176	1.7176	164.21**
A x B	1	0.0208	0.0208	1.99
A x C	1	0.0016	0.0016	0.16
B x C	1	0.0003	0.0003	0.03
A x B x C	1	0.0016	0.0016	0.16
Error	40	0.4184	0.0105	----

Table 3-14: ANOVA summary for Cls for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	5.1805	---------	----
Presentation (A)	1	0.0096	0.0096	0.18
Organization (B)	1	1.8330	1.8330	34.46**
Practice (C)	1	1.0860	1.0860	20.42**
A x B	1	0.0192	0.0192	0.36
A x C	1	0.0021	0.0021	0.04
B x C	1	0.0469	0.0469	0.88
A x B x C	1	0.0560	0.0560	1.05
Error	40	2.1276	0.0532	----

Table 3-15: ANOVA summary for Prn for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.4544	---------	----
Presentation (A)	1	0.0560	0.0560	7.58*
Organization (B)	1	0.0075	0.0075	1.01
Practice (C)	1	0.0800	0.0800	10.83**
A x B	1	0.0016	0.0016	0.22
A x C	1	0.0056	0.0056	0.76
B x C	1	0.0075	0.0075	1.01
A x B x C	1	0.0003	0.0003	0.04
Error	40	0.2957	0.0074	----

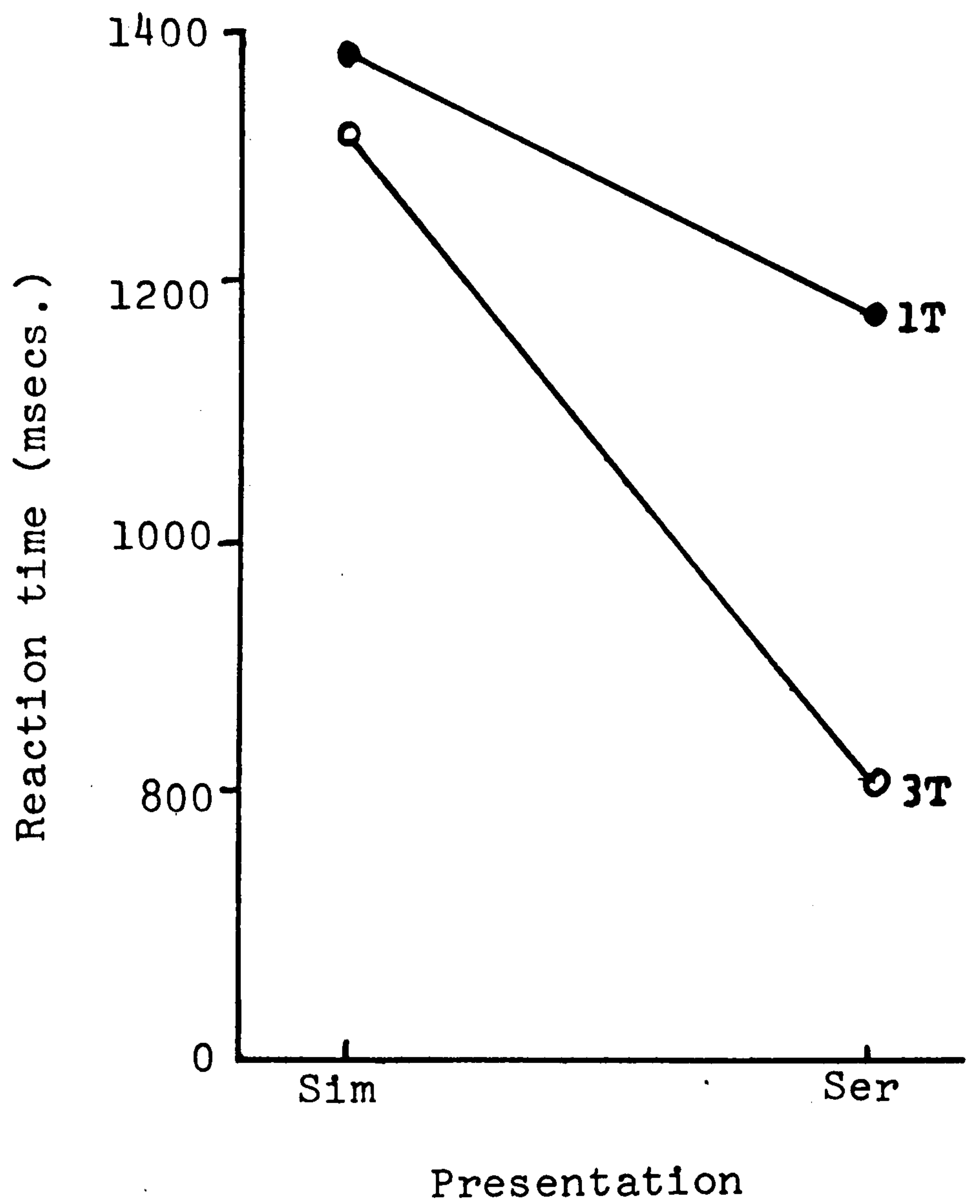
Table 3-16: ANOVA summary for $P(\bar{A})$ for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.1408	--------	----
Presentation (A)	1	0.0130	0.0130	9.76**
Organization (B)	1	0.0009	0.0009	0.69
Practice (C)	1	0.0638	0.0638	47.90**
A x B	1	0.0029	0.0029	2.14
A x C	1	0.0054	0.0054	4.07
B x C	1	0.0009	0.0009	0.69
A x B x C	1	0.0006	0.0006	0.45
Error	40	0.0533	0.0013	----

Reaction time: This is the critical measure in terms of the context hypothesis since, it has been argued, accuracy measures are not sufficient to adequately reflect recognition differences which are a function of organizational factors. Organizational factors are understood to be those which relate to the encoding of items in terms of attribute selection and which help determine the structure of the memory set as opposed to the strength of the items within that set, although the latter would also be affected to a degree by organizational processes.

There was a significant effect of mode of presentation on RTs to "old" items ($F = 47.51$, $p < .001$) with RTs being significantly longer in the BLS condition. This is also the condition in which organization has the strongest effect and in which encoding specificity would be greatest. The effect of increasing encoding specificity, according to the context hypothesis, would be to increase the likelihood of a search operation in recognition due to constraints upon the encoded interpretations (and their strength) which decreases the likelihood of accessing an encoded interpretation and making a fast decision based solely on familiarity.

The mode of presentation x practice and mode of presentation x list structure interactions were each significant, ($F = 8.60$, $p < .01$), and ($F = 13.29$, $p < .005$), respectively. These interactions are illustrated in Figs. 3-4 and 3-5 respectively. The effect of practice is greatest in the Ser condition with increases in practice leading to decreases in RTs, there is no difference due to practice in the Sim mode of presentation, in which encoding specificity is



<u>Fig. 3-4</u>. RT for "old" responses as a function of the mode of presentation x practice.

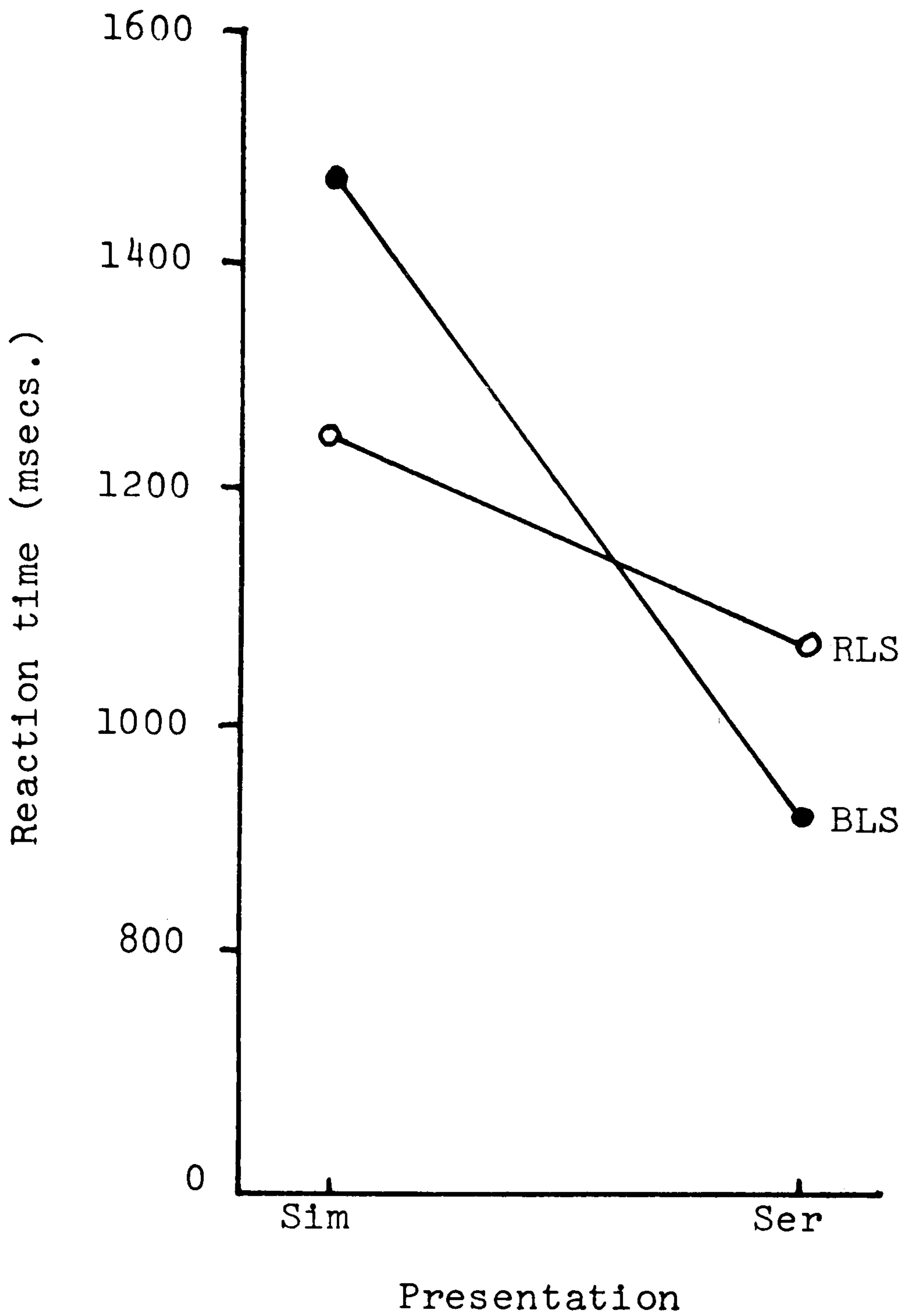


Fig. 3-5. RT for "old" responses for mode of presentation at levels of list structure.

high, relative to the Ser mode of presentation. The effect of list structure is such that in the Ser mode of presentation RTs are anomalously faster in the BLS condition, although the actual difference is slight, while in the Sim mode of presentation the effect of list structure is such that RTs are fastest in the RLS condition. The latter effect is the basic prediction of the contest hypothesis, namely that RTs are faster in the conditions which promote encoding variability. The logic of this must be that in the Ser mode of presentation encoding variability is higher in the BLS condition. This would be true in a situation, for example, in which inter-item information was not attended to. The results of the ANOVA are summarized in Table 3-17.

The differences in RTs to "new items as a function of mode of presentation were significant ($F = 4.08$, $p < .05$) with the fastest RTs occurring for the Ser mode of presentation. It was in this condition that occurrence strength was greatest and that discrimination of "old" from "new" was greatest. The ANOVA results are summarized in Table 3-18.

DISCUSSION

The recall and clustering results are those one would typically expect to find; increasing organization and increasing practice both lead to increases in recall and in clustering. These results could be predicted by virtually all models of memory which deal with recall phenomena, and are common in the literature.

The effect of mode of presentation on Prn for "old" items supported the contention that in the Ser mode of

Table 3-17: ANOVA summary for RT "old" for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	4486067.00	---------	----
Presentation (A)	1	1555200.00	1555200.00	47.51**
Organization (B)	1	15624.08	15624.08	0.48
Practice (C)	1	580800.00	580800.00	17.74**
A x B	1	435102.09	435102.09	13.29**
A x C	1	281520.33	281520.33	8.60*
B x C	1	191774.09	191774.09	5.86
A x B x C	1	116624.08	116624.08	3.56
Error	40	1309422.33	32735.56	----

Table 3-18: ANOVA summary for RT "new" for combined data.

Source	df	Sum of Squares	Mean Square	F
Total	47	4640415.31	--------	----
Presentation (A)	1	1084504.69	1084504.69	4.08*
Organization (B)	1	30653.52	30653.52	0.12
Practice (C)	1	1684876.02	1684876.02	6.33*
A x B	1	140508.52	140508.52	0.53
A x C	1	201891.02	201891.02	0.76
B x C	1	82419.19	82419.19	0.31
Error	40	10641084.83	266027.12	----

presentation there is a tendency for occurrence information to be emphasized, implicitly. In this situation the items are presented singly and any semantic information must be derived by the subject from his own internal memory representation, whereas in the Sim condition all the information is present and the subject can actively explore it without relying on his own internal memory representation. The effect of this is that the subject appears to adopt a seriation strategy in the Ser condition. There was some evidence that this was also the case in the Sim condition, and if so, it was even more pronounced in the Ser condition. The effect of practice appears to be one of incrementing occurrence information as well as, in appropriate circumstances, facilitating the discovery of organizational properties inherent in the list. In addition, the Ser presentation is closest to the conditions of a recognition test and the change of semantic context hypothesis (Light & Carter-Sobell, 1970) would predict the results of the mode of presentation as well, since the change is greatest for the Sim condition, and Prn should be poorer in this condition, as it was.

The context hypothesis, as developed in Chapter 1, deals with a model of recognition memory which is difficult, if not impossible, to investigate using the common accuracy measures such as Prn. Instead, RT measures are appropriate for using in investigating this hypothesis. The results of the treatment effects on RTs for "old" items support an interpretation based on the context hypothesis. In the Ser mode of presentation each item is processed relatively independently of the list structure, particularly with a RLS condition. The effect of this is that each time the item is rehearsed a slightly different replica may be set up since there are few semantic constraints in this situation. In other words, one would expect a high level of encoding variability. In the BLS condition with a Sim mode of presentation the RTs are quite long and do not decrease as much with a RLS situation as in the Ser mode of presentation.

The alternative hypothesis discussed throughout this thesis to this point has been the effective presentation time hypothesis. This hypothesis would predict that performance in recognition should be better in the Sim and the BLS conditions since, presumably, these conditions provide a situation in which effective presentation times are longer since the material is easier to process or read in these conditions. In this situation one would predict higher Prn in the Sim mode of presentation as well as with a BLS condition of list structure. This was not the situation which was observed, in fact, it was the opposite. The context hypothesis would predict that Prn would be higher in those conditions in which encoding variability was high since in those conditions the probability of accessing an encoded representation is high and occurrence information overall may be some function of level of encoding variability and number of replicas in memory. Such a situation would certainly reduce interference effects associated with uncertainty and consequent search operations.

An assessment of the situations in which encodings are more likely to be variable requires that one regard subjects as operating according to some process like the law of least effort with a strategy aimed at attaining maximum gain for that least effort. The effect of this would be for subjects under a BLS treatment to follow the organization set out in this condition, presuming discovery of the existence of the organization, and to rehearse items in terms of this organization. With a Ser mode of presentation this process is relatively difficult since there is an apparent limited capacity to immediate memory and with a Ser mode of presentation the inherent list structure is not as obvious (or discoverable) as in a Sim condition. This is an important point and will be elaborated upon in the final chapter of this thesis in which the results of all the experiments will be compared, contrasted, and discussed in terms of the context hypothesis as well as alternative hypotheses.

A number of assumptions were required in order to offer even an a posteriori explanation of the results of this last experiment, and that is not a desirable state of affairs. A more reasonable prediction might have been that overall differences would be slight and, with the exception of the RT "old" results for RLS - 1T, this was the case. The context hypothesis leads one to predict an attenuation of effect which was obtained with the exception of the data point mentioned. Thus, while these results were explained, they were not predicted.

The experiments reported have been run using small numbers of subjects and for this reason the results are perhaps not as robust as would be desired. Consequently, any arguments based on these results alone are weak arguments, especially since, for the most part, the effects on RTs are small and not tremendously powerful. For these reasons the previous experiments were subjected to replication and the results are presented in the following chapter.

CHAPTER 4

Carey & Lockhart (1973) found that task expectancy affected recognition performance. If subjects expected a recognition test they performed better on that test than subjects who did not expect the recognition test. Carey & Lockhart interpreted this result as supporting the hypothesis that the subject's encoding and storage of information is in a format which the subject believes will permit an optimal utilization of the information. The implication of this is that control processes are vitally important to memory and that subjects can modify their performance to be congruent with their expectancies about the performance demands of the task. Carey & Lockhart claim that:

> "... the present study emphasizes the possibility that utilization of stored information should be maximal when knowledge of the functional properties of retrieval is available to the subjects at the time of encoding." (Carey & Lockhart, 1973, p. 300)

This appears to be an extension of the position adopted by Tulving (1968) in which he proposed that organization is the result of a retrieval plan which was established at the time of input of information. Bower (1972) presented a similar proposal: he regarded organization as being based on one or more strategies selected from a small set of possible ones and which were essentially encoding or input strategies.

The important problem facing subjects who are to be tested for recognition is for them to be able to discriminate list from non-list items. In such a situation item or occurrence information is very important while organization information is regarded as being less important, except as it facilitates the discrimination of list and non-list items or, as it affects the decision process (es).

In terms of the context hypothesis one would assume that a task which required attending to items, per se, would effectively reduce attention to interitem information, in a specific sense, and would lead to encodings which would be highly variable, even given that recall was also a requirement of the situation. In a task in which both recall and recognition tests were to be used one would expect, if the subject were aware of both tasks, that organization would be relatively low and encoding variability would be relatively high (relative to the situation in which only recall was expected). The result of this would be a reduction of RTs to "old" items and an attenuation of any effects of list structure or other organization variables.

In the previous experiments in this thesis recognition instructions were not given the subjects until they had completed the recall task, nor were they told that there would be a recognition test following recall. The reason for this was that it was felt that recognition instructions might lead to lower levels of organization and the purpose of the experiments was to investigate the effects of organization on memory performance, particularly for recognition memory task performance.

In this chapter the results of experiments using three somewhat different experimental paradigms will be reported. Two of the paradigms used are those used in experiments previously reported in Chapters 2 and 3, and the third paradigm is a categorized list paradigm in which additional structural information is provided. The experiments were conducted treating the experimental paradigm as a within-subject factor which was counterbalanced with the remaining experimental treatments according to a Latin Square type of design. The reasons for this are that the design is economical of subjects and a Latin Square type of design helps to control for order effects.

The following is a description of the Method and the Procedure elements which are common to all the experiments in this chapter. Any differences in either Method or Procedure between the three paradigms will be reported with the results for that paradigm.

Essentially, the experiments represent replications of the earlier experiments with the exception that recognition instructions were given to the subjects prior to the acquisition of the material for recall and with the exception of the paradigm which included additional structure information. In all other aspects the experiments were virtually identical replicates, the only other major difference being the apparatus and a slight list difference in the categorized list paradigm; the list was shortened to four categories with five words per category.

METHOD

Subjects and Design: The subjects were 24 students who were enrolled in Part I Psychology at the University of Stirling. The subjects participated in order to fulfill a course requirement. The design for each paradigm was a 2 x 2 factorial with fixed effects and with six subjects assigned to each cell of the design on a random basis. A second group of 24 students was run in a similar situation but the mode of presentation was changed from a Simultaneous presentation to a Serial presentation. For each paradigm a final analysis which treats mode of presentation as a variable was performed.

Apparatus and Materials: The presentation of the verbal materials both during acquisition and testing as well as all timing and the recognition test RTs was via a PDP 11/45 computer and a PDP GT40 visual display system which was interfaced with the main computer. Software programs were prepared by Mr. Charles Foster of the Psychology Department of the University of Stirling. The data from the recognition tests was output on a peripheral teletype and recall was spoken and was recorded on a tape recorder for subsequent transcription.

Procedure: Each subject was randomly assigned to one of the treatment conditions derived from the Latin Square type of design which is illustrated in Fig. 4-1. This determined the combination of the three paradigms the subject would perform in. Each subject was told that there would be three short experiments and that he would be given instructions pertinent to each one before it began. For each paradigm the subjects were told the number of items in the list, the time for which the list was to be presented, the amount of time permitted for recall, and the number of acquisition trials they would have. In addition, for the 3T condition the subjects were told that the items would be presented in the same order on each acquisition trial and that they were to recall the items after each trial. The recall

Subject #	Treatment Combination		
1	A 1-1	B 2-3	C 1-3
2	B 2-1	C 1-3	A 1-1
3	C 1-3	A 1-1	B 2-1
4	A 2-3	B 1-1	C 2-1
5	B 1-1	C 2-3	A 2-1
6	C 2-1	A 2-3	B 1-1
7	A 1-3	B 2-3	C 2-1
8	B 2-3	C 1-3	A 2-1
9	C 1-1	A 1-3	B 2-3
10	A 2-1	B 1-3	C 2-3
11	B 1-3	C 2-3	A 1-1
12	C 2-3	A 2-1	B 1-1
13	A 1-1	B 2-1	C 1-3
14	B 2-1	C 1-1	A 1-3
15	C 1-3	A 1-1	B 2-3
16	A 2-3	B 1-3	C 1-1
17	B 1-1	C 2-1	A 2-3
18	C 2-1	A 2-3	B 1-3
19	A 1-3	B 2-1	C 1-1
20	B 2-3	C 1-1	A 1-3
21	C 1-1	A 1-3	B 2-1
22	A 2-1	B 1-1	C 2-3
23	B 1-3	C 2-1	A 2-3
24	C 2-3	A 2-1	B 1-3

Paradigm

A - Nested hierarchy
B - Categorized list
C - Additional information treatment

1 - 1 BLS-1T
1 - 3 BLS-3T
2 - 1 RLS-1T
2 - 3 RLS-3T

Fig. 4-1. Order of paradigms and treatment conditions for each subject for experiments reported in this chapter, for both Ser and Sim modes of presentation. Paradigm order was based on a simple Latin Square, and treatment

A	B	C
B	C	A
C	A	B

combinations were counterbalanced over subjects.

instructions were standard _free_ recall instructions. The subjects were instructed that after the final recall they would be tested for recognition of the list items for that experiment and that they would be shown both list and non-list words in random order. Subjects were instructed to respond "old" for a list word and "new" for a non-list word and they were to respond as quickly _and_ accurately as possible. Each subject was told that the word READY would appear and that a test word would follow two seconds later and the test word would remain on the screen until they made a response by pressing the appropriately labelled button before them. One-half of the subjects used their right hand to respond "old" and the other half used their left hand.

NESTED HIERARCHY PARADIGM

EXPERIMENT 5: Simultaneous presentation

The independent factors in this experiment were list structure (BLS or RLS) and practice (1T or 3T). The presentation times were three seconds per item (averaged over total time) as in the previous studies. The materials used were the same as those used in Experiments 1 and 2.

Predictions: The general finding in the literature is that a blocked presentation facilitates recall as do increases in practice, and this is the prediction for the recall phase of this experiment. However, since the recognition task is known prior to acquisition, it is presumed that there will be, at the least, an attenuation of recall performance effects. This presumption is based on Carey & Lockhart (1973) in that encoding is a function of the perceived functional characteristics of the task.

As for Experiment 1, it is predicted that the only effect on Prn will be one of practice, with Prn being highest in the 3T condition. A similar prediction is made regarding the sensitivity measure $P(\bar{A})$. For RTs to "old" items it is predicted that RTs will be fastest in the RLS condition since this is the condition in which encoding variability is highest. Also, it is predicted that overall RTs should be faster than those for Experiment 1 since, in the present experiment, the subjects will likely encode in a manner more appropriate to recognition task performance, i.e., they will attend more to occurrence information. RTs will also decrease as practice increases, since increases in practice are presumed to facilitate occurrence information acquisition, both in and out of the contextual constraints of the list. For RTs to "new" items it is predicted that the fastest RTs will be in the 3T level of practice and there will be no effect of list structure.

In the result sections dealing with combined results the tables of means are for significant interactions or main effects of mode of presentation. In those cases in which there are no significant interactions a complete (all-factor) table of means is presented as also for the situation in which there is a significant three-way interaction. While this leads to some redundancy, it is hoped that the ease of following the results for the reader is increased and that this offsets the redundant nature of such reporting.

Few figures illustrating results are presented in this chapter. For the most part, these experiments constitute replications of the experiments in Chapters 2 and 3, and figures will be presented in Chapter 6 when the results of the various experiments will be contrasted and compared.

RESULTS

All results are based on one and 20 degrees of freedom, unless otherwise stated.

Recall: There was no effect of list structure on Prl in this experiment although Prl was higher in the BLS condition ($F = 1.65$, $p > .05$). There was a significant effect of practice ($F = 7.07$, $p < .01$) with Prl being highest in the 3T condition. There was no significant interaction effect ($F = 1.65$, $p > .05$). Recall performance was very high in this experiment as it was in Experiment 1, and an examination of Table 4-2 indicates that there was very little difference in Prl for levels of practice in the BLS condition and that the differences due to practice were greater in the RLS condition although there was no significant interaction. The mean Prl for the treatment conditions is presented in Table 4-2, and the results of the ANOVA are presented in Table 4-1.

If subjects were attending primarily to occurrence information then one would expect an attenuation of performance in terms of Prl, as is evident. It is presumed that this apparent attenuation of recall is most likely a function of the perception of the perceived functional characteristics of the task (recognition), as discussed previously.

Organization: There was no effect of list structure on Cls scores ($F = 1.57$, $p > .05$) nor were there any significant effects of practice ($F = 2.76$, $p > .05$) or list structure

Table 4-1: Results of ANOVA for Prl for Simultaneous presentation with a nested hierarchy.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.3661	---------	---
Organization (A)	1	0.0198	0.0198	1.65
Practice (B)	1	0.0852	0.0852	7.07*
A x B	1	0.0198	0.0198	1.65
Error	20	0.2412	0.0121	---

Table 4-2: Mean Prl scores for simultaneous presentation.

	1T	3T	
BLS	0.77	0.95	0.86
RLS	0.77	0.83	0.80
	0.77	0.89	0.83

x practice interaction ($F = 2.03$, $p > .05$). An examination of Table 4-4 indicates that, in the RLS condition, performance decreased over trials, although the difference was not significant.

The direction of difference mentioned is that which one would expect if the subjects were attending primarily to occurrence information, and perhaps adopting a seriation strategy as they appeared to do in Experiment 1. However, this argument is speculative since the effects were not significant.

The mean Cls scores are presented in Table 4-4, and the results of the ANOVA are presented in Table 4-3.

Recognition: There were no significant effects due to treatments or their interaction on Prn for "old" items. The results of the ANOVA are presented in Table 4-5, and the mean Prn scores are presented in Table 4-6. Prn was very high for all conditions and the lack of effects may be due to a ceiling effect. In addition, if subjects attended primarily to occurrence information one would expect an attenuation of organization effects since the occurrence information is the same for all conditions. It should be noted that the only apparent difference, although non-significant, is that due to practice.

$P(\bar{A})$: There were no effects of treatments on $P(\bar{A})$. The difference due to practice was, however, marginally non-significant ($F= 4.26$, $.10 > p > .05$). The results of the ANOVA are presented in Table 4-7, and the mean $P(\bar{A})$ scores are presented in Table 4-8. Performance is at a very high level and, as for Prn, any effects might be obscured due

Table 4-3: Results of ANOVA on Cls scores for simultaneous presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.9565	---------	---
Organization (A)	1	0.0570	0.0570	1.57
Practice (B)	1	0.1001	0.1001	2.76
A x B	1	0.0730	0.0730	2.03
Error	20	0.7256	0.0363	---

Table 4-4: Mean Cls scores for simultaneous presentation.

	1T	3T	
BLS	0.63	0.61	0.62
RLS	0.64	0.40	0.52
	0.63	0.50	0.57

Table 4-5: Results of ANOVA for Prn for simultaneous presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.2214	---------	---
Organization (A)	1	0.0006	0.0006	0.06
Practice (B)	1	0.0171	0.0171	1.71
A x B	1	0.0043	0.0043	0.43
Error	20	0.1995	0.0100	---

Table 4-6: Mean Prn scores for simultaneous presentation.

	1T	3T	
BLS	0.89	0.97	0.93
RLS	0.92	0.95	0.94
	0.90	0.96	0.93

Table 4-7: Results of ANOVA for sensitivity measure for a simultaneous presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0161	---------	---
Organization (A)	1	0.0001	0.0001	0.10
Practice (B)	1	0.0028	0.0028	4.26(*)
A x B	1	0.00002	0.00002	0.03
Error	20	0.0132	0.0007	---

Table 4-8: Mean sensitivity ($P(\bar{A})$) scores for simultaneous presentation.

	1T	3T	
BLS	0.95	0.97	0.96
RLS	0.96	0.98	0.97
	0.95	0.97	0.96

to performance at ceiling levels. Also, as pointed out in the recognition results, this is an effect one would expect if the subjects had been attending primarily to occurrence information.

To this point it would appear that the principal mediator of both recall and recognition performance was occurrence information. It is evident however, that there was some slight difference in Cls scores and in $P(\bar{A})$ scores, although these differences were not significant. The direction of the differences was that they were slightly higher in the BLS condition.

The effects of organization, in terms of the usual facilitative effect on recall, were not present under the conditions of this experiment. Also, performance in terms of recognition and $P(\bar{A})$ was at a very high level and the lack of effect could be the result of ceiling effects.

Reaction time: There was a significant effect of list structure on RTs to "old" items ($F = 7.80$, $p < .025$) with RTs being fastest in the RLS condition, as predicted from the context hypothesis. There was no effect of practice nor of list structure x practice interaction (F's < 1). Mean RTs for "old" items are presented in Table 4-10, and the results of the ANOVA are presented in Table 4-9.

There were no effects of the treatment conditions or their interaction on RTs for "new" items. The mean RTs for "new" items are presented in Table 4-12, and the results of the ANOVA are presented in Table 4-11. The differences obtained however, were in the directions found in most of the previous studies, i.e., RTs were shortest in the RLS

Table 4-9: ANOVA for RTs to "old" items for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	592373.96	---------	---
Organization (A)	1	159251.04	159251.04	7.80*
Practice (B)	1	13968.38	13968.38	0.68
A x B	1	11051.04	11051.04	0.54
Error	20	408103.50	20405.18	---

Table 4-10: Mean RTs to "old" items for Sim presentation.

	1T	3T	
BLS	916	1007	961
RLS	796	801	798
	856	904	880

Table 4-11: ANOVA for RTs to "new" items for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	827755.96	---------	---
Organization (A)	1	27135.38	27135.38	0.85
Practice (B)	1	86760.38	86760.38	2.71
A x B	1	74705.03	74705.03	2.34
Error	20	639155.17	31957.76	---

Table 4-12: Mean RTs to "new" items for Sim presentation.

	1T	3T	
BLS	1070	839	954
RLS	892	883	887
	981	861	921

condition and the effect of practice was to reduce RTs.

The median RTs for both "old" and "new" items were consistently faster in this experiment than in those reported in Experiment 1. This is what one would expect on the basis of the context hypothesis in a situation in which the subjects were informed of the recognition task prior to acquisition of the list items. If the subjects attended primarily to occurrence information then one would expect the encoding to be variable and consequently the probability of performing a search of memory would tend to decrease since the probability of accessing an encoded representation would be relatively high in recognition. Note however, that simple explanations exist, i.e., we are faster doing something we have been warned to expect.

The effect of the hierarchical presentation structure is evident in the RT results. A seriation strategy would facilitate a degree of encoding specificity in the BLS condition since the seriation strategy would tend to follow the structural properties of the list and this information would, presumably, impose a limitation on the contextual variability preceived in the list. This would account for the observation that there was some organization present in recall and acting in recognition, as measured by RTs. This is reasonable since the tasks involved in this study were a recall <u>and</u> a recognition task, and, according to Tulving (1968), recall is dependent upon organization, although the format of the organization is unspecified.

The effect of a focus of attention on items, per se, would be to increase the distance between "old" and "new" items, on a familiarity scale, in terms of criterion points. This shifting of the distributions of familiarity for "new" and "old" items would be to reduce the overlap of item strength and functionally reduce the area, in terms of items, of extended memory search while increasing the areas of fast "yes" and "no" response times. Reference to Fig. 1-4 will help illustrate this point. The $P(\bar{A})$ data supports this argument since sensitivity is considerably higher in this experiment than it was in Experiment 1, with smaller treatment differences as well. To this point, the results support the predictions derived from the context hypothesis.

DISCUSSION

The lack of an effect of list structure on Prl is taken as evidence suggesting that encoding is primarily in terms of occurrence information with a focus of attention on organization information being secondary. The effect of practice, which accompanied the lack of list structure effects, supports this interpretation since one effect of practice is to presumably strengthen occurrence or organization information: although if organization information was attended to in a major way one would expect the effect of practice would have been to emphasize the difference between levels of list structure. In fact, this was the trend observed; the BLS-RLS difference is larger after 3T: it is not significant possibly because of ceiling effects. Organization effects appear to be attenuated in this experiment for Prn and $P(\bar{A})$, and, as stated, this may be due to ceiling effects. It must be remembered that even though there is a slight tendency in this (organization information) direction, the main effect of practice appears to be one of promoting increases in familiarity value. It should also be noted that the effective presentation time hypothesis, in a situation in which attention is primarily directed to occurrence information, would predict no difference between the BLS and RLS conditions for Prl and would also predict low Cls scores. While the Cls scores were low, it does not appear that the effective presentation time hypothesis is adequate to explain the recognition results.

Recognition performance was very high but the effects of the experimental treatments were not significant in terms of either Prn or $P(\overline{A})$. The effect of list structure on RTs for "old" items was significant however, and was in the direction predicted by the context hypothesis; RTs were longest in the BLS condition. One of the contentions of this thesis, stated in Chapter 1, was that accuracy measures are not adequate to effectively determine organization-type effects in recognition. Once again this contention appears to have been upheld.

A dual-process approach is inadequate to explain the results obtained since, while it can explain the decrease in error rates and the decrease in overall RTs, it cannot effectively handle the differential effects of list structure. It is suggested that this effect is the result of the difference in degree of encoding variability between the BLS and RLS conditions. If the subjects adopt a seriation strategy, the result is that in the BLS condition they will acquire the organization of the list as well as the occurrence information while in the RLS condition they will acquire, functionally, only the occurrence information. However, the nature of a seriation strategy is that the focus is on the position of the items and not on their semantic relatedness. For the purposes of recall however, the subjects do attend to some of the organizational information but this degree of attention is less than it would have been, had no recognition instructions been given. In Experiment 1, the levels of performance on Prn and $P(\bar{A})$ were lower and there were effects of list structure. Given the high levels of performance on Prn and $P(\bar{A})$ in this experiment the assumption of an attenuation of organization effects appears warranted and justified. The effect of this organization acquisition is to promote encoding specificity in the BLS condition, relative to the RLS condition. The rationale of this argument has been presented earlier, in Chapter 2 in discussion of Experiment 4.

The replication of Experiment 1 with the addition of recognition instructions prior to acquisition has provided support for the context hypothesis and represents a basically successful replication of the earlier experiment. The following is a replication of Experiment 2, again, with recognition instructions given prior to acquisition of the list items.

Experiment 6: Serial presentation

The Method and Procedure were the same as for Experiment 5 with the exception that a different group of 24 subjects was used and the list items were presented in a serial as opposed to a simultaneous manner.

Predictions: The predictions derived from the context hypothesis which are specific to this experiment are that recall and clustering will be facilitated by list structure with the best performance being in the BLS condition. However, in acknowledgement of the effects of recognition instructions, based on Carey & Lockhart (1973) it is expected that the effects will be attenuated relative to Experiment 2. The predictions dealing with Prn and $P(\bar{A})$ are that the only treatment which will have an effect is that of practice since Prn and $P(\bar{A})$ are mediated primarily, but not solely, by occurrence information. Performance on these measures will be better in the 3T condition of practice. Since one of the presumed properties of a Ser mode of presentation is an attenuation of organization information effects and an overall increase in encoding variability, it is predicted that the effect of list structure on $P(\bar{A})$ will also be attenuated relative to that found with a Sim mode of presentation. It is predicted that RTs to "old" items will be fastest in the RLS condition although this effect may be attenuated, as will the effect of practice on RTs. The reason for this is the presumed overall increase in encoding variability. An effect of practice on RTs to "new" items is also predicted on the same basis as in the previous experiment (Experiment 2).

RESULTS

Recall; There were no significant effects of the experimental treatments on Prl. The Prl for BLS and RLS conditions was virtually identical and the difference between 1T and 3T was very slight with Prl being slightly higher in the 3T condition. The mean values for Prl are presented in

Table 4-14 and the results of the ANOVA are presented in Table 4-13.

According to Carey & Lockhart (1973) instructions have an effect on the format of the subject's encoding and storage of information. If recognition is regarded as being principally facilitated by occurrence information then the subjects would encode on that basis.

The serial presentation should facilitate processing in terms of the acquisition of occurrence information and this would account for the lack of a significant effect of any of the treatment conditions on recall performance. Since occurrence information is, potentially, equivalent for all conditions of presentation one would expect that the only effect would be that due to practice. The difference between 1T and 3T conditions was in the expected direction but the difference did not achieve significance. Recall was very high even after a single acquisition trial and the additional trials did not add much to the total recall, i.e., it appears that recall was at or approaching a ceiling level. The greatest difference in Prl as a function of practice was for the RLS condition.

If a subject were attending primarily to occurrence information then one would expect, for recall, the greatest degree of facilitation to occur in the RLS condition. The reason for this is that in the RLS condition there is relatively little obvious organization. Since the subjects presumably attended to occurrence information and appear to have adopted a seriation strategy which is facilitated by practice, especially at the expense of organization or

Table 4-13 : ANOVA for recall for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.4889	--------	---
Organization (A)	1	0.0009	0.0009	0.04
Practice (B)	1	0.0551	0.0551	2.63
A x B	1	0.0135	0.0135	0.65
Error	20	0.4193	0.0210	---

Table 4-14: Mean Prl for Ser presentation.

	1T	3T	
BLS	0.75	0.80	0.78
RLS	0.69	0.84	0.76
	0.72	0.82	0.77

list structure information, then the greatest change as a function of practice would, for Prl, occur in the RLS condition.

<u>Organization</u>: There was a significant effect of list structure on Cls scores ($F = 12.79$, $p < .005$) with Cls being higher in the BLS condition. There was no effect due to practice ($F < 1$) or to any interaction ($F = 1.21$, $p > .05$). The results of the ANOVA are presented in Table 4-15, and the mean Cls scores are presented in Table 4-16.

The Cls scores were not very high for any condition and in comparison with Experiment 2 they appear to be somewhat lower for the BLS condition and somewhat higher for the RLS condition. In essence, the decrease in overall Cls scores is regarded as additional evidence supporting the proposition that in a serial presentation with recognition instructions prior to acquisition subjects will attend actively to occurrence information to a greater degree than when the subjects perform on the basis of expecting only a recall test. This is, essentially, the point made by Carey & Lockhart (1973).

<u>Recognition</u>: There were no effects of the experimental treatments and their interaction on Prn (all F's < 1). The mean Prn for treatments is presented in Table 4-18, and the results of the ANOVA are reported in Table 4-17. As can be seen in Table 4-18, Prn scores are very high for all treatment conditions and it is apparent that the existence of ceiling effects obscures whatever differences might have been due to experimental treatments. If the subjects attended primarily to occurrence information in this

Table 4-15: ANOVA for Cls scores for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.5949	--------	----
Organization (A)	1	0.2223	0.2223	12.79**
Practice (B)	1	0.0040	0.0040	0.23
A x B	1	0.0210	0.0210	1.21
Error	20	0.3476	0.0174	----

Table 4-16: Mean Cls scores for Ser presentation.

	1T	3T	
BLS	0.57	0.54	0.55
RLS	0.32	0.40	0.36
	0.44	0.47	0.46

Table 4-17: ANOVA for Prn for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.1140	--------	----
Organization (A)	1	0.0030	0.0030	0.58
Practice (B)	1	0.0030	0.0030	0.58
A x B	1	0.0035	0.0035	0.67
Error	20	0.1044	0.0052	----

Table 4-18: Mean Prn for Ser presentation.

	1T	3T	
BLS	0.91	0.91	0.91
RLS	0.91	0.96	0.93
	0.91	0.93	0.92

experiment, then one would expect relatively little difference in Prn for the various conditions, with the possible exception of the practice factor. In addition, it was predicted that a Ser mode of presentation would facilitate the acquisition of occurrence information and this appears to be the case, given the very high Prn scores which are presumed to reflect a sensitivity to occurrence information, and this was the case, although firm conclusions cannot be drawn due to the lack of significance of effects. Still, an examination of the data warrants such a speculation.

$P(\bar{A})$: There were no significant effects of the treatments or their interactions on sensitivity as measured by $P(\bar{A})$. The mean $P(\bar{A})$ values are presented in Table 4-20, and the results of the ANOVA are reported in Table 4-19. It is clear from an examination of Table 4-20, that $P(\bar{A})$ performance was at a very high level, as was Prn, and that any effects are likely obscured by a ceiling effect. If $P(\bar{A})$ were primarily sensitive to occurrence information then one would expect very high levels of performance in a paradigm in which such information was emphasized.

RT "old": There was a significant effect of list structure on RTs to "old" items ($F = 7.27$, $p < .025$) and there was also a significant effect of practice ($F = 11.99$, $p < .005$). RTs were fastest in the RLS condition and in the 3T condition. The interaction was not significant ($F = 1.08$, $p > .05$). These results, particularly those for the list structure effect, support the predictions derived from the context hypothesis. The mean RTs are presented in Table 4-22 and the results of the ANOVA are presented in Table 4-21.

Table 4-19: ANOVA for sensitivity for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0149	--------	----
Organization (A)	1	0.0005	0.0005	0.79
Practice (B)	1	0.00004	0.00004	0.06
A x B	1	0.0015	0.0015	2.35
Error	20	0.0128	0.0006	----

Table 4-20: Mean sensitivity ($P(\bar{A})$) for Ser presentation.

	1T	3T	
BLS	0.96	0.95	0.96
RLS	0.96	0.98	0.97
	0.96	0.96	0.96

Table 4-21: ANOVA for RTs to "old" items for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	617842.62	---------	----
Organization (A)	1	111384.37	111384.37	7.27*
Practice (B)	1	183575.04	183575.04	11.99**
A x B	1	16590.04	16590.04	1.08
Error	20	306293.17	15314.66	----

Table 4-22: Mean RTs for "old" items, with a Ser presentation.

	1T	3T	
BLS	1086	859	961
RLS	897	775	836
	992	817	904

In Experiment 2 it was proposed that RTs would be attenuated with a Ser mode of presentation relative to a Sim mode of presentation and the same is true of this experiment. An examination of Tables 4-10 and 4-22 indicate that there was little difference between RTs for the two conditions of presentation, but a comparison with Experiments 1 and 2 indicate that the RTs were considerably faster in the present experiments and it is conceivable that the subjects reached a ceiling in terms of their speed of reaction in these tasks. In Experiment 1 mean RT "old" was 1230 and in Experiment 2 it was 1127 , whereas the means for RT "old" for Experiments 5 and 6 were 880 and 904 , respectively. It should be noted that the faster RTs occurred in the 3T condition for the Ser presentation, as can be seen in Tables 4-10 and 4-22.

The effect of practice indicates that there was a general increase in occurrence information while the decrease in RTs for the RLS condition indicates that there was a context effect, however slight, and that organization had an effect on recognition performance which was not established by any of the accuracy measures.

<u>RT "new"</u>: Similar to the results for RTs to "old" items, there was an effect of treatments on RTs to "new" items such that RTs were faster in the RLS condition ($F = 4.95$, $p < .05$) and in the 3T condition ($F = 20.46$, $p < .001$) with the greatest difference occurring in the 3T condition. The interaction was not significant ($F = 1.44$, $p > .05$). The mean RTs to "new" items are presented in Table 4-24 and the results of the ANOVA are presented in Table 4-23.

Table 4-23: ANOVA for RTs to "new" items for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	939049.96	---------	----
Organization (A)	1	99202.04	99202.04	4.95*
Practice (B)	1	410032.04	410032.04	20.46***
A x B	1	28912.05	28912.05	1.44
Error	20	400903.83	20045.19	----

Table 4-24: Mean RTs to "new" items for Ser presentation.

	1T	3T	
BLS	1157	839	991
RLS	959	767	863
	1058	796	927

In the 1T condition it might be expected that the effects of list structure would be most powerful since, in this condition, the subject first sees the list and would tend to process the list as it was being presented, i.e., adopt a seriation strategy. The effect of this would be that the subject would learn this list in terms of both the item information and the organization since they are isomorphic. However, since the expected tasks were a recall and a recognition, it was proposed that subjects would attend more to occurrence information, and this appears to be so, as can be seen by comparing Table 2-11 (b) with Table 4-24, which support an interpretation of attenuation of organization effects in this experiment. The net effect, apart from that of list structure, per se, would be a decrease in RTs over practice as a function of increased occurrence information levels in encoding and storage.

The effects of the treatments on "new" responses are, in effect, the complement of the "old" response RTs in that an increase in the probability of making a fast correct response to an "old" item is, to some degree, a function of being able to discriminate rapidly that item from a "new" item; consequently the RTs for "new" items mirrored those for "old" items.

DISCUSSION

The results supported the interpretation which was based on the context hypothesis. An interpretation based on the effective presentation time hypothesis is not adequate to explain the results obtained, nor is any explanation based on a dual-process approach. Both approaches ignore the role of context in determining the encoding process and the consequent storage format. As Carey & Lockhart (1973) point out, such considerations are of prime importance to an understanding of performance on various tasks such as recall and recognition. Further, Atkinson & Shiffrin (1968) point out that control processes such as attentional processes, selection processes, and encoding process, are most likely under subject control. For the most part, studies which have compared recall and recognition have made such comparisons on the basis of accuracy and not power (speed) information, and have thus missed a critical component in the distinction.

An interpretation based on a change of semantic context hypothesis (Light & Carter-Sobell, 1970) will not explain the effects obtained in this experiment in an adequate manner. According to this hypothesis there should be no effect of list structure on Prn for "old" items in a Ser presentation, although any differences which might be present should consist of a decrement in performance in the BLS condition. However, this hypothesis does not address any effects due to mode of presentation and deals only with a well-defined semantic context. The context hypothesis developed in this thesis represents an extension of that developed by Light & Carter-Sobell (1970) with the addition of concepts derived from the recognition model proposed by Atkinson & Juola (1972) as well as a consideration of the effects that task situation and characteristics might have on the encoding specificity-variability relationship.

In the present experiment some of the effects were apparently obscured by ceiling effects, as indicated by the extremely high levels of performance on Prn and $P(\bar{A})$, for example. However, the effects on the critical RT measures were as predicted from the context hypothesis.

Overall ANOVAS were performed on data combined for the Ser and the Sim modes of presentation and the results which follow are only for the mode of presentation factors and their interactions with the other factors since the results for those other factors have already been presented. Similarly, the tables of means represent only the Ser-Sim results and their interactions.

Predictions: The major predictions derived from the context hypothesis concern RT performance. It is predicted that there will be a mode of presentation x practice interaction on the RT measure since, in a Ser presentation the effect of practice is to increase occurrence information and there will be a smaller change of context between acquisition and recognition test in this condition, than in the Sim condition. In the recognition test the items are presented singly, as with a Ser presentation, whereas in the Sim condition, the items are presented quite differently from the recognition test. A more detailed rationale for this argument appears in the discussion of the combined results for Experiments 1 and 2.

RESULTS

Recall: There were no effects due to mode of presentation nor to mode of presentation x other factor interactions. The results of the ANOVA are reported in Table 4-25, and as can be seen, there was an overall effect of practice on Prl. The mean Prl for mode of presentation and the various

Table 4-25: ANOVA for Prl for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.9006	---------	----
Presentation (A)	1	0.0456	0.0456	2.76
Organization (B)	1	0.0147	0.0147	0.89
Practice (C)	1	0.1387	0.1387	8.40**
A x B	1	0.0061	0.0061	0.37
A x C	1	0.0016	0.0016	0.10
B x C	1	0.0003	0.0003	0.02
A x B x C	1	0.0331	0.0331	2.00
Error	40	0.6605	0.0165	----

interactions is presented in Table 4-26.

Organization: There was a significant effect of mode of presentation on Cls with Cls being highest in the Sim condition. This is the result one would expect from the data in the literature concerning blocked versus random paradigms. Similarly, there was a significant effect of list structure, overall, with Cls being highest in the BLS condition. There were no significant interactions. The results of ANOVA are presented in Table 4-27, and the mean Cls scores are presented in Table 4-28.

$P(\bar{A})$: There were no significant effects on sensitivity due to mode of presentation or to mode of presentation x other treatment interactions. As for the separate or main treatment effects, $P(\bar{A})$ was at very high levels and these levels most likely represent a ceiling level of performance. The mean sensitivity scores are presented in Table 4-29 for the mode of presentation effects and interactions and the results of the ANOVA are presented in Table 4-30.

Recognition: As for $P(\bar{A})$ there were no significant effects of mode of presentation or its interactions on Prn. Again, Prn was at very high levels and represents a ceiling effect. Prn scores for the mode of presentation and interaction results are presented in Table 4-31, and the results of the ANOVA are reported in Table 4-32.

RT "old": There was no significant effect of mode of presentation on RTs to "old" items ($F < 1$), but there was a significant effect of mode of presentation x practice on RTs to "old" items ($F = 8.37$, $p < .01$) with RTs decreasing

Table 4-26: Mean Prl for combined results.

		BLS	RLS	
Sim	1T	0.77	0.77	0.77
	3T	0.95	0.83	0.89
Ser	1T	0.75	0.69	0.72
	3T	0.80	0.84	0.82
		0.82	0.78	0.80

Table 4-27: ANOVA for Cls for combined results for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	47	1.7010	---------	----
Presentation (A)	1	0.1496	0.1496	5.58*
Organization (B)	1	0.2523	0.2523	9.40**
Practice (C)	1	0.0320	0.0320	1.19
A x B	1	0.0271	0.0271	1.01
A x C	1	0.0721	0.0721	2.69
B x C	1	0.0080	0.0080	0.30
A x B x C	1	0.0867	0.0867	3.23
Error	40	1.0732	0.0268	----

Table 4-28: Mean Cls scores for combined results.

		BLS	RLS	
Sim	1T	0.63	0.64	0.64
	3T	0.61	0.40	0.51
Ser	1T	0.57	0.32	0.44
	3T	0.54	0.40	0.47
		0.59	0.44	0.51

Table 4-29: Mean $P(\overline{A})$ scores for combined results.

		BLS	RLS	
Sim	1T	0.95	0.96	0.96
	3T	0.97	0.98	0.98
Ser	1T	0.96	0.96	0.96
	3T	0.95	0.98	0.97
		0.96	0.97	0.96

Table 4-30: ANOVA for $P(\bar{A})$ for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.0310	----------	----
Presentation (A)	1	0.0001	0.0001	0.08
Organization (B)	1	0.0005	0.0005	0.72
Practice (C)	1	0.0018	0.0018	2.69
A x B	1	0.0001	0.0001	0.16
A x C	1	0.0011	0.0011	1.69
B x C	1	0.0006	0.0006	0.92
A x B x C	1	0.0009	0.0009	1.41
Error	40	0.0261	0.0007	----

Table 4-31: Mean Prn for combined results.

		BLS	RLS	
Sim	1T	0.89	0.92	0.91
	3T	0.97	0.95	0.96
Ser	1T	0.91	0.91	0.91
	3T	0.91	0.96	0.94
		0.93	0.94	0.93

Table 4-32: ANOVA for Prn scores for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.3361	----------	----
Presentation (A)	1	0.0008	0.0008	0.10
Organization (B)	1	0.0032	0.0032	0.42
Practice (C)	1	0.0173	0.0173	2.27
A x B	1	0.0005	0.0005	0.06
A x C	1	0.0029	0.0029	0.38
B x C	1	0.00002	0.00002	0.003
A x B x C	1	0.0078	0.0078	1.02
Error	40	0.3039	0.0076	----

as a function of practice in the Ser condition and increasing in the Sim condition. This is illustrated in Fig. 4-2. Also, in the Sim condition might be strengthening organization information and hence slowing RTs, although the Cls data presented in Table 4-28 do not support this. In the Ser condition it is expected that an increase in practice would facilitate the acquisition and strengthening of occurrence information to a greater extent than in the Sim condition, and also, the Ser condition represents a minimal change of context relative to the recognition task since the items are presented singly. The context hypothesis is supported.

The mean RTs for "old" item responses are presented in Table 4-33, and the results of the ANOVA are presented in Table 4-34. It should be noted that there is an overall effect of list structure such that RTs are faster in the RLS condition.

<u>RT "new"</u>: There were no significant effects due to mode of presentation nor to the interaction of mode of presentation with the other treatments. There were significant effects of list structure and practice on the overall data. The mean RTs are presented in Table 4-35, and the results of the ANOVA are reported in Table 4-36. It should be noted that the list structure x practice interaction approached significance ($F = 3.78$, $.10 > p > .05$).

Since the "new" items were not presented for acquisition they can accrue no strength via presentation and there is no reason to presume that mode of presentation should differentially effect contextual information given that

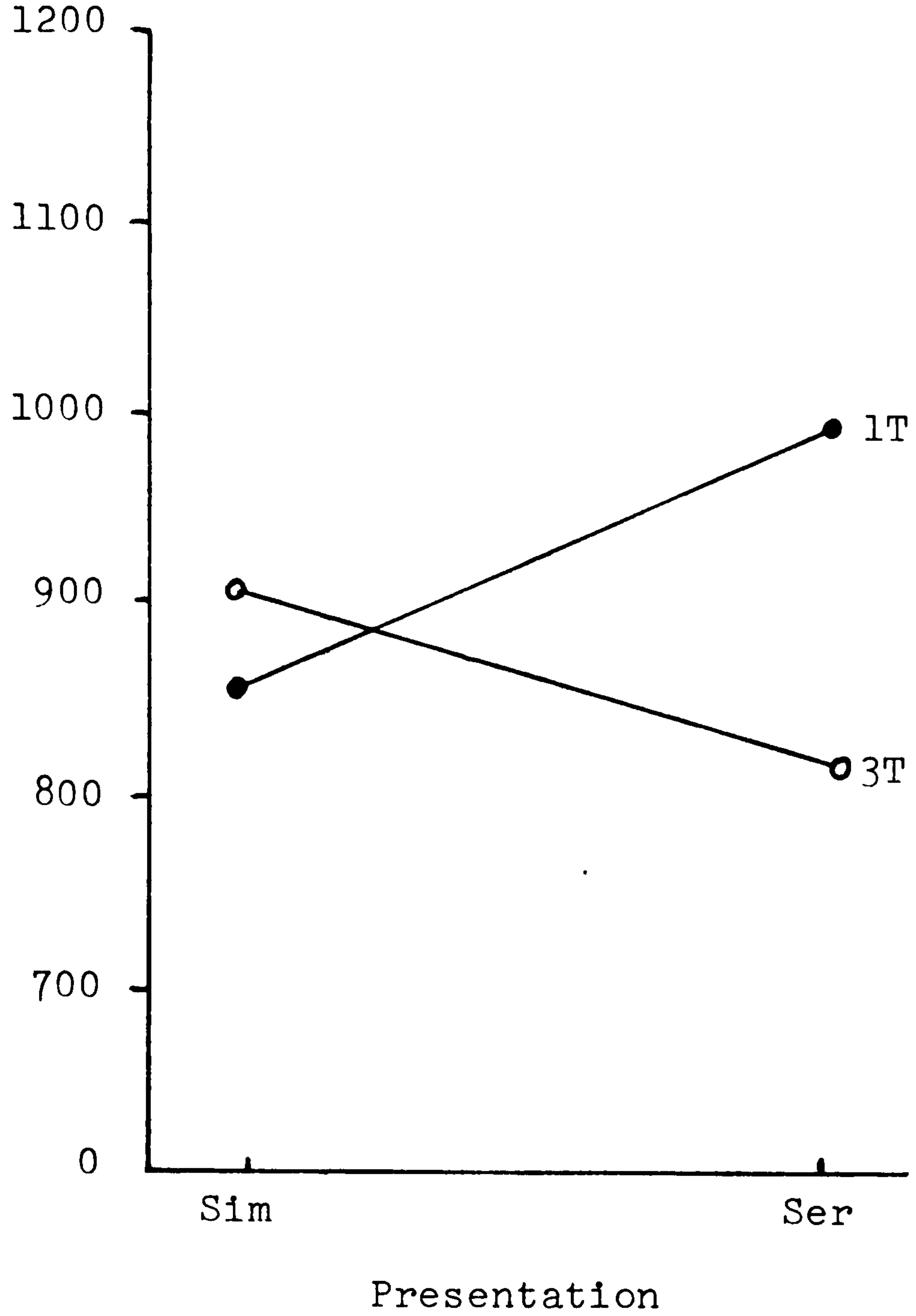


Fig. 4-2. RT "old" as a function of mode of presentation for level of practice.

Table 4-33: Mean RTs to "old" items for combined results.

		BLS	RLS	
Sim	1T	916	796	856
	3T	1007	801	904
Ser	1T	1086	897	992
	3T	859	775	817
		967	817	892

Table 4-34: ANOVA for RTs to "old" items for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	1217321.92	---------	----
Presentation (A)	1	7105.34	7105.34	0.40
Organization (B)	1	268502.09	268502.09	15.03***
Practice (C)	1	48133.34	48133.34	2.70
A x B	1	2133.32	2133.32	0.12
A x C	1	149410.07	149410.07	8.37**
B x C	1	280.32	280.32	0.02
A x B x C	1	27360.77	27360.77	1.53
Error	40	714396.67	17859.92	----

Table 4-35: Mean RTs to "new" items for combined results.

		BLS	RLS	
Sim	1T	1070	892	981
	3T	839	883	861
Ser	1T	1157	959	1058
	3T	826	767	796
		973	875	924

Table 4-36: ANOVA for RTs to "new" items for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	1767237.92	---------	----
Presentation (A)	1	432.00	432.00	0.02
Organization (B)	1	115052.09	115052.09	4.42*
Practice (C)	1	437008.34	437008.34	16.81***
A x B	1	11285.33	11285.33	0.43
A x C	1	59784.08	59784.08	2.30
B x C	1	98282.99	98282.99	3.78 (*)
A x B x C	1	5334.09	5334.09	0.21
Error	40	1040059.00	26001.48	----

performance appeared to be at a ceiling level. The overriding contextual constraint appears to be a function of list structure for "new" items and this is plausible on the grounds of the effect of list structure on any spread of activation hypothesis. Spread of activation would not be differentially effected by mode of presentation.

DISCUSSION

The results of the nested hierarchy experiments which were reported in this chapter support the context hypothesis. The results of the experimental treatments on recall performance suggest that subjects were attending to item information since there were no effects of list structure or mode of presentation on Prl and the practice effect was only significant in the Sim condition.

The significant mode of presentation and list structure effects on Cls indicate, on the surface, that organization information was attended to. However, the Prl results do not support such a contention. The Cls scores were within a narrow range over the BLS condition, and also over the Sim condition with the exception of the RLS - 3T cell. If subjects adopted a seriation strategy then these are the sort of results one would, basically, expect. Also, with a seriation strategy the focus of attention would be on the items and their position and not to as great an extent on inter-item relationships. It is also the case that in the Sim condition with a BLS presentation, an effective seriation strategy would produce relatively high levels of Cls as an artifact. The results reported by Mandler & Dean (1969) lend support to this interpretation which is that organization effects are attenuated in these experiments.

The effects of list structure on RTs support the context hypothesis since RTs were significantly faster in the RLS condition than in the BLS condition, as predicted from the context hypothesis. Similarly, the effects of practice were to reduce RTs and this effect is related to an increase in occurrence information and encoding variability as a function of practice. This is a central postulate of the context hypothesis which was derived from Bernbach's (1970) replica theory of memory. It should be noted that the replica theory of memory by itself is not sufficient to explain the results obtained since it would predict better recall performance in the RLS condition, given current assumptions regarding replica formation.

The overall reduction in mean RTs between the current studies and those of Chapter 2 (Experiments 1 and 2) lends support to the results reported by Carey & Lockhart (1973) that knowledge of the functional characteristics of the retrieval task will have an effect on performance and the fact that the effect was a reduction of RTs supports the context hypothesis.

Interpretations based on reading differences which suggest that effective presentation time is greater in the BLS condition lead to the prediction that RTs would be fastest in the BLS condition and this is simply not the case.

Many models of memory lead to the predictions dealing with the effects of list structure and of practice on the various accuracy measures, e.g., Atkinson & Shiffrin (1968), Johnson (1972), and others, but none present a model which, as it exists, predicts or explains the effect of list structure on RTs. The context model does the latter and does not negate the importance of these and other factors for recall and accuracy measures of recognition.

CATEGORIZED LIST PARADIGM

The experiments reported in this section represent replications of the experiments described in Chapter 3, with the addition of recognition instructions having been given prior to acquisition of the verbal material. The other major change was that the number of categories was reduced from five to four, giving a list of 20 items (five per category). The category "animal" was dropped since it was also the category used in the nested hierarchy experiments. In this section subjects performed in each of the paradigms and it was felt the inclusion of the same category in two paradigms would lead to unnecessary complications.

The Method and Procedure used with this paradigm was the same as that outlined at the beginning of the chapter, the Design and Subjects were also the same used in the previous experiments in this chapter; the only differences between the nested hierarchy and categorized list paradigms were in terms of the materials and the list structures.

Experiment 7: Simultaneous presentation

Predictions: The general finding reported in the literature dealing with recall and organization with categorized lists is a facilitation of recall and of organization as a function of both practice and blocked presentation. It is predicted that these findings will hold for this experiment as well. Similarly, it is predicted that $P(\overline{A})$ and Prn will be highest in those conditions in which occurrence information is greatest, namely in the 3T and the RLS condition. These are general predictions and are based on the usual findings reported in the literature under a number of models and are not specific to the context hypothesis. Predictions derived from the context hypothesis involve the RT measures principally. It is predicted that RTs to "old" items will be fastest in the RLS condition and that the effect of increased practice will be to reduce RTs. However, since the subjects are aware of the recognition task prior to acquisition, it is expected that the differences in RT between RLS and BLS will be attenuated somewhat, relative to those found in Experiment 3.

The only effect of treatments on RTs for "new" items is predicted to be that of practice, since the items are not presented at acquisition. A slight effect of list structure may be present to the degree that a spread of activation is present or that list structure facilitates familiarity.

RESULTS

The results are based on one and 20 degrees of freedom, unless otherwise stated.

Recall: There was no significant effect of list structure on Prl, but Prl was a bit higher in the BLS condition ($F = 1.05$, $p > .05$). There was a significant effect of practice ($F = 11.15$, $p < .005$) with Prl being highest in the 3T condition. The interaction was not significant. The mean Prl values are presented in Table 4-38, and the results of the ANOVA are presented in Table 4-37. The predictions were supported.

Organization: There were significant effects of list structure on Cls ($F = 18.38$, $p < .001$) and a significant list structure x practice interaction ($F = 8.55$, $p < .01$). Cls scores were highest in the BLS condition and, for the BLS condition, increased as a function of practice. In the RLS condition the effect of practice was a lowering of Cls scores. This is the effect one would expect in subjects who were attending primarily to occurrence information. If the subjects adopted a seriation strategy the result, from attending primarily to occurrence information, would be an inflation of Cls scores in the BLS condition. In the BLS condition the list structure facilitates the effectiveness of a seriation strategy. The lack of an overall effect of practice would indicate a lack of support for the contention of attention to occurrence information. However, it appears that the interaction effect reduces the practice main effect, and the interaction is in a direction consistent with use of a seriation strategy by subjects. The mean Cls scores are presented in Table 4-40, and the results of the ANOVA are reported in Table 4-39.

$P(\bar{A})$: There were significant effects of practice ($F = 5.52$, $p < .025$) and of list structure ($F = 6.25$, $p < .025$). $P(\bar{A})$ was higher in the RLS condition and increased with increases in practice. This is what one would expect if the subjects were attending primarily to occurrence information and if there was a lack of organizational bias as a function of the

Table 4-37: ANOVA for Prl for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.6913	---------	----
Organization (A)	1	0.0104	0.0104	1.05
Practice (B)	1	0.4817	0.4817	48.37***
A x B	1	0.00001	0.00001	0.001
Error	20	0.1992	0.0100	----

Table 4-38: Mean Prl for Sim presentation.

	1T	3T	
BLS	0.69	0.98	0.84
RLS	0.65	0.93	0.79
	0.67	0.96	0.82

Table 4-39: ANOVA for Cls scores for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1.3137	---------	----
Organization (A)	1	0.4988	0.4988	18.38***
Practice (B)	1	0.0400	0.0400	1.47
A x B	1	0.2321	0.2321	8.55**
Error	20	0.5428	0.0271	----

Table 4-40: Mean Cls scores for Sim presentation.

	1T	3T	
BLS	0.57	0.85	0.71
RLS	0.48	0.36	0.42
	0.53	0.61	0.57

list structure. These results are similar to those found for the nested hierarchy experiment (Experiment 5), and slightly different than for Experiments 1 and 3 in which the $P(\bar{A})$ scores were slightly higher in the BLS condition, relative to the RLS condition. The mean $P(\bar{A})$ scores for the present experiment are presented in Table 4-42, and the results of the ANOVA are presented in Table 4-41.

It should be noted that performance was at very high levels.

Recognition: There was a significant effect of list structure ($F = 9.17$, $p < .01$) with Prn being highest in the RLS condition. No other effects were significant. This also supports the notion that Prn is a function of occurrence information, since it is proposed that such information is emphasized in an RLS level of list structure. It should be noted that the effect of practice was marginally non-significant ($F = 3.30$, $.10 > p > .05$) with Prn being highest in the 3T condition. The mean Prn scores are presented in Table 4-44, and the results of the ANOVA are reported in Table 4-43.

RT "old": There were no significant effects of the experimental treatments on RTs for "old" items. The RTs were slightly faster in the RLS condition, but not significantly so, and, by comparison with Experiment 3, the RTs are considerably faster overall. However, in Experiment 3, particularly in the 3T condition, the difference between the RLS and BLS conditions for 3T of practice were greater than those found in the present experiment. This is consistent with the context hypothesis interpretation and, since

Table 4-41: ANOVA for $P(\bar{A})$ for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0236	---------	----
Organization (A)	1	0.0045	0.0045	6.25*
Practice (B)	1	0.0040	0.0040	5.52*
A x B	1	0.0005	0.0005	0.69
Error	20	0.0145	0.0007	----

Table 4-42: Mean $P(\bar{A})$ for Sim presentation.

	1T	3T	
BLS	0.94	0.97	0.96
RLS	0.97	0.99	0.98
	0.96	0.98	0.96

Table 4-43: ANOVA for Prn for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.1513	---------	----
Organization (A)	1	0.0417	0.0417	9.17**
Practice (B)	1	0.0150	0.0150	3.30(*)
A x B	1	0.0038	0.0038	0.83
Error	20	0.0908	0.0045	----

Table 4-44: Mean Prn for Sim presentation.

	1T	3T	
BLS	0.86	0.93	0.90
RLS	0.97	0.99	0.98
	0.92	0.96	0.94

there was no significant effect of list structure in this experiment, is consistent with the argument that the effect of recognition instructions is a concentration on occurrence information with a consequent attenuation of list differences. However, the attenuation would tend to reduce the effect if subjects were performing near a ceiling level of speed of reaction.

The mean RTs are presented in Table 4-46, and the results of the ANOVA are presented in Table 4-45.

RT "new": There were no significant effects of experimental treatments on RTs to "new" items. The similarity of the differences to those obtained for RTs to "old" items should be noted. Any differences which do occur are in the direction one would expect if the subjects were attending primarily to occurrence information, and if one of the effects of contextual constraint were to facilitate discriminability of "old" and "new" items, at least on the basis of lessening of an effect of any spread of activation in the RLS condition. The mean RTs are presented in Table 4-48 and the results of the ANOVA are reported in Table 4-47.

DISCUSSION

Although there was a significant effect of list structure on organization, this did not correspond to a similar effect for Prl, as one would expect. However, if the subjects were attending primarily to occurrence information then one would expect that the Cls scores in the BLS condition might be inflated. According to Bower (1972) an executive monitor is responsible for checking and implementing

Table 4-45: ANOVA for RTs to "old" items for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	586556.62	---------	----
Organization (A)	1	48870.37	48870.37	1.96
Practice (B)	1	20945.04	20945.04	0.84
A x B	1	18648.38	18648.38	0.75
Error	20	498092.83	24904.64	----

Table 4-46: Mean RTs to "old" items for Sim presentation.

	1T	3T	
BLS	974	859	917
RLS	828	824	826
	901	842	872

Table 4-47: ANOVA for RTs to "new" items for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	335754.96	---------	----
Organization (A)	1	7884.38	7884.38	0.57
Practice (B)	1	33078.38	33078.38	2.40
A x B	1	18984.37	18984.37	1.38
Error	20	275807.83	13790.39	----

Table 4-48: Mean RTs to "new" items for Sim presentation.

	1T	3T	
BLS	961	831	896
RLS	869	851	860
	915	841	878

retrieval plans. According to Mandler & Dean (1969) seriation is a preferred strategy when learning a list of words, unless some other process is quite obvious, in which case it will tend to be utilized. Carey & Lockhart (1973) proposed that the task demands (as perceived by the subjects) determine the strategy which will be used in encoding and storage. Kintsch (1968) claims, essentially, that occurrence information is the principle determinant of recognition performance.

The recall results are what one would expect if the subjects were attending to occurrence information principally. There was no difference as a function of list structure on Prl, but there was an effect of practice. For Cls, there was an effect of list structure, no effect of practice, and a significant effect due to the interaction. It was argued that the Cls results are those one would expect if the subjects adopted a seriation strategy with a consequent attenuation of effects of organization information.

In the BLS condition, the list structure which is inherent is also isomorphic with a serial order, thus there must obviously be some contextual constraint as a function of organization, but not to the degree one would expect in a situation in which the perceived task for the subjects was a free recall task. The effect of attending to occurrence information is a relative one, with the greatest degree of occurrence information being picked up in the RLS condition. This accounts for the fact that the sensitivity ($P(\bar{A})$) is less in the BLS condition. The effect of organization information is to facilitate a spread of activation along the lines of the semantic constraint and thus reduce encoding variability, relative to that in the RLS condition. Similarly, since recognition performance is regarded as a function of occurrence information and occurrence information is greatest in the RLS condition, one would expect that Prn would also be highest in this condition, and it is.

The critical measure for the context hypothesis is that of RTs. In the present study there was no effect of treatment on RTs to "old" or "new" items. An examination of the mean RTs indicates that what differences did appear were in the direction predicted by the context hypothesis. However, the RTs were very fast and the lack of significant difference may be due to the presence of a ceiling effect on speed of response. Also, one would, as argued previously, expect an attenuation of differences based on organization information if subjects paid greater attention to occurrence information.

Experiment 8: Serial presentation

Predictions: Recall and recognition are expected to be best in the BLS condition, as is organization and $P(\bar{A})$. The reasoning behind this is that in the BLS condition, with a Ser mode of presentation, the acquisition of occurrence information is even easier than in the RLS condition with a Sim mode of presentation, and also, the acquisition of organization will be somewhat facilitated in the BLS condition since the items are presented serially and a seriation strategy will correspond with the inherent organization. It is predicted that differences in RTs as a function of treatments will be such that the fastest RTs will occur in the RLS condition, and that the RTs will be faster than with a Sim presentation, unless there are ceiling effects.

RESULTS

All results are reported for one and 20 degrees of freedom, unless otherwise stated.

Recall: There was an effect of list structure ($F = 11.15$, $p < .005$) and of practice ($F = 11.15$, $p < .005$) on Prl with Prl being highest in the BLS and in the 3T conditions. The interaction was not significant. The largest difference due to practice was in the RLS condition, as would be expected. The mean Prl values are presented in Table 4-50, and the results of the ANOVA are presented in Table 4-49.

Organization: There was a significant effect of list structure on Cls scores ($F = 25.63$, $p < .001$) as well as a significant effect due to practice ($F = 5.98$, $p < .05$) with organization being greatest in the BLS and in the 3T conditions, as predicted. There was no significant interaction effect. These results parallel the recall results, and are identical to the results obtained in Experiment 4. The mean Cls scores are presented in Table 4-52, and the results of the ANOVA are presented in Table 4-51.

$P(\bar{A})$: The effect of list structure on sensitivity was marginally non-significant ($F = 3.99$, $.10 > p > .05$) with performance being slightly higher in the BLS condition. There was a significant effect of practice with performance increasing as a function of increased practice ($F = 10.34$, $p < .005$) and the interaction was also significant

Table 4-49: ANOVA for Prl for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.3974	---------	----
Organization (A)	1	0.1001	0.1001	11.15**
Practice (B)	1	0.1001	0.1001	11.15**
A x B	1	0.0176	0.0176	1.96
Error	20	0.1796	0.0090	-----

Table 4-50: Mean Prl for Ser presentation.

	1T	3T	
BLS	0.78	0.85	0.82
RLS	0.59	0.78	0.69
	0.69	0.82	0.76

Table 4-51: ANOVA for Cls for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	1.2723	---------	----
Organization (A)	1	0.6240	0.6240	25.63***
Practice (B)	1	0.1457	0.1457	5.98*
A x B	1	0.0155	0.0155	0.64
Error	1	0.4871	0.0244	----

Table 4-52: Mean Cls scores for Ser presentation.

	1T	3T	
BLS	0.59	0.70	0.64
RLS	0.22	0.43	0.33
	0.41	0.57	0.49

($F = 7.69$, $p < .025$), with the greatest difference being between 1T and 3T in the RLS condition. These results support the contention that subjects attend primarily to occurrence information, particularly in the RLS condition. Mean $P(\bar{A})$ values are presented in Table 4-54, and the results of the ANOVA are presented in Table 4-53. It can be seen from Table 4-54 that performance is at a high level, generally.

Recognition: There was a significant effect of list structure on Prn ($F = 10.91$, $p < .005$) with Prn being highest in the BLS condition. Similarly, there was an effect of practice ($F = 30.30$, $p < .001$) with Prn increasing as practice increased. The list structure x practice interaction was also significant ($F = 36.67$, $p < .001$), with Prn increasing as a function of practice in the RLS condition and not in the BLS condition.

The major difference appears to be the effect of list structure in the 1T condition. As practice increases, Prn improves in the RLS condition but not in the BLS condition. Presumably, instead of accruing occurrence information, per se, in the BLS condition, subjects are more concerned with organization information which does not help Prn. If the subjects accrued more occurrence information in the RLS condition, this is the result one would expect. The results are similar to those obtained with the $P(\bar{A})$ measure.

The mean Prn values are presented in Table 4-56, and the results of the ANOVA are presented in Table 4-55.

RT "old": There were no significant effects of the experimental treatments or their interaction on RTs to "old"

Table 4-53: ANOVA for $P(\overline{A})$ for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0569	-------	---
Organization (A)	1	0.0054	0.0054	3.99(*)
Practice (B)	1	0.0140	0.0140	10.34**
A x B	1	0.0104	0.0104	7.69*
Error	20	0.0271	0.0014	----

Table 4-54: Mean $P(\overline{A})$ for Ser presentation.

	1T	3T	
BLS	0.97	0.98	0.98
RLS	0.90	0.99	0.95
	0.94	0.99	0.97

Table 4-55: ANOVA for Prn for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.1346	-------	----
Organization (A)	1	0.0150	0.0150	10.91**
Practice (B)	1	0.0417	0.0417	30.30***
A x B	1	0.0504	0.0504	36.67***
Error	20	0.0275	0.0014	----

Table 4-56: Mean Prn for Ser presentation.

	1T	3T	
BLS	0.95	0.94	0.95
RLS	0.81	0.98	0.90
	0.88	0.96	0.92

items. However, the direction of observable differences was in the direction predicted from the context hypothesis; RTs were faster in the RLS condition. Again, the RTs were very fast, relative to those obtained in Experiment 4, and were attenuated relative to those times in Experiment 4. The mean RT "old" times are presented in Table 4-58, and the results of the ANOVA are presented in Table 4-57.

RT "new": There were no effects of the experimental treatments or their interaction on RTs to "new" items. The RTs were fast, and, as for RTs to "old" items, there is the distinct possibility that these times represent ceiling levels of performance for the task. The mean RTs are presented in Table 4-60, and the results of the ANOVA are presented in Table 4-59.

DISCUSSION

The significant effects of list structure and of practice on recall and organization were to be expected, based on general findings reported in the literature. For recognition, as measured by sensitivity, the effect of list structure was marginally non-significant while the effect of practice and the effect of the interaction were both significant, with the effect of practice being most pronounced in the RLS condition. This is the sort of result which one would expect based on a hypothesis such as the effective presentation time hypothesis. Essentially the same results and interpretation hold for Prn as well, with the exception that the effect of list structure was significant. These results differ from those found in the Sim condition and also from those reported in Experiment 4.

Table 4-57: ANOVA for RTs to "old" items for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	635406.96	--------	----
Organization (A)	1	57135.04	57135.04	2.03
Practice (B)	1	14357.04	14357.04	0.51
A x B	1	108.38	108.38	0.004
Error	20	563806.50	28190.33	----

Table 4-58: Mean RTs to "old" items for Ser presentation.

	1T	3T	
BLS	877	921	899
RLS	775	828	802
	824	875	850

Table 4-59: ANOVA for RTs to "new" items for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	558546.96	-------	----
Organization (A)	1	14259.38	14259.38	0.54
Practice (B)	1	9720.38	9720.38	0.37
A x B	1	1890.37	1890.37	0.07
Error	20	532676.83	26633.84	----

Table 4-60: Mean RTs to "new" items for Ser presentation.

	1T	3T	
BLS	961	938	950
RLS	930	872	901
	946	905	926

While there was no effect of the treatments or their interaction on RTs to "old" or "new" items, the directions of observable differences was in the direction predicted from the context hypothesis, i.e., RTs were slightly faster in the RLS condition. In this experiment the subjects knew there was to be a recognition test and the words were presented singly (a condition representing a minimal contextual change between acquisition and recognition testing). It appears that the net effect of this is to firstly reduce the overall RTs, and secondly, to reduce them furthest in the RLS condition. These results also support the contention of Carey & Lockhart (1973) regarding knowledge of the task parameters.

In terms of significant results this experiment does not provide support for the context hypothesis, but does provide support for the hypothesis previously discussed, as well as that proposed by Carey & Lockhart (1973). While this hypothesis is supported, it is not central to the context hypothesis except in so far as it illustrates the attentional and control process component involved in the context hypothesis. The former hypothesis, or contention, is that if subjects attend more to occurrence information one would expect an attenuation of organization differences, as was found.

The results for the Ser and the Sim treatments were combined and analyzed with these factors as part of the design. The results of these analyses will be presented for this factor (mode of presentation) and its interactions.

RESULTS

The results are based on one and 40 degrees of freedom unless otherwise specified.

Recall: The effect of list structure was significant, with Pr1 being highest in the BLS condition ($F = 5.29$, $p < .05$). Also, the mode of presentation x practice interaction was also significant ($F = 7.53$, $p < .01$) with effect of practice being greatest in the Sim Condition. The results of the ANOVA are presented in Table 4-61, and the results for mode of presentation and its interactions are presented in Table 4-62.

Organization: There was no effect of mode of presentation on Cls, although Cls was somewhat higher in the Sim condition. There was a significant interaction of mode of presentation x list structure x practice ($F = 7.14$, $p < .025$).

Clustering increases with practice with Ser, since Ser presentation itself encourages clustering through a seriation process. With Sim, only the obvious organization of BLS encourages further organization with practice. The mean Cls scores are presented in Table 4-64, and the results of the ANOVA are presented in Table 4-63.

$P(\overline{A})$: There was no effect of mode of presentation ($F = 1.06$, $p > .05$) but there was a significant mode of presentation x list structure interaction ($F = 9.53$, $p < .005$) as well as a significant mode of presentation x list structure x practice interaction ($F = 7.45$, $p < .01$). An examination of the results indicates that, in the Ser condition, sensitivity is lowest in the RLS - 1T condition, while in

Table 4-61: ANOVA for Prl for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	1.1387	--------	----
Presentation (A)	1	0.0501	0.0501	5.29*
Organization (B)	1	0.0876	0.0876	9.25**
Practice (C)	1	0.5105	0.5105	53.91***
A x B	1	0.0230	0.0230	2.43
A x C	1	0.0713	0.0713	7.53**
B x C	1	0.0088	0.0088	0.93
A x B x C	1	0.0088	0.0088	0.93
Error	40	0.3788	0.0095	----

Table 4-62: Mean Prl for combined results for mode of presentation and practice.

	1T	3T	
Ser	0.68	0.81	0.75
Sim	0.67	0.95	0.81
	0.68	0.88	0.78

Table 4-63: ANOVA for Cls for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	2.6604	-------	----
Presentation (A)	1	0.0744	0.0744	2.89
Organization (B)	1	1.1194	1.1194	43.47***
Practice (C)	1	0.1692	0.1692	6.57**
A x B	1	0.0035	0.0035	0.14
A x C	1	0.0165	0.0165	0.64
B x C	1	0.0638	0.0638	2.48
A x B x C	1	0.1838	0.1838	7.14*
Error	40	1.0299	0.0257	----

Table 4-64: Mean Cls for combined results.

		BLS	RLS	
Sim	1T	0.57	0.48	0.52
	3T	0.85	0.36	0.60
Ser	1T	0.59	0.22	0.41
	3T	0.70	0.43	0.57
		0.68	0.37	0.52

Table 4-65: ANOVA for $P(\bar{A})$ for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.0816	-------	----
Presentation (A)	1	0.0011	0.0011	1.06
Organization (B)	1	0.00001	0.00001	0.02
Practice (C)	1	0.0165	0.0165	15.86***
A x B	1	0.0099	0.0099	9.53**
A x C	1	0.0015	0.0015	1.46
B x C	1	0.0032	0.0032	3.05
A x B x C	1	0.0078	0.0078	7.45**
Error	40	0.0416	0.0010	----

Table 4-66: Mean P($\bar{A}$) for combined results.

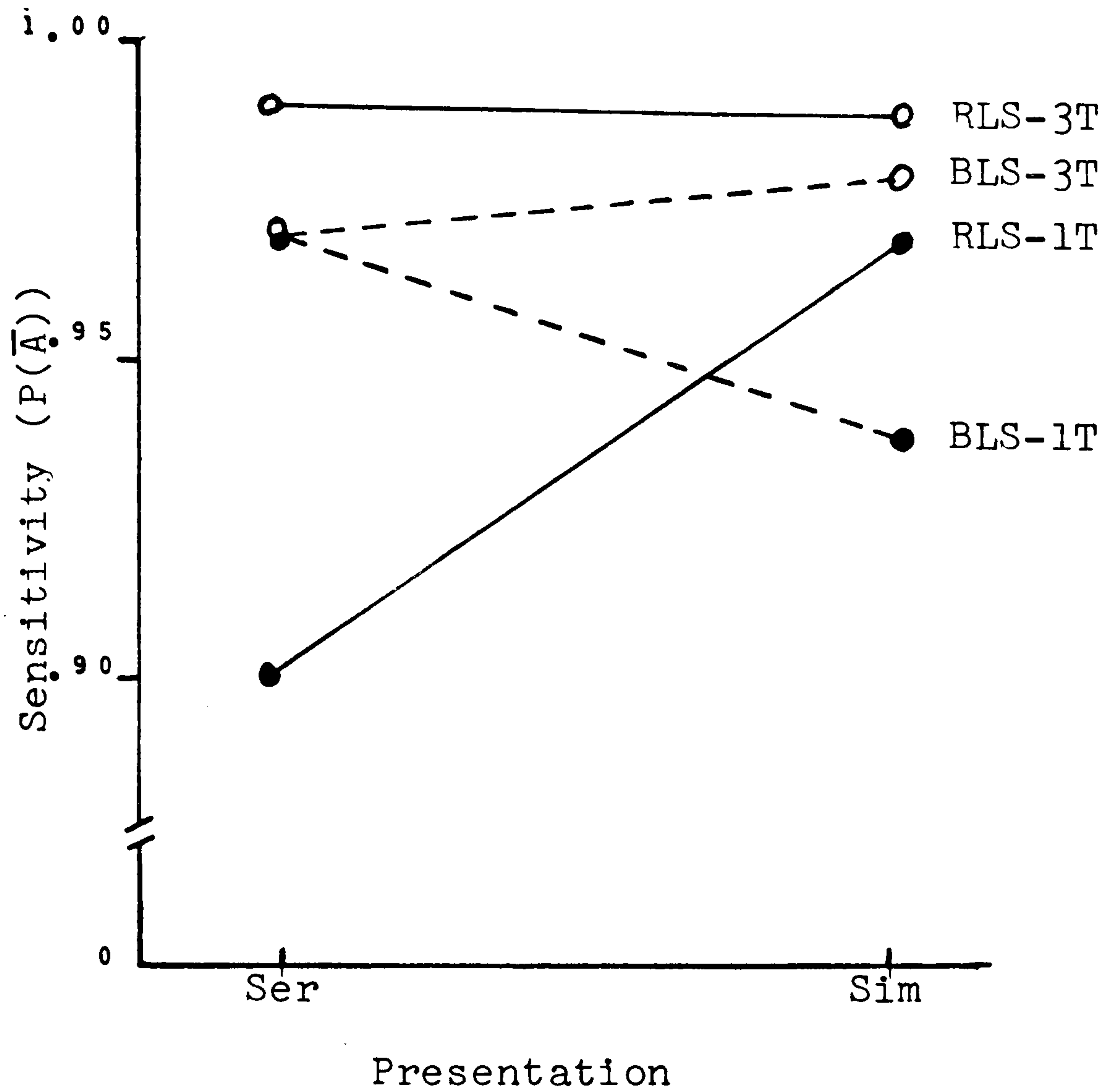
		BLS	RLS	
Sim	1T	0.94	0.97	0.96
	3T	0.97	0.99	0.98
Ser	1T	0.97	0.90	0.94
	3T	0.98	0.99	0.98
		0.96	0.96	0.96

the Sim condition sensitivity is lowest in the BLS - 1T condition. Overall, sensitivity is better for the BLS condition with a Ser presentation and for the RLS condition with a Sim presentation.

$P(\bar{A})$ is low in the RLS - Ser - 1T treatment combination presumably because this is the most difficult condition in which to take in information at a single pass; this is a sort of effective presentation time hypothesis. Also, the BLS - Sim combination puts greatest emphasis on organization information to the detriment of occurrence information, consequently, 1T performance is poor. It should be noted that 3T performance is very high and almost certainly reflects ceiling effects, therefore, one shouldn't put too much weight on these interactions as they may be ceiling effect artifacts. These results are illustrated in Fig. 4-3. The mean $P(\bar{A})$ scores are presented in Table 4-66, and the results of the ANOVA are presented in Table 4-65.

Recognition: There were significant effects of the mode of presentation x list structure interaction ($F = 18.03$, $p < .001$) list structure x practice interaction ($F = 4.51$, $p < .05$), and list structure x practice x mode of presentation interaction ($F = 13.81$, $p < .001$).

In the Ser condition Prn is higher in the BLS - 1T than in the RLS - 1T, while in the Sim condition the opposite is the case with, in general, RLS performance being higher than BLS performance. This is the sort of result which one would expect based on Carey & Lockhart (1973), and on a concept that occurrence information is the principal mediator of Prn performance. This is essentially the same



<u>Fig. 4-3.</u> Sensitivity (P($\bar{A}$)) for List structure x practice for levels of mode of presentation. Note in this figure P($\bar{A}$) is given for 0.90 to 1.00.

argument as could be used with the sensitivity results, which were very similar.

The mean Prn scores are presented in Table 4-68, for the mode of presentation effect and interactions, and the results of the ANOVA are presented in Table 4-67.

RT "old": The only effect of any consequence was a marginally non-significant effect of list structure overall ($F = 3.99$, $.10 > p > .05$) and RTs to "old" items were slightly faster in the RLS condition, as predicted from the context hypothesis. The RTs for the mode of presentation condition were virtually identical with a difference of approximately 20 msecs. favoring faster times in the Ser condition. The mean RTs were very fast. The mean RTs are presented in Table 4-70, and the results of the ANOVA are reported in Table 4-69.

RT "new": There were no effects of treatments of their interactions on RTs to "new" items. Also, the times were slightly longer than for RTs to "old" items, thus following the pattern of past experiments in this thesis. The greatest observed difference is that as a result of practice. The RTs for 3T practice are somewhat faster than for 1T. This is what one would expect if occurrence information is of major importance for RTs to "new" items.

The mean RTs to "new" items are presented in Table 4-72, and the results of the ANOVA are presented in Table 4-71.

DISCUSSION

Essentially, the results obtained offer weak support for the context hypothesis. There were significant effects

Table 4-67: ANOVA for Prn for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.2892	--------	----
Presentation (A)	1	0.0033	0.0033	1.13
Organization (B)	1	0.0033	0.0033	1.13
Practice (C)	1	0.0533	0.0533	18.03***
A x B	1	0.0533	0.0533	18.03***
A x C	1	0.0033	0.0033	1.13
B x C	1	0.0133	0.0133	4.51*
A x B x C	1	0.0408	0.0408	13.81***
Error	40	0.1183	0.0030	----

Table 4-68: Mean Prn for combined results.

		BLS		RLS			
Sim	1T	0.86	0.90	0.97	0.98	0.92	0.94
	3T	0.93		0.99		0.96	
Ser	1T	0.95	0.95	0.81	0.90	0.88	0.92
	3T	0.94		0.98		0.96	
		0.92		0.94		0.93	

Table 4-69: ANOVA for RTs to "old" items for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	1227297.67	--------	----
Presentation (A)	1	5334.09	5334.09	0.20
Organization (B)	1	105844.09	105844.09	3.99(*)
Practice (C)	1	310.09	310.09	0.01
A x B	1	161.32	161.32	0.006
A x C	1	34991.99	34991.99	1.32
B x C	1	10799.99	10799.99	0.41
A x B x C	1	7956.77	7956.77	0.30
Error	40	1061899.33	26547.48	----

Table 4-70: Mean RTs to "old" items for combined results.

		BLS	RLS	
Sim	1T	974	828	901
	3T	859	824	842
Ser	1T	877	775	826
	3T	921	828	875
		908	814	861

Table 4-71: ANOVA for RTs to "new" items for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	920904.00	--------	---
Presentation (A)	1	26602.08	26602.08	1.32
Organization (B)	1	21675.00	21675.00	1.07
Practice (C)	1	39330.75	39330.75	1.95
A x B	1	468.75	468.75	0.02
A x C	1	3468.00	3468.00	0.17
B x C	1	4446.75	4446.75	0.22
A x B x C	1	16428.00	16428.00	0.81
Error	40	808484.67	20212.12	----

Table 4-72: Mean RTs to "new" items for combined results.

		BLS	RLS	
Sim	1T	961	869	915
	3T	831	851	841
Ser	1T	961	930	946
	3T	938	872	905
		923	880	902

of mode of presentation or its interactions on recall and organization, with recall and organization being somewhat better in the Sim condition, or in interactions involving the Sim condition. Prn and P($\overline{A}$) were slightly better in the Ser condition and in those interactions involving the Ser condition. These results are consistent with a dual-process approach in that they support an interpretation which stresses the importance of occurrence information for recognition and of organization information for recall and organization.

While there were no significant effects of mode of presentation, or its interactions on RTs to "old" items, the observed differences were in a direction consistent with predictions of the context hypothesis; the faster times were in the RLS condition and in the Ser condition.

The major interpretation placed on the results of the categorized list studies is that they support the Bower, et. al. (1969a) contention that the categorized list paradigm is a 'weak' paradigm, and that this 'weakness' has led to, or contributed to, much of the ambiguity in the literature concerning the role of organization information in recognition. Further discussion of these results will be given later in the final chapter, in which the results of the various experiments will be compared and contrasted.

Before presenting the final experimental evidence for this chapter, it is important to note that a critical factor in the experiments for this chapter is that the subjects were aware of the recognition task prior to acquisition of the list material. The effect of this appears to be an alteration of strategy for acquisition to take greater advantage of occurrence information than was the case in the previous experiments of Chapters 2 and 3. The major finding of reduced RTs, overall, points to the role of occurrence information in recognition. The argument of this thesis is not that occurrence information plays no part in recognition, but that organization information, of a sort (semantic context) does in fact operate in a recognition task. Evidence presented to this point tends to support such a hypothesis, but the support is not overwhelming. However, more traditional approaches are not adequate to explain the results, nor to predict those results.

ADDITIONAL STRUCTURE INFORMATION PARADIGM

This paradigm involved the presentation of a categorized list along with additional structural information. The method used was the same as the general method given at the beginning of this chapter. The subjects were given both recall and recognition instructions prior to acquisition. The major difference concerned the list materials presented.

The list of items consisted of the names of 10 countries in Europe (the categories), the names of the capital city of each of the countries, and the name of a major city within each of the countries. Distractors were chosen from countries of Europe as well, and also consisted of the capital cities and a major city for each of those countries on the list of distractors. The countries were chosen such that the major geographical distributions were approximately equal for both the target and the distractor lists, this geographical distribution referring to a North - East -

South - West distribution. In addition to this, an outline map of Europe was presented on the display device with the country borders indicated.

The subjects were told that they would see a list of items consisting of the names of countries of Europe, capital cities of countries of Europe and names of major non-capital cities of countries of Europe. Presentation time was approximately three seconds per item and the items were presented either simultaneously or sequentially. The subjects were also told that they would see a map of Europe along with the list items and that dots would appear within this map and this information could be useful in learning the list material. The subjects were instructed that the map was presented as an aid to learning the list and that they should attempt to use it but were not <u>required</u> to use it.

Within the map the information provided by the dots was relevant in that it pinpointed the country, the capital city within the country and the major city within the country. In the Ser condition a dot appeared on the map corresponding to the item presented and was replaced when the next word was presented by the dot relevant for that item. In the Sim condition all the list items and all the map information was presented at once.

The outline map was not presented during recognition. The reason for this was that the original purpose of the map was to provide additional structural information and it was felt that presentation of the map during recognition would lead to unnecessary complications since, for example,

Targets	Distractors
NORWAY	SWEDEN
OSLO	STOCKHOLM
BERGEN	UPPSALA
DENMARK	FINLAND
COPENHAGEN	HELSINKI
ODENSE	TAMPERE
ENGLAND	EIRE
LONDON	DUBLIN
BIRMINGHAM	CORK
BELGIUM	NETHERLANDS
BRUSSELS	AMSTERDAM
ANTWERP	UTRECHT
FRANCE	E. GERMANY
PARIS	BERLIN
LIMOGES	LEIPZIG
W. GERMANY	AUSTRIA
BONN	VIENNA
BREMEN	LINZ
SWITZERLAND	CZECHOSLOVAKIA
BERNE	PRAGUE
ZURICH	BRNO
HUNGARY	POLAND
BUDAPEST	WARSAW
PECS	POZNAN
YUGOSLAVIA	PROTUGAL
BELGRADE	LISBON
TRIESTE	COIMBRA
SPAIN	ITALY
MADRID	ROME
BARCELONA	BOLOGNA

Fig. 4-4: List items (Targets) and non-list items (Distractors) used in the additional information paradigm. The above list order represents the order used in the BLS presentation. The outline map presented with this list indicated the position of the country within Europe and the dots indicated the position of the city within the country.

the subjects might use a reconstructive process based on the presence of the map rather than rely more completely on a memory representation alone. Also, all the previous experiments relied solely on the subject's internal representation of the list.

The list items are presented in Figure 4-4, and consists of the list and distractor items for the BLS conditions. The list items were the same for the RLS condition but the order of the items was randomized.

Experiment 9: Simultaneous presentation

This experiment was similar to Experiments 3 and 7 in that it was a categorized list paradigm. However, additional structural information was supplied which was relevant to the material presented, and the materials were highly specific.

Predictions: The materials presented were, for the most part, well known and familiar materials, particularly for a BLS list structure. In this situation it was easy for the subjects to examine the items and to determine their position both in the list in relation to one another and on a map which was presented. In the BLS condition there should be less variation in encoding since all the information is presented at once and it is in a logical and consistent form and it may be reviewed by the subjects in a direct manner. In the RLS condition such a review and checking procedure is somewhat more difficult. The effect of this would be that in the BLS condition encoding specificity would be high, relative to occurrence information, while in the RLS condition, occurrence information would be high relative to organization information. The effect of this would be longer RTs, on average, in the BLS condition.

There should be an effect of list structure such that Prl and Cls are better in the BLS condition. If there is an effect of the additional information it is expected that this effect would be to facilitate clustering in the BLS condition. One purpose of providing the additional information was to supplement the subject's information about the items. To the extent this is successful, one would expect facilitative effects overall.

Since the subjects were aware of the recognition task prior to acquisition, one would expect that RTs would be fast overall, and that a seriation strategy or a strategy which emphasized occurrence information would beof major importance. This is expected, although since the material is highly structured in its own right an effect of context, as predicted, is also expected.

RESULTS

All results are reported for one and 20 degrees of freedom, unless otherwise specified.

Recall: The effect of list structure was marginally nonsignificant ($F = 4.24$, $.10 > p > .05$), with Prl being slightly higher in the BLS condition. There was a significant effect of practice, with Prl increasing as level of practice increased ($F = 14.54$, $p < .005$). These are the results which one would expect, namely that learning did occur, and that a highly, and obviously, organized list appears to be learned somewhat more easily than a less highly structured of organized list. The mean Prl scores are presented in Table 4-74, and the results of the ANOVA are

Table 4-73: ANOVA for Prl for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.7844	--------	---
Organization (A)	1	0.0828	0.0828	4.24(*)
Practice (B)	1	0.2838	0.2838	14.54**
A x B	1	0.0273	0.0273	1.40
Error	20	0.3904	0.0195	----

Table 4-74: Mean Prl for Sim presentation.

	1T	3T	
BLS	0.65	0.94	0.79
RLS	0.60	0.75	0.68
	0.63	0.84	0.73

presented in Table 4-73.

Organization: There was a significant effect of list structure on Cls ($F = 20.22$, $p < .001$) with Cls scores being higher in the BLS condition. The effect of practice was marginally non-significant ($F = 3.44$, $.10 > p > .05$), with Cls scores being slightly higher in the 3T condition. In the BLS condition, each country is given with its capital and major cities. Consequently, all the subject must do is review those geographical facts which he already has and learn those which are new to him. This should conceivably lead to a high degree of encoding specificity in the BLS condition.

The pattern of results for Cls is similar to that obtained in Experiment 7, but are of lesser magnitude, as can be seen by comparing Tables 4-76 and 4-40. This is what one might expect given a longer list in the present experiment with more and smaller categories. Alternatively, or perhaps even additionally, if the subjects used the additional information to derive a retrieval rule or structure, and used that then one would expect similar results, with the BLS condition leading to higher Cls scores as a function of inherent list structure. It is likely also that such a strategy would be serially based and arguments applied to previous experiments, i.e., 7 and 8 for example, apply here as well. Note that the rule is not as obvious in the RLS condition in which a seriation strategy, per se, is more likely to be adopted.

The mean Cls scores are presented in Table 4-76, and the results of the ANOVA are presented in Table 4-75.

Table 4-75: ANOVA for Cls for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.7551	-------	----
Organization (A)	1	0.3408	0.3408	20.22***
Practice (B)	1	0.0580	0.0580	3.44 (*)
A x B	1	0.0193	0.0193	1.14
Error	20	0.3370	0.0169	----

Table 4-76: Mean Cls for Sim presentation.

	1T	3T	
BLS	0.45	0.60	0.53
RLS	0.27	0.31	0.29
	0.36	0.46	0.41

Recognition: There was a significant effect of list structure on Prn ($F = 11.83$, $p < .005$) with Prn being highest in the RLS condition. No other effects were significant. If subjects adopt a seriation strategy which is implemented differently for the BLS and RLS condition, then one would expect a difference. If, in the BLS condition subjects adopted a "map rule" then one would expect a highly specific encoding with little variability. Consequently, Prn should be higher in the RLS condition since there is less of a "map rule" dependency. The mean Prn scores are presented in Table 4-78, and the results of the ANOVA are reported in Table 4-77.

$P(\overline{A})$: There were no significant effects of the experimental treatments on sensitivity although the list structure x practice interaction was marginally non-significant ($F = 3.99$, $.10 > p > .05$). The performance levels for sensitivity were at very high levels and any effect present may have been obscured by ceiling levels of performance. Mean sensitivity scores are presented in Table 4-80, and the results of the ANOVA are presented in Table 4-79.

RT "old": There was a significant effect of list structure on RTs to "old" items ($F = 7.66$, $p < .025$) with RTs being faster in the RLS condition, as predicted on the basis of the context hypothesis. No other effects were significant. The direction of the effect is that found in most of the experiments in this thesis and is regarded as support for a context hypothesis interpretation of the results. The mean RTs are presented in Table 4-82, and the results of the ANOVA are reported in Table 4-81.

Table 4-77: ANOVA for Prn for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.1303	-------	----
Organization (A)	1	0.0451	0.0451	11.83**
Practice (B)	1	0.0067	0.0067	1.75
A x B	1	0.0024	0.0024	0.63
Error	20	0.0762	0.0038	----

Table 4-78: Mean Prn for Sim presentation.

	1T	3T	
BLS	0.89	0.83	0.86
RLS	0.95	0.94	0.95
	0.92	0.89	0.90

Table 4-79: ANOVA for $P(\bar{A})$ for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0139	-------	---
Organization (A)	1	0.0006	0.0006	1.18
Practice (B)	1	0.0011	0.0011	2.10
A x B	1	0.0020	0.0020	3.97(*)
Error	20	0.0102	0.0005	----

Table 4-80: Mean $P(\bar{A})$ for Sim presentation.

	1T	3T	
BLS	0.95	0.95	0.95
RLS	0.94	0.97	0.96
	0.95	0.96	0.96

Table 4-81: ANOVA for RTs to "old" items for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	250505.33	---------	---
Organization (A)	1	69122.66	69122.66	7.66**
Practice (B)	1	140.16	140.16	0.02
A x B	1	704.18	704.18	0.08
Error	20	180538.33	9026.92	----

Table 4-82: Mean RTs to "old" items for Sim presentation.

	1T	3T	
BLS	886	871	879
RLS	768	774	771
	827	822	825

RT "new": There were no effects of treatments on RTs to "new" items. The differences are such that RTs are slightly faster in the RLS condition and in the 3T condition, as would be expected, particularly the difference for the 3T condition. The mean RTs are presented in Table 4-84, and the results of the ANOVA in Table 4-83.

DISCUSSION

The results of this experiment support the context hypothesis since the RTs to "old" items are faster in the RLS condition (low, or weak, context). The other hypotheses which have been proposed as alternatives to the context hypothesis, the effective presentation time hypothesis and the dual-process approach, would both lead to a prediction that RTs should be faster in the BLS condition, particularly the effective presentation time hypothesis. In fact, the dual-process approach holds that there will be no effect of organization (list structure) on recognition, and this is obviously at odds with the data as presented in this thesis.

Experiment 10: Serial presentation

This experiment is similar to the previous one except that the list items were presented sequentially instead of simultaneously.

Predictions: The predictions for this experiment are similar to those for the previous experiment. However, since the list items are presented serially, an attenuation of any effect of list structure is expected. The reason for this is that this presentation is more like that for a recognition

Table 4-83: ANOVA for RTs to "new" items for Sim presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	222195.62	---------	----
Organization (A)	1	4620.37	4620.37	0.48
Practice (B)	1	25415.04	25415.04	2.66
A x B	1	828.38	828.38	0.09
Error	20	191331.83	9566.59	----

Table 4-84: Mean RTs to "new" items for Sim presentation.

	1T	3T	
BLS	949	896	990
RLS	933	856	895
	941	876	909

test, and occurrence information is stressed even more highly than with a simultaneous presentation. Also, it is more difficult for subjects to check information by referring to the list items since they must be carried in memory. This would lead to a greater reliance on memory and hence would likely involve more organization information in the BLS condition, relative to the RLS condition.

The results are reported for one and 20 degrees of freedom unless otherwise specified.

RESULTS

Recall: There was no effect of list structure on Prl ($F = 2.47$, $p > .05$) although Prl was slightly higher in the BLS condition. There was, as expected, a significant effect of practice with Prl increasing as practice increased ($F = 5.49$, $p < .05$). These results are as one would expect from the literature. The mean Prl scores are presented in Table 4-86, and the results of the ANOVA are presented in Table 4-85.

Organization: There was a significant effect of list structure on Cls ($F = 20.22$, $p < .001$) with Cls being highest in the BLS condition, as expected. No other effects were significant.

In the BLS condition the list structure is compatible with a seriation strategy and the Cls scores might reflect both organization and occurrence coding to a greater degree than would be the case in the RLS condition. The mean Cls scores are presented in Table 4-88, and the results of the ANOVA are presented in Table 4-87.

Recognition: There was no significant effect of list structure on Prn ($F < 1$) but the effect of practice was significant

Table 4-85: ANOVA for Prl for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.5120	--------	---
Organization (A)	1	0.0434	0.0434	2.47
Practice (B)	1	0.0963	0.0963	5.49*
A x B	1	0.0216	0.0216	1.23
Error	20	0.3508	0.0175	----

Table 4-86: Mean Prl for Ser presentation.

	1T	3T	
BLS	0.74	0.92	0.83
RLS	0.71	0.78	0.75
	0.73	0.85	0.79

Table 4-87: ANOVA for Cls for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.6292	--------	----
Organization (A)	1	0.2882	0.2882	19.02***
Practice (B)	1	0.0018	0.0018	0.12
A x B	1	0.0360	0.0360	2.38
Error	20	0.3031	0.0152	----

Table 4-88: Mean Cls for Ser presentation.

	1T	3T	
BLS	0.52	0.62	0.57
RLS	0.38	0.32	0.35
	0.45	0.47	0.46

($F = 7.08$, $p < .025$) with Prn being highest in the 3T condition. No other effects were significant.

These results support an interpretation based on encoding for occurrence information. The mean Prn scores are presented in Table 4-90, and the results of the ANOVA are presented in Table 4-89.

$P(\bar{A})$: As for recognition, there was a significant effect of practice ($F = 7.28$, $p < .025$) with sensitivity being highest in the 3T condition. No other effects were significant. The mean sensitivity scores are presented in Table 4-92, and the results of the ANOVA are presented in Table 4-91.

The results to this point, based on accuracy measures, tend to support an interpretation of recognition performance based on the use, or importance, of occurrence information, or strategies which emphasize such information. This is particularly so in the light of the lack of any significant effect of list structure on Prl and the note that Cls scores could reflect unrealistically high organization as a result of the adoption of seriation as a strategy for encoding the list. The following RT data contradict this, as will be shown.

RT "old": There was a significant effect of list structure ($F = 8.10$, $p < .01$) and of practice ($F = 6.29$, $p < .025$) on RTs to "old" items with RTs being fastest in the RLS condition and the 3T condition. These are the effects one would expect based on an interpretation derived from the context hypothesis. With the exception of the BLS - 1T

Table 4-89: ANOVA for Prn for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.1913	-------	----
Organization (A)	1	0.0018	0.0018	0.27
Practice (B)	1	0.0477	0.0477	7.08*
A x B	1	0.0070	0.0070	1.04
Error	20	0.1348	0.0067	----

Table 4-90: Mean Prn for Ser presentation.

	1T	3T	
BLS	0.83	0.95	0.89
RLS	0.88	0.93	0.91
	0.86	0.94	0.90

Table 4-91: ANOVA for $P(\bar{A})$ for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.0329	--------	----
Organization (A)	1	0.0009	0.0009	0.81
Practice (B)	1	0.0084	0.0084	7.28*
A x B	1	0.0003	0.0003	0.29
Error	20	0.0232	0.0012	----

Table 4-92: Mean $P(\bar{A})$ for Ser presentation.

	1T	3T	
BLS	0.93	0.98	0.96
RLS	0.95	0.98	0.97
	0.94	0.98	0.96

condition the RTs were quite fast and the differences were rather small, reflect an attenuation of effect in the remaining conditions relative to the situations in which the subjects were not aware of the recognition task prior to acquisition. Mean RTs are presented in Table 4-94 and the results of the ANOVA are presented in Table 4-93.

RT "new": As for the results above, the effects of list structure and of practice were significant ($F = 16.80$, $p < .001$) and ($F = 6.96$, $p < .025$), respectively. RTs were fastest in the RLS and the 3T conditions. Mean RTs are presented in Table 4-96 and the results of the ANOVA are presented in Table 4-95.

DISCUSSION

The results of this experiment support the context hypothesis in that RTs were fastest in the RLS condition. It is in this condition in which, presumably, encoding variability would be highest. However, with such specific material and with the information provided by the map, it is unclear as to what the range of possible encoding might be. Items such as Limoges, for example, apparently have a wider range of possible encoding, but items such as Madrid do not appear to have as wide a range. For example: Limoges is a type of chinaware; Brussels can refer to a kind of vegetable, and so on. Other items may not have the same range of possible interpretations. None the less, the alternative hypotheses do not predict the effect obtained and the context hypothesis does. A fuller discussion of this experiment will be presented at the end of this chapter.

In order to assess the effects of mode of presentation

Table 4-93: ANOVA for RTs to "old" items for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	325100.00	---------	----
Organization (A)	1	70200.17	70200.17	8.10**
Practice (B)	1	54530.67	54530.67	6.29*
A x B	1	27068.16	27068.16	3.12
Error	20	173301.00	8665.05	----

Table 4-94: Mean RTs to "old" items for Ser presentation.

	1T	3T	
BLS	1022	860	941
RLS	847	819	833
	935	839	887

Table 4-95: ANOVA for RTs to "new" items for Ser presentation.

Source	df	Sum of Squares	Mean Square	F
Total	23	333209.33	--------	----
Organization (A)	1	127021.50	127021.50	16.80***
Practice (B)	1	52640.66	52640.66	6.96*
A x B	1	2360.17	2360.17	0.31
Error	20	151187.00	7559.35	----

Table 4-96: Mean RTs to "new" items for Ser presentation.

	1T	3T	
BLS	1046	933	990
RLS	881	807	844
	964	870	917

the data for the Ser and the Sim conditions was combined and ANOVAs performed on this data with mode of presentation included as a factor. The effects of mode of presentation and its interactions will be reported. All results are based on one and 40 degrees of freedom, unless otherwise specified.

RESULTS

Recall: There was no effect of mode of presentation on Prl ($F = 1.76$, $p > .05$), nor were any of the mode of presentation interactions significant. The effects of list structure ($F = 6.64$, $p < .025$) and of practice ($F = 19.18$, $p < .001$) were significant. The mean Prl for mode of presentation and its interactions is presented in Table 4-98, and the results of the ANOVA are presented in Table 4-97.

Organization: There was no effect of mode of presentation on Cls performance ($F = 1.97$, $p > .05$). None of the interactions involving mode of presentation reached significance. The mean Cls scores are presented in Table 4-100, and the results of the ANOVA are presented in Table 4-99.

Recognition: The only effect involving mode of presentation as a factor which reached significance was the mode of presentation x practice interaction ($F = 8.54$, $p < .01$) in which the differential effects of practice were greatest in the Ser condition. The lack of an effect of practice in the Sim condition might reflect a greater emphasis on organization information in that condition which is consistent with the context hypothesis; the organization information being based on a seriation strategy. The mean Prn scores are presented in Table 4-102. The results of the

Table 4-97: ANOVA for Prl for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	1.3289	--------	----
Presentation (A)	1	0.0326	0.0326	1.76
Organization (B)	1	0.1230	0.1230	6.64*
Practice (C)	1	0.3554	0.3554	19.18***
A x B	1	0.0032	0.0032	0.17
A x C	1	0.0248	0.0248	1.34
B x C	1	0.0488	0.0488	2.63
A x B x C	1	0.0002	0.0002	0.01
Error	40	0.7411	0.0185	----

Table 4-99: ANOVA for Cls for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	1.4158	--------	-----
Presentation (A)	1	0.0315	0.0315	1.97
Organization (B)	1	0.6279	0.6279	39.24***
Practice (C)	1	0.0403	0.0403	2.52
A x B	1	0.0011	0.0011	0.07
A x C	1	0.0196	0.0196	1.22
B x C	1	0.0540	0.0540	3.37(*)
A x B x C	1	0.0013	0.0013	0.08
Error	40	0.6402	0.0160	-----

Table 4-98: Mean Prl for combined results, for list structure and practice.

	1T	3T	
BLS	0.69	0.93	0.81
RLS	0.66	0.76	0.71
	0.67	0.85	0.76

Table 4-100: Mean Cls for combined results, for list structure and practice.

	1T	3T	
BLS	0.48	0.61	0.55
RLS	0.32	0.31	0.32
	0.40	0.46	0.43

Table 4-102: Mean Prn for combined results for mode of presentation and practice.

	1T	3T	
BLS	0.92	0.89	0.90
RLS	0.85	0.94	0.90
	0.89	0.92	0.90

ANOVA are presented in Table 4-101.

P($\overline{A}$): There were no effects due to mode of presentation or its interactions. The only significant effect was that due to practice ($F = 9.30$, $p < .005$). The mean sensitivity scores are presented in Table 4-104 and the results of the ANOVA are presented in Table 4-103.

The results based on both the Prn and the sensitivity measures would seem to indicate that recognition is very sensitive to differences in organization information. This argument is, as has been stated previously in this thesis, largely a matter of using a measure which is sensitive to the kind of changes in performance which might be expected to be most sensitive to the effects of organization information. In this case RTs are such a measure, while Prn is not as sensitive a way of picking up this effect of organization.

RT "old": There was a significant effect of mode of presentation on RTs to "old" items ($F = 5.24$, $p < .05$) such that RTs were faster in the Sim condition. This effect was in a direction opposite that predicted from the context hypothesis. It must be remembered that in this experiment additional information, in the form of a map, was presented to the subjects. It would be expected that the maximal effect of such information should occur in the Sim condition in which the subjects could compare the list information with that provided by the map, and use the map to supplement their geographical knowledge on the list material. The overall effect of this would (possibly) be the establishment of an encoding and retrieval plan based on the map structure.

Table 4-101: ANOVA for Prn for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.3180	--------	----
Presentation (A)	1	0.0003	0.0003	0.05
Organization (B)	1	0.0326	0.0326	6.17*
Practice (C)	1	0.0094	0.0094	1.77
A x B	1	0.0144	0.0144	2.72
A x C	1	0.0450	0.0450	8.54**
B x C	1	0.0006	0.0006	0.11
A x B x C	1	0.0088	0.0088	1.67
Error	40	0.2110	0.0053	----

Table 4-103: ANOVA for $P(\bar{A})$ for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	0.0475	--------	----
Presentation (A)	1	0.0008	0.0008	0.90
Organization (B)	1	0.0015	0.0015	1.82
Practice (C)	1	0.0078	0.0078	9.30**
A x B	1	0.00002	0.00002	0.02
A x C	1	0.0018	0.0018	2.10
B x C	1	0.0004	0.0004	0.42
A x B x C	1	0.0020	0.0020	2.40
Error	40	0.0334	0.0334	----

Table 4-104: Mean $P(\bar{A})$ for combined results for mode of presentation and practice.

	1T	3T	
BLS	0.95	0.96	0.96
RLS	0.93	0.98	0.96
	0.94	0.97	0.96

Table 4-106: Mean RTs to "old" items for combined results, for mode of presentation and list structure.

	BLS	RLS	
Sim	879	771	825
Ser	941	833	887
	910	802	856

Table 4-108: Mean RTs to "new" items for combined results, for mode of presentation and list structure.

	BLS	RLS	
Sim	923	895	909
Ser	990	844	917
	956	869	913

This is potentially a very rapid method for retrieval, for both recall and for recognition. In the Ser condition the map did not appear to be as facilitative, and decisions based more completely on occurrence information, per se, may have been made, with a consequent increase in average RTs, relative to the Sim condition. This is a plausible argument, but it is a post hoc argument and, in fact, this difference still is in a direction opposite that predicted by the context hypothesis, as it has been developed to this point in the thesis. The mean RTs are presented in Table 4-106 and the results of the ANOVA are presented in Table 4-105.

RT "new": There was no effect of mode of presentation on RTs for "new" items ($F < 1$). There was a significant mode of presentation x list structure effect ($F = 4.86$, $p < .05$) such that RTs to "new" items were faster in the RLS condition and this list structure difference was greatest in the Ser condition. This effect is illustrated in Fig. 4-5. The mean RTs to "new" items are presented in Table 4-108, and the results of the ANOVA are presented in Table 4-107.

DISCUSSION

The results of the categorized list paradigms with supplemental information support the context hypothesis, for the most part. There was at least one discrepancy however; RTs to "old" items were faster in the Sim condition when the context hypothesis leads to a prediction that they would be faster in the Ser condition.

The recall and organization results are what one would expect and would be predicted on the basis of most, if not

Table 4-105: ANOVA for RTs to "old" items for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	621981.67	----------	----
Presentation (A)	1	46376.34	46376.34	5.24*
Organization (B)	1	139320.75	139320.75	15.75***
Practice (C)	1	30100.09	30100.09	3.40
A x B	1	2.08	2.08	0.0002
A x C	1	24570.74	24570.74	2.78
B x C	1	18252.00	18252.00	2.06
A x B x C	1	9520.34	9520.34	1.08
Error	40	353839.33	8845.98	----

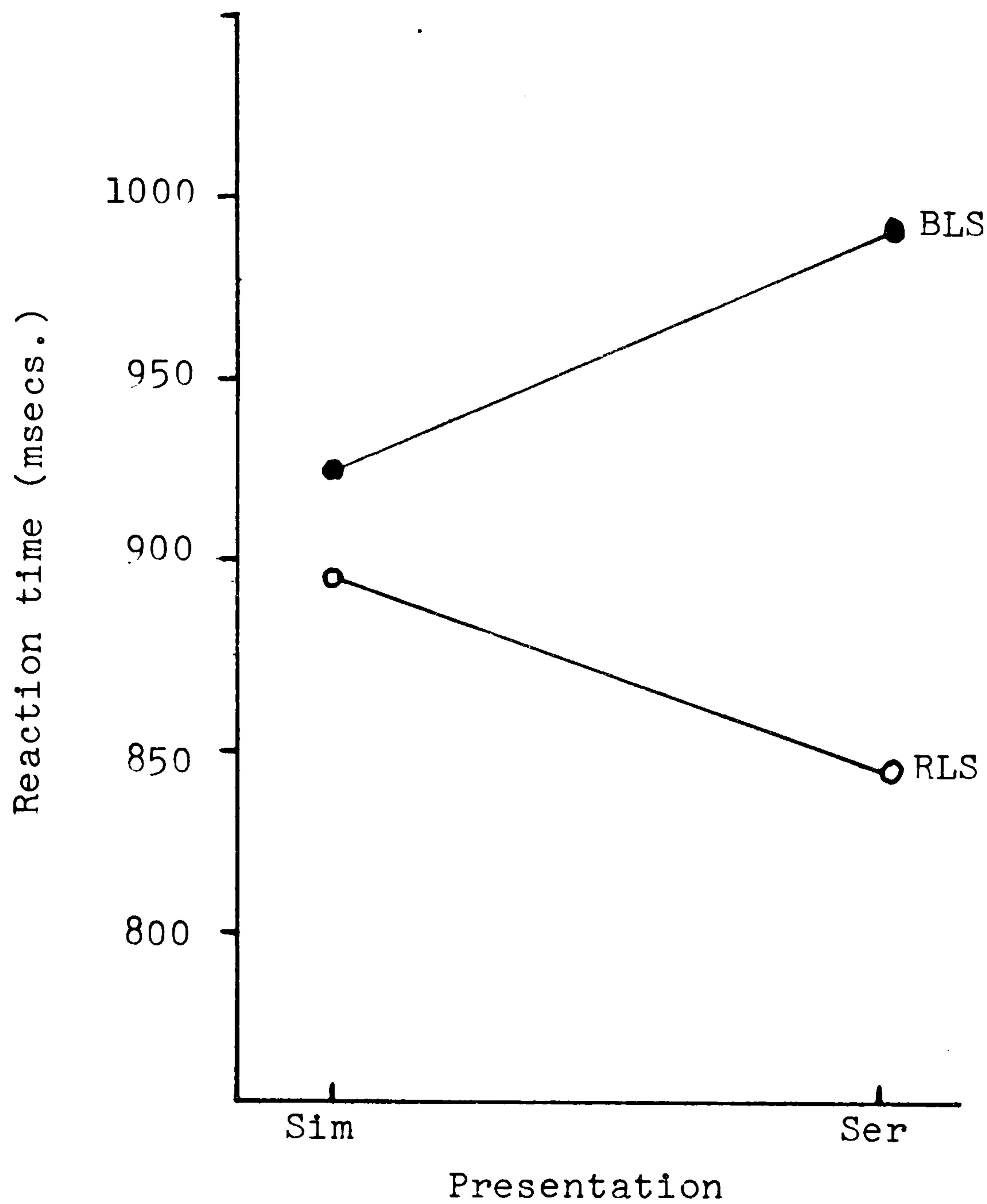


Fig. 4-5. RT "new" for mode of presentation x level of list structure.

Table 4-107: ANOVA for RTs to "new" items for combined results.

Source	df	Sum of Squares	Mean Square	F
Total	47	556213.48	--------	----
Presentation (A)	1	808.52	808.52	0.09
Organization (B)	1	90046.69	90046.69	10.52**
Practice (C)	1	75604.69	75604.69	8.83**
A x B	1	41595.19	41595.19	4.86*
A x C	1	2451.02	2451.02	0.29
B x C	1	196.02	196.02	0.02
A x B x C	1	2992.52	2992.52	0.35
Error	40	342518.83	8562.97	----

all, contemporary theories of organization and recall. The effects of list structure on Prn lend support to the context hypothesis since Prn is superior in the RLS condition for both Ser and Sim presentations. In the RLS condition, it is assumed that occurrence information is attended to a greater degree than is organization information, consequently, the effects of context and encoding specificity are relatively low. The result of this is that "old" items should be readily discriminable from "new" items to a greater extent than for the BLS condition and this is the case. Sensitivity is somewhat higher in the RLS condition and this supports the previous argument.

The RT results for "old" items leads to the equivocation in the results. While, as predicted, RTs were faster in the RLS condition, they were also faster in the Sim condition. The latter result is in a direction opposite that predicted from the context hypothesis. An argument was presented which rationalized this finding in terms of the context hypothesis, but this was a post hoc argument and the fact remains that the context hypothesis, as presented to this point, was not adequate to predict the results for mode of presentation.

In all the experiments reported in this chapter, the median RTs have been very fast, relative to the experiments of the earlier chapters (Experiment 1 - 4). This data supports the contention of Carey & Lockhart (1973) that knowledge of the retrieval task will influence subsequent performance on that task. This knowledge might also produce a differential effect by interacting with mode of presentation and list structure, given that two tasks, recall and recognition, were involved in these experiments. In Experiments 9 and 10 the effect of knowledge of the tasks might have been to induce a processing bias into the different conditions in terms of the way in which supplementary information was utilized.

CHAPTER 5

In the experiments reported to this point in the thesis, context has been manipulated in terms of properties inherent in the list of words, e.g., list structure, mode of presentation, practice. In the following experiment the contextual information was manipulated in a more direct manner. Light & Carter-Sobell (1970) demonstrated that a change of semantic context had an effect on recognition performance and they manipulated semantic context by using polysemous nouns with a variety of adjectival modifiers. These modifiers biased particular meanings of the nouns and this biasing was systematically varied across acquisition and recognition test. This is essentially the type of paradigm used in this study.

In a series of experiments Light & Carter-Sobell found that, for recognition, testing with the same adjective as that used during acquisition or original learning produced significantly better recognition performance than testing with the same noun but with a different adjective; i.e., present 'strawberry jam' and test 'raspberry jam' when the subject's task is to respond as to whether or not the word 'jam' was on the list of presented words. In another condition the meaning of the noun was changed by using another modifier, e.g., present 'strawberry jam' and test with 'traffic jam'. In the latter situation recognition performance was again superior when the test items were the same as those presented, and performance was better with the same meaning as opposed to a different meaning. In all cases the recognition task was to respond to the noun only.

Light & Carter-Sobell argued that more than one memory representation may be checked for recency information during recognition. They went on to argue that if this were the case, then the effects of changed semantic context might be better interpreted in terms of memory search interference, i.e., biasing one meaning of a noun may simply increase the difficulty of locating recency information associated with other semantic interpretations of that noun through some form of "set". This is a simpler version of a major premise of the context hypothesis as developed in this thesis.

A final point made by Light & Carter-Sobell is that "it is clearly not sufficient to simply state that presentation of a test item obviates the need for retrieval operations by directing S to the memory representation of a test item for purposes of making recency judgments." (Light & Carter-Sobell, 1970, p. 9). Again, this is a point which has been made repeatedly in this thesis, particularly with reference to dual-process approaches to recognition memory models.

Light & Carter-Sobell talk about interpretations while in this thesis the term encoding specificity - variability covers the notion of multiple encodings which often may be different interpretations. The notion of search processes is common to both this thesis and the above study.

METHOD

Subjects and Design: The subjects were 24 students from the University of New Brunswick, assigned randomly to experimental treatments. The design of the experiment was a 2 x 2 x 4 (list structure x presentation x adjective type used in test) factorial design with repeated measures on the last factor. Six subjects were run in each condition of the between factors.

Apparatus and Materials: The apparatus consisted of a SR-400 programmed learning machine which was used to present the materials. The items were typed on fanfold paper and the machine was set to present the items at the rate of one item every three seconds during acquisition in the serial condition. For the simultaneous condition the items were typed on a sheet of paper and the subjects were permitted to study them for a total time equivalent to a per-item-time of three seconds.

The materials consisted of a list of 64 nouns composed of 16 nouns from each of four categories, and adjectives which biased the meaning of the nouns either for category membership or for a meaning unrelated to the particular category. The items were selected from Thorndike-Lorge and were of equivalent frequency for targets and distractors, i.e., if a target item had a frequency of AA, then its equivalent distractor also had a frequency of AA, and so on. One-half of this list of nouns, with modifiers, was used as an acquisition list and the other half as a recognition distractor list. All 64 items were presented for recognition. The materials are presented in Fig. 5-1. For both the target and the distractor items one-quarter of the items in each category were presented with the same adjective, one-quarter with a different adjective which biased meaning toward inclusion in the same category, one-quarter with an adjective which biased a different meaning, and one-quarter with no adjective.

Figure 5-1. Materials for acquisition and recognition test. Order is that used for BLS presentation. Items were presented in random order for recognition, not in order as indicated here. * denotes a distractor and this symbol did not appear with the items.

PRESENTED	TESTED	
	SA & SM	DM & NA
soda CRACKER	*soda WATER	*motor OIL
virginia HAM	*sugar GLAZE	*wing NUT
spiked PUNCH	spiked PUNCH	safe CRACKER
sugar CUBE	dinner ROLL	skinny DIP
dinner ROLL	*chocolate BAR	*CHEESE
strawberry JAM	*banana SPLIT	*DATE
chip DIP	baked HAM	CUBE
sandwich SPREAD	sweet JAM	SPREAD
wood SCREW	*metal CATCH	*cribbage PEG
rubber BAND	*rubber CEMENT	*fish HOOK
shirt BUTTON	wood SCREW	lightning BOLT
safety PIN	safety PIN	canal LOCK
metal SNAP	*nylon ZIPPER	*JOINT
yale LOCK	*finish NAIL	*GLUE
masking TAPE	coat BUTTON	SNAP
carriage BOLT	elastic BAND	TAPE
fallen ARCHES	*strong BACK	*spoken TONGUE
bruised HEEL	*wide FACE	*department HEAD
wide MOUTH	blind EYE	gothic ARCHES
big FEET	big FEET	harbour MOUTH
blind EYE	*slim NECK	*BONE
strong ARMS	*pointed NOSE	*HAND
burly CHEST	hairy CHEST	ARMS
broad SHOULDERS	sore HEEL	SHOULDERS
pitch FORK	*steam CLEANER	*record PLAYER
food GRINDER	*air COMPRESSOR	*temporal PLANE
fountain PEN	pitch FORK	powdered HORN
steam IRON	letter OPENER	cast IRON
air HORN	*cold CHISEL	*BIT
letter OPENER	*grease GUN	*DRILL
weight SCALE	quill PEN	SCALE
measuring RULE	meat GRINDER	RULE

Procedure: Each subject was assigned to a condition at random and was told that they were participating in a memory experiment. They were told that they would be shown pairs of words and that their task was to learn the capitalized words and that the word presented with it might help them to learn the capitalized word. The subjects were instructed to read the words aloud the first time they encountered them, and the subjects were not informed of the recognition task at this time.

Recall acquisition was for a single trial and on completion of this trial the subject was asked to recall as many of the capitalized words as possible in any order. Subjects were permitted one minute for recall. Following recall the subjects were instructed for the recognition test phase. Each subject was told that he was to be shown a pair of words or a single word on the machine in front of him (SR-400) and that he would be given a signal when the word was to appear. The subject was instructed that his task was to respond as quickly and as accurately as possible to the capitalized noun by identifying it as an "old" item which was from the list he had learned or as a "new" item which was not from the list he had learned.

Predictions: It is predicted that Prl will be higher in the BLS condition of list structure and also in a Sim mode of presentation. Cls scores will also follow a similar pattern. These predictions are based on usual findings in the literature and are not tied specifically to the context hypothesis. An effect of adjective type on Prn is predicted with Prn being highest in the Same Adjective (SA) condition and poorest in the Different Meaning (DM) condition; little difference, if any, is expected between Same Meaning (SM) and No Adjective (NA) conditions, although whatever differences may exist would be such that Prn would be higher in the SM condition, since the probability of accessing an encoded representation would be somewhat higher in the SM condition, relative to the NA condition. It is predicted that the pattern of results for the sensitivity measure will be essentially the same as for the Prn measure since both appear to primarily reflect processes dependent upon recency information. Also, since Prn and $P(\bar{A})$ are regarded, in this thesis, as being primarily sensitive to occurrence types of information, it is predicted that Prn and $P(\bar{A})$ will be higher in the RLS and the Ser conditions, both of which are presumed to facilitate a greater degree of encoding variability.

Similarly, for RTs to "old" items, it is predicted that there will be an effect of list structure such that the fastest RTs will occur in the RLS condition, also the fastest RTs will occur in the Ser condition of mode of presentation. The predictions made with regard to the effects, if any, of adjective type on RTs to "old" items are that RTs should be fastest in the SA condition and in the SM condition and slowest in the DM and NA conditions, with the slowest RTs being in the DM condition and the fastest in the SA condition. Also, since encoding variability is presumed to be greatest in the Ser mode of presentation, it is predicted that the RTs in this condition will be faster than in the Sim condition and that there should be an interaction of both mode of presentation and list structure with adjective type. The reasoning behind this is that with a Ser presentation, rather than a Sim presentation, the degree of encoding variability may be more similar to that encountered in the recognition testing conditions of adjective change.

Following this reasoning there are several interesting effects one can predict, as follows:

(1) RTs to "old" items, as stated, will be fastest in the Ser and RLS conditions since these conditions promote a greater reliance on occurrence information.

(2) Information in the SA condition is congruent with the presented material. Such congruence has two major consequences in terms of the presented model; (a) when the subject relies primarily on occurrence information to make a recognition decision he should be able rapidly to find the appropriate memory locations and check for occurrence; (b) if the subject relies on a search of list, the congruent SA condition allows him to search the right list and not to be distracted. Both these effects argue for faster recognition RTs for SA. Similarly, the partial congruence of SM and NA with presented material will lead to slower RTs and the incongruence of DM to still slower RTs.

(3) DM, and to a lesser extent SM and NA, which deliberately introduce encoding variability <u>into the testing phase</u>, will be less penalized when the acquisition conditions also introduced encoding variability (Ser and RLS conditions). Relative to SA, the DM, SM and

NA will give longer RTs in all conditions, but the effect will be diminished with a Ser-RLS presentation. The latter prediction asserts the strong assumption that encoding variability introduced via Ser and RLS is of the same sort as displayed by the adjective type variable (SA - SM - NA - DM). As shall be seen from the experimental results, this assumption turns out to be false. These predictions lead to results of the form illustrated in Fig. 5-2.

RESULTS

All results are reported for one and 20 degrees of freedom for between-subject treatments and for three and 60 degrees of freedom for within-subject treatments, unless otherwise specified. This is made clear in the ANOVA tables.

Recall: There was no effect of mode of presentation on Prl ($F < 1$), although Prl was slightly higher in the Sim condition. There was a significant effect of list structure ($F = 9.51$, $p < .01$) with Prl being highest in the BLS condition. The mean Prl scores are presented in Table 5-2 and the results of the ANOVA are presented in Table 5-1.

Organization: The results for Cls mirrored those for Prl with the only significant effect being that due to list structure ($F = 9.17$, $p < .01$), with Cls being highest for the BLS treatment level. These predictions are, for the most part, those one would expect. The mean Cls scores are presented in Table 5-4 and the results of the ANOVA are presented in Table 5-3.

Recognition: There was a marginally non-significant effect

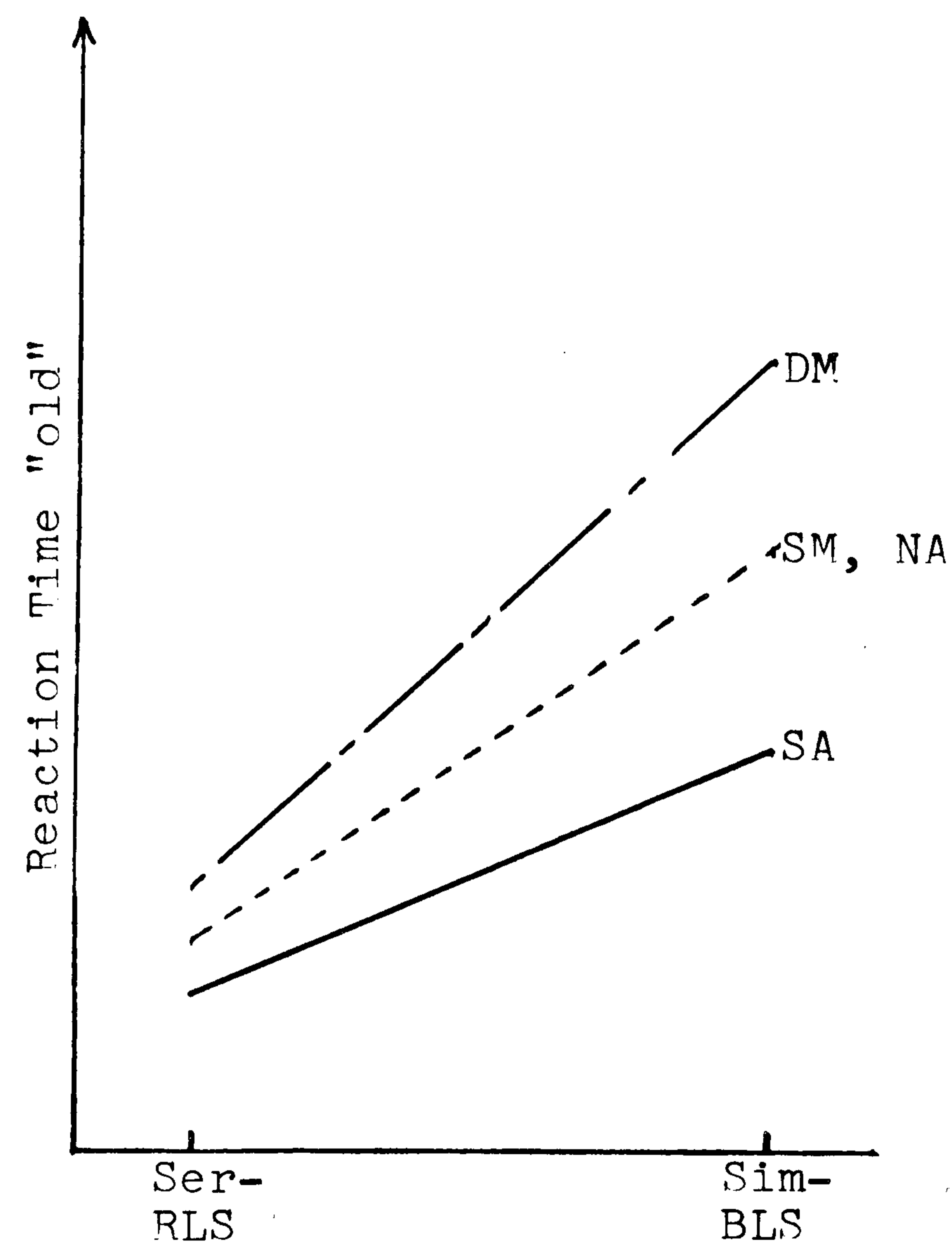


Figure 5-2. Predicted effects of adjective type for RTs to "old" items for Ser-RLS vs. Sim-BLS conditions.

Table 5-1: ANOVA summary for Prl.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.2813	-------	-----
Presentation (A)	1	0.0024	0.0024	0.27
Organization (B)	1	0.0840	0.0840	9.51***
A x B	1	0.0182	0.0182	2.05
Error	20	0.1768	0.0088	-----

Table 5-2: Mean Prl scores.

	Ser	Sim	
BLS	0.68	0.75	0.71
RLS	0.61	0.58	0.59
	0.64	0.66	0.65

Table 5-3: ANOVA summary for Cls.

Source	df	Sum of Squares	Mean Square	F
Total	23	0.7274	--------	----
Presentation (A)	1	0.0070	0.0070	0.28
Organization (B)	1	0.2262	0.2262	9.17***
A x B	1	0.0007	0.0007	0.03
Error	20	0.4935	0.0247	----

Table 5-4: Mean Cls scores.

	Ser	Sim	
BLS	0.78	0.81	0.79
RLS	0.58	0.62	0.60
	0.68	0.71	0.70

of mode of presentation on Prn ($F = 3.05$, $.10 > p > .05$) with Prn being slightly higher in the Sim condition. This is in a direction opposite that predicted from the context hypothesis. While there was no effect of list structure, the direction of the observed difference was such that Prn performance was in the direction predicted from the context hypothesis, i.e., Prn was slightly higher in the RLS condition.

There was a significant effect of adjective type on Prn with Prn being highest in the SA and in the SM conditions, with poorest performance in the DM condition, as predicted ($F = 102.75$, $p < .001$). In addition, there was a significant mode of presentation x adjective type interaction ($F = 8.23$, $p < .001$). This interaction is illustrated in Fig. 5-3, and it can be seen in this figure that the major difference between Sim and Ser modes of presentation is in the NA condition in which Prn is higher for a Sim mode of presentation, and DM goes down while others go up. The mean Prn scores are presented in Table 5-5 and the results of the ANOVA are presented in Table 5-6.

<u>$P(\bar{A})$</u>: The only significant effects of treatments on $P(\bar{A})$ were those due to adjective type ($F = 34.41$, $p < .001$) and a mode of presentation x adjective type interaction ($F = 8.54$, $p < .001$). These results are illustrated in Fig. 5-4. These results are very comparable to Prn in that NA shows the greatest difference, while DM actually goes down in Sim. This implies that NA, least tied to context, benefits most from Sim presentation organization, whereas DM, most distracted by context, benefits least from Sim. The $P(\bar{A})$ mean scores are presented in Table 5-7 and the results of the

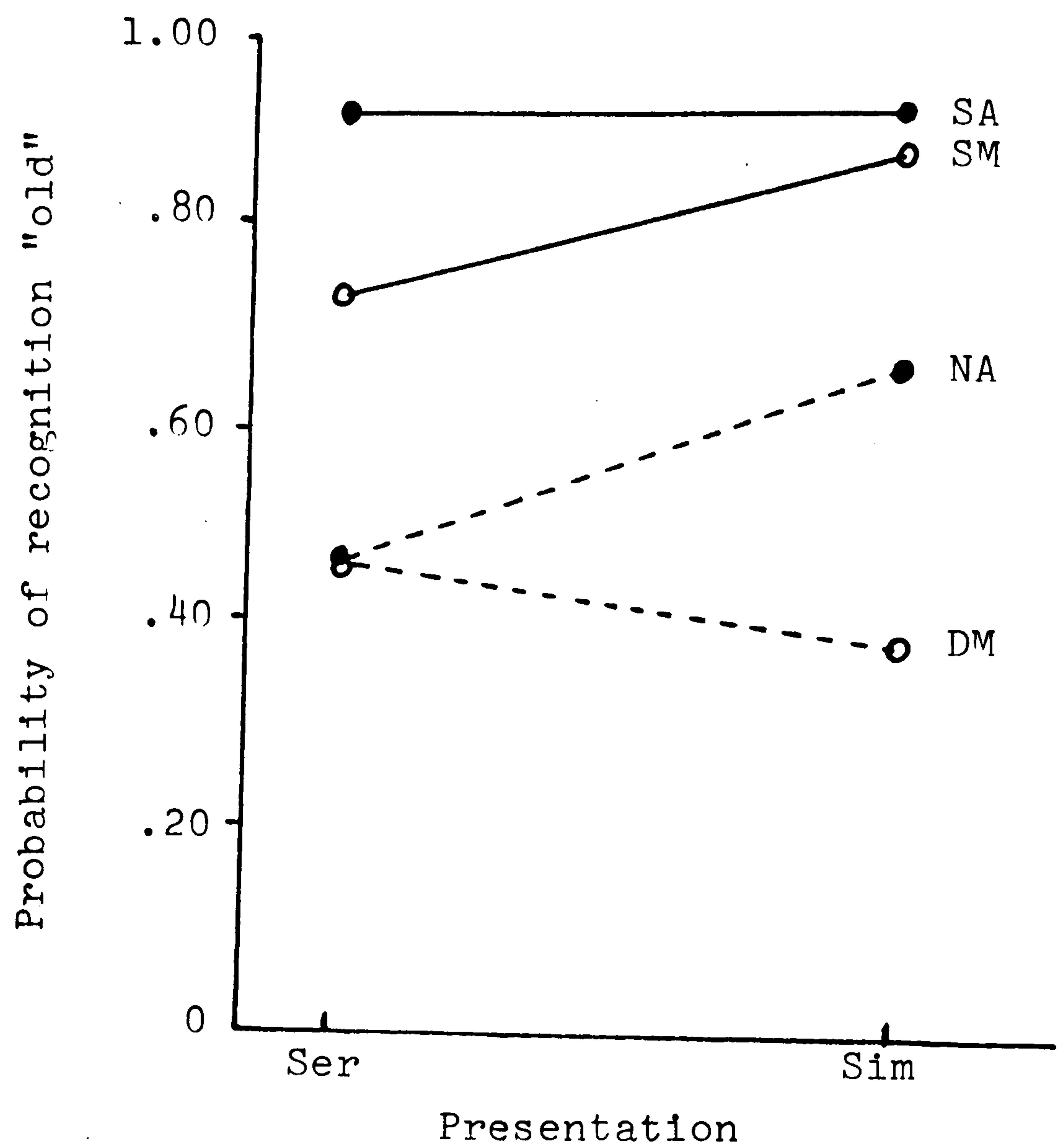


Figure 5-3. Probability of correct recognition of "old" items for mode of presentation x adjective type.

Table 5-5: Mean Prn scores.

		SA	SM	DM	NA	
Ser	BLS	0.90	0.71	0.44	0.46	0.63
	RLS	0.94	0.75	0.48	0.46	0.66
Sim	BLS	0.92	0.83	0.36	0.63	0.68
	RLS	0.96	0.92	0.40	0.71	0.75
		0.93	0.80	0.42	0.56	0.68

Table 5-6: ANOVA summary for Prn.

Source	df	Sum of Squares	Mean Square	F
Between S	23	1.0170	----------	----
Presentation (A)	1	0.1269	0.1269	3.05(*)
List structure (B)	1	0.0527	0.0527	1.27
A x B	1	0.0059	0.0059	0.14
Error	20	0.8315	0.0416	----
Within S	72	4.8678	-------	----
Adjective type (C)	3	3.8116	1.2705	102.75***
A x C	3	0.3052	0.1017	8.23**
B x C	3	0.0020	0.0007	0.05
A x B x C	3	0.0072	0.0024	0.19
Error	60	0.7419	0.0124	----

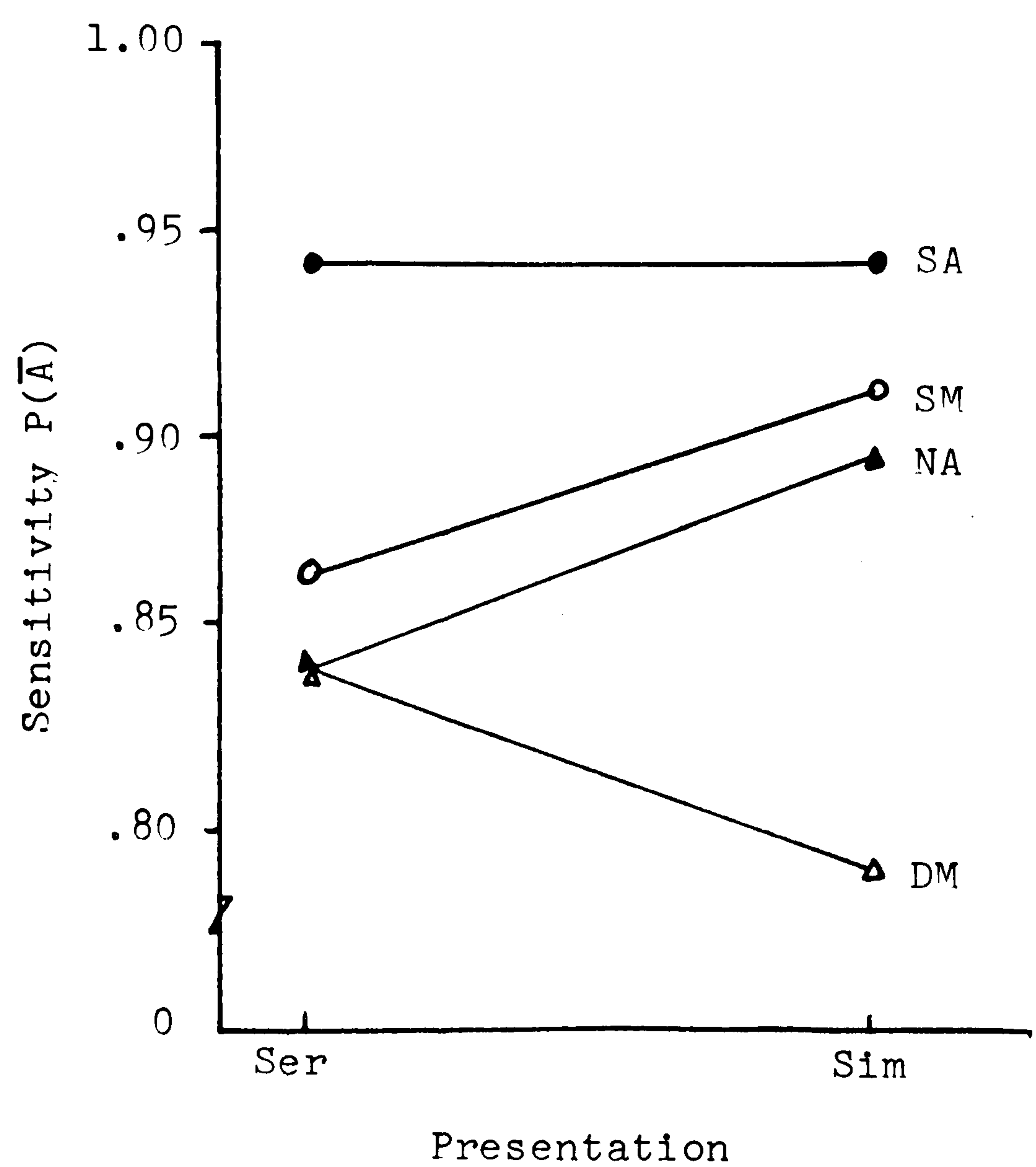


Figure 5-4. P($\bar{A}$) for mode of presentation x adjective type.

Table 5-7: Mean $P(\overline{A})$ scores.

		SA	SM	DM	NA	
Ser	BLS	0.93	0.84	0.83	0.83	0.86
	RLS	0.95	0.88	0.85	0.85	0.88
Sim	BLS	0.94	0.92	0.77	0.87	0.87
	RLS	0.94	0.93	0.80	0.90	0.89
		0.94	0.89	0.81	0.86	0.88

ANOVA are presented in Table 5-8.

RT "old": There was a significant effect of mode of presentation ($F = 85.17$, $p < .001$) with RTs being fastest in the Ser condition, as predicted from the context hypothesis. There was no effect of list structure, per se ($F = 1.58$, $p > .05$), but there was a marginally significant mode of presentation x list structure interaction which is illustrated in Fig. 5-5 ($F = 6.19$, $p < .05$).

There was a significant effect of adjective type ($F = 41.68$, $p < .001$) such that the fastest RTs were for the SA and SM conditions, as predicted, and as can be seen in Fig. 5-6. This figure illustrates the mode of presentation x adjective type interaction ($F = 4.83$, $p < .001$). The list structure x adjective type interaction ($F = 4.75$, $p < .001$) was also significant and is illustrated in Fig. 5-7.

For the mode of presentation x adjective type interaction it can be seen that the greatest difference due to adjective type occurs in the Ser condition. In this condition RTs are fastest for SA and SM and slowest for DM and NA conditions, and there is little difference within these adjective type pairs. In the Sim condition the differences between the pairs (SA, SM vs. DM, NA) is of lesser magnitude, multiple comparisons based on a Newman-Keuls procedure (Kirk, 1968, p. 91) are presented in Table 5-9. An examination of this table indicates the source of the interaction, i.e., Ser differences were large, Sim differences were small and largely insignificant.

The list structure x adjective type interaction is presented in Fig. 5-7 and the multiple comparisons (Newman-

Table 5-8: ANOVA summary table for $P(\bar{A})$.

Source	df	Sum of Squares	Mean Square	F
Between S	23	0.1626	---------	----
Presentation (A)	1	0.0047	0.0047	0.64
List structure (B)	1	0.0128	0.0128	1.77
A x B	1	0.0002	0.0002	0.02
Error	20	0.1449	0.0072	----
Within S	72	0.3889	------	----
Adjective type (C)	3	0.2042	0.0681	34.41***
A x C	3	0.0538	0.0179	8.54***
B x C	3	0.0008	0.0003	0.13
A x B x C	3	0.0015	0.0005	0.24
Error	60	0.1287	0.0021	----

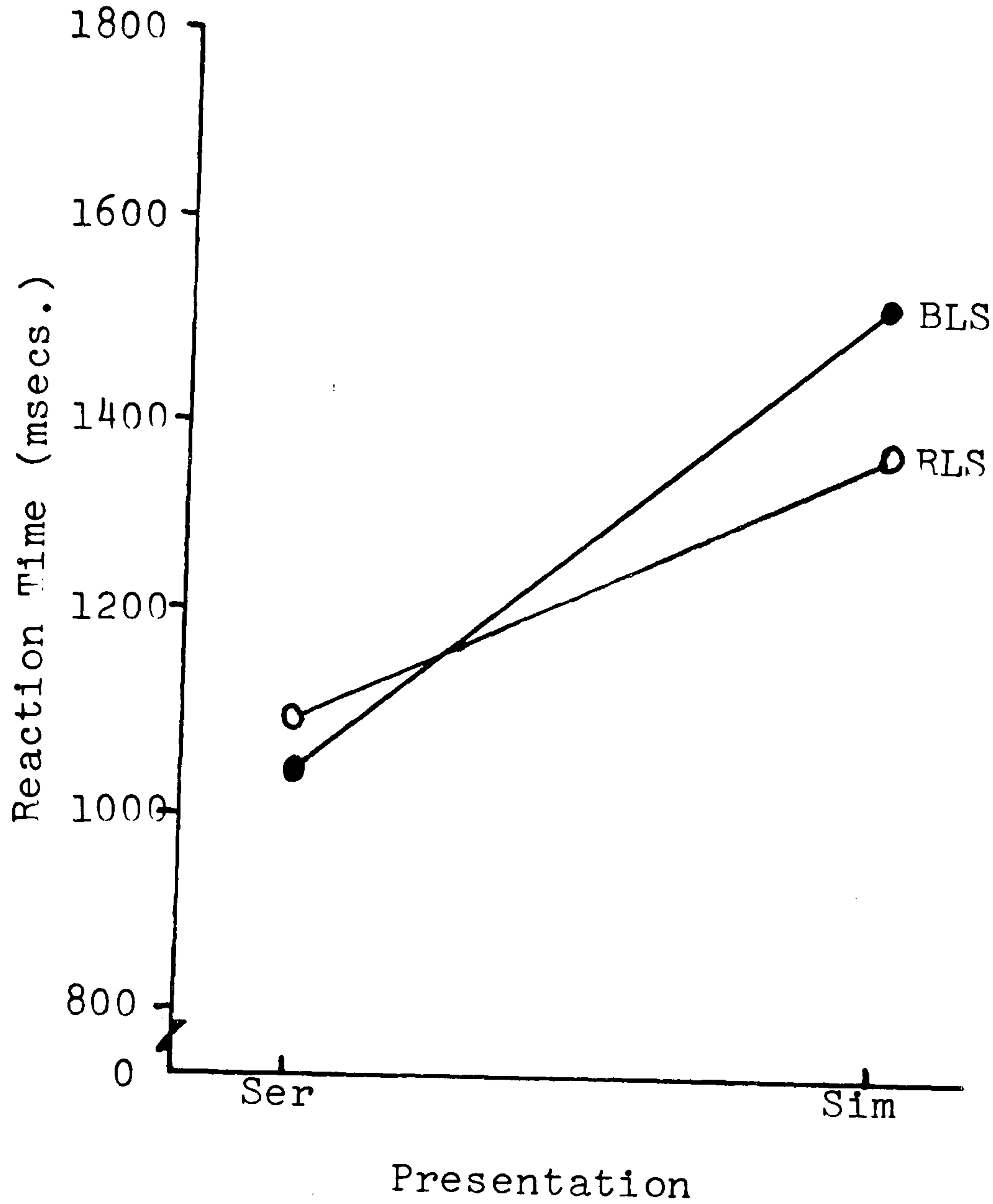


Figure 5-5. RT "old" for mode of presentation x list structure.

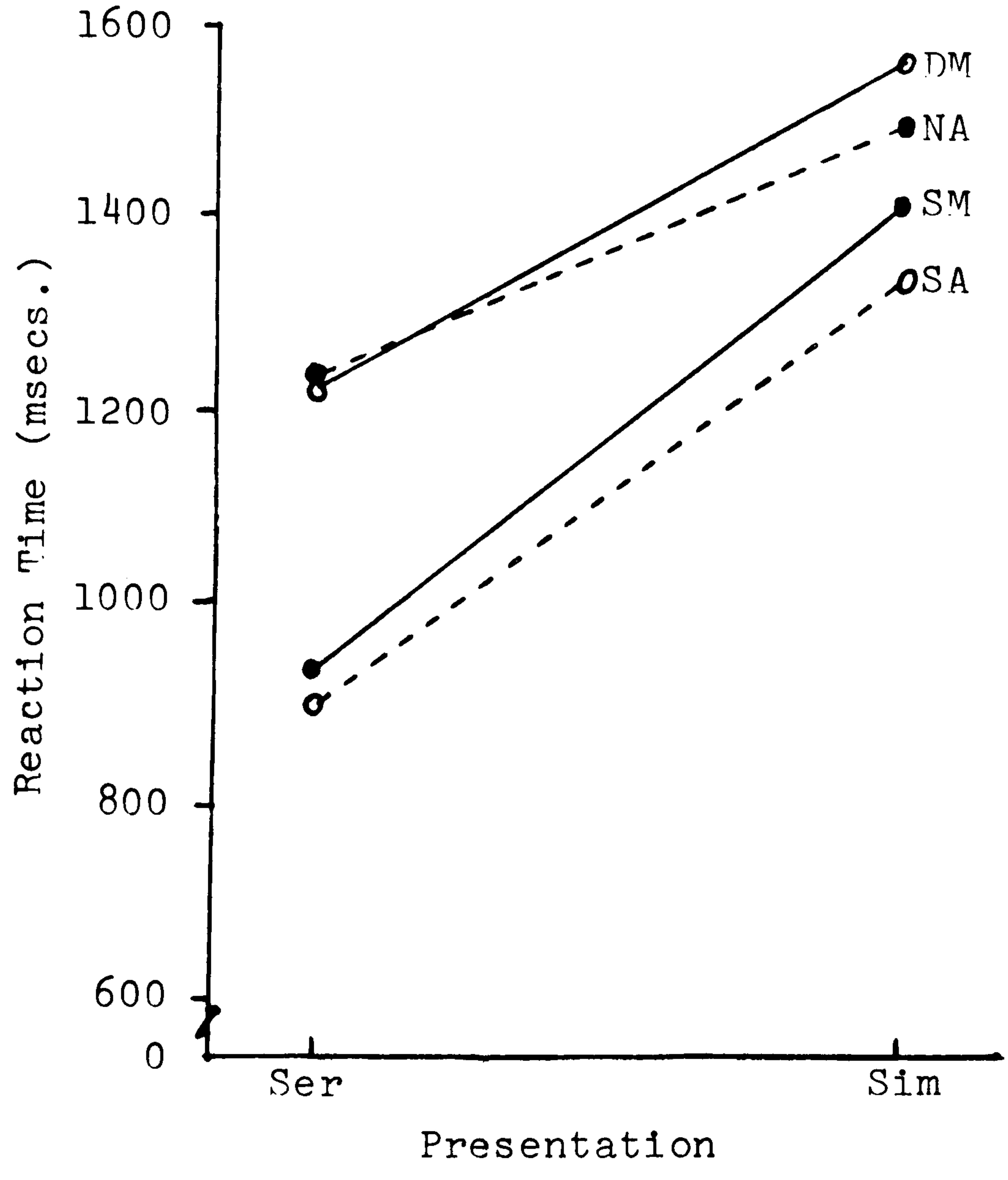


Figure 5-6. RT "old" for mode of presentation x adjective type.

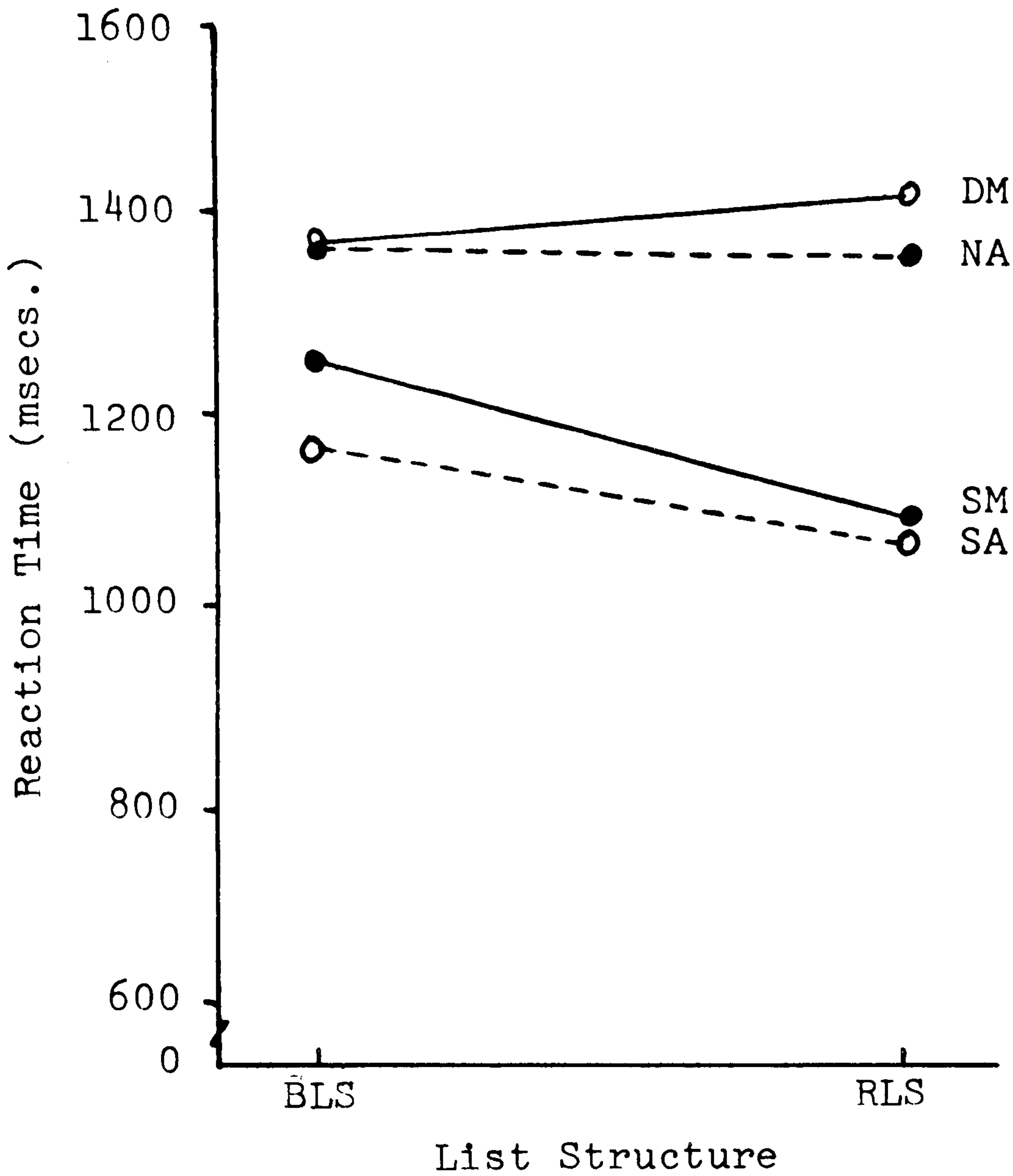


Figure 5-7. RT "old" for list structure x adjective type.

Table 5-9: Multiple comparison using Newman-Keuls procedure with significance level of 0.01 for mode of presentation x adjective type interaction.
* denotes a significant difference for that comparison.

		Comparison							
		1	2	3	4	5	6	7	8
1.	Ser-SA	---	47	328*	344*	444*	520*	609*	675*
2.	Ser-SM		---	281*	297*	397*	473*	562*	628*
3.	Ser-DM			---	16	116	192	281*	347*
4.	Ser-NA				---	100	176	265*	331*
5.	Sim-SA					---	76	165	231*
6.	Sim-SM						---	89	155
7.	Sim-NA							---	66
8.	Sim-DM								---

Keuls) are presented in Table 5-10. As for the previous interaction, the effect appears to be due to the differences centered on the SA - SM levels of adjective type as compared to the DM - NA levels within and between levels of list structure.

The change of context hypothesis (Light & Carter-Sobell, 1970) is sufficient to explain the effects of adjective type in recognition, although it requires an extension to a RT data base, but it is not sufficient to explain the list structure and the mode of presentation effects. The predictions derived from the context hypothesis were that differences between adjective types should be greater with the Sim-BLS combination. In fact, an examination of Fig. 5-6 & 5-7 and a comparison of these figures with Fig. 5-2 shows obtained results which are counter to the context hypothesis. It would appear that there are perhaps at least two sorts of context, an episodic context which is manipulated by changes in mode of presentation and list structure, and a semantic context which leads to faster RTs when encoding variability is relatively low and constrained. Conceivably, the latter could involve processes which are more sensitive to the size of the memory area to be searched. The episodic context referred to above clearly incorporates semantic components at some level, but it is equally clear that the above results are not predicted by the context hypothesis as developed, at least not in sufficient detail of process. The mean RTs to "old" items are presented in Table 5-11, and the results of the ANOVA are presented in Table 5-12.

There was a significant effect of mode of presentation

Table 5-10: Multiple comparison using Newman-Keuls method with significance level of 0.01 for list structure x adjective type interaction.
* denotes a significant difference for that comparison.

Item	Comparison							
	1	2	3	4	5	6	7	8
1. RLS-SA	---	29	95	190	301*	305*	305*	358*
2. RLS-SM		---	66	161	272*	276*	276*	329*
3. BLS-SA			---	95	206	210	210	263*
4. BLS-SM				---	111	115	115	168
5. RLS-NA					---	4	4	57
6. BLS-DM						---	0	53
7. BLS-NA							---	53
8. RLS-DM								---

Table 5-11: Mean RTs "old".

		SA	SM	DM	NA	
Ser	BLS	909	981	1120	1177	1047
	RLS	872	893	1333	1292	1097
Sim	BLS	1410	1527	1619	1561	1529
	RLS	1257	1294	1512	1437	1375
		1112	1174	1396	1367	1262

Table 5-12: Anova summary table for RT "old".

Source	df	Sum of Squares	Mean Square	F
Between S	23	4596591.00	---------	-----
Presentation (A)	1	3466360.00	3466360.00	85.17***
List structure (B)	1	64273.50	64273.50	1.58
A x B	1	251945.10	251945.10	6.19*
Error	20	814012.40	40700.62	-----
Within S	72	2469029.00	----------	-----
Adjective type (C)	3	1420250.60	473416.87	41.61***
A x C	3	164972.90	54990.97	4.83**
B x C	3	162253.90	54084.63	4.75**
A x B x C	3	38833.70	12944.57	1.14
Error	60	682717.90	11378.70	-----

on RTs to "new" items and this is illustrated in Fig. 5-8 ($F = 36.59$, $p < .001$). RTs were faster in the Ser treatment overall. There was no effect of list structure, but there was a mode of presentation x list structure interaction ($F = 12.46$, $p < .005$). The faster RTs occurred in the Ser mode of presentation with a BLS treatment, while the opposite was the case for a Sim mode of presentation. This result will perhaps be more clear after the presentation of the results involving adjective type.

There was a significant effect of adjective type ($F = 24.23$, $p < .001$) with the faster RTs occurring for the DM and NA levels of treatment. In addition, there was a significant mode of presentation x list structure x adjective type interaction ($F = 5.43$, $p < .005$). This interaction is illustrated in Table 5-13. As can be seen in this table, the major differences in RTs to "new" items were for the SA and SM conditions as a function of list structure. The differences were greatest for SA and SM and the RTs were faster, generally, for the DM and NA treatments. Note particularly the relatively long RTs for the RLS condition with a Ser mode of presentation for SA and SM levels of adjective type.

These results are, essentially, the opposite of those for RTs to "old" items which are illustrated in Fig. 5-6. For RTs to "old" items it is argued that increases in encoding variability decrease RTs while, in this case, for RTs to "new" items the opposite appears to be true. However, the "new" items in this experiment are unusual in that, for the SA and SM conditions, the adjective presented is "old". The noun is "new" however, and not coded, and the effect

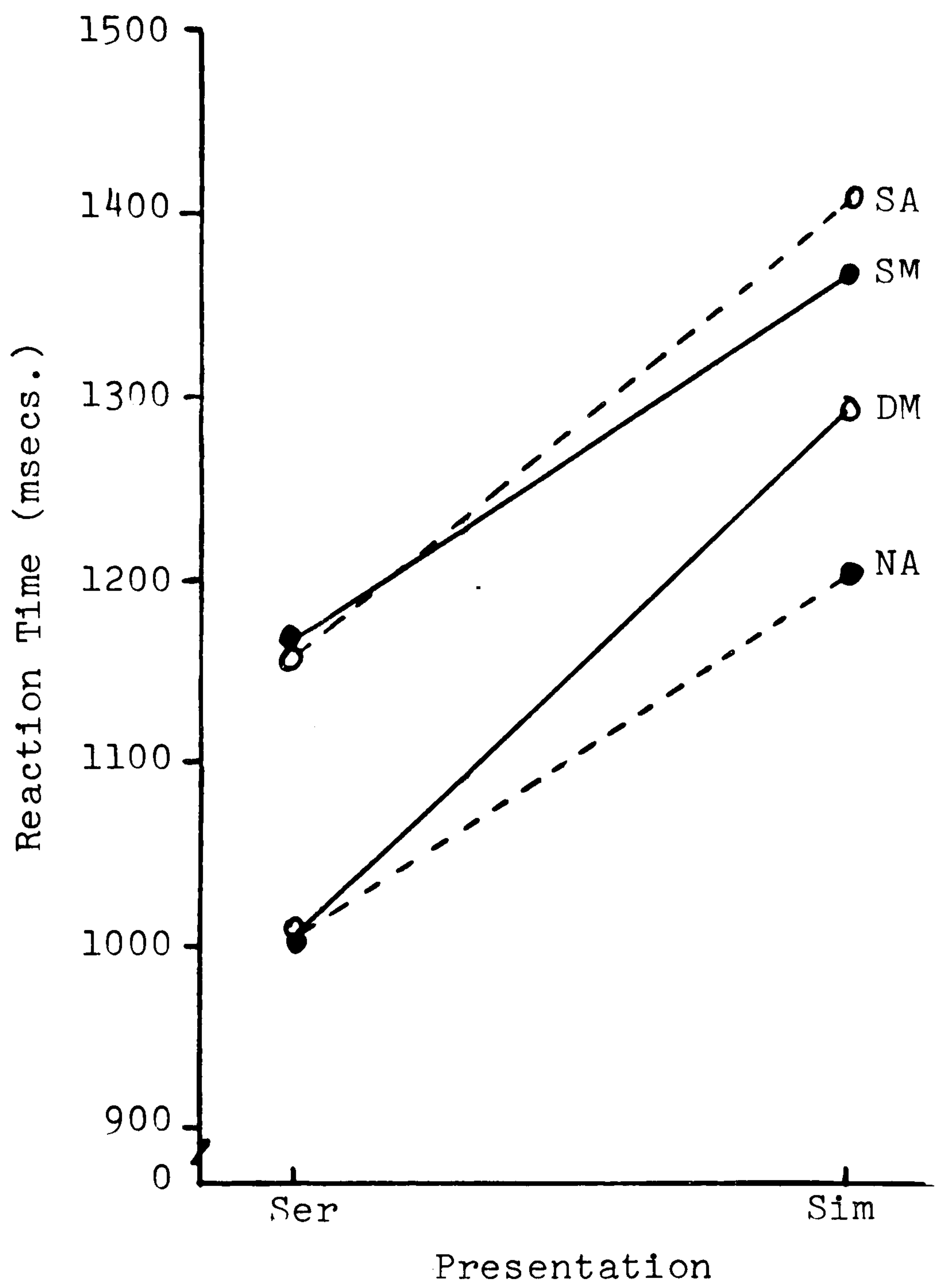


Figure 5-8. RT "new" for mode of presentation x list structure for levels of adjective type.

Table 5-13: Mean RTs "new".

		SA	SM	DM	NA	
Ser	BLS	1057	1044	1000	969	1017
	RLS	1266	1300	1014	1044	1156
Sim	BLS	1500	1475	1348	1242	1391
	RLS	1319	1282	1237	1180	1254
		1285	1275	1150	1109	1205

appears to be one of interference due to "old" adjectives. This is not directly related to the context hypothesis, as developed in this thesis. However, one could presume that a previously encountered meaning, or adjective, would have a higher probability of having some attached occurrence information and thus the likelihood of a search process would be greater for those items, resulting in longer RTs for the SA and SM distractors. The mean RTs for "new" items are presented in Table 5-13 and the results of the ANOVA are reported in Table 5-14.

In summary, the effective presentation time hypothesis does not appear able to adequately explain the results obtained, nor does a dual-process approach. The context hypothesis, as developed in this thesis does predict the major findings and does explain them. It must be pointed out that the context hypothesis is an extension and modification of the change of semantic context hypothesis as proposed by Light & Carter-Sobell, 1970. However, the context hypothesis did lead to predictions which were not supported by the obtained experimental results. The context hypothesis is, consequently, falsifiable in this experimental situation at least. RT was proposed that there are perhaps at least two sorts of context, episodic and semantic, and that the context hypothesis is mainly concerned with the episodic.

DISCUSSION

The effects found for recall and clustering are, for the most part, those one would expect from the literature on organization in free recall. The lack of a significant

Table 5-14: ANOVA summary for RT "new".

Source	df	Sum of Squares	Mean square	F
Between S	23	2525969.20	----------	----
Presentation (A)	1	1338592.70	1338592.70	36.59***
List structure (B)	1	22.10	22.10	0.00
A x B	1	455677.00	455677.00	12.46**
Error	20	731677.40	36583.87	----
Within S	72	1215135.20	----------	----
Adjective type (C)	3	569348.50	189782.83	24.23.***
A X C	3	26845.70	8948.57	1.14
B x C	3	21377.80	7125.93	0.91
A x B x C	3	127676.60	42558.87	5.43**
Error	60	469886.60	7831.44	----

effect of mode of presentation was not predicted, but it must be remembered that only a single acquisition trial was given and this could account for the lack of such an effect.

The change of semantic context hypothesis (Light & Carter-Sobell, 1970) predicts that performance should be better with the SA and Sm conditions than with the DM and NA conditions, and this was the case. This supports the argument that items are encoded with multiple representations or interpretations. Similarly, one could predict that $P(\overline{A})$ should be highest for the SA and SM conditions, and this also was the case.

Neither the effective presentation time hypothesis nor the dual-process approach address the issue of change of semantic context, per se, but they are, in a sense, relevant to the concept of organization (mode of presentation, list structure) effects in recognition memory. The effective presentation time hypothesis would predict that recognition performance should be higher in the Sim and the BLS conditions. In fact, Prn is slightly higher in the Sim condition, but slightly (non-significantly) lower in the BLS condition. This difference due to mode of presentation appears to be a function, at least in part, of the adjective type. The dual-process approach would lead to the prediction that there would be no differential effects of organization variables on recognition performance, but that Prn should be considerably higher for the SA and SM condition since this information would facilitate direct access of the item concerned.

None of the precoding alternative approaches leads to consideration of performance based on an examination of the time to perform a task, and, in a generalization from traditional Prn data to RT data, the predictions derived from the effective presentation time and the dual-process approaches were not confirmed. The predictions from the context hypothesis were that there would be an effect of mode of presentation such that RTs to "old" itmes would be faster for the Ser mode, as they were. This is regarded as support for the hypothesis that encoding variability is higher in this condition and the likelihood of directly accessing an encoded representation is thus relatively high. The opposite (Sim) effect of this is high encoding specif-icity and, consequently, the invoking of a search operation with an increase in the time to respond correctly. Also, the context hypothesis leads to the prediction that RTs will be faster in the RLS condition of list structure, and this was partially the case. In this experiment, the effect of list structure interacted with mode of presentation, but in a manner commensurate with the precepts of the context hypothesis. The difference in RTs due to list structure was very small in the Ser condition of mode of presentation. It is in this mode of presentation that encoding variability is high and appears to be more or less equated across levels of list structure, given a single trial. It was also evident that the constraints on encoding specificity imposed by the adjective modifiers also had an effect and this effect, as one might expect, was most pronounced in the Sim mode of presentation with a BLS level of list structure.

Additional support for the context hypothesis comes from the results of RTs to "new" items. Since these items had not been seen before one would expect them to have no familiarity and hence to be responded to quickly, except for the effects of, for example, a spread of activation. There was an effect of mode of presentation and its interaction with list structure, as well as an effect of adjective type and its interaction with the other variables. In this experiment it was observed that the faster RTs were in the DM and NA conditions of adjective type. The simplest explanation is that there was interference from the adjectives, which had been presented for the SA and SM conditions and that this interference led to longer RTs in these conditions. Consequently, RTs were faster for the DM and NA levels. However, the existence of organizational effects supports the context hypothesis since RTs were fastest in those conditions in which encoding variability was greatest (RLS and Ser).

In summary, the context hypothesis was supported by the obtained presentation effects. An incongruency between the predictions of the context hypothesis and the obtained results was reported and a speculative explanation was offered. Essentially, this explanation was that there are at least two kinds of context and the context hypothesis is most relevant to an episodic-semantic context rather than a semantic context. The latter appears to be more involved in situations involving adjective modifiers but does not, at this point, deal with effect of list structure and mode of presentation. In addition, an interference effect of "old" adjectives or meanings on RTs to "new" items was reported and briefly discussed.

Chapter 6

To this point the results of various experiments have been presented and have been briefly discussed, with particular reference to the context hypothesis and, as alternate hypotheses, the effective presentation time hypothesis and the change of semantic context hypothesis, as developed by Bower, et. al. (1969), and Light & Carter-Sobell (1970), respectively. In addition, an attempt has been made, in the preceding chapters to demonstrate that a dual-process approach, such as that advocated by Kintsch (1968, 1970) is not adequate to explain the results which form the body of this thesis, nor will it explain many of the results of other studies in the literature which deal with the effects of organization on recognition.

The purpose of this chapter is to present a somewhat more detailed discussion of the results obtained from the studies reported in Chapters 2, 3, 4, and 5, and to examine some of the implications of those studies in the light of the context hypothesis. In addition, a more thorough examination of some of the alternative hypotheses will be undertaken. Finally, the conclusions and interpretations from the studies will be discussed.

Before proceeding with further discussion, it must be pointed out that there are many manipulations and treatments which might have had an effect on organization processes in recognition, one of which would have been the ordering and importance of tasks. It is realized that having a recognition before a recall, or no recall, could have had an effect on both recall and recognition performance. However, it is not possible, usually, to study the effects of all possible treatment variables and those studied in this thesis were list structure, practice, mode of presentation, and adjective modification, as well as task instructions.

Change of semantic context hypothesis

Light & Carter-Sobell (1970) reported that when the semantic context in which an item was presented during acquisition was changed for a recognition test, the result was an impairment of recognition performance. This finding was interpreted in terms of an encoding specificity hypothesis. If a set of cues was used during encoding and these cues were changed during recognition testing, then the recency information encoded with the first set could not be accessed as readily. The effect of this was a decrement in recognition performance. This is essentially what Tulving & Thomson (1971) found, and those authors offered a similar interpretation.

In both the Light & Carter-Sobell (1970) and the Tulving & Thomson (1971) studies, the task was similar to a cued recall task in that specific cues were presented during acquisition and systematically varied during recognition testing. The interpretation on the basis of an encoding specificity hypothesis states that only those cues present at time of test which were encoded with an item during acquisition will be effective cues for subsequent retrieval of the item. While it is quite clear from the studies cited above that retrieval plays a role in recognition, it is not clear that this is the general case.

The semantic contexts which were manipulated were not those which have traditionally been directly manipulated in studies of recall and recognition. Thus, the results lack some generality and it would be desirable if these results could be obtained in different situations. This is precisely what has been attempted in this thesis.

The change of semantic context hypothesis described above is not adequate to predict the results one would expect in some other situations and must be extended. The context hypothesis presented in this thesis represents one such extension and its salient points will be developed and contrasted with the change of semantic context hypothesis in this chapter with reference to the results from the studies reported in the preceding chapters.

Light & Carter-Sobell (1970) refer to the encodings of "interpretations", i.e., words may have various 'meanings' which might differ as a function of the semantic context in which they are perceived to occur. Mandler (1967, 1968) in his proposed hierarchical model of memory regarded the meaning of a word as being a function of the position of that word in the hierarchy which was established. The particular encoding of a word specifies its 'meaning' and this encoding is in terms of the perceived semantic context in which the word appears. Similarly, other authors have emphasized the importance of semantic context as a determinant of the meaning of a word (Kintsch, 1970; Norman & Rumelhart, 1970), although these models were developed to explain recall phenomena and not recognition phenomena. The point of this argument is that if the meaning of interpretation of a word is a function of the context in which it is perceived to occur, and if words are encoded in terms of selected attributes (as has been argued earlier in this thesis) then the perceived context will, in large part, determine those attributes which will be selected as the basis for encoding the word.

An additional factor to be considered is the function of what Bower, for one, has termed an 'executive monitor' and which mediates the effect of strategies on acquisition and task performance. Carey & Lockhart (1973) pointed out that a knowledge of the functional task characteristics is important for performance. This point will be discussed in greater detail later in this chapter.

A summary of some of the characteristics, strengths and weaknesses of the major hypotheses or approaches dealt with in this thesis is presented in Table 6-1.

Effective presentation time hypothesis

Bower, et. al. (1969a) investigated the effects of manipulating structural information, i.e., organization, on free recall and on recognition. They found that the effect of increasing the level of relevant structural information was an improvement in both free recall and recognition performances. The recognition data were interpreted in terms of a functional relationship between recognition performance and the effective presentation time for individual items. According to this hypothesis, it takes longer to read a randomly arranged list of words (RLS) than an orderly arranged list of words (BLS), resulting in a shorter effective presentation time for each word in the RLS condition than in the BLS condition. The

<u>Table 6-1</u>: Some characteristics, strengths, and weaknesses of the major hypotheses presented in this thesis.

Model	Characteristics	Strengths & Weaknesses
Context hypothesis	(1) encoding of an item is specific to a perceived context (2) encoding process involves selection of attributes and establishment of attribute vectors as well as production of replicas on each rehearsal/presentation (3) involves different control processes in response to different perceived task requirements (4) uses an Atkinson/Juola familiarity check and list search model	(1) makes specific predictions for recognition RTs (2) illustrates limitations of accuracy measures of performance (3) is vague about which list structures - task requirements will lead to which control processes being used (4) is falsifiable when dealing with more direct semantic memory manipulations (5) specifies an item accessing process in recall (ENTRYSET)
Dual-process approach	(1) recall = search + decision; recognition = direct access - decision (2) a qualitative difference model in terms of process (3) decision process most commonly a single threshold (criterion) process (a GO/NO GO process)	(1) a simple and parsimonious modeling, on the surface (2) vague about how items are accessed, especially in recall (3) represents a general approach rather than a specific model (4) limits role of organization to recall only
Effective presentation time hypothesis	(1) uses assumption that processing efficiency is a function of ease of establishing and using organizational schema (2) implicitly a strength model emphasizing occurrence information	(1) accounts for organization effects in blocked vs. random paradigms (2) vague about processes underlying organization (3) does not specify retrieval/decision processes

effect of this is a reduction in the amount of rehearsal or review an item receives in a RLS condition, relative to that same item in a BLS condition.

The effects one would predict on the basis of this position are that recognition performance would be, in terms of Prn or of sensitivity ($P(\bar{A})$), better in a BLS condition than in a RLS condition and that RTs for "old" items should be faster in the BLS condition, given equivalent overall presentation times for the list. In fact, the results reported for the experiments in this thesis, for the most part, do not support such a hypothesis, rather, the opposite effects were most often found.

Dual-process approach

The basis proposition of this approach is that recall and recognition use different processes. Recall is regarded as, essentially, a search and decision process, while recognition is regarded as involving only a decision process. Recognition is regarded as occurring by the checking of a directly accessed representation of a presented item for recency information and making a decision on the basis of the results of the recency check. A strong dual-process approach will not consider any search processes as being operative in recognition. The position adopted in this thesis is that search processes are a part of recognition, but representations are directly accessed.

Recall and organization

In general, recall and organization (Prl and Cls) were better with a BLS condition and increased as practice increased. These findings are, as mentioned previously, typical of the results reported in the literature, and were not critical for the context hypothesis. However, the context hypothesis does lead to the same predictions and is thus not contraindicated by these results. These results are summarized in Table 6-2.

In the recognition instruction (RI) situation, the effects of list structure on Prl and Cls were more varied, but in a direction which was appropriate, i.e., performance was at least slightly better in the BLS and the 3T conditions. However, an attenuation of these effects was predicted on the basis of Carey & Lockhart (1973) which leads to a consideration of the functional task requirements. In the experiments in this thesis, the task requirement was to learn the items for recall <u>and</u> recognition. One strategy would be to emphasize item information, perhaps via a seriation process, and the results support such an interpretation. The effect of this was an attenuation of organization effects, particularly for Prl. Since the serial order and organization were isomorphic for the BLS condition, there was a significant effect of list structure on Cls, with Cls being better in the BLS condition.

The above pattern of results for Prl and Cls held across all paradigms, with the pattern for the additional information paradigm and adjective modifier paradigm being similar to the other paradigms in the RI situation. These results are presented in Table 6-3 and are summarized in Table 6-2.

<u>Recognition and P($\bar{A}$)</u>

The most consistent effect on recognition and P($\bar{A}$)

Table 6-2: Predictions of various hypotheses for all measures and results obtained, in summary form.

	Context hypothesis	Dual-process approach	Effective presentation time hypothesis	General results
Recall	3T > 1T BLS > RLS Sim > Ser	3T > 1T BLS > RLS Sim > Ser	3T > 1T BLS > RLS Sim > Ser	3T > 1T BLS > RLS equivocal
Organization	3T > 1T BLS > RLS Sim > Ser	3T > 1T BLS > RLS Sim > Ser	3T > 1T BLS > RLS Sim > Ser	3T > 1T BLS > RLS equivocal
Recognition (Prn)	3T > 1T BLS ≥ RLS Sim ≥ Ser	3T > 1T BLS = RLS Sim = Ser	3T > 1T BLS > RLS Sim > Ser	3T > 1T BLS ≤ RLS Sim ≥ Ser
Recognition $P(\bar{A})$	3T > 1T BLS ≥ RLS Sim ≥ Ser	3T > 1T BLS = RLS Sim = Ser	3T > 1T BLS > RLS Sim > Ser	3T > 1T equivocal equivocal
RT "old"	3T < 1T BLS > RLS Sim > Ser	3T < 1T BLS = RLS Sim = Ser	3T < 1T BLS < RLS Sim < Ser	3T < 1T BLS > RLS Sim > Ser
RT "new"	3T < 1T BLS ≤ RLS Sim ≤ Ser	3T < 1T BLS = RLS Sim = Ser	3T < 1T BLS < RLS Sim < Ser	3T < 1T equivocal Sim ≤ Ser

Table 6-3: Mean Prl and Cls for treatment levels for NRI and RI situations, for all paradigms.

			Nested hierarchy		Categorized list		Additional information	Adjective modifier
			Prl		Prl		Prl	Prl
			NRI	RI	NRI	RI	RI	RI
Ser	BLS	1T	.72	.75	.59	.78	.74	.68
		3T	.96	.80	.95	.85	.92	
	RLS	1T	.63	.69	.40	.59	.71	.61
		3T	.85	.84	.77	.78	.78	
Sim	BLS	1T	.68	.77	.47	.69	.65	.75
		3T	.97	.95	.87	.98	.94	
	RLS	1T	.54	.77	.39	.65	.60	.58
		3T	.82	.83	.76	.93	.75	
			Cls		Cls		Cls	Cls
Ser	BLS	1T	.54	.57	.69	.59	.52	.78
		3T	.89	.54	.97	.70	.62	
	RLS	1T	.21	.32	.25	.22	.38	.58
		3T	.33	.40	.55	.43	.32	
Sim	BLS	1T	.57	.63	.54	.57	.45	.81
		3T	.74	.61	.99	.85	.60	
	RLS	1T	.33	.64	.32	.48	.27	.62
		3T	.23	.40	.50	.36	.31	

was that of practice, with both Prn and P($\bar{A}$)increasing as level of practice increased. In those situations in which there was a significant effect of list structure on Prn or P($\bar{A}$), the effect was such that performance was better in the BLS condition, not as predicted from the change of semantic context hypothesis or the context hypothesis which predicted slightly better performance in the RLS condition, if there were any difference at all. The major prediction was that Prn and P($\bar{A}$) would be particularly sensitive to factors influencing item information, per se, and thus should show effects of practice, as was the case for the NRI situation.

For the RI situation, the significant effects of list structure on Prn and P($\bar{A}$) were such that performance was better in the RLS condition, as predicted by the change of semantic context hypothesis and the context hypothesis. In the RI situation, the effect of practice was as for the NRI situation; increased practice facilitated Prn and P($\bar{A}$). These results are presented in Table 6-4 and are summarized in Table 6-2.

Reaction time

The prediction of the context hypothesis was that as encoding variability increased, RTs should be faster. Therefore, RTs should be faster in the BLS condition and in the 3T condition. Also, RTs should be faster with a Ser mode of presentation. These predictions are for RTs to "old" items. For RTs to "new" items, it was predicted that the major factor would be practice and RTs would, in this case, decrease as practice increased.

Table 6-4: Mean Prn and $P(\bar{A})$ for treatment levels for NRI and RI situations, for all paradigms.

			Nested hierarchy		Categorized list		Additional information	Adjective modifier			
			Prn		Prn		Prn		Prn (RI)		
			NRI	RI	NRI	RI	(RI)	SA	SM	DM	NA
Ser	BLS	1T	.81	.91	.85	.95	.83	.90	.71	.44	.46
		3T	.97	.91	.93	.94	.95				
	RLS	1T	.82	.91	.88	.81	.88	.94	.75	.48	.46
		3T	.98	.96	.92	.98	.93				
Sim	BLS	1T	.83	.89	.74	.86	.89	.92	.83	.36	.63
		3T	.91	.97	.87	.93	.83				
	RLS	1T	.79	.92	.81	.97	.95	.96	.92	.40	.71
		3T									
			$P(\bar{A})$		$P(\bar{A})$				$P(\bar{A})$		
Ser	BLS	1T	.84	.96	.92	.97	.93	.93	.84	.83	.83
		3T	.99	.95	.98	.98	.98				
	RLS	1T	.82	.96	.92	.90	.95	.95	.88	.85	.84
		3T	.96	.98	.97	.99	.98				
Sim	BLS	1T	.85	.95	.85	.94	.95	.94	.92	.77	.87
		3T	.97	.97	.96	.97	.95				
	RLS	1T	.75	.96	.89	.97	.94	.94	.93	.80	.90
		3T	.93	.98	.96	.99	.97				

These were, in fact, the results which were obtained. In addition, it was predicted that when the subjects were aware of the recognition requirement prior to acquisition, there would be an attenuation of list structure or organization differences with overall faster RTs for "old" items. Again, this was the situation for the general case. These results are presented in Table 6-5 and are summarized in Table 6-2.

As was mentioned in the preceding chapters a dual-process approach is not adequate to handle the results obtained in this thesis. However, the change of semantic context hypothesis and the effective presentation time hypothesis do make predictions which must be considered. For recall and organization, the effective presentation time hypothesis leads to the prediction of better performance in the BLS condition and in the 3T condition. These were the results which were obtained. However, the effective presentation time hypothesis also leads to the prediction of superior Prn and $P(\bar{A})$ in the BLS and 3T conditions. Performance on these measures was better for the 3T condition, but the results of the list structure manipulation are not so clear. In those cases where significant differences were obtained, Prn performance was better for the BLS condition with a Ser presentation and for the RLS condition with a Sim presentation. For $P(\bar{A})$ the opposite appears to be the rule. However, these results are ambiguous since Prn and $P(\bar{A})$ appear to be principally determined by item occurrence information and are thus more sensitive to effect of practice. This is also an argument presented in this

Table 6-5: Mean RT "old" and RT "new" for treatment levels for NRI and RI situations, for all paradigms.

			Nested hierarchy RT "old"		Categorized list RT "old"		Additional information RT "old"	Adjective modifier RT "old" (RI)			
			NRI	RI	NRI	RI	RI	SA	SM	DM	NA
Ser	BLS	1T	1080	1086	989	877	1022	909	981	1120	1177
		3T	1200	859	841	921	860				
	RLS	1T	1315	897	1368	775	847	872	893	1333	1292
		3T	913	775	770	828	819				
Sim	BLS	1T	1515	916	1485	974	886	1410	1527	1619	1561
		3T	1127	1007	1446	859	871				
	RLS	1T	1383	796	1286	828	768	1527	1294	1512	1437
		3T	894	801	1191	824	774				
			RT "new"		RT "new"		RT "new"	RT "new"			
Ser	BLS	1T	1319	1157	1261	961	1046	1057	1044	1000	969
		3T	1138	826	842	938	933				
	RLS	1T	1485	959	1505	930	881	1266	1300	1014	1044
		3T	1032	767	915	872	807				
Sim	BLS	1T	1501	1070	1543	961	949	1500	1475	1348	1242
		3T	1019	839	1378	831	896				
	RLS	1T	1511	892	1565	869	933	1319	1282	1237	1180
		3T	894	893	1240	851	856				

thesis and central to it: accuracy measures are not adequate to explain the effects of organization on recall and recognition and, in fact, lead to ambiguity of results and interpretation. This said, it must be pointed out however, that the change of semantic context hypothesis leads to the prediction of superior Prn performance in the RLS condition, as does the context hypothesis.

The crucial measure in this thesis to distinguish between the various hypotheses is the RT measure. In most conditions, within and between paradigms, RTs to "old" items were, as predicted from the context hypothesis, faster in the RLS condition. If, as one would expect from the effective presentation time hypothesis, learning was superior in the BLS condition, and so was Prn, then one would also expect that RTs would be faster in the BLS condition, and this was not the case. The conclusion is that the effective presentation time hypothesis was not supported by the results overall, and the context hypothesis was, in those situations where there were differential predictions.

The change of semantic context hypothesis deals with changes in semantic context between acquisition and recognition test. The context hypothesis deals with a more general case of the effect of organization, and other, effects on encoding variability and the subsequent effects of this on recall and recognition performance as measured by RTs.

Additionally, the notion of a change in semantic context is very cumbersome in the experimental situations used in this thesis. The order of items was identical for Ser and Sim modes of presentation and the items were the same for the lists within each paradigm, thus, the question of how one would attribute any differences obtained to changes in semantic context emerges. Also, in the adjective modifier experiment, there were effects of adjective type which were as predicted by the change of semantic context hypothesis, but there were also interaction effects which are interpretable from a context hypothesis, and not so easily from a change of semantic context hypothesis.

It is relatively easy to discern a possible change in the way in which information is processed, since with a Sim presentation all the information is presented concurrently, while with a Ser presentation, the subject must rely on memory for previous items during rehearsal, and there is a limit on the capacity of immediate memory. It must however be stressed that all the information which was potentially available to the subjects, was identical and the only way in which it differed was the presentation. It would appear more reasonable, as well as parsimonious, to assume that it is not the role of semantic context, per se, which is important in determining recognition performance, but it is the way in which the information is processed which is important. Control processes are vitally important not only for recall performance, but for recognition performance as well. Anything which affects the selection and utilization of control processes, e.g., instructions, will have an effect on recall, recognition, or both. This is a point made by Atkinson & Juola (1972) and by Atkinson & Shiffrin (1968). In those studies, control processes were assigned central roles in remembering and recognizing.

The effect of the various manipulations was, as mentioned previously, in most cases that RTs were longer in the BLS condition and decreased as level of practice increased. In the two cases in which RTs were longer in the RLS condition, the paradigms were those for a categorized list and the presentation mode was Ser. Both of these factors are regarded as being associated with an emphasis on processing of occurrence information because, in these situations, organization information is difficult to identify, i.e., attention is focussed on occurrence or item information and the result is a high level of encoding variability. Also, the categorized list paradigm was regarded by Bower, et. al. (1969a) as a weak manipulation of organization factors.

Differences in Rts to "old" items for (a) BLS minus RLS levels of list structure, and (b) Sim minus Ser levels of mode of presentation are presented in Table 6-6. Positive values demonstrate support for the context hypothesis and negative values indicate a lack of support. An examination of this table indicates, for the most part, the context hypothesis was supported by the obtained results. A more detailed discussion of each result has already been presented in the relevant chapters.

The sources which did not indicate support for the context hypothesis were the differences between BLS and RLS in both the nested hierarchy and categorized list paradigms in the Ser-1T treatment combination under conditions in which subjects were not informed of the recognition task until they had completed the recall task (no

Table 6-6: Differences in RTs to "old" items for (a) BLS-RLS levels of list structure, and (b) Sim-Ser levels of mode of presentation, for experiments presented in this thesis.

		Nested hierarchy paradigm		Categorized list paradigm		Additional structure information paradigm (RI)	Adjective modifier paradigm (RI)			
		NRI	RI	NRI	RI		SA	SM	DM	NA
	(a)									
Ser	1T	-235	+189	-379	+102	+175	+ 37	+ 88	-213	-115
	3T	+287	+ 84	+ 70	+ 93	+ 41				
Sim	1T	+132	+120	+199	+146	+118	-117	+233	+107	+124
	3T	+233	+206	+255	+ 35	+ 97				
Sim-Ser (b)		+103	- 24	+360	+ 22	- 62	+443	+474	+339	+264

recognition instructions - NRI). The effective presentation time hypothesis is supported by these results. However, this is not true for the 3T level of practice and for the overall BLS - RLS difference. For the latter situations, the predictions derived from the context hypothesis received support. In all other conditions, but those noted above, for the nested hierarchy, categorized list and additional structure information paradigms, the RT differences were in a direction, for BLS - RLS, consistent with the predictions of the context hypothesis.

The adjective modifier paradigm presented a slightly different and more complex picture. It was in this paradigm that the context hypothesis was shown to be falsifiable and it was proposed that, apparently, at least two sorts of context, an episodic and a semantic, were involved. Also, the adjectives themselves are presumably processed and this can lead to interference sorts of effects which account for the negative BLS - RLS differences in the Ser treatment with the DM and NA conditions of adjective modification. The negative difference obtained in the Sim treatment was not significant.

The predictions for RTs to "old" items for mode of presentation which was derived from the context hypothesis, was that RTs should be faster in the Ser mode of presentation. This was the generally obtained result. In the recognition instruction (RI) versions of the nested hierarchy and categorized list paradigms, the differences were small, including the negative one, and are regarded as demonstrating the attenuation of differences under the RI level of instructions. This essentially supports the position presented by Carey & Lockhart (1973). The RT "old" and "new" results are summarized in Table 6-5.

Control processes

One basic conclusion which can be drawn from this thesis is that control processes, such as those illustrated in the model of the context hypothesis (Fig. 1-2), are very important and that these control processes, in terms of memory tasks, are all based on a principle of organization of material for subsequent use. The particular encoding or organization varies as a function of the perceived requirements of the task, and a knowledge of the functional retrieval requirements modifies the way in which the material is processed by altering the selection of, and emphasis on, particular control processes.

One effect which is mediated by the operation of control processes is the degree of encoding specificity or variability which is evident. Encoding specificity and variability are really two ends of a single continuum related to the number of attributes which are used to encode an item. To the extent that a subject uses relatively few attributes to encode an item, the encoding will be considered to be highly specific, and will become more variable as the number of attributes, and hence the number of possible interpretations increases.

Control processes determine which type of organization is to be developed and to what degree. Organization may be based on the semantic and other properties of the words or may be based on the position of the word within a list, or both. In the RI situation, the effect of instructions leads to an emphasis on occurrence information or seriation and biases a selection of control processes aimed at obtaining and using this information to a greater degree than semantic information.

The seriation process described by Mandler & Dean (1969) is one such process regarded as a control process function, which is aimed at processing item position information primarily. A second process which operates in conjunction with the seriation process is an attribute selection process. In this situation, only enough attributes need be encoded so the subject can identify the word as a list item. The action of this process is to access the presented items in long-term or semantic memory and tag those attributes regarded as being necessary or useful for subsequent recall or recognition of the item.

In the RI situation, the effect of semantic bias is relatively small since there is an emphasis on the items, per se, and the control process is regarded as acting to select several different attributes relating to several interpretations. The spread of activation is greater as there is no semantic bias operative to constrain this process. Additionally, there is a greater degree of variability in the Sim and the BLS conditions for the RI situation. In the NRI situation, the control process operates to select those attributes which define an item in terms of other list items, in so far as that is possible, consequently, there are more constraints, particularly in the Sim and BLS conditions, which act to promote a greater encoding specificity.

Rehearsal operations are basically control processes.

These control processes select information for use in maintaining items in memory and transferring them to a more permanent store. In addition, control processes determine the structural form of this more permanent store and also, to a degree, the level of transcience of this store.

The effect of altering the degree of encoding variability through altering the selection of number and type of attributes is twofold. First, there is a type of cognitive economy in using few attributes and recall is not affected to any great extent provided the subject has adequate 'starting points' or, in terms used by Anderson & Bower (1973), ENTRYSET items. One effect of seriation as a basis for encoding is that the ENTRYSET is not perhaps as well defined as it might be in a more systematic organization, i.e., there tend to be fewer points in the ENTRYSET than if it had been established on a less rigidly linear basis. Consequently, recall tends to be somewhat poorer. The drawback to highly specific encoding seems to occur in tests of recognition memory in which case familiarity value seems to be important, regardless of the encoding scheme. The second aspect of altering the level of encoding variability is related to the notion of familiarity. If familiarity is a function not only of the items accessed at the time of recognition test, but also of the number of attributes, and hence the number of interpretations, then recognition will improve as encoding variability increases and this is illustrated in the results reported in this thesis. In situations in which one would expect highly variable encoding, both Prn and RT "old" performances are superior to a situation in which one would expect highly specific encoding.

During recognition testing, a control process, or processes, operates so as to access a representation of the presented item and check that item for occurrence tags. To the extent that several interpretations of the item have been accessed previously, during acquisition or rehearsal, for purposes of encoding and establishing a memory structure, then the probability of the accessed item being an encoded representation is quite high. Consequently, the RT should be fast, since the probability of performance of a search is relatively low. Similarly, items which have been accessed several times, with several alternative interpretations being used, would tend to be highly discriminable from non-accessed items, consequently, recognition performance should be high for those items.

Mandler (1967, 1968) proposed that memory structures established during acquisition would be transient and would outlast the experimental situation by a relatively short time. Tulving (1972) in discussing the semantic-episodic memory distinction states that the semantic and episodic systems interact and that information in semantic memory is used, or may be used, by the episodic system, but the reverse is not as likely. Thus, any episodic situation is likely to be transient. In this sense, a strategy used to establish a hierarchy or network in the episodic system is likely to be transient and unless it is compatible with the requirements of subsequent tasks it will tend to act as an interference source. This is illustrated by the fact that while the differences in Prn and RTs to "old" items were in the same direction on the NRI experiments, and the RI experiments, there was an attenuation of effect with RTs being faster and Prn higher in the RI situation. In other words, the structure established in memory for the NRI situation tended to be ineffective for recognition, while that established in the RI situation tended to be effective for both recall and recognition. The memory structures, per se, are not critical for recognition, but the processes involved in establishing and developing the structures leave their mark in long-term memory and lead to differences in recognition performance. The actual transient memory structure becomes important only when a search of memory is undertaken.

An analogy which might serve to clarify the preceding discussion is that of a draftsman's sketch pad of worksheet. The draftsman's worksheet at first contains bits of information regarded as useful and which are perceived as forming the basis of the desired end product. In other words, aspects of the data base (the draftsman's knowledge and experience) are placed on the worksheet after having been selected as pertinent. From this point the draftsman can either elaborate the design by adding more detail or he can simplify the design by removing superfluous detail. If the desired output is a layout including many different possible designs from a common base, then the draftsman will tend to add many details and show different views or combinations and interpretations of the basic elements.

If, on the other hand, the end product is to be a coherent single structure which serves a limited purpose, the draftsman will tend to either not include superfluous detail or not add additional detail except where necessary for the purpose of the design. If the draftsman is regarded as working with a computer interface, then the data base will be a permanent repository of information, but the worksheet will be a temporary workspace from which the information can be transferred to permanent store only if necessary or desired, or it can be erased or allowed to decay once its usefulness is over. One additional point is that the draftsman will keep a record of what details he has accessed from the permanent store and may use this information to determine if he has either seen, or produced similar designs before in a given context.

In summary, the results reported in this thesis do, for the most part, support the context hypothesis which was developed in Chapter 1. Aspects of the reported data provided support for the alternative hypotheses, but neither could produce the range of explanation the context hypothesis did. The change of semantic context hypothesis comes closest and this is reasonable, since the context hypothesis is an extension and modification of this hypothesis. The direction of the extension and the modification extend the context hypothesis' range to cover recall as well as recognition.

In addition, it was proposed that the categorized list paradigm was a weak paradigm, and this was also indicated by the results reported in this thesis. A more important point is, however, that accuracy measures such as Prn and $P(\bar{A})$ are not adequate to permit a full exploration of the effects of organizational processes on recall <u>and</u> recognition. While the context hypothesis is far from perfect, it did do a reasonable job of predicting relevant effects and of explaining those which were not predicted without requiring extensive modifications of the model, and with only reasonable assumptions having to be made about the strategy underlying, for example, list acquisition and structure interfaces.

<u>Omissions and implications</u>

There are some omissions in the experiments conducted as well as in the variables investigated. For example, the additional information paradigm was run only in the RI situation. Furthermore, the additional information supplied was always relevant and the subjects had some choice in the degree of attention they paid to this additional information. Of the variables which could have been investigated, one which has been mentioned, has been the presence of a recall task, either before recognition, as was the case for the studies in this thesis, or after the recognition task. There are many other potential manipulations which could be made and which would be expected to differentially affect recognition processes, but it would be impossible to conduct all possible experiments so a choice was made to manipulate the variables which were manipulated in the thesis.

One additional measure which might have proved useful would have been a rating by the subject of the degree of certainty of his or her responses. This would have supplemented the P($\bar{A}$) measure and would have provided additional information which conceivably would have made it possible to explore criterion effects. Such a measure was obtained in a pilot study, but the amount of variation due to individual differences as well as the very strong tendency for the subjects to polarize their responses led to the decision not to include such a measure at this time.

The results reported in this thesis point to several implications for the study of semantic memory generally. The importance of control processes pointed out by Atkinson & Shiffrin (1968) was reasserted, as was the way in which control processes operated to mediate the levels of encoding specificity. A model such as that proposed by Collins & Quillian (1969) has several drawbacks, one of which is that all the attributes associated with an item are, by implication at least, equally accessible at any given level and no distinction is drawn between the relative importance of different types of attribute.

A more recent approach by Smith, Rips & Shoben (1974) has emphasized the concept of 'typicality' as being a principal determinant of recognition differences such as those reported by, among others, Collins & Quillian (1969). However, an examination of the concept of typicality indicates that as items become more typical of a category, the constraints upon the number of alternative interpretations increase and the items are more rigidly defined and by a smaller pool of attributes. Again, the number of attributes used to define an item appears to be related to performance, this time in a semantic memory situation. This is a point which is worth more consideration than it has received.

According to the context hypothesis, any operation which constrains the interpretations which may be placed on an item or items during acquisition operates so as to increase encoding specificity with the result that recall will tend to be quite good, but recognition will not be as good, particularly as measured in terms of RTs. When there is no time stressor, or measure, performance may not differ overall as a function of list structure or other organizational variables.

The basic implication of the context hypothesis for a more general theory of semantic memory is that it is not necessary, nor even desirable, to separate recall and recognition processes since they share so many common features and interact. Rather, it is important to examine the ways in which instructions, organization, and other variables may affect control processes and to examine the ways in which various control process operations might produce differential task effects, using the same information. It is perhaps important to ask what we know about knowing and doing and the context hypothesis has been one way of doing this.

Conclusions

The results of the experiments reported in this thesis support the context hypothesis as presented in Chapter 1. It is obvious that a dual-process approach cannot be defended, at least not in a strong form as it is not adequate to explain the results obtained. Similarly, the change of semantic context hypothesis is not adequate to explain all the results of this thesis. This hypothesis does not, as it was presented, address the issue of organization effects nor does it address the issue of differential effects of recall and recognition. Additionally, it will not explain the effects of recognition instructions. The context hypothesis developed in this thesis incorporates the notion of interpretations and their effect on recognition and expands this to take account of search operations and discriminability effects of organization and list structure. In addition, it was demonstrated that semantic context can be manipulated via manipulations of list structure.

A principal point made in the change of semantic context hypothesis was that the semantic context acts to reduce the range of interpretations which are encoded. This has not been developed in the current literature and one of the purposes of the development of the context hypothesis was to extend this notion.

The effective presentation time hypothesis clearly was not adequate to handle the RT results, nor the Prn results, since a consideration of this hypothesis leads to the prediction of better performance in the BLS condition, and this was not the case. The effective presentation time hypothesis does handle the recall results, but so does the context hypothesis. However, the context hypothesis does have some inherent weaknesses such as its inability to predict accurately, beforehand, all the categorized list results, and its reliance on a somewhat vague set of assumptions about the nature of the functional task requirements.

The recognition model proposed by Atkinson & Juola (1972) serves to describe the recognition process and to point to some of the parmeters involved as well as to some of the ways in which they can be manipulated, but little can be said about the acquisition process on that basis. Similarly, a hierarchical model such as that proposed by Mandler (1967) is adequate to account for variations in specificity of encoding in terms of differences in numbers of chunks and the integrity of the chunks, but is somewhat limited in direct applicability to recognition processes as well as in its ability to predict effects of various organization strategies on both recall and recognition.

The context hypothesis states that any operation which increases the degree of encoding variability during acquisition will tend to result in lower recall levels and in higher recognition performance levels. However, the properties of the task must be taken into consideration. Tasks in which serial processing is relatively easy will differ from tasks in which seriation is difficult or not as effective and in which some other strategy might be preferred, such as with a nested hierarchy. Recognition is regarded as a process in which a test item is accessed and the accessed representation checked for recency information or familiarity. The greater the number of encoded representations there are, the less the likelihood of a search process and the faster the RTs and the better the Prn.

The major processes which have been repeatedly emphasized in this thesis are those of selection and encoding of attributes and the action of control processes to these ends. These processes form central tenets of other theories such as Light & Carter-Sobell's (1970) change of semantic context hypothesis but, for the most part, there is an apparent dearth of literature in which the various components have been combined so as to provide a model of recall and recognition memory which predicts the differential effects found and details a plausible and reasonable explanation and theoretical framework to account for the effects.

The way in which these processes are integrated is through the action of control processes which may be selected by the subject to accomplish the perceived task. The attribute selection and encoding process may be biased in a number of ways, depending on the perceived task requirments and characteristics, from the subject's point of view, and on the knowledge and experience the subject can bring to bear on the functional retrieval characteristics of the task. The selection process is viewed as a strategy-based process.

The level of encoding specificity is, in turn, a function of the emphasis placed on either occurrence (item) information or organization (semantic) information and the ease with which each type of information can be discovered and used. There is also an operative organizational process which establishes a transient memory structure and derives the elements of this structure from semantic memory. Marks of the selection process are left in semantic memory and these marks may be used in recognition tests.

The differences between recall and recognition are not completely qualitiative and can both be affected by strategies and type of organization schema used, as has been repeatedly demonstrated in this thesis.

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