INFLUENCES OF NOISE AND TIME OF DAY ON MEMORY STRATEGIES IN RECALL AND RECOGNITION

A thesis submitted to the University of London for the degree of Doctor of Philosophy

by

ELSE KRISTIN LEWIS

Bedford College,

May 1981

ABSTRACT

This thesis is concerned with influences of noise and time of day on test expectations in recall and recognition.

In Chapter 1 the similarities and differences between recall and recognition memory are discussed, while the literature on noise and time of day is reviewed in Chapter 2. In the following chapters relevant information from the memory and arousal area are combined to form a theoretical and experimental framework.

The first four studies examine recall and recognition performance following recall and recognition instructions. It was found that recall-instructed subjects produced a significantly larger primacy effect than recognition-instructed subjects on tests of ordered and free recall (Experiment 1 and 2).

The results of the two subsequent experiments suggest this is mediated by differences occurring at input, and is due to increased rehearsal by subjects expecting a recall test.

In Experiments 5 and 6 time of day was manipulated and an interaction was obtained between time of day and instruction suggesting that the differences in strategies between recall and recognition test expectations are enhanced in the afternoon. At this time recall-instructed subjects performed better and recognition-instructed subjects performed worse on a test of free recall.

A similar interaction, but between noise and instruction was obtained in Experiment 7. The results of

Experiment 8 further support the notion that noise may reduce the amount of rehearsal engaged in by subjects expecting a recognition test.

In the final study subjects performed a semantic orienting task and noise improved the recall of highly associated items while impairing the recall of non-associated words. This suggests noise may enhance semantic processing when this is required by the task.

It is concluded that the effect of noise and time of day are, at least in part, determined by the nature of the task requirements.

ACKNOWLEDGEMENTS

First of all I am extremely grateful to my supervisor Dr. John Wilding for his unfailing encouragement, suggestions and advice.

I am also very much indebted to Dr. Simon Folkard for his useful comments and constructive criticisms.

Also, I want to thank Drs. Leslie Henderson and John Cowley for providing facilities at Hatfield Polytechnic for carrying out Experiment 2 and 9; Ray Matthews for his assistance with the computer analyses; Rosemary and the technicians at Bedford College for their help with the apparatus and experimental equipment and last but not least, Mary Walton for her efficient typing of the manuscript.

I would also like to thank the Social Science Research Council for their financial support and all the staff, students and postgraduates at Bedford College, particularly Bessie, Chaz, Eileen, Kath, Len, Liz (my colleague at Hounslow Borough College), Luke, Naresh, Shashi and Tina who all contributed in their own different ways.

Finally, I especially want to thank Ian without whose moral support this thesis may never have been written.

TABLE OF CONTENTS

CHAPTER 1

RECALL AND RECOGNITION

A major theoretical issue in memory research has been the nature of the similarities and differences between recall and recognition.

Chapter 1 will consider two approaches to this problem. The first approach is concerned primarily with differences between the two types of test. In these experiments subjects normally receive the type of test which the instructions lead them to expect. Consequently, both test expectations and the nature of the test may influence the result. The second and alternative approach therefore, has been to concentrate on how recall and recognition test expectations may influence the information encoding stage.

1.1 Differences between the two types of test

It may be assumed that if the underlying processes of recall and recognition differ qualitatively, it should be possible to show they are affected differentially by the same experimental manipulations. This has been demonstrated by a number of investigators concerned with recall-recognition and the effects of word frequency, list organization and intentional and incidental learning. A selection of these experiments will be reviewed and interpreted in terms of two major theoretical frameworks namely, the

Dual-Process Model of recall and recognition (Anderson & Bower 1972; Bahrick 1969 and Kintsch 1970), and Tulving's Episodic Ecphory Theory (Tulving 1976).

(i) Evidence leading up to the Dual-Process Model

Hall (1954) and Dale (1966) both found that high frequency words were better recalled than low frequency words. Conversely, the recognition results of Shepard (1967) went in the opposite direction, with low frequency words being better recognized than high frequency words. Similar results have been obtained by others (Gorman 1961 and Schwartz & Rouse 1961) suggesting that recall and recognition may be sensitive to different aspects of the stimulus material. However, as pointed out by Gregg (1976), recall is not always positively related to frequency (Matthews 1966 and Paivio & Madigan 1970), and Gregg (1970) also obtained shorter response latencies for high frequency probes relative to low frequency ones suggesting there are exceptions to the low frequency superiority in recognition memory.

Estes and Dapolito (1967) compared recall and recognition performance for intentional and incidental learners. The intentional learners were told prior to the presentation of the material that their task was to remember the experimental stimuli which were CVC- digit pairs, while the incidental learners were presented with the material as part of a problem solving task. The results showed no difference in proportion correct for the recognition groups, but the intentional learners recalled a greater proportion of words than the incidental learners. So recall performance was superior following intentional learning instructions whereas recognition performance was similar under both sets of instructions. Winograd & Smith (1978) suggested that with standard recall instructions subjects expect a recall test and prepare for it by organizing and looking for associations between items. Semantic orienting tasks on the other hand, prevent subjects from doing this and should favour recognition performance since generally they lead to elaboration coding of individual items with less information stored about inter-item relationships.

If recall instructions induce subjects to organize and look for associations between items, one would expect to find an effect of inter-item relations on recall but not on recognition performance. Bruce & Fagan (1970) tested recall and recognition for related and unrelated lists of 42 words. The related material consisted of six words from seven categories, while the unrelated material was represented by one word from each of 42 different categories. In the free recall test subjects were asked to recall as many words as they possibly could and then to add items until they had written down a total of 42. While subjects in the recognition group were not affected by the type of material used subjects recalled a higher proportion of words in the related than the unrelated condition.

Similarly, Kintsch (1968) presented recall- and recognition-instructed subjects with a highly organized and a poorly organized list, and found that recognition performance was the same for both lists, while subjects recalled about 50% more from the organized list.

Experiments designed to test the effect of retrieval practice on recall and recognition further suggest that recall is better following opportunities for recall (Darley & Murdock 1971), and recognition is better following an increase in item-exposure time (Hogan & Kintsch 1971). Darley & Murdock showed that subjects recalled more following an earlier test of the material than in the absence of prior tests, while no differences were obtained between the two recognition groups (previous recall test and no previous recall test).

Hogan & Kintsch (1971) gave subjects either four presentations of a list, or one presentation followed by three successive recall tests. When performance was tested two days later, recognition was significantly better with increased item-exposure time, and recall was significantly better where there had been more opportunity for retrieval.

In a different study by Thomson & Tulving (1970) the presence of strong extralist associates of target items as retrieval cues facilitated recall but had no effect or even interfered with the recognition of the target items.

The results of these experiments strongly suggest there are certain differences between the underlying processes of recall and recognition and Kintsch (1970) summarized the situation as follows: "The basic difference between recall and recognition appears to be that recall involves a search process and recognition does not. In recognition the problem of retrieval is simple: the item is sensorily present and it is a simple matter to retrieve its corresponding representation in memory (although how this is done is by no means obvious); the subject then has some means of judging the newness of the trace (response strength, familiarity); if the newness satisfies some criterion, the subject says he recognizes the item; otherwise he calls it new; irrelevant alternatives are not considered in this judgement . . . The problem in recall is very different. Items are not considered sensorily present to be judged for newness, but they must be retrieved from memory. Retrieval involves getting from one memory trace to the next. What is important therefore are inter-item relationships. An item in a free recall experiment is not retrieved in vacuo, but only as a member of a larger structure," (p. 337).

In short, the Generation-Recognition Model or the Two-Stage Theory of recall and recognition is based on the assumption that recall involves two stages; a retrieval stage where generation of possible responses occur and a decision stage where it is decided whether the generated alternatives were presented previously or not, and recognition involves only the decision stage.

According to the two-stage theory any experimental variable that affects only the probability of retrieval should affect recall and not recognition, and a variable that exerts an effect only at the decision stage should produce a difference in both recall and recognition. Consequently it has been argued that retrieval attributes are more easily established for high frequency words and discriminative attributes more easily established for low frequency words. Similarly, intentionality of learning, inter-item relations and opportunity for recall are believed to affect the retrieval stage because they produce a difference in recall and not in recognition performance. However, it would seem that it is difficult to test the assumptions of the dual-process theory without employing arguments of circularity since there is no <u>independent</u> method of determining whether a variable affects one, the other or both stages of processing. Also, it is difficult to see how intentionality could affect retrieval except via method of storage.

In order to show that it is possible to separate the processes involved in the retrieval and decision stage, Anderson & Bower (1972) presented subjects with different combinations of 16 words (from a set of 32 words) on 15 successive trials. Every new list would give subjects the opportunity to tag associative pathways and when tested for free recall their performance increased over the first lists, then declined. This was explained in terms of an initial increase in item retrievability, but when item retrievability had reached its ceiling, problems of recognition continued to increase. This was further supported by a second experiment where subjects were asked to recall all the words presented to them during the experiment after each list. Recall of words from the most recent list suggested there was a systematic improvement in retrievability whereas when on each trial subjects were asked to indicate which of the retrieved words came from the most recent list (Recognition test) performance decreased over lists. According to Anderson & Bower therefore, free recall may be divided into two independent processes of retrieval and recognition, retrieval which depends on the extent to which appropriate associative pathways among the words have been tagged and recognition which depends on the extent to which items in memory have been tagged with list markers referring to the most recent list. The decision processes underlying recall and recognition are assumed to be the same and following a repetition of the Anderson & Bower 1972 experiment except for the exclusion of a recall test, recognition performance was indeed found to decline throughout the experiment as predicted on the basis of the previous results.

A modified version of the two-stage theory however, (Anderson & Bower 1974) incorporates the possibility that recognition too may require both a retrieval and decision stage. Tulving's finding (Tulving & Thomson 1971; Light & Carter-Sobell 1970) that changes in context between study and test produce an impairment in recognition performance, does seem to suggest the performance on a recognition test may be sensitive to retrieval as well as to decision failure. This further implies that the assumption of automatic access to the memory trace of a stimulus following the presentation of that stimulus is somewhat inadequate.

(ii) The Episodic Ecphory Theory

An alternative to the Generation-Recognition Model of recall and recognition has been proposed by Tulving (1976). He argues that there is no justification for retaining the idea of two successive stages in both recall and recognition. "If everything correctly identified by the retrieval process were always accepted by the decision mechanism, then the necessity for a separation of the two stages would become meaningless",(p.50). Tulving's Episodic Ecphory Theory postulates no separate decision process following the retrieval of items. Whenever the trace information is combined with appropriate retrieval information, retrieval is successful and its product is entered into conscious awareness. "The notion of 'reversal' of processes in recall and recognition makes little sense in the episodic ecphory theory, since 'item' and 'context' refer to two different components, both of which are necessary for the definition of an event. The TBR event is an item-in- context," (p.68).

According to Tulving recognition performance typically exceeds recall performance because there is more ecphoric information available in the recognition test. The term ecphory is distinguished from retrieval and is defined by Tulving (1976) as "the process by which information stored in a specific memory trace is utilized by the system to produce conscious memory of certain aspects of the original event," (p.40).

The studies initially quoted in support of the two-stage theory are interpreted by the episodic ecphory theory as follows: Depending on input conditions, the informational content of the ecphoric environment in a free recall situation is more appropriate for high familiarity than low familiarity items; for traces resulting from intention to learn than those produced by incidental learning; for traces of related words than unrelated words; and following a recall test compared with not following opportunity for retrieval. In recognition performance the informational content extracted from the old test items is thought to be equally appropriate and overlap the trace information equally well under both input conditions, an explanation which in comparison with the generation-recognition model of recall and recognition appears to be equally circular.

The main experimental evidence quoted in support of Tulving's theory is the finding that recall- may under certain circumstances exceed recognition performance. This is at odds with the two-stage theory which presupposes it would be impossible for a person to recall an item he cannot recognize. Tulving & Thomson (1973) presented a list of weak semantic associates (BABY - grasp) and the subjects were then given strong pre-experimental associates of the target words (e.g. infant instead of baby) as stimulus words in a free association task. The generated associates included many copies of target items from the input list. Next, the subjects were asked to circle the words that appeared in the input list and finally they were given a cued recall test. Following this experimental procedure it was found that recall was significantly higher than recognition, and Tulving (1976) suggests "the list cue contained more relevant information for the purpose of providing access to the stored cue-target trace than did the literal copy of the target item, either because the cue-target compounds stored in memory contained little information that matched the information in 'copy' cues or because the subjects did not know what was the appropriate information to be extracted from the copy cues in the recognition test," (p. 69-70).

One major criticism of the Tulving and Thomson study, is that the recall and recognition decision phase did not involve the same number of alternatives and the alternatives were not equally discriminative in both tests. For example, an optimal condition for recall (cued recall) and non-optimal condition for recognition (several highly similar alternatives) were used. Previous studies have shown that recall significantly improves with cued recall (Tulving & Pearlstone 1966), and recognition significantly deteriorates with an increased number of items and increased item similarity (Bahrick & Bahrick 1964; Bruce & Cofer 1967).

In a related but different experiment Wiseman & Tulving (1975) presented a series of words accompanied by weakly associated contextual words, followed by a recognition test and then by a cued recall test using the weak associates as cues. Here recall was superior to recognition (62 and 45% respectively) and this occurred when the distractor items on the recognition test were semantically unrelated to the target items.

However, another important criticism of this and the previous study is that the recognition test was given before the recall test. This could have influenced recall, although Wiseman & Tulving seem to think it unlikely that unsuccessful recognition should improve performance on a recall test.

More importantly however, Wallace (1978) showed that it is possible for items missed on an initial memory test to be remembered correctly on a subsequent test in the absence of additional study opportunity, when a different and more appropriate test context is introduced on the second test.

In a 2 x 3 factorial design Wallace presented subjects with a list of 24 target words. Each word occurred together with a cue word and all subjects were then tested on a cued recall test. Next a second <u>critical</u> list was presented in the same manner as list 1, and following the presentation of this last list subjects had to perform a symbol-cancellation task for 10 minutes. All subjects were then asked to do a free choice recognition test. The recognition test included 72 distractors plus the 24 target words from list 2. Half of the subjects were given an uncued recognition test and the other half were presented with the cue words in a cued recognition test. Similarly, on a second test subjects were either given a cued recall, cued recognition or uncued recognition test. When subjects in the uncued condition were given the original cue words for the second test there was a dramatic increase in the number of correct responses, that is first-test recognition failures were correct on a second test and this was true for both the cued recall and recognition groups.

According to Wallace the phenomenon of recognition failure of recallable words exploits this situation by requiring an initial uncued or changed cue test that involves recognition and a second cued test that involves recall.

Thus it would appear that recognition failure of recallable words may be more accurately interpreted in terms of context effects in recall and recognition, and does not necessarily represent a critical test of the two theoretical alternatives.

Clearly, there are obvious procedural differences between recall and recognition. Also, subjects tend to do better on a recognition test. This suggests recall may be more difficult than recognition and a less sensitive measure of what is laid down in the memory trace. Thus for example, Tulving & Pearlstone (1966) have demonstrated how an item may be available but not accessible to subjects at the time of test. They gave two groups of subjects identical lists of words. The words were taken from various categories and the members of each category were presented together with the category name. Following presentation, subjects in the cued condition were given the category names and then asked to recall the category instances whereas subjects in the non-cued condition were simply asked to recall as many words as they could from the list. The first group recalled significantly more words than the last group. It seems possible therefore that the subjects in the non-cued condition may have stored more words than they recalled, but were unable to access these without the appropriate retrieval cues. Thus cued recall (and recognition), provides subjects with retrieval information not available in free recall.

If recall is more difficult because subjects have to generate the relevant information themselves, one would expect recall to involve more complex operations than recognition. The two-stage theory solves this problem by introducing a retrieval and a decision stage in recall and only a decision stage in recognition. Tulving on the other hand claims the decision stage in unnecessary, the only difference between recall and recognition being the amount of retrieval information available at test. One major problem in choosing between these two theoretical frameworks is that most of the experimental evidence can be incorporated by both.

However, the results of Anderson & Bower (1972) support the assumption that recall involves two different processes of retrieval and recognition. Similarly, context effects in recognition suggest retrieval may also be of some importance in recognition performance.

Furthermore, clinical evidence suggests there may be a physiological basis for a decision or retrieval check mechanism further justifying the retention of a theoretical distinction between retrieval and decision processes. Thus for example, Warrington & Weiskrantz (1970; 1971) found people with damage to the hippocampus were impaired on both recall and recognition, but the effect was greater for recognition than recall performance. Further enquiries suggested this impairment was due to an inability on the part of these subjects to inhibit irrelevant information. In support of this Miller (1978) obtained results where performance on a recognition test decreased as response alternatives increased, a tendency which was found to be significantly greater for subjects with pre-senile dementia than for normal controls.

(iii) An Alternative View

An alternative way of looking at the similarities and differences between recall and recognition would be to assume they both involve retrieval and decision processes. However, instead of being viewed as separate mechnisms it seems likely there is a certain overlap between the different operations responsible for output both from short- and long-term memory. Furthermore, the relative importance of these retrieval and decision processes may vary from one experimental situation to the next depending on the task requirement and the type of material used. This would allow for the possibility that retrieval and decision processes operate simultaneously and not necessarily in succession, in which case it would be unrealistic to consider memory in terms of a retrieval and decision stage.

Thus for example, in a free recall test subjects are primarily asked to perform a retrieval task and although the decision process(es) may be of minor importance it seems likely they would be automatically implemented by the retrieval operations. Similarly, in a standard recognition test where subjects are required to make decisions as to whether an item has been presented previously or not, it is decision and not retrieval which is the predominant response although presumably not the only one.

In addition it would appear that the retrieval processes involved in recall should be different from those involved in recognition where subjects specifically have to inhibit the retrieval of 'new' items and reinforce the retrieval of 'old' ones.

Cued recall is an example of where the retrieval demands are less and the decision involvement greater than in a free recall test and conversely where the decision demands are fewer and the retrieval demands greater than in a standard recognition test. It follows from the above that cued recall should induce subjects to involve the combined processes of retrieval and decision to a greater extent than in either pure recall or recognition. Some support for this is provided by Tulving & Pearlstone (1966). They found that the introduction of category cues resulted in items from more categories being recalled and not more items per category, suggesting there is a limit to the number of words subjects can retrieve or store from a given category. Thus if it can be shown that there is a limit on retrieval, it may be concluded that the improved performance of subjects in a cued recall condition is not entirely due to increased retrieval but is also influenced by overlapping retrieval and recognition processes.

Lazar & Buschke (1972) performed a study on retrieval from semantic memory, and their results are in agreement with the view that subjects may only be able to retrieve a limited number of items at a time. Similarly, Tulving (1967) gave subjects three successive free recall tests following the presentation of a list of unrelated words. He found that of all the words recalled at least once within a given test only approximately 50% were recalled three times. Patterson (1972) obtained similar findings with a categorized word list thus lending some support to the argument presented above.

So far the present review has been concerned exclusively with recall and recognition differences occurring at the time of test. It has been suggested that recall primarily involves retrieval and recognition primarily involves a decision requirement, although the retrieval and decision processes appear to a certain extent to be overlapping in both recall and recognition. Thus it may be considered impossible or even futile to test the separate effects of retrieval and decision experimentally.

An alternative approach has been to concentrate on how recall and recognition test expectations may influence the information encoding stage. Apart from being of interest in its own right, information relating to subjects encoding strategies may also contribute to our knowledge of performance requirements in recall and recognition tests respectively.

1.2 Recall and Recognition Test Expectations

Tulving has argued that recall and recognition differ only with respect to the retrieval information available. Thus subjects are thought to store the same information whether they expect a recall or a recognition test. However, if recall and recognition represent different task requirements as the two-process theory suggests, they should differ with respect to the processes necessary for successful performance.

Tversky (1973; 1974) presented subjects with pictures of familiar objects together with their names and calculated recall and recognition scores on the basis of the following groups:

(i) Recall Instructions - Recall then Recognition test
(ii) Recall " - Recognition then Recall test
(iii) Recognition " - Recall then Recognition test
(iv) Recognition " - Recognition then Recall test

When tested for recall subjects were asked to write down as many of the objects as they could remember, and when tested for recognition they were shown a set of old and new pictures and asked to distinguish between them.

Tversky obtained a significant effect of instruction on the recognition scores (the recognition performance of recognition- instructed subjects exceeding that of recall- instructed subjects), but not on the recall scores. There was an effect of test order on the recall scores where subjects presented with the recognition test first did better than those presented with the recall test first. The subjects expecting a recall test recalled more items than those expecting a recognition test, only if the pictures were ordered in clusters during presentation and when subjects were explicitly instructed to remember related words together.

The failure to find a substantial correlation between recall and recognition of items (phi correlation = .061 and .049 in Tversky 1973 and 1974 respectively) indicates that the recognition test was mainly performed from pictorial encoded information while the recall test involved more semantic information. This is not surprising considering the recognition test required picture recognition and the recall test did not.

The interesting point here is that recall- instructed subjects performed significantly worse than recognition-instructed subjects on the recognition test which is contrary to studies (described later) where recall- instructed subjects do at least as well or generally surpass recognition-instructed subjects on most measures of retention. This discrepancy between experiments may in part be due to the different stimulus material used. Tversky's results strongly suggest that subjects' choice of coding strategy is influenced both by instructional set - whether they expect a recall or a recognition test, and by the type of stimulus material - recall-instructed subjects tending to rely more on semantic information and recognition-instructed subjects seemingly preferring to code items according to their pictorial informaton. The notion that pictorial stimuli particularly enhance recognition performance is supported by Snodgrass and Burns (1978) who obtained results where pictures maintained their advantage over words in recognition memory after six repeated tests with the same items. Similarly, Frost (1972) presented a list of visually and semantically categorized pictures. Free recall of the picture names and recognition of the pictures were performed by subjects who expected either name recall or picture recognition. Although overall free recall and recognition performance did not differ, the subjects with a recognition set clustered both by visual and semantic categories, while the subjects with a free recall test primarily clustered semantically.

Thus it appears subjects expecting a recall and recognition test prefer to code items according to semantic and pictorial attributes respectively. In terms of recall and recognition test expectations however, it would be interesting to know the extent to which the same material is coded differentially.

Loftus (1971) engaged subjects in a continuous paired associate procedure (the stimuli were digits from 1 to 9 and the responses were the 26 letters of the alphabet) under three instructional conditions; a recall instruction, a recognition instruction and a recall or recognition mixed condition where subjects did not know whether they would be tested by a recall or recognition test. It was argued that if the recognition instruction - recognition test does not differ from the mixed instruction - recognition test condition, and the recall instruction - recall test does not differ from the mixed instructions - recall test condition then differences between recall and recognition can not be accounted for in terms of storage.

The same paradigm was used by Freund, Brelsford & Atkinson (1969) and their findings suggested the recall and recognition differences were due to retrieval only. According to Loftus however, their design may have been biased against obtaining storage differences between recall and recognition. Firstly, the two- alternative forced-choice recognition test did not differ greatly from the nine-alternative forced-choice recall test. Secondly, subjects were given all experimental conditions within a single session which means that in order for subjects to store differently they would have to change their method of study from one condition to the next. Consequently, Loftus used a yes-no recognition test, recall included 26 alternatives and although subjects were presented with all three study conditions they were only tested in one experimental condition at a time.

Loftus found that when subjects knew how they would be tested, their performance was better on recall but worse on recognition than when they did not know how they would be tested. The results were interpreted as support for the view that differences in storage processes partially account for performance differences in recall and recognition. Loftus analysed the results in terms of Atkinson & Shiffrin's (1968) model of memory. The model provided an excellent fit to the data and the obtained parameter values were interpretable in support of possible storage strategies used by subjects following recall and recognition instructions. It was suggested that for a recognition test minimal information about a response is often sufficient to generate a correct response. A good strategy would therefore be to generate as much information as possible about each item and allow the information to decay away since it is still useful in a degraded form. For recall, on the other hand, such degraded information is not as useful, and there would be more reason to try to maintain complete information about as many items as possible in short-term store. This interpretation is in agreement with the ideas presented in a previous section where recall and recognition were reported to produce different results following intentional and incidental learning (Estes & Dapolito 1967), and following the presentation of related versus unrelated lists of words (Bruce & Fagan 1970; Kintsch 1968).

As early as 1948 Postman & Jenkins were concerned with influences of test expectations and looked at the effects of three types of instruction on the same three types of test (Recall, Recognition and Anticipation) in a 3 x 3 factorial design. The anticipation method which required subjects to write the words (25 two-syllable adjectives), in their original order of presentation, produced superior performance on both the free recall and anticipation test. However, the interaction between instruction and test was statistically significant with recognition-instructed subjects tending to do better on the recognition test.

Bruce and Cofer (1967) on the other hand, obtained results where subjects learning for recall retained significantly more words than subjects learning for recognition irrespective of which method was used for testing long-term retention. Their subjects learned individual lists of 28 CVC trigrams to approximately 75% level of accuracy and were tested for retention after 20 minutes and 24 hours.

Similarly, Hall, Grossman & Elwood (1976) tested subjects' memory for lists of unrelated words in a 2 x 2 design with paced and free study as one factor and recall and recognition instructions (followed by a recall and subsequent recognition test) as the second experimental manipulation. Subjects expecting a recall test were found to perform significantly better on both the recall and recognition test relative to subjects expecting a recognition test. The recall and recognition performance of subjects in the free study condition was also superior to that of subjects in the paced condition.

In a related experiment the recall superiority of recall-instructed subjects increased with a longer study period whereas no effect of study period was found on the recognition data.

Post-experimental questionnaires on processing strategies revealed that simple item repetition was more common when subjects expected a recognition test, and various item grouping methods more common when subjects expected a recall test, although associative methods were reported as more frequently used in both groups than were simple item repetition.

Hall, Grossman & Elwood concluded that the performance differences in recall and recognition were quantitative rather than qualitative in nature. They obtained no interaction between presentation mode and test, and if encoding differences were qualitative one would expect an interaction since the opportunity to use an appropriate strategy should have been greater under the free relative to the paced study condition. Secondly, the item correlations between conditions were higher than would be expected with qualitative differences in encoding operations. Also, the serial position data were similar for both instructional groups.

Thus in agreement with Bruce & Cofer (1967) and Loftus (1971) they found that subjects expecting a free recall test performed significantly better on recall and a subsequent recognition test than subjects expecting a recognition test. The improved recall and recognition performance of subjects presented with the certainty or the possibility of a recall test suggests the recall instructions induce subjects to learn the material better generally, indicating that it is not just a question of compatibility between instructions and test.

Hall, Miskiewicz & Murray (1977) were concerned with the nature and development of encoding strategies for free recall and recognition of unrelated nouns. Their experimental design was similar to that of Hall, Grossman & Elwood (1976), and it was found that the effect of test expectancy (recall versus recognition) was greater for 6th grade compared with 3rd grade children. Also, at the 6th grade level 9 out of 12 recall expecting subjects reported rehearsal of items in blocks while only 4 out of 12 of the recognition expecting subjects did so.

On a pre-experimental questionnaire 88% of the 6th graders judged recall as being more difficult than recognition while only 33% of the younger children did so. Following experience with two practice tests however, children at both levels (88 and 79% respectively) judged recall as being more difficult than recognition.

These results suggest that subjects expecting a recall test engage in more active processing, possibly by relying more on subvocal rehearsal. Further support for this hypothesis was provided by Maisto, Dewaard & Miller (1977). They asked one group of subjects to repeat each word aloud three times as it appeared on the screen, thereby preventing rehearsal of other list items. As predicted, the enforced vocalization impaired the recall of subjects expecting a recall test but had no significant effect on that of subjects expecting a recognition test.

1.3 Concluding Remarks

The experimental manipulations involved in the two approaches outlined in section 1.1 and 1.2 have been combined in two studies investigating the combined effects of test expectations with list organization and word frequency respectively.

Results obtained by Connor (1977) suggest that test expectancy and semantic organization effects are interactive rather than additive in both recall and recognition. Although admittedly, there are certain aspects of the data which are difficult to interpret. Thus for example, the type of test expectation and the type of list (categorized versus non categorized list of 32 words), had no effect on recognition performance while subjects expecting a recall test showed superior recall of unrelated words and of a categorized list of words which were presented in a random order. However, in a second experiment the performance of recall-instructed subjects was superior on a free recall and recognition test of words from a categorized list of items blocked by category, but not from a categorized list of words in random order. The recognition-instructed subjects on the other hand, appeared to recognize more items from a categorized list of words not blocked by category. Thus blocking facilitated performance for subjects expecting a recall - but not a recognition test.

More recently Balota & Neely (1980) obtained the standard word-frequency effect with high frequency words being better recalled but more poorly recognized than low frequency words. However, it was also found that recall-instructed subjects did better than recognition-instructed subjects on a recall and recognition test for high frequency words while the effect for low frequency words was nearly non-existent. This is in agreement with Gregg's (1976) interpretation of the word frequency effect that "high frequency words offer more encoding options and this gives them a greater likelihood of being readily encoded within the list context, i.e. of being incorporated within an effective retrieval scheme," (p.214), which should increase their probability of being recalled and presumably also recognized following instructions to expect a free recall and not a recognition test.

In conclusion therefore, it would appear that subjects encode information in a manner consistent with retrieval demands maximizing item discriminability in recognition and rehearsing and organizing the items for recall in order to facilitate retrieval.

CHAPTER 2

NOISE AND TIME OF DAY.

Influences of noise and time of day have generally been interpreted in terms of the inverted-U relationship between arousal and performance. In view of this Chapter 2 presents a brief introduction to the concept of arousal and proceeds to discuss it in terms of experiments on time of day and memory.

Noise is considered in greater detail in sections 2.6 - 2.8 which are concerned almost exclusively with influences of noise on memory and attention.

2.1 An Introduction to the Concept of Arousal

In his much cited article on "Drives and the C.N.S. (Conceptual Nervous System)", Hebb (1955) reviews relevant physiological and psychological data and proposes a theory of arousal which may be considered a precursor to Eysenck and Gray's conceptualization of individual differences in the characteristics of the nervous system.

As pointed out by Hebb the nervous system is alive "the nerve cell is not physiologically inert and does not have to be excited from outside in order to discharge". Similarly, the human brain is structured to be alive and its continuous activity is what determines behaviour. Physiologically cortical functioning is facilitated when the "diffuse bombardment of the arousal system" is at a low level, but when drive or arousal (arousal is conceived as a general drive state) is at a high level "the greater bombardment may interfere with the delicate adjustments involved in cue function, perhaps by facilitating irrelevant responses". On a behavioural level a weak representation of a stimulus may attract whereas a strong representation of the same stimulus may repel "by disrupting the pattern and facilitating conflicting or alternative responses".

Duffy (1957) was concerned with individual differences in arousability and ways in which arousal could be inferred physiologically by measurable changes in skin resistance, muscle tension, EEG and heart rate. She does, however, suggest it is the organism as a whole which mediates arousal and not a single aspect of the system.

According to Duffy frequent and intense physiological arousal should lead to fatigue and a reduced rather than increased level of overt activity, and like Hebb, she describes the relationship between arousal and performance in terms of the inverted-U. Stennett (1957) provided further experimental support in favour of this interpretation when he found that tracking performance was most efficient at intermediate levels of palmar skin conductance and intermediate steepness of electromyographic (EMG) gradients.

The notion of an inverted-U relationship between arousal and performance was not new. It first became operational with the Yerkes-Dodson law in 1908 when Yerkes and Dodson discovered that increasing the intensity of shock administered to mice, facilitated the learning of brightness discrimination, but only up to a point after which further increases of shock intensity caused learning to deteriorate. Similarly, the optimum level of shock intensity was higher in easy discriminations and the effects of shock more pronounced during more difficult discriminations. As pointed out later in the review however, other studies have not always produced results consistent with the assumptions of the inverted-U.

Malmo (1957) strongly supported the use of psychophysiological techniques and drew attention to the finding that psychoneurotics and patients who were predominantly anxious tended to be physiologically more responsive than normal controls. Studies on noise and induced muscle tension (produced by squeezing a rubber bulb), suggested the most reliable difference between anxious patients and controls was in the 'after-response' following the period of primary reflex-startle.

Lindsley (1952), also closely associated with the arousal theorists, concentrated primarily on the nature of the relationship between electroencephalography (EEG) and behavioural efficiency. His later work identifies the brain-stem Reticular Formation as a determinant of arousal, a finding which was consistent with Moruzzi and Magoun's (1949) observation that lesions in the Reticular Formation caused animals to become permanently comatose.

Thus the early theorists assumed a relationship between cortical and autonomic activity with a unidimensional continuum of arousal ranging from coma to the most excited forms of behaviour. More recently, Gray (1964) succeeded in unifying and expanding the 'arousal theory' by adding a new dimension of 'arousability' a concept partly derived from the Russian work on the strength of the nervous system and partly from the traditional western approach to arousal. To quote Gray:

"The weak nervous system is more sensitive than the strong: it begins to respond at stimulus intensities which are ineffective for the strong nervous system; throughout the stimulus-intensity continuum its responses are closer to its maximum level of responding than the responses of the strong nervous system; and it displays its maximum response, or the response decrement which follows this maximum, at lower stimulus intensities than the strong nervous system", (p.281).

This approach is similar to H.J. Eysenck's (1967) view that differences in personality are mediated by inherited differences in the nervous system. Eysenck suggests a person's position on the extraversion-introversion scale is determined by the amount of excitation or inhibition exerted on the central nervous system by various parts of the Reticular Formation. Within this framework excitation refers to the facilitation of learning, conditioning, memory, perception, discrimination, thinking and mental processes generally whereas inhibition has the opposite effect of reducing the efficiency of the cortex. According to Eysenck extraverts should have a tendency to generate cortical inhibition more quickly and dissipate it more slowly whilst introverts should have a tendency to be chronically more aroused than extraverts.

Eysenck considers cortical activity (arousal) and activation (autonomic activity which is closely related to neuroticism) as relatively separate functions of anatomically separate structures with the qualification that cortical arousal can take place without autonomic activation but not the other way around.

One line of evidence quoted in support of Eysenck is the observation that certain types of drugs with direct action on various parts of the brain(e.g. alcohol, barbiturates and amphetamines) can shift a person's position on the extraversion-introversion continuum. Extraverts and introverts also differ with respect to performance on a variety of tasks. Thus for example, it has been reported that extraverts show a greater decline in vigilance performance (Bakan, Belton & Toth, 1963; Carr, 1971; Keister & McLaughlin, 1972; Krupski, Raskin & Bakan, 1971), and condition more poorly than introverts (Franks 1956 and 1957) whilst introverts tend to have lower sensory thresholds (Fisher, Griffin & Rockey, 1966; Haslam, 1967; Smith, 1968); higher levels of skin conductance (Revelle, 1974); and more spontaneous galvanic skin responses (Coles, Gale & Kline, 1971).

However, in view of its simplicity Lacey (1967) strongly argues against the adoption of a unidimensional model of arousal and in favour of a division of electro-cortical, autonomic and behavioural arousal into three separate arousal systems with complex interactions. His proposal was derived from four kinds of physiological evidence, three of which are relevant to the present review;

Firstly, he cites the finding that contradictory behavioural and electrocortical signs of arousal can be produced pharmacologically (Bradley 1958) and by localized lesions in the central nervous system (Feldman & Waller 1962). According to Bradley (1958) and Wikler (1952) atropine produced EEG waves similar to those observed in sleep except that they were not accompanied by signs of behavioural drowsiness. Furthermore, when atropine was coupled with amphetamine the slow wave pattern persisted while the experimental animals became behaviourally alert and excited.

Secondly, there is the lack of sizeable correlations between various autonomic measures and between autonomic and electroencephalographic indices of arousal.

Lacey's third source of evidence is the observation that different stimulus situations can produce different physiological response-patterns. Thus for example, Davis (1957) showed male students pictures of female nudes and contrary to expectations, he found the pulse rate slowed down whilst the activity of other autonomic responses increased, a response- pattern referred to by Lacey (1967) as directional fractionation. Similarly, Lacey (1959); Lacey, Kagan, Lacey & Moss (1963) and Obrist (1963) obtained a reduction in heart rate and an increase in the activity of other autonomic measures when subjects were attending to a task without response requirement. However, when subjects were required to manipulate the information presented in a task directional fractionation is replaced by the more common arousal pattern of generalized sympathetic dominance. According to Lacey this pattern occurs in situations where subjects try to resist stimulation because of its aversive or distracting nature, and directional fractionation occurs in situations of attentive acceptance of external stimulation, a suggestion which is not entirely consistent with the results of Libby, Lacey & Lacey (1973) where the largest cardiac deceleration was obtained for the most unpleasant stimuli.

Alternatively, Obrist suggests the heart rate deceleration is a general inhibitory somatic response controlled by the central nervous system and concerned with the body's "preparatory activities". Obrist studied the responses occurring between the presentation of a signal and a stimulus in a reaction time task, and the interval between a neutral conditioned stimulus and an aversive unconditioned stimulus in a classical conditioning paradigm where cardiac deceleration was found to be accompanied by a marked reduction of irrelevant movements and by a steady fixation of the eyes (Obrist, Webb & Sutterer 1969; Webb & Obrist 1970).

Thus it would appear from the physiological evidence at least that the unidimensional model of arousal cannot account for the available data given that the relationship between physiological measures and arousal is not at all clear. In this respect one would tend to agree with Broadbent (1971) who argues that, "the physiological concept of arousal is certainly of interest and of ultimate relevance to the one found in behaviour, but at this stage the connection of any suggested physiological measure and the psychological state is too remote to make it practical to attach one concept directly to the other," (p.413).

One argument in favour of adopting a behavioural approach is the possibility of different experimental manipulations giving rise to similar physiological but different behavioural outcomes. Increased task difficulty and motivation may for example produce identical somatic responses and yet be associated with a variety of behavioural effects.

In the following sections the arousal theory will be examined further in view of evidence obtained from studies concerned with the effects of time of day, personality and noise on performance generally and memory in particular.

2.2 Time of Day and Circadian Rhythms

Diurnal variations have been observed in a number of physiological and psychological measures such as for example body temperature, catecholamine and melatonine secretion, subjective ratings of alertness and capacity for work. Of these measures body temperature has been the one most often used, presumably because of the ease with which it can be measured. Characteristic temperature peaks can be found around 20.00 - 21.00 hours with a trough at 4.00 - 5.00 hours, and a rapid rise between 8.00 and 11.00 hours followed by a more gradual rise over the next nine hours, (Colquhoun, Blake & Edwards 1968). On average people's temperature rhythms tend to show this pattern and earlier studies revealed a positive relationship between the circadian rhythm in body temperature and that in performance efficiency on certain types of tasks (Dressler 1892; Kleitman 1939). Thus for example, Kleitman (1939) observed faster reaction times with rising body temperature and more recently, Blake (1967a), Fort & Mills (1976), Hughes & Folkard (1976) and Klein, Wegmann & Hunt (1972) found improved performance on a visual search task with a rise in temperature over the day.

While Gates (1916) believed the daily variation in sleepiness or alertness was directly linked to the sleep-wakefulness cycle, Kleitman (1939) made the important observation of a marked parallellism between the time of day effect in performance and that in body temperature. According to Kleitman the improvement in performance speed over the day is caused by the circadian rhythm in body temperature and "either (a) mental processes represent chemical reactions in themselves or (b) the speed of thinking depends upon the level of metabolic activity of the cells of the cerebral cortex, and by raising the latter through an increase in body temperature, one indirectly speeds up the thought process," (p. 160).

In line with Kleitman, Colquhoun et. al. (1968) showed that when the temperature rhythm of a group of subjects had been shifted to a new cycle, the rhythm of performance tended to do likewise, strongly supporting the notion of a relationship between temperature and performance.

However, Colquhoun (1971) rejected the idea of a causal relationship between temperature and performance and argued for an explanation in terms of arousal. To quote Colquhoun "the general level of 'sleepiness' falls (i.e. arousal rises) during the waking day, to reach a minimum somewhere in the evening," (p. 51). Thus with an exception of the post-lunch decrement circadian changes in body temperature are believed to parallel changes in basal (resting) arousal level, and are perceived in terms of the inverted-U relating performance efficiency to arousal level.

Assuming that introverts are chronically more aroused than extraverts, Colquhoun (1960) was one of the first to suggest there may be a relationship between personality and the time of day effects obtained in performance, and the analysis of 17 vigilance experiments carried out at different times of day did indeed reveal a positive relationship between introversion and efficiency in the morning and a negative correlation in the afternoon. A similar pattern of result was obtained on a letter cancellation task provided the subjects were tested individually, (Colquhoun & Corcoran 1964). Similarly, Blake (1967b) found a significant positive correlation between introversion and body temperature in the morning (8 am) and a significant negative correlation at 9 and 11 pm and 1 am at night. However, averaged across 24 hours the correlation between temperature and personality was not significant, possibly because the differences between extraverts and introverts were primarily due to the temperature of introverts tending to rise more quickly in the morning and fall off earlier in the evening. It seems possible therefore, that introverts may not be permanently more aroused than extraverts but that their circadian rhythms represent a difference in phase.

Similarly, Eysenck (1977) also suggested that the basal level of arousal need not necessarily be different for introverts and extraverts, but that the optimal level of arousal may be lower for introverts or the consequences of stimulation may be different for the two personality groups. Thus introverts may be more aroused than extraverts under some conditions and not under others.

2.3 Time of Day, Arousal and Memory

To quote Freeman & Hovland (1934) "the balance of evidence apparently favours an afternoon superiority for sensory and motor performance, but there is little agreement as to the time when complicated mental work can be done most efficiently," (p. 786). Although the majority of studies have tended to show improved performance on perceptual motor tasks over day, the results of Gates (1916) and Laird (1925) suggested there was a decline in short-term memory performance with time of day, a finding which was later confirmed by Baddeley, Hatter, Scott & Snashall (1970), and Blake (1967a).

Gates (1916) and Laird (1925) attributed the decrease in short-term memory over day to increased 'mental fatigue' but this interpretation cannot account for the results of studies where arousal improved long-term memory and impaired memory at short retention intervals (Folkard & Monk 1978; Folkard, Monk, Bradbury & Rosenthall 1977).

Walker (1958) first observed the above interaction between arousal and memory in a study where arousal was increased by the use of highly emotional words. Walker suggested that arousal strengthened the consolidation process thus leading to a longer lasting trace, superior long-term retention and a greater inhibition of retrieval of items from short-term memory.

Support for Walker's hypothesis has been provided primarily by studies of paired associate learning where arousal was manipulated by assigning each item to a high or low arousal category according to each subject's GSR to that item (Butter 1970; Kleinsmith & Kaplan 1963; Walker & Tarte 1963), by using different levels of noise at presentation (Berlyne, Borsa, Craw, Gelman & Mandell, 1965; McLean 1969), or by assigning subjects to a high or low arousal category according to their scores on the Eysenck Personality Inventory (Howarth & Eysenck 1968).

However, except for Haveman & Farley (1969) who found no effects of noise on immediate free recall, recall of paired associates or recall of paired associates 24 hours later, most of the results obtained from free recall studies are not consistent with Walker's predictions (Corteen, 1969; Maltzman, Kantor & Langdon, 1966; Sampson, 1969; Schönpflug & Beike 1964). This suggests the effect may be peculiar to paired-associate learning which has been thought to involve response and associative learning whilst free recall primarily requires the former (Underwood & Schultz 1960). Thus Eysenck (1977) suggested that arousal may facilitate the retrieval of responses, but hinder the retrieval of appropriate associative links at short retention intervals.

Archer & Margolin (1970), Schwartz (1974b) and Wesner (1972), obtained results where white noise improved performance on an immediate recognition test supporting Eysenck's suggestion. However, Levonian, (1967) found poorer short-term retention and better long-term recognition for high- arousal items and Folkard et. al. (1977) obtained a similar pattern of result following afternoon presentation of information presented in prose. They played a tape recording of a story at 9.00 or 15.00 hours and tested a group of school-children immediately or a week later on a multiple-choice questionnaire. Similarly, Folkard & Monk (1980) gave students a different 1500 word article to read for three minutes each at 8.00, 11.00, 14.00, 17.00, 20.00 and 23.00 hours and a morning superiority was found for immediate retention of the information presented in the article when this was tested by a multiple choice questionnaire.

Thus influences of arousal at short retention intervals are not consistent across experiments possibly because the type of material or type of task may interact with the effects of arousal and to some extent determine the results, a problem which will be returned to in the experimental section of the thesis.

2.4 Time of Day and Changes in Strategy

Recently, a number of investigators have suggested that arousal may affect qualitatively the resultant memory trace. For example, Hamilton, Hockey & Quinn (1972) obtained results where loud noise specifically improved the retention of order information and Schwartz (1975) found highly aroused subjects (as indicated by extraversion and neuroticism scores) tended to make fewer errors on a paired associate learning task with semantically similar response terms than low arousal subjects who made fewer errors when the response terms were phonetically similar (i.e. when they rhymed). Thus it was suggested by Schwartz that subjects high in arousal process information by relying more on the physical than the semantic aspects of the task. Folkard (1976a;1979; 1981) on the other hand, makes rather the opposite prediction. According to Folkard low arousal (morning presentation) induces a greater reliance on maintenance rehearsal at the expense of elaboration processing while high arousal (afternoon presentation) enhances elaboration coding and reduces the reliance on rehearsal processes and the articulatory loop (Baddeley & Hitch 1974). Substantial evidence has been provided in support of Folkard and a selection of this evidence will be reviewed in greater detail below.

Acoustic confusability tends to discourage vocalization of stimuli and should therefore alter the time of day effects if subjects engage in different levels of rehearsal at different times of day. This was supported by Folkard (1976a) who found that contrary to a non-confusable version of a verbal reasoning task which was best performed at two o'clock in the afternoon, subjects' performance on an acoustically confusable version of the same task was unaffected by the time of day manipulation. Similarly, the effect of induced muscle tension (argued by Folkard (1979a) to increase arousal and reduce subvocal rehearsal), was limited to a control condition where rehearsal had not already been minimized by subvocal suppression. Also a greater detrimental effect of suppression was obtained in the morning than the afternoon suggesting subjects relied more heavily on subvocalization at this time of day (Folkard 1976b).

In a more direct investigation of rehearsal processes Folkard (1979a, Experiment 2) tested performance following standard recall instructions (Control condition), or instructions to group and rehearse a number of digits at input. These instructions were combined in a 2 x 3 design with three sets of output instructions where subjects were instructed to write down the digits in any order they chose provided the final written order corresponded to that which they had heard originally (Ordered); to write the first digit first, then the second and so on, (Serial); and to dump the last few digits they had heard first, and then fill in any of the earlier digits they could remember, (Dump).

A significant main effect of time of day on the Control-ordered condition was obtained suggesting subjects were more likely to spontaneously rehearse the digits in the morning (10.30 am) than the afternoon (7.30 pm), an effect which disappeared in the Group & Rehearse -, Control-Serial - and Control-Dump conditions.

These results offer considerable support for the view that time of day affects immediate memory by influencing the type of strategy which subjects spontaneously adopt. However, the overall picture must be more complex since no time of day effects occurred in two of the control conditions and an effect occurred unexpectedly in the Group & Rehearse-Serial condition. This may possibly be explained by the extent to which performance is affected by the amount of compatibility between the input- and output-instructions a point which will receive further elaboration in a later chapter of the thesis. In the Control-Serial and Control-Dump condition the output instructions may have interferred with subjects' own organization of the material thus overriding the effect of arousal. Subjects in the Group & Rehearse condition however, were induced by instruction to rehearse, a strategy which in itself should be more compatible with a morning strategy and presumably also with a test of serial recall.

Studies by Hockey, Davies & Gray (1972) and Jones, Davies, Hogan, Patrick & Cumberbatch (1978) (Experiment 7) suggest the effects of time of day on memory may be restricted to the recency items. Folkard however, argues that it is unlikely the effect of time of day on the immediate memory for information presented in prose (Folkard et. al. 1977; Folkard & Monk, 1980) could be accounted for by variation in primary rather than secondary memory.

In order to investigate further the relationship between time of day and the serial position curve, he tested subjects on immediate recall of 15 four letter words following presentation at 8.00, 11,00, 14.00, 17.00 and 20.00 hours and after twenty minutes of visual matching following presentation of the material at 11.00, 14.00, 17.00 and 20.00 hours (Folkard & Monk 1979).

No effect of time of day was obtained on the number of items recalled in immediate memory but recall from the recency position showed a different trend to recall from the pre-recency positions, and separate analyses of these revealed a significant effect of time of day on recall from both. Recall from the recency positions was lower at 11.00 than at 14.00 or 20.00 hours and recall from the pre-recency positions showed a slight (nonsignificant) improvement from 8.00 to 11.00 hours followed by a significant decrease at the later times of day.

No significant effect of time of day was obtained for the total number of words recalled, or the number of words recalled from the recency or pre-recency positions following a 20-minute delay.

In a second experiment subjects were presented with six lists of 15 words at 10 am or 4 pm following standard recall instructions or instructions to count repeatedly from 1 to 10 during presentation at a rate of two digits per second in time to a metronome (articulatory suppression). Again the immediate free recall of words from the pre-recency positions was better in the morning than the afternoon, and this effect disappeared after a 20 minute delay and under articulatory suppression. It was concluded that the nature of the processing of pre-recency items changes systematically over the day with greater reliance being placed on maintenance rehearsal in the morning and elaboration processing in the afternoon, an explanation which can also account for the greater effect of articulatory suppression on immediate recall in the morning.

Further support for the above hypothesis was obtained by Folkard (1979b). In an experimental paradigm essentially similar to that of Baddeley (1966), subjects were shown five words from a set of eight and asked to place them in their original order of presentation given a display of all eight words. As predicted, acoustic similarity had a greater detrimental effect on performance in the morning than the afternoon and the reverse was true for items of semantic similarity.

2.5 Time of Day and the Arousal Theory

Recently, studies of time of day have thrown further light on the inadequacy of the unidimensional model of arousal. Folkard & Monk (1978 & 1980) showed 50 female nurses a 10-minute film on Radium Therapy. Twenty-six subjects were shown the film at 8.30 pm and 24 subjects at 4.00 am. Each of the experimental groups included subjects who were either adjusted or not adjusted to nightwork and all subjects were tested immediately and after a delay of 28 days. Contrary to expectations, there was no significant difference between the early morning and evening presentation on immediate recall unless subjects were divided into those least adjusted and those most adjusted to shift work. The former showed a morning superiority and the latter an evening superiority while performance on delayed retention went in the anticipated direction regardless of circadian adjustments, suggesting short- and long-term memory may adjust at different rates to shift work. Similar results were obtained by Akerstedt & Levi (1978) who found different rates of adjustment of the circadian rhythms in the secretion of adrenalin and nor-adrenalin to a shift in the sleep - wake cycle. Thus it has been argued that a dissociation of two rhythms which are normally in phase suggests they may be mediated by different circadian factors and according to Folkard these results necessitate a multifactor model where rhythms adjusting rapidly to a shift in the sleep - wake cycle are thought to be governed by exogeneous factors (e.g. sleep and eating times) and those adjusting slowly to be governed predominantly by endogeneous ones.

A few multidimensional systems of arousal have been suggested mainly by Berlyne (1967), Broadbent (1971), Routtenberg (1968) and Thayer (1978). The models proposed by Broadbent (1971) and Thayer (1978) will be considered briefly in view of their relevance to the present review.

With reference to a wide selection of behavioural studies of noise, heat, sleeplessness, incentive, personality and time of day, Broadbent (1971) concluded that the unidimensional model of arousal cannot account for the available data, and in the same vein proposed an alternative model with a lower level mechanism concerned with the execution of well-established decision processes and a higher level mechanism which monitors and alters the parameters of the lower level in order to maintain constant performance. Folkard (personal communication) takes this argument a step further by speculating that "the Upper system is responsible for the immediate memory results and is relatively exogenous, while the Lower system is responsible for the effects on delayed retention and is relatively endogenous".

Because of the problems of interpretation associated with directional fractionation Thayer (1978) suggested self-report might be a better indicator of generalized arousal than a single psychophysiological measure. Thayer proposed two separate energizing dimensions A: Energy - Sleep and B: Tension - Placidity which he believes are necessary to account for most behavioural variations in arousal. Dimension A is briefly defined as underlying many aspects of cognitive activity, particularly verbally oriented processes and it varies in a circadian rhythm with the general sleep-waking cycle. Dimension B underlies emotion and stress reactions and is related to anxiety and the effects of at least one external stressor i.e. noise, (Thayer, Anderson, Spadone & White, 1970). During high tension and also in conditions of high energy and vigour dimension A and B are negatively correlated a suggestion which is similar to that of Duffy (1957) regarding internal arousal and overt activity.

Thayer (1967 and 1978) found that the peak in self-rated arousal occurs considerably earlier than that in body temperature, a finding which represents further problems for the arousal theory, particularly since the majority of studies using subjective ratings of arousal have obtained similar results (Akerstedt, 1977; Clements, Hafer & Vermillion 1976; Folkard, Glynn & Lloyd 1976; Folkard, Monk & Lobban, 1978; and Taub & Berger, 1974).

Thus besides its being plagued with arguments of circularity there is also a considerable amount of evidence which cannot be accounted for by the unidimensional model of arousal. Up until now the theory has generated a great deal of research and its application has made important contributions to several areas of psychology. In view of the evidence however, a new approach is needed where attempts are made to elucidate some of the underlying physiological and/or psychological mechanisms responsible for the experimental results.

2.6 Noise

(i) Noise and Arousal

By way of introducing the literature on noise a brief examination of its 'arousing' qualities would seem to be in order.

A variety of noises e.g. buzzers, alarms, music, pure tones and white noise (produced by a mixture of different frequencies of the same intensity) have been studied experimentally and a distinction is usually made between impulsive or sudden, intermittent and continuous noise.

Whilst a number of physiological changes may be observed in response to a sudden noise, the ear will adapt fairly quickly to continuous noise. The use of short bursts of sound may to some extent overcome this adaptive process by way of allowing some recovery without complete return to baseline and thus retain the effect of the noise for a longer period of time. The influence of intermittent noise however, is dependent on the intensity of the noise and the interstimulus interval (Davis, Buchwald & Frankman, 1955; Epstein & Fenz, 1970; and Grings & Schell, 1969), but unfortunately these studies were concerned primarily with the adaptive process of a repeated stimulus and not with the arousing qualities of the noise.

The aural reflex (adaptation to prevent ear damage from prolonged exposures) has been demonstrated in animals (Buchwald & Humphrey, 1972), and in man Fletcher, 1961; Fletcher & Riopelle, 1960) and studies using continuous noise have indicated that there is little definite evidence to suggest that noise alone produces prolonged physiological arousal beyond an initial startle (Black 1964; and Furchtgott & Black 1963). However, when noise is used in combination with a task the situation appears to be somewhat different.

It is well-established that performance on a variety of tasks produces increased physiological activity (Bradshaw, 1968; Chase, Graham & Graham, 1968; Davis, 1938; Malmo & Davis, 1956; Thackery, Jones & Touchstone 1973). Due to their interactive qualities however, it is more or less impossible to distinguish the physiological effects of noise from those produced by the task, a situation which appears to justify further an approach in terms of behavioural as well as physiological measures. Thus for example, in "Decision and Stress" Broadbent (1971) compares the effects of noise and sleeplessness and quotes studies by Corcoran (1962) and Wilkinson (1963) which suggest that noise and sleeplessness cancel each other out when applied together. Furthermore, Broadbent & Gregory (1965) observed a deterioration in vigilance performance with noise for frequent signals only, whilst Corcoran (1963) found sleeplessness impaired performance for signals with a low event rate. According to Broadbent

(1971): "Sleeplessness and noise appear consistently however to be opposite to one another. It seems clear that we cannot therefore maintain the 1958 view that noise has its effect by being a distracting stimulus: rather it must be taken as changing some general state of the organism, just as sleeplessness does. Noise moves this state in one direction, and sleeplessness in the opposite direction, " (p. 411). Broadbent goes on to call this general state of the system 'arousal', although with reference to a selection of behavioural studies he also concludes that the unidimensional model of arousal cannot account for the available data.

Similarly, in a review of the physiological and psychological influences of noise Davies (1968) suggested the positive effects of noise on performance may be explained in terms of arousal although "this does not mean that increasing the level of arousal is the only effect of noise: depending on the task, on the environmental situation in which the task is performed and on the individual, noise can be an activator, or distractor or an overactivator, and a drain on spare mental capacity", (p. 230).

(ii) Attentional Selectivity

In spite of its theoretical inadequacies the inverted-U has been used both as a predictive and explanatory concept and Kahneman (1973) attempted to explain the detrimental effects of high and low arousal in terms of different mechanisms. He suggests the failure of under-aroused subjects is due to lack of effort, assuming that subjects cannot try as hard on a relatively easy task unless they are provided with some form of internal or external motivation. The detrimental effects of over-arousal however, is attributed to a change in the allocation of capacity which may cause a decrement in the performance of certain tasks. This is in line with Easterbrook's (1959) suggestion that emotional arousal has the effect of "restricting the range of cue utilization," an hypothesis which has been supported by earlier and later studies concerned with the effects of arousal on attention to peripheral and central stimuli (Bahrick, Fitts & Rankin, 1952; Bruning, Capage, Kozuh, Young & Young 1968; Bursill, 1958; McNamara & Fisch, 1964; Reeves & Bergum, 1972). In the study by Bahrick et. al. (1952) subjects were asked to monitor the occurrence of occasional lights in the visual periphery whilst performing a continuous tracking task, and increased monetary incentive for both tasks improved performance on the central task but impaired performance on the peripheral monitoring task. Also, Bursill (1958) suggested the impaired peripheral detection in high arousal may not occur in situations where the peripheral task was being emphasized, a suggestion which received some support from the results obtained by Reeves & Bergum (1972).

Hockey (1970a) used loud noise (100 dB compared with 70 dB 'quiet') and found it improved tracking performance (the primary task), and the detection of centrally located lights but impaired the detection of peripherally located lights. It was suggested that the centrally located lights may be attended to more often in noise either because of their physical location or their high subjective probability of providing signals. A second experiment (Hockey 1970b) revealed a differential effect of noise for central and peripheral locations when the central signals were seen to have a greater probability of occurrence but not when an equal number of signals were seen at all locations supporting the subjective probability hypothesis.

Hockey also argued that if selectivity is increased by arousal - inducing treatments, it should be reduced by conditions thought to lower the level of arousal, and a third experiment (Hockey 1970c) did indeed show that sleeplessness impaired tracking performance and the monitoring of centrally located lights but not the monitoring of peripherally located lights.

Recently, Forster & Grierson (1978) failed to replicate Hockey's results thus questioning the reliability of his findings. They performed four experiments none of which produced the attentional selectivity found by Hockey (1970). In a reply to Forster and Grierson, Hockey (1978) pointed out that their 'replication' included a number of procedural differences two of which might have been of some importance in determining the results. Firstly, different noise levels were used. Due to more severe regulations concerning hearing risks Forster & Grierson were forced to use 70 dB continuous broadband noise of 62.5 - 4 kHZ in the quiet and 92 dB in the noise condition whilst Hockey used 70 and 100 dB respectively. Secondly, Forster & Grierson used a more difficult tracking task where subjects only managed scores of 30 - 40 percent time on target compared with 60 - 70 percent time on target in Hockey's experiments. "If the tracking task is specified as 'primary' and subjects are achieving 60 - 70 percent time on target there is every reason to believe it will retain its pre-emptive control of attentional resources whereas 30 - 40 percent may not be enough to convince subjects that it is such an important activity", (p. 502). It seems possible therefore, that the primary task was regarded as less important by subjects in Forster & Grierson's experiments thus influencing their results.

Although Easterbrook's hypothesis has been supported by a number of different studies involving heat stress (Bursill, 1958), noise (Hockey, 1970), anxiety (Zaffy & Bruning 1966) and stimulant drugs (Callaway & Stone 1960), Kahneman (1973) points to certain limitations of the hypothesis. "First, it implies the unlikely idea that the difficulties of the under-aroused, drowsy subject result from an excessive openness to experience. Second, it suggests that concentration is highest when arousal is high. This is contrary to every-day observation, which indicates that a state of high arousal is associated with high distractibility", (p.40). Hartley & Adams (1974) did indeed find increased Stroop interference in 100 dBC noise compared with a quiet 70 dBC noise condition. (They used broadband noise with a constant energy between 50 - 4000 Hz per cycle). However, a brief 10 minutes exposure to noise was beneficial and decreased interference whilst a long 30 minutes exposure increased interference suggesting a cumulative adverse effect of noise. The situation therefore appears to be rather complex allowing for the possibility that performance is sensitive to a number of variables such as the level of noise, the exposure time and the type of task used. For example, in contrast to Hartley & Adams's Stroop experiment, subjects in the tracking studies were specifically asked to give priority to the tracking task whilst monitoring a different secondary task. Thus noise may increase the tendency to focus on a few relevant cues when these are available, but the extent to which it does so may further depend on their degree of dominance or relevance and the extent to which they are interferred with by other more or less dominant aspects of the task situation. As far as noise is concerned then the task requirement appears to be of some importance and this will be given further consideration in subsequent chapters of the thesis.

Regarding Kahneman's suggestion that it is unlikely the difficulties of the under-aroused drowsy subject results from an excessive openness to experience, the reader's attention is directed to the purely anecdotal evidence that artists sometimes find it easier to work in a state of sleep deprivation. It may be because they are more open to unusual ideas or impressions in this state.

In the following section the generality of Easterbrook's hypothesis will be examined further in the light of experiments performed on noise and memory.

2.7 Noise and Memory

In a test of Easterbrook's hypothesis Hockey & Hamilton (1970) asked subjects to recall eight bisyllabic adjectives in their original order of presentation. Each word was shown in one of four corners of a screen and noise (80 versus 55 dB quiet) improved performance on order recall but produced a significant impairment in the recall of locations supporting an interpretation in terms of a redirection of attention in noise.

Davies & Jones (1975) repeated the same experiment with two additional experimental conditions; an incentive and an incentive plus noise condition. Like Hockey & Hamilton they obtained significantly lower scores on the location measure in noise than in quiet but contrary to Hockey & Hamilton they found no effect of noise on ordered recall.

No significant differences were obtained between the quiet and the combined incentive plus noise condition except that the control group tended to be better on the location measure - a difference which nearly reached significance at the .05 level of significance suggesting that noise and incentive are not additive in their effects upon selectivity.

The incentive group produced higher scores on ordered recall than the control group but no differences were found between the location measures of the two groups suggesting that incentive may allow increased selectivity without a reduction in attentional capacity, whereas in noise it appears increased selectivity occurs together with and possibly as a result of reduced attentional capacity. Contrary to Davies & Jones (1975), Bahrick et. al. (1952) found an improvement in central task efficiency with a loss of peripheral monitoring when monetary incentive was provided. The discrepancy between the results of these two experiments could be due to differences in experimental procedure or task requirements and suggests that noise and incentive may also be similar in their effects upon performance.

Niemi, von Wright & Koivunen (1977) attempted to replicate Hockey & Hamilton's (1970) findings, and found noise had little or no effect on the incidental learning of item location. In an immediate recall test noise tended to increase the number of words recalled in their original order but the results did not approach statistical significance. However, some evidence for a detrimental effect of noise on the recall of incidental material was found over a 24 hour retention interval, (i) when the subjects did not attempt to memorize but were trying to assess the readability of words presented upside-down and (ii) when old-age pensioners were used as subjects. Niemi et. al. concluded that it was doubtful whether noise has any appreciable detrimental effects on incidental learning except in conditions approaching information overload. "Taking Kahneman's (1973) "allocation policy" model of the relation between arousal, information content and selective attention as a starting point, one may speculate that loud noise perhaps gives rise to task-irrelevant internal cues, the ignoring of which requires some effort. This tends somewhat to reduce the subject's capacity for processing other cues. Whether or not this in its turn, leads to a reallocation of attention in the way suggested by Hockey & Hamilton (1970) - i.e. to an allocation away from the low - priority task components - may depend on the characteristics of the task and, in particular, on the information load of the main task", (p.13). Hamilton, Hockey & Rejman (1977) did indeed find that white noise impaired performance on a task with high memory load. They varied storage load and transformation requirement in a transformation task where subjects had to respond to a letter with a letter following it in the alphabet some specified number of places later.

Fowler & Wilding (1979) performed three experiments in an attempt to test Davies & Jones' finding that noise reduces attentional capacity whilst incentives increase it against Hamilton, Hockey & Quinn's (1972) suggestion that noise increases attentional capacity. Hamilton et. al. based their conclusion on an experiment where noise (75 versus 55 dB quiet) improved the recall of paired associates provided the items were tested in their original order of presentation, suggesting the increased capacity was used to process additional order cues.

The first experiment reported by Fowler & Wilding was similar to that of Hamilton et. al. except they used a 2 x 2 design with monetary incentive instead of noise. Each subject was asked to remember eight three letter nonsense words and their corresponding colour. The experimenter would read out the colours (in fixed or random order) and the subject was required to respond with the appropriate stimulus word. As predicted subjects in the fixed order incentive condition recalled significantly more words than subjects in the other three experimental conditions. The authors concluded that the results may be explained both in terms of increased capacity or "a redirection of attention from other aspects of the situation to cues relevant to the task".

Two additional experiments were performed to test whether incentive and noise would increase the tendency to use a retrieval cue other than order when no instruction to do so and no consistent order cues were given. The subjects were shown a list of eight words presented in one of eight different spatial locations and shown twice in a different order. At the test trial subjects were given all the list items and asked to recall their spatial locations. The mean number of locations recalled in three experimental conditions; incentive at learning and recall, incentive at recall only and a control condition improved with incentive whilst performance in noise (60, 80 and 100 dB), went in the opposite direction with impaired performance in loud (100 dB) noise. These results support Davies & Jones' finding that noise reduces attentional capacity whilst incentive increases it. However, as pointed out by Fowler & Wilding "an explanation simply in terms of reduced capacity under noise does not explain the increased use of order cues in noise as found by Hockey & Hamilton (1970), Hamilton et. al. (1972) and Daee & Wilding (1977)", (p.153).

Perhaps most relevant in this context is Dornic's (1973) suggestion that noise may have a similar effect to that of increased task difficulty inducing subjects to rely more on a "lower order" learning strategy. He found that increased task difficulty had little effect on the retention of items in correct order, but reduced the probability of recall when the order was not retained. Dornic tested subjects' performance on a tracking and simultaneous memory task for consonants and digits in four experimental conditions. Each message consisted of 7-items (4 digits and 3 consonants) and the subject either had to

(i) Attend to the tracking task during the presentation of the memory task but not during recall.

(ii) Attend to the memory task only (the control condition).

(iii) Attend to the tracking and memory task during presentation and test.

(iv) Attend to the memory task at presentation and both tasks at recall.

The tracking task was defined as the more important task and subjects were instructed to fully concentrate on it.

Thirty messages were presented in each experimental condition and subjects had to recall each message immediately after its presentation. Performance in the four conditions was tested following free recall instructions or instructions to recall the items in their original order of presentation. No effect of instruction occurred and the data for the two instructional conditions were therefore combined. The percentage of messages in which all the items were recalled regardless of order (score A), the percentage of correctly recalled messages with items in the right order (score B) and the percentage of messages in which all the items were recalled with items in the wrong order (score C) were calculated. Groups 2 and 4 did better than groups 1 and 3 respectively on measure A, a difference which was due primarily to an increase in the recall of messages with items in the wrong order. The retention of list items in the correct order showed no statistically significant differences across the four experimental conditions. Dornic concluded that "The lower overall performance in conditions TM (i) and TT (iii) appears to be caused by the fact that the retention of item information was bound to the retention of order information; having forgotten the order, the subject lost at the same time a great deal of item information", (p.123) Thus Dornic argues that noise or increased task difficulty encourages subjects to use a more primitive "parotting back" form of learning inducing them to rely more on order information.

(i) Strategic Changes in Noise

Daee & Wilding (1977) reported seven experiments concerned with the effect of white noise (Quiet, 75 and 85 dB) on a number of short-term memory tasks. Free recall of 40 words was found to decrease in 85 dB noise while recall of items in their original sequence increased and recall by category decreased at an intermediate noise level (75 dB). Similarly, recall of the original sequence (as shown by the ability to give in response to a word the word which immediately followed it in the original list) was superior in 75 dB. It was argued that noise affects the strength of the memory trace and the interconnections established between the items; "At an intermediate level of noise, traces are of optimal duration to establish a connection with the trace of the next item when it arrives, without becoming connected to traces of later items . . . . At still higher levels of noise, traces last longer, and more interconnections develop and therefore compete with each other", (p.346). This is contrary to Hamilton, Hockey & Rejman's (1977) suggestion that noise speeds up the rate of information processing at the expense of a reduced short-term store.

Whilst Dornic found little or no effect of task difficulty on the retention of items in their original order, Daee & Wilding (1977), Hamilton et. al. (1972), Hockey & Hamilton (1970) and Millar (1979), all obtained results where high intensity white noise tended to improve the retention of order information. However, by requiring subjects to remember consonants and digits Dornic may have induced a greater reliance on order cues generally and possibly also a ceiling effect for this type of information although admittedly there are some experiments which have not produced an effect of noise on ordered recall (Davies & Jones, 1975; Haveman & Farley, 1969; and Murray, 1965).

Wilding & Mohindra (1980) suggest the results of Daee & Wilding (1977) implies a less efficient working memory (Baddeley & Hitch 1974) and a more efficient articulatory loop which is explicable in terms of increased rehearsal in noise. However, Folkard makes the opposite prediction for time of day (i.e. afternoon presentation), and Poulton (1977) argues that noise suppresses inner speech. According to Wilding & Mohindra noise should have a similar effect to that produced by suppression of rehearsal if noise suppresses the articulatory loop; it should impair ordered recall (Healy, 1975; Millar, 1979; and Murray, 1967), remove the advantage of acoustically dissimilar lists (Healy, 1975; Murray, 1967) and impair free recall of items from the beginning of the list (Richardson & Baddeley, 1975).

They tested memory for sequence by asking subjects to recall five letters in their original order of presentation when the set of letters was known beforehand. Their results revealed that suppression of rehearsal (saying 'the' continuously during list presentation) impaired performance on both acoustically confusable and non-confusable lists while loud noise (85 dBC compared with 65 dBC quiet) during presentation improved performance on the acoustically confusable lists in the no-suppression condition but had no effect in the suppression conditions. It does not appear therefore that noise suppresses inner speech since noise and suppression affected performance differently. Contrary to noise which improved performance at a slow presentation rate (one item every 2 seconds), articulating the items aloud during list presentation improved performance at a fast rate (one item every ½ second) and impaired it at a slow rate possibly because articulation interfered with a more appropriate rehearsal strategy at the slow rate while noise left subjects free to adopt the best internal strategy. On the whole the authors concluded that noise and articulation encourage maintenance rehearsal at the expense of elaboration rehearsal.

Also, in a recent experiment Millar (1979) obtained results where noise improved performance of order recall relative to quiet when subjects were forced to count rapidly from 1-7, suggesting that noise may perhaps make subjects more impervious to the effects of suppression.

Thus if by inducing subjects to use a lower order memory strategy noise directs attention towards order information, it should reduce the amount of semantic processing performed on the input. Daee & Wilding (1977); Hörmann & Osterkamp (1966), and Smith (1978), did indeed obtain results where noise reduced the amount of category clustering in free recall, and Schwartz (1974a) obtained a highly significant interaction between noise and type of material in a free recall task where noise had no effect on the recall of semantically similar items but improved performance for unrelated and phonemically related words. Similarly, Schwartz (1975), suggested highly aroused subjects (as indicated by extraversion and neuroticism scores) tended to rely more on the physical than the semantic aspects of a task.

Stevenson, Hockey, Crome & Gunnell (1979), tested immediate memory for information presented in a story and found noise (88 dBA versus 50 dBA quiet) significantly impaired performance, further supporting the notion that higher order semantic processing is less likely to occur in noise.

Smith, Jones & Broadbent and Smith & Broadbent (papers submitted) however, question the view that noise always produces a shift in favour of physical rather than semantic attributes. In a series of experiments they investigated the effects of noise on free recall of dominant and non-dominant instances of various categories. According to their results category clustering was not reduced in noise and the interaction between noise and dominance was not statistically significant. In one experiment subjects carried out different classification tasks concentrating on physical or semantic aspects of the task and again no effect of noise on clustering emerged and the interaction between noise and type of encoding was not significant.

Recently, Craig, Humphreys, Rocklin & Revelle (1979) varied stimulus instead of response similarity and failed to replicate Schwartz's results. Similarly, the early experiments on the effect of arousal on short- and long-term memory are difficult to reconcile with the findings of less semantic processing in noise.

Mueller, Carlomusto & Marler (1977) suggest high anxiety induces maintenance rather than elaboration processing allowing for the possibility that maintenance rehearsal does not necessarily imply a lack of semantic processing only a reduction in the number of associations or relations made between items. According to their results anxiety reduced the amount of clustering by phonemic and semantic similarity implying a lack of elaboration at both levels rather than a lack of semantic processing per se. Similarly, Mueller (1979) and Mueller & Courtois (1980) concluded it is elaboration or breadth of encoding rather than depth alone which is affected by anxiety.

Clearly it is necessary to test the efficiency of semantic processing more directly than in the above experiments where subjects had a choice of strategy and the absence of semantic processing does not necessarily prove inability to process information semantically if this is required by the task.

In a more direct test of semantic processing Eysenck & Eysenck (1979) used a form of Sternberg's (1966) search task in which subjects were presented with a set of words (memory set) then a single target word and asked to say whether the target was present in the memory set or not. In one version a physical match was required and in the other the memory set consisted of category names and subjects had to say whether the target was a member of one of the categories in the memory set. Extraverts and introverts showed no difference in performance on the first task but on the second task the decision times of introverts increased more rapidly as the size of the memory set increased.

Similarly, Schwartz (1979) presented pairs of words and required subjects to respond positively in the case of physical identity (e.g. deer-deer), homophone identity (e.g. deer-dear) or category identity (e.g. deer-elk) and the difference in response between introverts and extraverts increased from the physical to the category matches in the direction of Eysenck & Eysenck's (1979) results.

As well as manipulating subject arousal Eysenck & Eysenck included variation in the level of white noise and found no significant effects of 85 dB noise on response latencies. In the same vein Wilding & Mohindra (unpublished study) examined the effect of three levels of white noise on a task similar to that used by Eysenck & Eysenck (1979), except that their semantic task required judgements of synonymity. No effect of noise was obtained on semantic processing supporting the notion that noise and personality affect performance differently. These results also suggest the reduced category clustering observed in noise must be due to an optional strategy of reduced semantic processing or reduced elaboration in processing, a conclusion which is similar to that of Mueller's regarding anxiety.

2.8 The Relevance of Retrieval

The present review has been concerned almost exclusively with manipulations occurring at the input stage. According to M.W. Eysenck (1974; 1975), however, the processes involved in the retrieval of information should also be accounted for. Eysenck (1974b; 1975a), tested performance on a semantic memory task using a recall and recognition paradigm where subjects had to produce a word from a specified category starting with a particular letter e.g. 'fruit-A' (recall), or they had to respond 'yes' if a category name was followed by a member of that category, and 'no' if it was not, (Recognition). Subjects judged high on arousal responded fastest on the recognition trials (i.e. the easy task), while the relationship between arousal and speed of recall was affected by the dominance of the information tested, with high arousal subjects producing a faster response for dominant items. Similarly, in a study of paired-associate learning Eysenck (1975b), found that highly aroused subjects tended to recall the responses from highly associated pairs faster than low-arousal subjects, whereas intermediate subject arousal led to the fastest production of responses from a second list involving response competition. To look at response competition Eysenck (1975) used an A-B, A-Br transfer paradigm where the stimuli and responses of a first list are re-paired to form a second list. Thus high subject arousal appears to facilitate the retrieval of relatively dominant information but has a slowing effect on the retrieval of non-dominant information.

With respect to noise however, Eysenck (1975a), found no selective influence of 80 dB white noise upon high or low dominance latencies in a semantic recognition task similar to that described previously although he did find that noise inhibited the recall speed of low dominance items, suggesting noise may have a different effect on recall and recognition.

According to Millar (1979) the recognition task used by Eysenck is not one of pure recognition because it requires a decision about the word's category membership as well as a judgement of its simple name identity. Millar therefore proposed semantic word recognition be re-examined using simple recognition and a wider separation of dominance levels. He used a modified recognition - threshold procedure where the test-word was back-projected and rendered completely undecipherable until the projector gradually brought it into focus and subjects vocalized the word when confident of its identity. Separate groups performed the task in 95 dBA noise or 70 dBA quiet and on half of the trials the test-word's category membership was revealed before its presentation. The recognition of semantically low dominance items was not significantly impaired by noise but the recognition of high dominance words was reliably faster in noise "indicating the vulnerability of even recognition's small retrieval component to arousal".

The failure to find inhibited low dominance recognition in noise is explained by recourse to Eysenck's (1975a) point concerning the relative availability of retrieval cues in semantic recognition where the displayed test word provides more retrieval cues to its memory location than the provision of its initial letter in recall thus rendering word retrieval faster. Millar argues the "provision of such useful retrieval cues in recognition might mitigate any potential difficulty in retrieving low dominance information in noise which would otherwise arise from the hypothesized concentration upon more dominant material", (p.234-235).

With respect to time of day Folkard & Monk (1980) failed to obtain an effect of time of presentation on a category instance generation task where subjects were given five minutes to write down as many instances as possible from two categories printed at the top of a page. Six pairs of categories approximately matched for the number of common instances, were used and subjects were tested at three hourly intervals from 8.00 to 23.00 hours.

Similarly, school-children's delayed retention of information presented in prose was uninfluenced by whether the test was administered at the original time of presentation or not, suggesting there is no effect of time of day on the ability to retrieve information from long-term memory. In the latter experiment Folkard & Monk examined performance by means of a recognition memory task, namely a multiple-choice questionnaire, and Millar, Styles & Wastell, (1980) suggested the sensitivity of their retrieval measure could be sharpened by considering retrieval latency instead of retrieval probability. They tested three separate groups on a semantic classification task at 09.00, 14.00 or 18.00 hours and the difficulty of retrieval was varied by requiring classification of words having 'high', 'medium' or 'low dominance' in given semantic contexts. A category name was presented on each trial followed by a test word and subjects were required to say 'yes' if the test word was a member of the category or otherwise respond by saying 'no'. Retrieval efficiency (as defined by a decreasing difference in latency between high- and low-dominance classification speed) was greater for the subjects performing at 18.00 hours indicating that retrieval latency in a long-term semantic classification task does vary as a function of time of day.

Whilst Eysenck and Millar attribute the effects of subject-arousal, noise and time of day on the recall speed of items from long-term memory to an effect of these on the search process, it is also possible they may have influenced the subjects' degree of caution. For example Gillespie & Eysenck (1980) obtained results supporting the notion that introverts adopt a more stringent response criterion than extraverts. Similarly, Schwartz (1974b) found noise influenced the signal detection parameters d' and β in a probed-recognition test of memory for surnames where subjects were required to give confidence judgements to probe items in a transcript of a passage originally heard in noise. In quiet subjects employed a significantly more cautious criterion for rare names than for common names while they tended to employ a similar response criterion for both classes of stimuli in noise. The parameter d' showed an increased sensitivity in noise for common names.

Broadbent & Gregory (1965) also found that noise had an effect on subjects' criteria on confidence judgements of events presented in a vigilance task. In quiet subjects tended to show intermediate levels of confidence while they adopted judgements at more extreme levels of confidence in noise. The tendency for β to diminish for rare names and increase for common names was interpreted by Schwartz in terms of Broadbent's (1971) application of 'pigeon-holing' strategies in memory, supporting the hypothesis that arousal improves pigeon-holing in conditions favouring cautious responding and impairs it in conditions favouring risky responding.

However, both in terms of hit rate and d' Schwartz found that performance tended to be superior for common names. This is contrary to Ingleby (1969), who found d' was greater for rare names and Rabinowitz, Mandler & Patterson (1977), who obtained results where the recognition of items with low taxonomic frequency was significantly better than that involving items of high taxonomic frequency. A second discrepancy concerns the interaction of changes in β with d'.

Schwartz suggested the changes in d' in noise could be due to masking of the auditorily presented prose passage and Jones & Thomas (1978) proposed to test this hypothesis by presenting the material visually instead of auditorily. They asked two groups of subjects to read three short stories each containing four main characters (two with common and two with rare surnames) whilst listening to 85 or 60 dBA white noise. Each subject was then given a response booklet with copies of the three stories where four surnames and two single words were underlined and asked to produce confidence ratings as to whether these had been included in the original story or not.

Analysis of the d' data revealed the d' values for rare surnames were significantly greater than for common surnames and d' for common surnames was significantly greater than for synonyms. The absence of any effect of noise on d' suggests the results of Schwartz may have been caused by peripheral masking. For β the only significant effect was an interaction between noise and type of stimulus which appeared to be due to a significant drop in β for rare surnames in the noise condition. This was taken to support Schwartz's findings and strengthen Broadbent's assertion that noise produces an effect on pigeon-holing (response selection) rather than filtering (stimulus selectivity).

Contrary to Schwartz however, Jones & Thomas (1978) obtained a modest decline in β for common surnames in noise. Since their β values for common surnames in quiet were similar to those found by Schwartz for rare surnames, they suggested the possibility that initial levels of β in quiet influence the direction of changes due to noise. "That is, high β values in quiet lead to increased risk in noise, and low β values in quiet lead to decreased risk when noise is introduced", (p.8) which is contrary to the view that noise strengthens the most dominant response tendency.

In conclusion, the overall picture would seem to suggest that noise increases selectivity by directing attention towards dominant sources of information, increases reliance on order information and sometimes reduce the amount of category clustering in free recall although it does not seem to seriously impair semantic processing when this is required by the task.

In Chapter 3 a framework for new research will be presented and further comments will be made on some of the experimental findings discussed in Chapter 2.

CHAPTER 3

INTRODUCTION TO THE EXPERIMENTS - THEORETICAL BACKGROUND

It has become clear from physiological (Lacey 1967) and psychological evidence (Broadbent 1971; Eysenck & Folkard 1980; Folkard 1981; and Thayer 1978), that the unidimensional model of arousal no longer provides an adequate explanation of the relationship between arousal and performance.

Arousal is typically defined as a non-specific increment in physiological activity and is thought to increase over the day, with noise, heat, incentive, introversion, neuroticism and anxiety whilst sleeplessness and depressant drugs are thought to decrease it.

Although the hypothesized inverted-U relationship between arousal and performance has been obtained in a number of studies a major criticism directed towards these results is that usually only two or three data points are sampled along the arousal continuum. Also, it is difficult to know exactly where to place the various arousers on this continuum since discrepant results have been obtained both within and between arousers. Thus for example, noise has been found to improve performance on some occasions and impair it on others, presumably depending on the type of subject and the type of task used. The arousal theory therefore, is capable of explaining a great deal which at the same time makes it rather less useful as a predictor of performance.

A consideration of separate arousers may further illustrate the complexity of some of the underlying relationships which are thought to contribute towards the overall arousal level. While noise and time of day will be discussed in greater detail in the experimental section, there are a couple of points regarding personality which may be of some relevance here. For example, Revelle, Humphreys, Simon & Gilliland (1980) obtained results suggesting the subscales of introversion-extraversion, impulsivity and sociability were differently affected by time of day and caffeine. They attributed the phase difference in circadian rhythms between introverts and extraverts (Blake 1967b) primarily to the impulsivity component of introversion-extraversion but did not take into account neuroticism scores. This is unfortunate since a re-analysis of Blake's data by Colquhoun & Folkard (1978) has shown the phase difference between introverts and extraverts to be most marked in subjects scoring high on the neuroticism scale.

Similarly, factor-analytic investigations of the Taylor Anxiety Questionnaire (TAQ) suggest that test anxiety may be divided into two separable components of worry and emotionality where worry represents concern for one's level of performance and emotionality represents the autonomic response to anxiety (Liebert & Morris 1967; Doctor & Altman 1969). According to Morris, Brown &

Halbert (1977), and Sarason (1975), worry is the stronger determinant of poor performance and appears to affect performance by distracting attention away from task relevant sources of information which is contrary to the effects of noise and time of day where arousal is thought to direct attention towards dominant aspects of the task, (Bahrick et. al. 1952; Folkard 1980; Hockey 1970a; Hockey & Hamilton 1970).

Clearly, the situation is more complex than allowed for by the unidimensional model of arousal and further analysis of the underlying mechanisms of each arousal manipulation appears to be required. Folkard & Monk's (1978;1980) observation that short- and long-term memory adjust at different rates to a shift in the sleep-waking cycle strongly suggests a multidimensional approach is required, and similar suggestions have been made by Berlyne 1967; Broadbent 1971; Routtenberg 1968; and Thayer 1978. There is also a strong possibility that different arousers interact with one another to produce similar or different effects upon performance depending on a number of physiological and psychological factors some of which will be considered in the experimental section of the thesis.

With respect to memory processing strategies a comparison of some of the theoretically more important arousal manipulations reveals a number of discrepancies with different arousers giving rise to different results. Folkard (1976; 1979; 1981) and Folkard & Monk (1978) have suggested subjects engage in maintenance rehearsal in the morning (low arousal), and elaboration processing in the afternoon (high arousal). On the contrary, the results obtained by Schwartz (1975) suggest highly aroused subjects (as indicated by introversion and neuroticism scores), rely more on the physical than the semantic aspects of a task. Similarly, Mueller (1979) concluded that "relative to low-anxiety subjects, high anxiety subjects can be characterized as encoding fewer semantic features, encoding less elaboratively, and being less flexible in utilizing alternative memory strategies", (p.288). Also, high intensity white noise appears to increase subjects' reliance on order information (Daee & Wilding 1977; Dornic 1973; Hamilton, Hockey & Quinn 1972; Hockey & Hamilton 1970; Wilding & Mohindra 1980) and reduce the amount of category clustering in free recall, (Daee & Wilding 1977; Hörmann & Osterkamp 1966; and Smith 1978). Although, when subjects were forced to process information semantically noise did not appear to influence response latency (Eysenck & Eysenck 1979; Wilding & Mohindra, paper submitted), suggesting it does not seriously impair semantic processing.

Eysenck & Eysenck (1979) and Eysenck (1975a; 1975b) also obtained different results for noise and introversion - extraversion on a memory search task and a semantic recall/recognition task supporting the notion that noise and personality affect performance differently.

A complete theory of arousal therefore, must allow for qualitative and quantitative differences both between arousers and tasks and possible interactions between them. Thus it is of some importance to compare performance across arousers and tasks and to look for similarities and differences between them.

This is, of course, beyond the scope of a thesis and the present research is limited to the effects of noise and time of day on processing strategies in recall and recognition.

3.1 Differences between Recall and Recognition in Response to Arousal

Inspection of the literature suggests there are discrepancies in the way in which recall, recognition and paired associate learning are influenced by various arousal manipulations. For example, it has been found that at a short retention interval high arousal has a facilitatory effect on free recall (Corteen 1969; Maltzman, Kantor & Langdon 1966; Sampson 1969; Schwartz 1975 although Daee & Wilding 1977 found the reverse) and recognition (Archer & Margolin 1970; Schwartz 1974b; Wesner 1972), and a detrimental effect on paired associate learning (Howarth & Eysenck 1968; Kleinsmith & Kaplan 1963; and McLean 1969).

Similarly, M.W. Eysenck (1975a) found noise inhibited the recall speed of low dominance items but had no effect on high or low dominance items in a semantic recognition task suggesting noise affects recall but not recognition performance. A strong interactive relationship between noise and self-reported activation for the recall results was also obtained where both high and low levels of arousal were associated with poor levels of performance while no interactive effects of noise and activation were found on the recognition scores suggesting noise may have affected the retrieval component of recall.

However, these results are limited to the retrieval of information from semantic memory while in episodic memory retrieval is likely to be determined predominantly by the way in which information has been coded at the input stage. An alternative approach therefore would be to look at the effect of noise on processing strategies induced by recall and recognition test expectations.

Firstly however, it seems appropriate to briefly summarise the assumed differences between recall and recognition memory and the relevance of these to the present research. Basically, there are two approaches to this problem. One which is concerned primarily with differences between the two types of test and the extent to which they are affected by experimental manipulations of word frequency, list organization, intentional and incidental learning. Thus for example, intentional learning and list organization are usually found to improve recall but not recognition performance (Bruce & Fagan 1970; Estes & Dapolito, 1967; and Kintsch 1968). Recognition performance on the other hand, is thought to depend on elaboration coding of individual items which in turn should maximize item discriminability.

Generally, one would expect subjects to encode information in a manner consistent with the test requirements organizing items for recall in order to facilitate retrieval, and maximizing item discriminability in recognition. An alternative approach therefore, has been to concentrate on how recall and recognition test expectations may influence the information encoding stage. In this type of study subjects are told to expect a recall (or recognition) test and are then given the different unexpected recognition and/or recall test.

According to the results of these experiments recall and recognition instructions appear to differ in the extent to which they induce rehearsal with subjects expecting a recall test tending to engage in more active processing than subjects expecting a recognition test, (Hall, Grossman & Elwood 1976; Hall, Miskiewicz & Murray 1977; Maisto, Dewaard & Miller 1977; and Loftus 1971).

Both these approaches therefore, suggest the major difference between recall- and recognition-instructed subjects lies in the extent to which they spontaneously rehearse.

In terms of the arousal literature which has been largely concerned with rehearsal strategies in short-term memory the above distinction is potentially useful because it allows a comparison of tasks with different rehearsal requirements. Thus apart from being of interest in its own right this approach may also provide answers to some rather interesting questions such as:

i) Does noise increase rehearsal regardless of the task requirement? In other words, does noise improve the recall of both recall- and recognition-instructed subjects particularly in the beginning of the list or are the instructions important in determining the extent to which it does so?

ii) Secondly, do the instructions interact with time of day? According to Folkard (1976; 1979; 1981) and Folkard & Monk (1978) subjects engage in maintenance rehearsal in the morning and elaboration processing in the afternoon. This suggests the difference between recall- and recognition -instructed subjects should be smaller in the morning than in the afternoon, assuming the recall performance of subjects expecting a recognition test indicate the extent to which they spontaneously rehearse.

It is difficult to make any predictions with respect to elaboration processing since it is possible little elaboration can be done on lists of unrelated words, except maybe for elaboration rehearsal or the elaboration of individual items engaged in by subjects in the recognition condition.

iii) A third point of interest is whether noise and time of day interact differentially with recall and recognition test expectations.

Also, arousal has been found to direct attention towards the most dominant source of information (Bahrick et. al. 1952; Folkard 1980; Hockey 1970a; and Hockey & Hamilton 1970). The present approach should reveal for noise and afternoon presentation at least, whether they direct the subjects' attention towards the most dominant strategy in which case the free recall performance of subjects expecting a recall test should improve while that of subjects anticipating a recognition test should tend to become worse.

Before proceeding with these experiments however, it is considered necessary to test further the extent to which recall- and recognition-instructed subjects differ in the degree to which they spontaneously rehearse. Presumably this may be best achieved by looking at the serial position effect in studies testing free recall and the retention of order.

3.2 Rehearsal and the Serial Position Effect

Immediate free recall usually yields the classical serial position curve with improved performance of the first and the last few items and a flat middle portion. It has been suggested by Waugh & Norman (1965) that the primacy effect is attributable to rehearsal or to long-term memory while the last few words are thought to be retrieved from a short-term limited capacity store. In the beginning of the list few items are competing for the subject's attention and these items are likely to receive a good deal of rehearsal which in turn should strengthen the memory trace. Furthermore, it is possible they are maintained in rehearsal as later items are being shown thus gaining rehearsal at the expense of items from the middle of the list.

The primacy effect is characteristic of most free recall and paired-associate data except when subjects are instructed not to rehearse or to concentrate on each item separately (Raffel 1936; Waugh & Norman 1965). By investigating subjects' rehearsal procedures Rundus (1971) also found the number of rehearsals tended to decrease steadily as a function of serial position.

In addition there is some evidence that terminal list items appear early in recall (Shuell & Keppel 1968). Several studies have shown that the usual recency effect is not obtained or is strongly diminished when subjects are forced to recall the early items first (Deese 1957; Murdock 1963; Raffel 1936; and Tulving & Arbuckle 1963; 1966). This suggests the recall of earlier items may interfere with the retention of items from the end of the list thus supporting the notion that the latter are retained in a limited capacity short-term store. Craik (1970) also found that words recalled late in immediate recall had the highest probability of retrieval on a second recall session suggesting they were retained in a more permanent long-term store.

The first four studies were designed primarily to test differences in rehearsal between subjects with recall and recognition test expectations. In view of previous discussions ordered- and free recall were chosen as the most suitable measures of retention where the primacy effect should indicate the extent to which subjects have spontaneously rehearsed. Also, factors affecting rehearsal should tend to show their effects mainly in the early part of the word list.

CHAPTER 4

. INFLUENCES OF TEST EXPECTATIONS ON MEMORY PROCESSING STRATEGIES IN RECALL AND RECOGNITION (EXPERIMENTS 1 - 4).

Previous investigations have suggested that subjects expecting a recall test engage in more active processing or rehearsal than subjects expecting a recognition test, (Hall, Grossman & Elwood, 1976; Hall, Miskiewicz & Murray, 1977; Loftus, 1971; Maisto, Dewaard & Miller, 1977). If recall instructions lead to increased rehearsal of items in blocks, recall-instructed subjects should retain more words in their original order than subjects anticipating a recognition test. An experiment was designed to test this hypothesis whereby subjects were presented with a list of twenty unrelated nouns and then asked to place the words in their original order of presentation. One advantage of this design is that both instructional groups are given the same unexpected test, contrary to previous experiments where recognition instructed subjects have been presented with a more difficult unexpected recall test.

An additional experimental manipulation was whether subjects knew the number of words in the list or not. It was assumed that knowledge of the number of words in the list would strengthen the tendency to concentrate on an appropriate strategy for the expected test and thus enhance the difference between recall and recognition instructions.

4.1 EXPERIMENT 1

Method

Subjects

Eighty subjects, all sixth formers with a mean age of 16.5, were assigned randomly to one of four experimental conditions.

Materials

Twenty unrelated nouns with a frequency of 50 per million were selected from the Thorndike & Lorge (1944) word count. Word frequency according to Kucera & Francis (1967) ranged from 2-130. Each word was printed in upper-case letters and presented on a memory drum with one word presented every two seconds (each word thus being exposed for approximately 1½ seconds). Following list presentation the same words were shown on individual 7.6 x 6.4 cm cards.

Design and Procedure

A 2 x 2 factorial design was used with instructions and knowledge of the number of words in the list as the two factors.

Each subject was seated at a desk and informed that he/she would be shown 20 words (knowledge) or some words (no knowledge) in the window of the memory drum. Subjects in the recall condition were then led to believe they would be given a free recall test whilst subjects in the recognition condition were told they would be shown some 'old' and 'new' words printed on individual cards, and that their task would be to pick out the words they recognized as having been presented previously.

Following list presentation, all subjects were shown the same 20 words typed on cards and arranged randomly in two rows on the desk in front of them. They were then asked to place the words in their original order of presentation and allowed a maximum of five minutes to do so.

Results

The numbers of words remembered in correct sequence (following the same word in recall as in the presentation list), correct position and both correct sequence and position from four serial position blocks of five words were calculated for each experimental condition. The means are shown in Table 1.1. A 2 x 2 analysis of variance with instruction by knowledge collapsed across serial position blocks, yielded a significant main effect of instruction only for the correct sequence and position data (F (1,76) = 5.19, $p < .05$), the recall-instructed subjects placing significantly more words in their original sequence and position than the recognition-instructed subjects.

The interactions between instruction and knowledge were significant at the .05 level of significance using one-tailed tests for the number of words remembered in correct sequence (F (1,76) = 3.59), and the number remembered in correct sequence and position (F (1,76) = 3.55). As predicted knowledge of the number of words in the list enhanced the instruction effect.

*Unless otherwise specified all significant effects have two-tailed p values.

TABLE 1.1

Mean number of words placed in correct sequence, correct position and correct sequence and position in four serial position blocks of five words following recall (RC) and recognition (RN) instructions (Experiment 1).

	Serial Position	1		2		3		4	
	Instructions	RC	RN	RC	RN	RC	RN	RC	RN
Correct	Knowledge	1.60	.75	.35	.35	.45	.15	.20	.45
Sequence	No Knowledge	1.15	1.05	.40	.50	.15	.45	.35	.55
Correct	Knowledge	2.85	1.95	.25	.15	.15	.25	.25	.25
Position	No Knowledge	2.15	1.95	.25	.10	.10	.25	.20	.45
Correct	Knowledge	1.55	.55	.05	0	0	0	0	0
Sequence	No Knowledge	.90	.80	0	0	0	0	0	0
& Position									

Table 1.1 shows that the difference between recall and recognition instructions was confined to the knowledge condition and the first five words in the list (block one). The interaction between instruction, knowledge and serial position was not tested statistically because of the floor effects in serial position blocks two to four. However, in order to determine whether the effect of instruction was primarily due to differences in the early serial positions, an analysis of variance (2 x 2) was repeated on the results in serial position block one, and a significant main effect of instruction was obtained for the correct sequence and

position data (F (1,76) = 4.85, $p < .05$). The interaction between knowledge and instruction was significant at the .05 level for correct position (F (1,76) = 4.84, $p < .05$), and at the .05 level of significance using a one-tailed test for the number of words placed in correct sequence (F = 3.65) and correct sequence and position (F = 3.24).

As already pointed out all scores were low over the last three serial position blocks, differences between the conditions were minimal and statistical tests inappropriate due to the floor effects.

Discussion

The results of Experiment 1 support the hypothesis that subjects expecting a recall test rehearse or code more items in their original order than subjects expecting a recognition test. However, the effect of instruction was mostly confined to serial position block one, suggesting that recall-instructed subjects initially attempt to use a more active rehearsal strategy, but are unable to maintain this level of activity throughout list presentation, possibly because there is a limit to how many items can be rehearsed at any one time.

Knowledge of the number of words in the list enhanced the difference between the two instructional conditions in serial position block one, but the generally poor performance of subjects in both conditions indicates that rehearsal does not necessarily result in complete retention of order information.

Whilst supporting the experimental hypothesis, the results of Experiment 1 also raise the question of whether a free recall test would produce a similar pattern of results. Fischler, Rundus and Atkinson (1970) suggested that the primacy effect in free recall results largely from a greater number of rehearsals given to earlier items. They found that fixed rehearsal (vocal rehearsal of the current item) reduced the primacy effect compared with silent study and free rehearsal of any item in the list.

Assuming that recall-instructed subjects initially use a more active rehearsal strategy, their free recall performance should yield a larger primacy effect than that of subjects expecting a recognition test. The next experiment attempted to test this hypothesis.

4.2 EXPERIMENT 2

Method

Subjects

Forty undergraduates from Hatfield Polytechnic were assigned randomly to one of four experimental conditions. Time of day was approximately balanced across conditions with six subjects tested in the morning (10 a.m. - 1 p.m.) and four in the afternoon (2 - 5 p.m.) in each group.

Materials

Two lists of 20 unrelated nouns with a frequency ranging from 20 to 100 (list 1), and 13 to 100 (list 2), per million were selected from the Thorndike & Lorge (1944) word count. Word frequency according to Kucera & Francis (1967) ranged from 11-83 (list 1) and 10-83 (list 2). The two lists were matched for word length and the first letter of each word.

The words were printed in uppercase letters and presented for two seconds each by means of a Kodak Carousel S AV 2000 projector with an attached timer. The recognition test included 40 words (20 from each list).

In addition to a recall and recognition test subjects were asked to indicate whether they used one or more of the following learning strategies:

1. Rehearsed the words in groups of two or more
2. Concentrated on one word at a time
3. Connected the words by making up a story
4. Made up images of each word

Methods 1 and 2 are most relevant to the present hypothesis and their order of presentation in the questionnaire was counterbalanced across the experimental conditions.

Design and Procedure

A 2 x 2 factorial design was used with instruction and test-order as the two main factors, and the two word lists assigned equally often to the four experimental conditions.

Each subject was seated at a desk and shown a list of 20 words after he/she had been given the appropriate recall or recognition instructions. Half of the subjects were then presented with a recognition test followed by a recall test or a recall test followed by a recognition test.

All subjects were allowed 1½ minutes in which to complete a free recall test, and 1½ minutes to circle the words they recognized amongst a set of 20 'old' and 20 'new' words in a recognition test. Special effort was made to equate the instruction time of the expected and unexpected tests following the learning trial. On completion of the two tests subjects were given a brief questionnaire on processing strategies.

Results

The numbers of words recalled and recognized from four serial position blocks of five words was calculated for each experimental condition and the mean scores are shown in Tables 2.1 and 2.2 respectively.

Figure 2.1 represents the mean number of words recalled in four serial position blocks of five words and a 2 x 2 x 4 analysis of variance (instruction by test order by serial position), performed on these results produced a significant main effect of instruction (F (1,36) = 4.33, $p < .05$), and serial position (F (3,108) = 9.49, $p < .01$).

TABLE 2.1

Mean number of words recalled from four serial position blocks of five words.

Serial position		1	2	3	4
Recall	Recall-Recognition Test	3.3	2.0	2.3	1.8
Instructions	Recognition-Recall Test	3.4	2.2	1.6	2.1
Recognition	Recall-Recognition Test	2.6	1.8	1.4	2.1
Instructions	Recognition-Recall Test	2.6	1.7	1.4	2.1

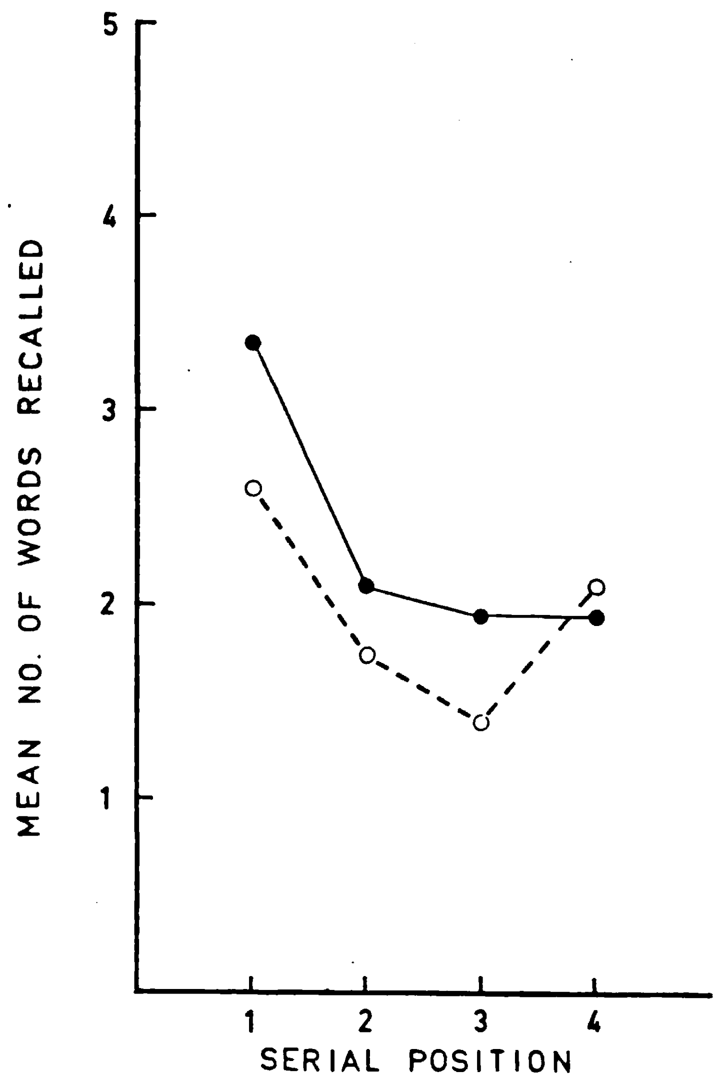

FIGURE 2.1

Mean number of words recalled from four serial position blocks of five words following Recall (●——●) and Recognition (○- - -○) Instructions.

TABLE 2.2

Mean number of words recognized from four serial position blocks of five words

Serial position		1	2	3	4
Recall	Recall-Recognition Test	4.3	3.5	3.9	3.9
Instructions	Recognition-Recall Test	4.1	3.9	3.3	4.0
Recognition	Recall-Recognition Test	3.8	4.3	3.7	3.6
Instructions	Recognition-Recall Test	4.4	3.8	3.7	3.8

There was no significant effect of test order and the overall interaction of instruction and serial position was not significant ($\underline{F}(3,108) = 1.093$, $p > .05$). The prediction that recall-instructed subjects would show greater superiority early in the list was tested by a planned comparison within that interaction comparing the difference due to conditions in serial position block 1 with the difference in blocks 2, 3 and 4 combined. This planned comparison was not significant ($\underline{F}(1,108) = 1.44$, $p > .05$). However, separate t-tests between the two instruction conditions for each serial position block did show a significant effect of instruction ($p < .05$) for block 1 only ($t(38) = 2.39$, 0.86, 1.62, 0.39 for the four blocks), giving some support to the prediction.

A 2 x 2 x 4 analysis of variance (instruction by test order by serial position), performed on the number of words recognized from four serial position blocks of five words, yielded no significant effects of instruction, test order or serial position and none of the interactions was significant. Similarly, a 2 x 2 analysis (instruction by test order), on the total number of words recognized minus false alarms, produced non-significant results.

The numbers of words recalled from the four serial position blocks of five words was calculated for each list in four experimental conditions and a 2 x 2 x 2 x 4 analysis of variance (instruction by test order by list by serial position) was performed on these results in order to test whether the type of list used may have influenced the results. However, no significant main effect of list was obtained and none of the interactions involving list as a factor approached statistical significance.

The chi-squared technique was used to test for a relationship between instruction, test order and the number of subjects who reported having "rehearsed the words in groups of two or more". Whilst no significant association was found between instruction and rehearsal, the analysis of test order just reached significance at the .05 level of significance (χ^2 (1) = 3.84, $p < .05$), indicating that subjects are more likely to say they have rehearsed following a recall-recognition than a recognition-recall test order. This suggests that self-reports may be influenced by variables occurring at the test stage and consequently should be interpreted with caution.

Discussion

The results of Experiment 2 produced a significant main effect of instruction on recall but not on recognition performance, the recall-instructed subjects performing significantly better than the recognition-instructed subjects. This result was similar to that of Experiment 1, but in the present experiment the superiority of recall-instructed subjects was not restricted so clearly to the first five words. Considering the nature of the two tests it was not unexpected that the effect of instruction was more evenly distributed across serial position blocks in Experiment 2.

In conclusion, the results of Experiments 1 and 2 suggest the difference between recall and recognition instructions may be attributed to increased rehearsal particularly in serial position block one, by subjects expecting a recall test.

An alternative interpretation has been advanced by d'Ydewalle (1979). In a design essentially similar to that of Experiment 2, he presented subjects with one, two or five lists of 10 words followed by a recall and a recognition test. In accordance with the present results d'Ydewalle also found that the anticipation of a recall test produced a larger primacy effect than the anticipation of a recognition test (except when four lists preceded), while no effect of test expectations was obtained on the recognition scores.

In a further experiment subjects were presented with a recognition test including 30 new and 10 old items, and their reaction times were measured. Again test expectancy did not influence accuracy measurements, but the reaction time data revealed significantly faster responses for subjects expecting a recall test. It was concluded that because the recall-instructed subjects expect a more difficult test they make more effort to search and retrieve from long-term memory, and this difference in effort between the two conditions was just enough to influence the response latency, but failed to change the recognition accuracy.

Similarly, the primacy difference between recall and recognition instructions was explained in terms of differing amounts of effort at retrieval. This is contrary to the present conclusion where the primacy difference was attributed to differing amounts of rehearsal at input.

If the primacy difference is caused by increased rehearsal at input, it should be possible to displace it to a different part of the list by asking subjects in the recall condition to rehearse specific items in serial position blocks two, three or four. The purpose of Experiment 3 was to test this hypothesis, and the serial position data of a standard recognition group was compared to that of a recall group specifically instructed to rehearse items in serial position blocks two (and three).

4.3 EXPERIMENT 3

Method

Subjects

Twenty undergraduates from Bedford College, London, were assigned randomly to one of two experimental conditions, eight males and two females in each condition, half of which were tested in the morning and the afternoon.

Materials

Forty unrelated nouns with a frequency of 50 per million were selected from the Thorndike & Lorge (1944) word count. Word frequency according to Kucera & Francis (1967) ranged from 18 to 114.

Half of the words were presented on a memory drum with a presentation rate of one word every two seconds, and the other half were used as fillers in a subsequent recognition test. The recognition and target items were approximately matched for frequency, word length and the first letter of each word.

In order to enable subjects in the recall condition to distinguish between serial position blocks one and two the first and the last five words in the list were typed in uppercase and the middle ten items printed in lowercase letters or vice versa. In accordance with the two previous experiments, subjects in the recognition condition were shown the twenty words typed in capital letters.

Design and Procedure

Two independent groups of ten subjects were tested on recall and recognition performance following standard recognition instructions and recall instructions to rehearse selectively items in serial position blocks two and three.

Each subject was seated at a desk in front of the memory drum and shown a list of 20 words after he/she had been given the appropriate recall or recognition instructions. Subjects in the recall condition were told they would be asked to do a free recall test and then presented with the following instructions to rehearse; "During list presentation I would like you to rehearse certain words in the list. You should start rehearsing when the letter type changes from uppercase to lowercase (or lowercase to uppercase) and try to rehearse as many of the words in lowercase (uppercase) letters as you can. By rehearsing I mean silently repeating two, three or more words together as the list proceeds". In order to allow for individual differences in short-term memory capacity, subjects were asked to rehearse as many of the lowercase (uppercase) letters as they could whilst it was assumed that most subjects would be unable to include many of the items from serial position block three.

Subjects in the recognition condition were told they would be shown a list of 'old' and 'new' words and asked to circle the items they recognized from the previous list presentation.

Following presentation of twenty words, subjects were allowed four minutes in which to complete a free recall and subsequent recognition test, (two minutes per test).

Results

The numbers of words recalled and recognized from four serial position blocks of five words, were calculated for each of the two experimental conditions, and the mean scores are shown in Tables 3.1 and 3.2 respectively. The mean number of words recalled in four serial position blocks of five words are shown in Figure 3.1 and a planned comparison on the difference between recall and recognition instructions in serial position block two against that in serial position blocks one, three and four was significant at the .05 level of significance ($\underline{F}$ (1,54) = 5.21, $p < .05$), thus supporting the experimental hypothesis.

No effect of instruction was found when the same analysis was applied to the recognition scores, $\underline{F}(1,54) = 3.28$, $p > .05$.

TABLE 3.1

Mean number of words recalled from four serial position blocks of five words.

Serial Position	1	2	3	4
Recall Instruction	2.3	2.9	1.7	2.0
Recognition Instruction	1.9	1.3	1.5	2.3

TABLE 3.2

Mean number of words recognized from four serial position blocks of five words.

Serial Position	1	2	3	4
Recall Instruction	3.7	3.6	3.1	2.7
Recognition Instruction	3.8	3.0	3.7	4.1

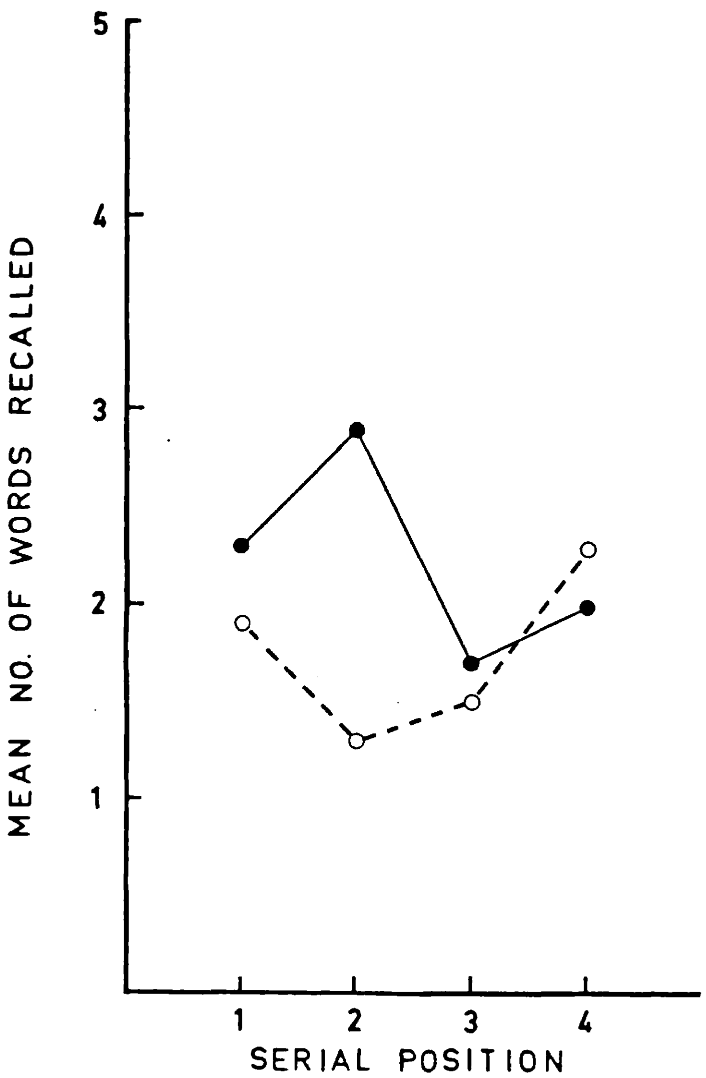

FIGURE 3.1

Mean number of words recalled from four serial position blocks of five words following Recall (●——●) and Recognition (○- - -○) Instructions.

Discussion

The results of Experiment 3 demonstrate that the primacy difference betweeen recall and recognition instructions can be displaced to a different part of the list by asking subjects in the recall condition to selectively rehearse items in serial position block two, suggesting that it may be due to differing amounts of rehearsal at input.

This is at odds with d'Ydewalle's suggestion that the primacy difference in free recall is due to differing amounts of effort at retrieval. However, it would seem unlikely that increased effort per se can produce superior recall regardless of the degree to which an item has been coded at the input stage. One way of testing the extent to which successful retrieval depends on the amount and type of effort produced at the input and the test stage respectively, would be to compare the relative importance of instructions presented before and after list presentation. A fourth experiment examined this possibility using standard free recall instructions and instructions to concentrate on items in serial position blocks two to three either at word presentation or at the test stage. It was assumed that the input-instructions would influence the structure of the memory trace and consequently also have a greater effect on performance than instructions presented at the retrieval stage.

An explanation in terms of the Von Restorff (1933) effect cannot be ruled out for the results of Experiment 3, though the lists involved a change in a series of items, whereas the Von Restorff effect usually involves improved performance on a single distinctive item in a homogeneous list. Nevertheless, subjects in the recall condition were required to rehearse specifically items printed in a different type case, possibly confounding the effect of instruction with that of list appearance since recognition-instructed subjects were shown a homogeneous list. However, if the results of Experiment 3 were due to this effect, a similar pattern of results should be obtained in all four experimental conditions of Experiment 4 regardless of instructions.

4.4 EXPERIMENT 4

Method

Subjects

Forty subjects, none of which had taken part in any of the previous experiments, were selected from the student population of Bedford College, London, and assigned randomly to one of four experimental conditions. Seven males and three females were tested in each condition and time of day was balanced across conditions with five subjects tested in the morning and the afternoon.

Materials

Subjects were presented with the same list(s) of twenty nouns used in the recall condition of Experiment 3.

Design and Procedure

A 2 x 2 experimental design was used with two sets of instructions at input and test. Prior to list presentation subjects were presented with standard recall instructions or instructions to concentrate on itemsin serial position blocks two to three. All subjects were first given the same standard free recall instructions and informed that "during the presentation of the words you will find that some words are printed in capital letters and some are not, this is to mark the beginning, middle and end of the list. The first and the last few words in the list will be printed in lowercase (uppercase) letters and the middle items in uppercase (lowercase) letters". Subjects in the second group were then told "to concentrate on the words in the middle part of the list and make a special effort to remember these".

Following list presentation half of the subjects were told "Now your task is to write down as many words from the whole list as you can. Could you please make a special effort to remember as many words as possible", whilst the other half received the following instructions: "Although your main task is to write down as many words as you can from the whole list could you please make a special effort to remember the middle items".

Results

The mean number of words recalled and recognized from four serial position blocks of five words are shown in Tables 4.1 and 4.2 respectively. Figure 4.1 represents the mean number of words recalled from four serial position blocks of five words and a 2 x 2 x 4 analysis of variance (input instructions by test-instructions by serial position), performed on these results yielded a significant main effect of serial position ($F(3,108) = 6.224$, $p < .01$), and a significant interaction between input instructions and serial position ($F(3,108) = 4.21$, $p < .01$). Subjects in the standard recall condition remembered fewer words in serial position block two than subjects in the focussed recall conditions, regardless of test instruction. None of the effects involving test instruction approached statistical significance. Thus the suggestion is supported that the instructional differences are due to differing amounts of rehearsal at input and not to retrieval strategies.

A planned comparison on the difference between the two sets of input instructions in serial position block two against that in serial position block one, three and four was significant at the .01 level of significance ($F(1,108) = 7.69$, $p < .01$), further supporting the experimental hypothesis.

No effect of a change in type case was found for either group with standard recall instructions, ruling out an explanation in terms of the Von Restorff effect for the results of Experiment 3.

TABLE 4.1

Mean number of words recalled from four serial position blocks of five words.

Serial Position		1	2	3	4
Standard Free Recall	Free Recall Test	2.6	1.9	1.8	1.6
Instructions	Focussed Recall Test	2.7	2.1	.9	2.4
Focussed Recall	Free Recall Test	1.8	2.7	1.8	1.6
Instructions	Focussed Recall Test	2.5	3.3	1.9	1.5

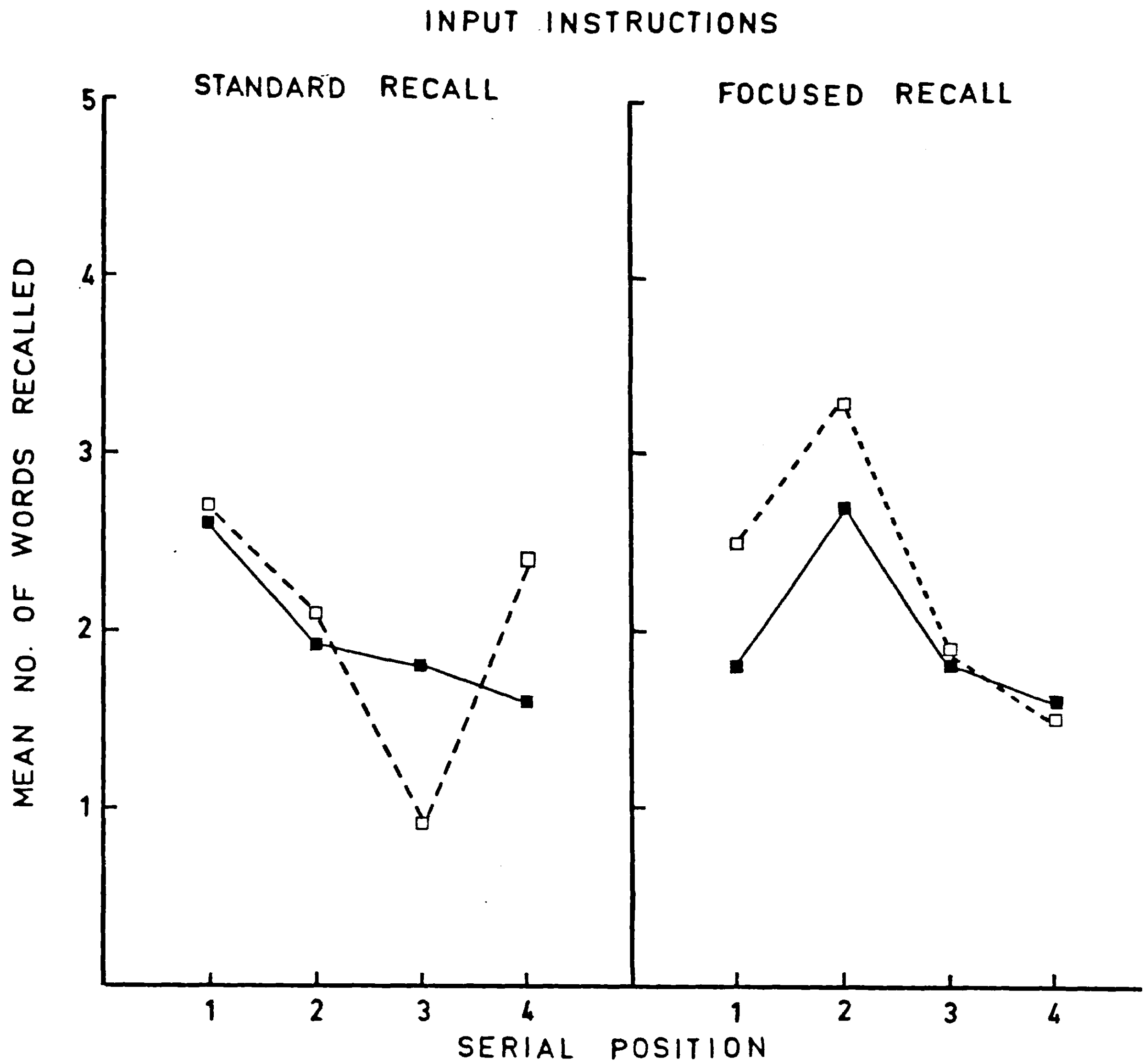

FIGURE 4.1
Mean number of words recalled from four serial position blocks of five words following Focused □---□ and Standard Recall ■—■ instructions at test.

TABLE 4.2

Mean number of words recognized from four serial position blocks of five words.

Serial Position		1	2	3	4
Standard Free Recall	Free Recall Test	3.8	3.3	2.9	2.5
Instructions	Focussed Recall Test	3.9	3.6	2.5	2.4
Focussed Recall	Free Recall Test	3.1	3.7	3.7	2.5
Instructions	Focussed Recall Test	4.1	4.5	3.3	2.5

General Discussion

Previous experiments have suggested that subjects expecting a recall test generally rehearse more than subjects expecting a recognition test. When a direct test of order recall was used (Experiment 1), the difference in performance between recall and recognition instructions was confined to the first five words in the list suggesting that recall-instructed subjects initially attempt to use a more active rehearsal strategy, but are unable to sustain this level of activity throughout list presentation.

Presumably the number of processing strategies available to subjects anticipating a free recall or a recognition test of unrelated words is rather limited, and rehearsal appears to be adopted spontaneously by recall- and recognition-instructed subjects alike, as evidenced by the serial position data of Experiments 1 and 2 where both types of instructions produced primacy effects, albeit of a different magnitude. In Experiment 2 the recall-instructed subjects performed significantly better overall and particularly on the early items further supporting the results and conclusion of Experiment 1.

In a third experiment the primacy difference was displaced and confined to serial position block two following recall instructions to selectively rehearse items in this part of the list, further suggesting that the difference between recall and recognition instructions is mostly due to varying amounts of rehearsal by subjects in the two experimental conditions.

Finally, the results of the last experiment (Experiment 4), indicate that the instructions at stimulus presentation influence the structure of the memory trace and consequently also performance on a free recall test.

The serial position curves of subjects asked to rehearse items in serial position block two (Experiment 3), and subjects asked to concentrate on items in this part of the list (Experiment 4) are almost identical, suggesting that subjects in both experiments engaged in rehearsal at this point during list presentation. The apparently spontaneous rehearsal of recall-instructed subjects in Experiments 1, 2 and 4 also suggest rehearsal may be a more integral part of the recall than recognition test expectations presumably because it helps to link items and facilitate retrieval. This is further supported by the finding that rehearsal affected recall but not recognition performance which is consistent with the results of experiments where intentional learning (Estes & Dapolito, 1967), and list organization (Bruce & Fagan, 1970; and Kintsch, 1968), was found to influence recall but not recognition performance.

Thus the remarkable insensitivity of the recognition scores to the experimental manipulations in Experiments 2, 3 and 4 suggests rehearsal does not affect recognition performance, possibly because of the nature of the recognition test.

It has been proposed earlier by Bahrick (1979) and Hasher & Zacks (1979) that recognition performance predominantly depends on automatic processing, a suggestion which is partially supported by the present results. According to Hasher & Zacks (1979) "Operations that drain minimal energy from our limited capacity attentional mechanism are called automatic; their occurrence does not interfere with other ongoing cognitive activity. Automatic operationsfunction at a constant level under all circumstances. They occur without intention and do not benefit from practice". "Contrasted with these processes are effortful operations such as rehearsal and elaborative mnemonic activities. They require considerable capacity and so interfere with other cognitive activities also requiring capacity. They are initiated intentionally and show benefits from practice," (p.356).

Hasher & Zacks suggest that frequency sensitivity and word meaning which are of importance for successful performance on a recognition test are automatically encoded. However, in the present experiments the limited primacy effects of recognition-instructed subjects in Experiment 2 and 3 do imply some effortful processing on the part of these subjects, if primacy effects are attributable to rehearsal.

Also temporal information is thought to be automatically encoded although the type of temporal information considered is rather different from that referred to in the present study. In their article they quote an experiment by Zimmerman & Underwood (1968) where the expectation of two temporal tests did not improve subjects' ability to judge the relative temporal position of 12 word lists or selected items within the lists, suggesting this information was processed automatically even when the test was not expected. However, all subjects expected a free recall test and presumably rehearsed to some degree, in which case there is no proof that encoding of order was automatic, and the test for order was much less stringent than in the present case, since only two items within each list had to be placed in temporal order. Hence this evidence would not seem to contradict the present conclusion that expectation of recall involves an active encoding of the sequence of items early in the list and that this occurs to a much lower degree when recognition is expected.

CHAPTER 5

EXPERIMENTS ON TIME OF DAY

According to the results of Experiments 2 to 4 rehearsal does not affect performance on a recognition test. Similarly, the finding that recall-instructed subjects spontaneously rehearsed more than subjects expecting a recognition test supports the notion that rehearsal is a more dominant feature of recall than recognition test expectations.

The next study took advantage of these findings in order to test whether subjects spontaneously rehearse more in the morning than the afternoon.

It has been suggested by Folkard (1976; 1979; 1981) and Folkard & Monk (1978) that subjects place greater reliance on maintenance rehearsal in the morning and elaboration processing in the afternoon. Thus for example, Folkard has shown there is a greater detrimental effect of suppression and acoustic similarity of items in the morning and of semantic similarity in the afternoon. Also, delayed retention is superior following afternoon presentation.

In terms of the experimental paradigm previously used in Experiment 2, it is suggested that the free recall performance of subjects expecting a recognition test should indicate the extent to which they spontaneously rehearse when rehearsal is not required by the task. Thus little or no difference in recall performance should be obtained between recall- and recognition-instructed subjects in the morning. Performance in the afternoon however, should become worse for subjects in the recognition condition if elaboration coding of individual items is more compatible with an afternoon strategy. For recall-instructed subjects on the other hand, a tendency to engage in elaboration processing may possibly enhance their performance on a free recall test at this time of day.

In memory research a distinction has indeed been made between two types of rehearsal; maintenance rehearsal when items are simply maintained and no permanent change in memory occurs, and elaboration rehearsal when items are elaborated on by certain features being abstracted or related to other types of incoming information. There is no sharp dividing line between these however, and it is somewhat difficult to know the extent to which subjects are engaging in either type of processing or both. Thus for example, Craik (1979) has suggested the possibility of "a continuum of rehearsal operations running from the minimal processing necessary to repeat a word continuously to various types of elaborative processing involving either further enrichment of one item or associative linkage of several items", (p.84).

A third experimental manipulation included in Experiment 5 is suppression of rehearsal. According to previous studies, suppression should have a more detrimental effect in the morning than the afternoon and presumably also in the beginning of the list and for subjects expecting recall.

5.1 EXPERIMENT 5. TIME OF DAY AND TEST EXPECTATIONS IN RECALL AND RECOGNITION (1).

Method

Subjects

The subjects were 80 undergraduate and post-graduate students from Bedford College, London; six males and four females assigned to each experimental condition with extraversion and neuroticism (EPI) scores approximately balanced across the eight conditions.

Apparatus and Materials

Forty unrelated nouns with a frequency of 50 per million were selected from the Thorndike & Lorge (1944) word count. Word frequency according to Kucera & Francis (1967) ranged from 2-130. Half of the words were presented on a memory drum with a presentation rate of one word every two seconds and the other half were used as fillers in a recognition test where subjects were asked to rate 40 words on a five-point scale:

QUITE CERTAIN you have not seen the word before	NOT CERTAIN but think you have not seen the word before	DON'T KNOW whether you have seen the word before	NOT CERTAIN but think you have seen the word. before	QUITE CERTAIN you have seen the word before
I	II	III	IV	V

The recognition and target items were approximately matched for frequency, word length and the first letter of each word.

Design and Procedure

A 2 x 2 x 2 factorial design was used with instruction, suppression and time of day as the main factors. Ten subjects were tested in each experimental condition and each subject was assigned randomly to the morning (10 am - 1 pm) or the afternoon (3 - 5 pm).

Each subject was seated at a desk and informed that he/she would be shown twenty words in the window of the memory drum. Subjects in the suppression condition were then given the following instructions: "For every new word that appears I would like you to say the word 'The' loud - not the word in the list just 'The' so you will be saying 'The' 20 times as there are 20 words in the list."

Next subjects were presented with the appropriate recall or recognition test instructions. The recall instructions were as follows: "When we have gone through the list of 20 words I will switch off the memory drum and ask you to recall as many of the words as you can possibly remember. The recognition instructions were: "When we have gone through the list of 20 words I will switch off the memory drum and show you some cards with words printed on. These are the same words as those presented on the memory drum plus a new set of words. The words will be shown one at a time and your task will be to write down those words you recognize as having been presented previously."

After the presentation of the last word all subjects were asked to perform a free recall test, the subjects in the recognition condition being told that "Before we go any further I would like you to write down as many of the words as you can possibly remember". Subjects were allowed 1 minute and 50 seconds in which to complete the recall test and were then presented with the following recognition test;

"Now I will show you some cards with words printed on. These are the same words as those presented on the memory drum plus a new set of words. The words will be presented one at a time and I would like you to write each word in the appropriate column of this five-point scale (the experimenter displaying the recognition sheet) indicating whether you are Quite certain you have not seen the word before, Not certain but think you have not seen the word before, Don't know whether you have seen the word before or not, Not certain but think you have seen the word before, Quite certain you have seen the word before."

Results

The numbers of words recalled and recognized from four serial position blocks of five words was calculated for each experimental condition and the mean scores are shown in Table 5.1 and 5.2 respectively.

TABLE 5.1

Mean number of words recalled from four serial position blocks of five words.

Time of Day	MORNING				AFTERNOON			
Serial Position	1	2	3	4	1	2	3	4
Instruction								
Recall/No Suppression	3.3	1.3	1.8	1.7	3.4	2.0	1.7	2.3
Recall/Suppression	2.4	1.4	1.4	1.8	3.3	1.4	1.2	1.8
Recognition/No suppression	2.7	1.4	1.3	2.8	2.4	1.3	.7	1.9
Recognition/Suppression	2.0	1.3	2.0	2.1	2.2	1.6	1.0	1.9

TABLE 5.2

Mean number of words recognized from four serial position blocks of five words

Time of Day	MORNING				AFTERNOON			
Serial Position	1	2	3	4	1	2	3	4
Instruction								
Recall/No Suppression	4.4	4.0	3.2	3.6	4.5	3.9	3.5	3.6
Recall/Suppression	4.2	3.6	3.5	3.2	4.6	3.2	3.3	3.4
Recognition/No Suppression	4.5	3.6	4.0	4.2	3.7	3.3	3.0	3.9
Recognition/Suppression	3.9	3.6	3.0	3.7	4.3	3.7	2.7	3.1

TABLE 5.3

Mean extraversion and neuroticism scores.

EP1	EXTRAVERSION		NEUROTICISM	
Time of day	Morning	Afternoon	Morning	Afternoon
Instruction				
Recall/No Suppression	14.0	11.8	9.4	10.7
Recall/Suppression	15.3	12.3	10.6	12.6
Recognition/No Suppression	14.4	13.7	10.2	9.0
Recognition/Suppression	13.0	11.6	12.0	9.7
Mean	14.18	12.35	10.55	10.50

Table 5.3 gives the mean extraversion and neuroticism scores for subjects in the eight experimental conditions and 2 x 2 x 2 analyses (Instruction by suppression by Time of Day) performed on these results did not produce any significant effects or even approach statistical significance. This suggests the groups are approximately matched with respect to their scores on the EP1.

The mean number of words recalled from four serial position blocks of five words are shown in Figure 5.1. A 2 x 2 x 2 x 4 analysis of variance performed on these results (Instruction by Suppression by Time of Day by Serial position) yielded a significant main effect of instruction [$F(1,72) = 4.084$ $p<.05$] with recall-instructed subjects performing better than subjects in the recognition condition.

The interaction between instruction and time of day was also significant [$F(1,72) = 6.668$ $p<.05$] indicating

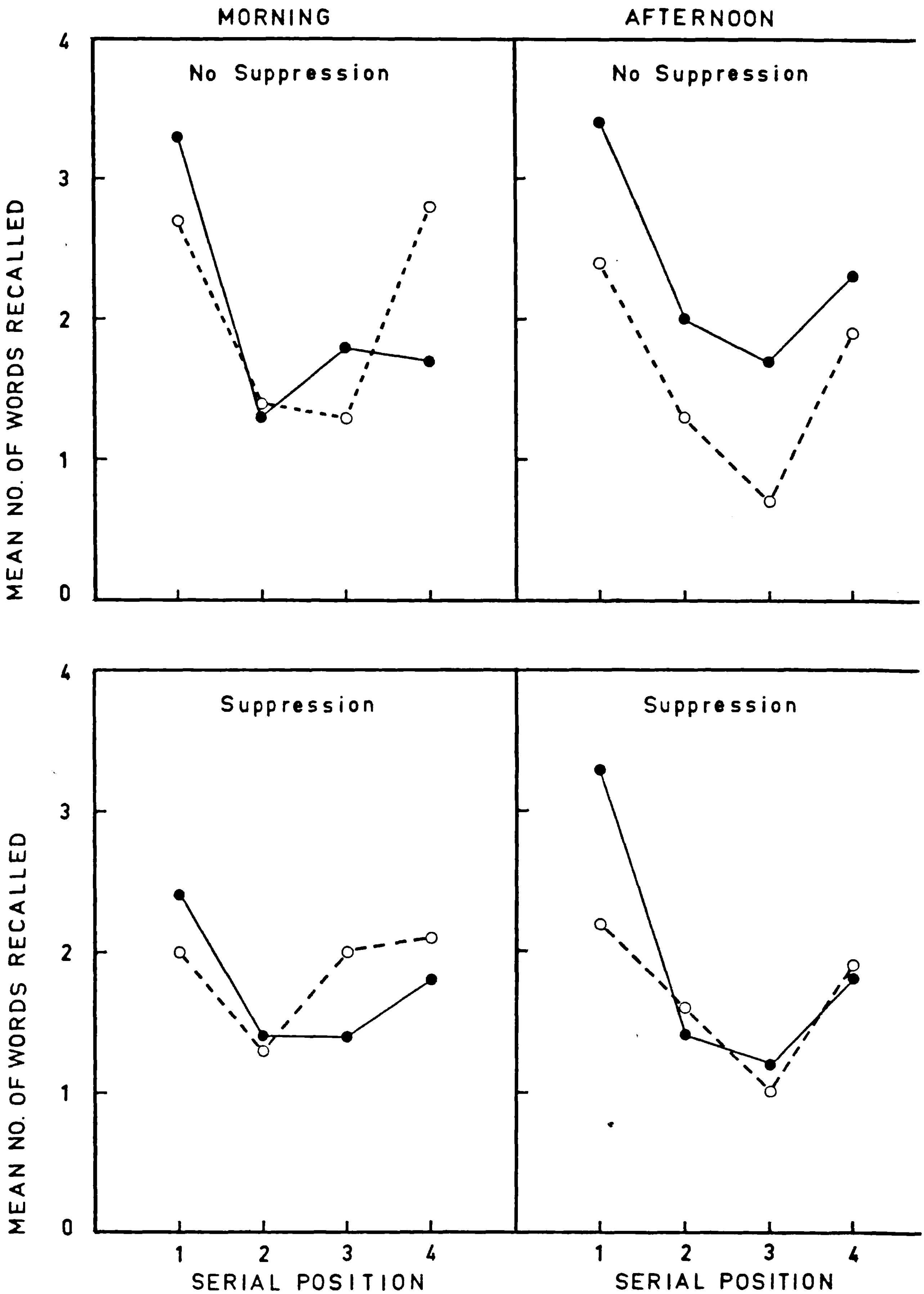

FIGURE 5.1

Mean number of words recalled from four serial position blocks of five words following Recall (●——●) and Recognition (○- - -○) Instructions.

that the recall performance of subjects expecting a recognition test was impaired in the afternoon relative to the morning, thus supporting the experimental hypothesis.

A significant main effect of serial position was obtained [$F(3,216) = 21.246$ $p<.01$] and the interaction between instruction and serial position just reached significance at the .05 level of significance, [$F(3,216) = 2.648$]. According to Figure 5.1 it appears the recall-instructed subjects perform best in the beginning of the list while the recognition-instructed subjects show more of a recency effect.

The effect of suppression was significant for a one-tailed test [$F(1,72) = 3.227$ $p<.05$] and suppression of rehearsal appears to have reduced the difference between the two instructional conditions mainly by impairing the performance of subjects in the recall group.

Although separate analyses of individual aspects of the data are not recommended statistically they were performed here in order to indicate which features of the results are most significant. Thus a 2 x 2 x 4 (instruction by time by serial position) analysis of variance performed on the no suppression data yielded a significant main effect of instruction [$F(1,36) = 6.378$ $p<.05$], and serial position [$F(3,108) = 16.135$ $p<.01$], and a significant interaction between instruction and time of day [$F(1,36) = 7.257$ $p<.05$]. The suppression data on the other hand produced a significant main effect of serial position only [$F(3,108) = 7.13$ $p<.01$] suggesting that suppression reduces the effect of instruction and of time of day, as would be expected if it reduces rehearsal.

Also, individual analyses of each serial position (2 x 2 x 2 on instruction by time by suppression), yielded a significant main effect of instruction [$F(1,72) = 10.665$ $p<.01$], and suppression [$F(1,72) = 4.006$ $p<.05$], for serial position block one only supporting the notion that this is where the effect of instructions lie. According to Figure 5.1 however, time of day appears to have influenced performance throughout the list and probably more so in serial position blocks two, three and four.

A 2 x 2 x 2 x 4 analysis of variance performed on the recognition data yielded a significant main effect of serial position only [$F(3,216) = 11.985$ $p<.01$] with improved performance in the beginning of the list.

The recognition data was also analysed in terms of d' and β and a 2 x 2 x 2 analysis of variance performed on these results yielded no significant effects of time of day on d' or β, [$F(1,72) = 2.12$ and $.274$ $p>.05$ respectively].

However, a significant main effect of suppression was obtained for values of d' [$F(1,72) = 8.243$ $p<.01$] suggesting suppression impaired performance on the recognition test. Table 5.4 and 5.5 represent the mean values of d' and β respectively.

TABLE 5.4

Mean values of d'

Time of day	MORNING		AFTERNOON	
Instruction	Recall	Recognition	Recall	Recognition
No Suppression	.47	.63	.55	.41
Suppression	.44	.37	.31	.33

TABLE 5.5

Mean values of β.

Time of day	MORNING		AFTERNOON	
Instruction	Recall	Recognition	Recall	Recognition
No suppression	2.20	.20	.60	-.80
Suppression	-.20	2.20	5.80	2.20

Discussion

In line with previous results a significant main effect of instruction was obtained and the largest difference between recall- and recognition-instructed subjects appears to be in serial position block 1, further supporting the results and conclusions of Experiments 1 to 4.

As predicted subjects expecting a recognition test performed better in the morning than the afternoon, thus supporting the hypothesis that subjects engage in more active processing in the morning. It is further suggested that following afternoon presentation subjects engaged in elaboration coding of individual items to the extent that it impaired their performance on the recall test. However, the recall performance of subjects expecting a recall test improved over the day possibly because of increased rehearsal and elaboration induced by both the task and time of presentation. This is consistent with the findings that (i) time of day improved performance in serial position blocks two, three and four and (ii) suppression does not appear to have reduced performance in serial position block one in the afternoon for subjects anticipating a recall test.

The over-all effect of suppression in the present study was significant by a one-tailed test only which was somewhat disappointing. In retrospect however, the suppression technique does not appear to be a very strong one. Also, separate analyses of the suppression and no suppression data suggest it has reduced the effect of both instruction and time of day, and the suggestion that suppression of rehearsal should have a greater detrimental effect in the morning than the afternoon is supported visually by the data in Figure 5.1.

According to a 2 x 2 x 2 analysis of variance performed on values of d', suppression also appears to have impaired the recognition performance of subjects in both the instructional conditions. However, it seems likely this represents a carry-over effect from the recall test which was performed immediately prior to the recognition test.

Experiment 6 attempts to replicate the results of Experiment 5 in a 2 x 2 x 2 experimental design where suppression has been replaced by a practice condition.

In view of Carey & Lockhart's (1973) finding, Experiment 1 to 5 have used single list presentations in order to avoid any differential effects of repeated presentations on recall and recognition test expectations. Carey & Lockhart (1973) compared recall performance of recall- and recognition-instructed subjects following four recall tests by subjects with a recall set and five recognition tests by subjects with a recognition set.

A similar procedure was used to look at differences in recognition performance.

Contrary to the results of Hall et. al. (1976; 1977) and Loftus (1971) subjects in the recognition condition produced superior performance throughout. With respect to the recall data this was interpreted in terms of the recognition-instructed subjects having practiced in the recognition mode thus becoming aware of the categorized nature of the list and in turn transforming the recall test into a recognition test by retaining the category label. An equally plausible explanation however, is the possibility that the performance of recall-instructed subjects is more likely to have been affected by interference from the previous presentations, thus impairing performance on both types of tasks.

In an attempt to possibly enhance the effect of instructional set while attempting to keep the possibility of proactive interference at a minimum subjects in Experiment 6 were presented with a short practice list (10 words) followed by the experimental list of twenty unrelated words.

Apart from subjects being tested individually and in groups of from 2 - 8 per session the procedure of Experiment 6 is essentially similar to that of Experiment 5.

5.2 EXPERIMENT 6. TIME OF DAY AND TEST EXPECTATIONS IN RECALL AND RECOGNITION (2).

Method

Subjects

Eighty undergraduate and postgraduate students from Bedford College, London, were assigned randomly to one of eight experimental conditions and tested individually or in groups of from two to eight subjects per session.

Apparatus and Materials

Two lists of words were selected from the Thorndike & Lorge (1944) word count.

List 1 was presented to subjects in all experimental conditions and included 40 words with a frequency of 13-100 per million. Word frequency according to Kucera & Francis ranged from 10-83. Half of the words were presented for two seconds each by means of a Kodak Carousel S-AV 2000 projector with an attached timer. The other half were used as fillers in a recognition test where subjects were asked to rate 40 words on a four point scale;

QUITE CERTAIN you HAVE seen the word before	NOT CERTAIN but think you HAVE seen the word before	NOT CERTAIN but think you have NOT seen the word before	QUITE CERTAIN you have NOT seen the word before

or

QUITE CERTAIN you have NOT seen the word before	NOT CERTAIN but think you have NOT seen the word before	NOT CERTAIN but think you HAVE seen the word before	QUITE CERTAIN you HAVE seen the word before

The recognition and target items were approximately matched for frequency, word length and the first letter of each word and the two rating scales were counterbalanced across experimental conditions.

List 2 was presented to subjects in the 'Practice' condition and included twenty words with a frequency ranging from 6-100 per million (Thorndike & Lorge 1944) and 2-760 in Kucera & Francis (1967). Half of the words were presented by means of a Kodak Carousel projector and the other half were used as fillers in a recognition test.

Design and Procedure

A 2 x 2 x 2 factorial design was used with instruction, practice and time of day as the main factors. Subjects were assigned randomly to the morning (10 am - 1 pm), or the afternoon (2 - 6 pm), and tested individually or in groups of from two to eight subjects per session.

In the 'No Practice' condition eath subject was seated at a desk and shown a list of 20 words after he/she had been given the appropriate recall or recognition test instructions. The recall instructions were as follows: "You will be shown 20 slides each with a word printed on it. When we have gone through the list of 20 words I will switch off the projector and ask you to write down as many of the words as you can possibly remember. You may recall the words in any order you like and you will have three minutes in which to do so." The recognition instructions were: "You will be shown 20 slides each with a word printed on it. When we have gone through the list of 20 words, I will switch off the projector and ask you to open the brown envelope (all subjects in the recognition condition were issued with these at the beginning of the experiment) which contains a word recognition test where some of the words are the same as those presented on the screen and some are new words. Your task will be to indicate on a four point scale (subjects were shown a 'blank' copy of the recognition sheet) which of these words you recognize as having been presented previously and which not."

After the presentation of the words all subjects were allowed six minutes in which to complete a free recall and subsequent recognition test. The recognition-instructed subjects were told: "Before we go any further could you please try and write down as many of the words as you can possibly remember on the back of the envelope." Special effort was made to equate the instruction time of the expected and unexpected tests following the learning trial.

Subjects in the 'Practice' and 'No Practice' conditions were given the same set of instructions with the exception that the former were allowed a practice trial where both recall- and recognition-instructed subjects received the appropriate recall or recognition test. Following the practice trial on list 2, each subject was presented with the test procedure previously described for subjects in the 'No Practice' condition.

Results

The number of words recalled and recognized from four serial position blocks of five words was calculated for each experimental condition and the mean scores are shown in Table 6.1 and 6.2 respectively.

TABLE 6.1

Mean number of words recalled in four serial position blocks of five words.

Time of day	MORNING				AFTERNOON			
Serial Position	1	2	3	4	1	2	3	4
Instruction								
Recall/No Practice	3.9	1.5	2.4	2.0	3.9	2.0	2.0	2.8
Recall/Practice	3.3	1.4	1.9	2.7	2.4	1.8	2.0	2.4
Recognition/No Practice	2.6	1.3	2.4	2.9	2.7	1.4	1.5	2.5
Recognition/Practice	2.5	1.0	2.4	2.4	1.9	1.6	1.5	2.4

TABLE 6.2

Mean number of words recognized in four serial position blocks of five words.

Time of day	MORNING				AFTERNOON			
Serial Position	1	2	3	4	1	2	3	4
Instruction								
Recall/No Practice	4.6	4.2	4.1	3.8	4.7	4.2	3.9	4.0
Recall/Practice	4.0	4.4	3.9	4.4	4.0	4.0	3.9	4.1
Recognition/No Practice	4.4	4.1	4.4	4.3	4.3	4.0	3.9	4.1
Recognition/Practice	4.4	3.4	4.4	4.2	3.8	4.1	3.9	4.5

The mean numbers of words recalled from four serial position blocks of five words are shown in Figure 6.1. Two of the subjects in the recognition condition produced an overall recall score of 15 and 17 respectively which is nearly twice the mean of subjects in the four recall conditions combined ($\bar{x}$ = 9.6). When asked these subjects revealed they had been trying to remember the words by making up a story i.e. by using the narrative chaining technique reported by Bower and Clark (1969). It was decided therefore to replace these subjects with two new ones in order to avoid the interpretative problems associated with extreme scores. Also, it seemed justifiable to exclude these subjects from the analyses (i) because they were using a mnemonic technique which may have been learned in a previous experiment and (ii) because the technique they used was not particularly compatible with the expectation of a recognition test. However, the possibility of some subjects adopting this kind of 'irrelevant' strategy must be considered a weakness of this particular paradigm, a point which will be returned to in the concluding chapter of the thesis.

A 2 x 2 x 2 x 4 analysis of variance (instruction by practice by time of day by serial position) performed on the recall results yielded a significant main effect of instruction [$F(1,72) = 4.70$ $p<.05$] and serial position [$F(3,216) = 21.589$ $p<.01$].

The interaction between instruction and serial position was also significant at the .05 level of

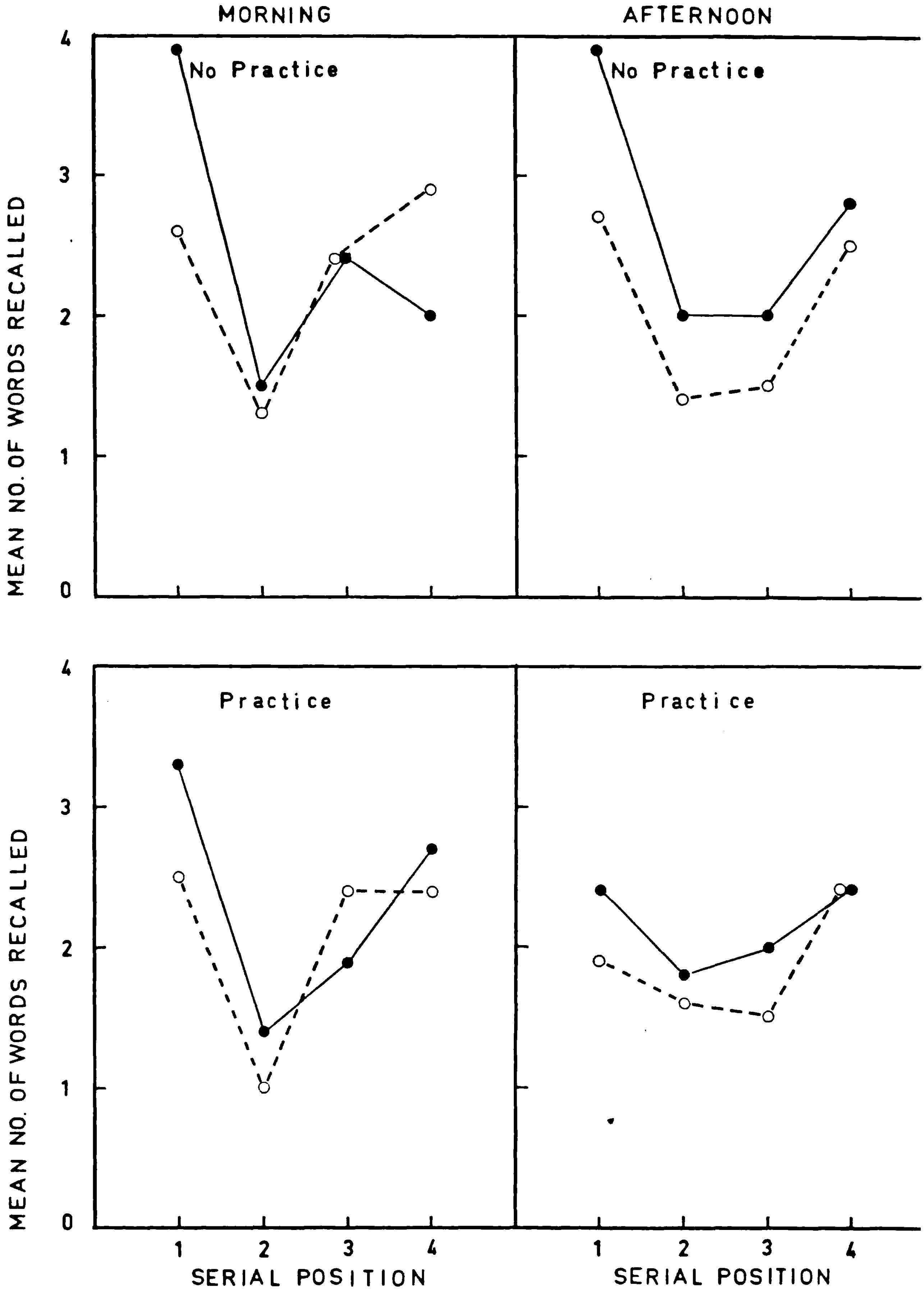

FIGURE 6.1

Mean number of words recalled from four serial position blocks of five words following Recall (●——●) and Recognition (○- -○) Instructions.

significance [$F(3,216) = 2.943$] with a larger primacy effect occurring for subjects expecting a recall test.

The interaction between instruction and time of day was not statistically significant [$F(1,72) = .738$ $p > .05$], nor the interaction between instruction, time and practice [$F(1,72) = .484$ $p > .05$] or instruction time, practice and serial position [$F(3,216) = .699$ $p > .05$].

Similarly, three separate 2 x 2 analyses of variance (instruction by time) performed on the No Practice, Practice and combined Practice - No Practice conditions did not yield a significant interaction between instruction and time of day. In fact these tests only produced one significant main effect of instruction for the two groups combined [$F(1,76) = 4.938$ $p < .05$]. Thus the interaction obtained in Experiment 5 between time of day and instruction is only supported visually by these results.

The mean numbers of words recalled from the practice list in the morning and the afternoon are shown in Table 6.3, and the difference in means between the two times of day did not reach statistical significance [$t(18) = 1.44$ $p > .05$].

TABLE 6.3

Mean number of words recalled from the practice list in the morning and afternoon.

Serial Position	1	2	Total
Morning	3.8	3.8	7.6
Afternoon	3.0	3.9	6.9

One of the major differences between this and the previous study is that subjects were tested either individually or in groups of varying sizes. However, the mean number of words recalled by subjects tested individually, in twos or in groups of from between 2 - 8 and 3 - 8 subjects per session appear to be rather similar although an influence of the number of subjects tested in groups cannot be ruled out altogether. Tables 6.4 and 6.5 give the mean numbers of words recalled by subjects in the various groups.

TABLE 6.4

Mean number of words recalled by subjects tested individually and in groups of from 2 - 8 per session.

	GROUP				INDIVIDUAL	
Time	MORNING	N*	AFTERNOON	N	MORNING	AFTERNOON
Instruction						
Recall/No Practice	9.80	10	10.70	10	-	-
Recall/Practice	8.17	6	8.75	8	10.00	8.00
Recognition/No Practice	9.20	10	7.78	9	-	11.00
Recognition/Practice	9.00	5	7.29	7	7.60	7.67
Means	9.04		8.63		8.80	8.89

*N = number of subjects.

TABLE 6.5

Mean number of words recalled by subjects tested individually and in groups of 2 (Group 1 - 2) and in groups of from 3 to 8 subjects per session (Group 3 - 8).

	GROUP 3-8				GROUP 1-2	
Time	MORNING	N	AFTERNOON	N	MORNING	AFTERNOON
Instruction						
Recall/No Practice	9.75	8	10.70	10	10.00	-
Recall/Practice	8.50	4	9.75	7	9.83	7.83
Recognition/No Practice	8.63	8	6.86	7	11.50	11.00
Recognition/Practice	8.33	3	8.33	3	8.79	7.00
Mean	8.80		8.91		9.91	8.61

A 2 x 2 x 2 x 4 analysis of variance performed on the number of words recognized from four serial position blocks of five words produced no significant effects of time of day, practice or instruction.

Similarly a 2 x 2 x 2 analysis of variance performed on values of d' and β yielded a significant main effect of instruction for β only /$F(1,72) = 4.066$ $p<.05$/. Mean values of d' and β can be found in Table 6.6 and 6.7 respectively.

TABLE 6.6

Mean values of d'

Time of day	MORNING		AFTERNOON	
Instruction	Recall	Recognition	Recall	Recognition
No practice	.64	.68	.73	.58
Practice	.71	.61	.66	.60

TABLE 6.7

Mean values of β.

Time of day	MORNING		AFTERNOON	
Instruction	Recall	Recognition	Recall	Recognition
'No practice'	1.60	2.00	-1.80	2.40
'Practice'	-1.20	1.40	-2.00	1.80

Discussion

The primacy difference obtained between recall- and recognition- instructed subjects in Experiments 1 to 5 is further replicated by these results where subjects expecting a recall test show improved performance in serial position block one relative to subjects expecting a recognition test.

Although statistically speaking there is no effect of practice it appears (i) to have changed the direction of the time of day effect for subjects expecting a recall test and (ii) to have reduced performance in all experimental conditions possibly by way of interfering proactively with the recall of a second list.

Some support is also provided for the suggestion that there is an interaction between instruction and time of day although contrary to the results of Experiment 5 this interaction was not statistically significant. However, the nonsignificant effect of time of day in the present experiment may possibly be accounted for in terms of the following factors:

(i) Unlike Experiment 5 the eight experimental groups were not matched for scores on the Eysenck Personality Inventory (EP1).

(ii) Subjects tested in groups may have been influencing each others performance in an incentive-like manner.

(iii) Experiment 5 was run in the summer term while Experiment 6 was conducted in the late autumn.

Theoretically it seems possible the results may have been influenced by either one or possibly all of these factors, in which case the time of day effect obtained in Experiment 5 does not appear to be a very strong one.

No significant difference occurred between morning and afternoon presentation of the practice list although morning subjects appeared to remember slightly more items from the beginning of the list.

There seems to be little point in making any comparisons across the practice and experimental list of 10 and 20 words since subjects should tend to perform better on the more difficult task because it requires more effort initially.

CHAPTER 6

NOISE

6.1 INTRODUCTION TO THE EXPERIMENTS

The majority of studies using white noise have found that noise produces an increase in the reliance on order information (Daee & Wilding 1977; Dornic 1973; Hamilton, Hockey & Quinn 1972; Hockey & Hamilton 1970; Millar 1979; Wilding & Mohindra 1980), suggesting it increases the extent to which subjects subvocally rehearse. Furthermore, noise has been found to reduce semantic processing (Schwartz 1974a) and the amount of category clustering in free recall (Daee & Wilding 1977; Hormann & Osterkamp 1966; Smith 1978). However, when subjects were forced to process information semantically noise did not appear to influence response latency on a memory search task suggesting it does not seriously impair semantic processing (Eysenck & Eysenck 1979). This further suggests the above results may perhaps be due to a change in strategy rather than inability to process information semantically in noise.

Also, Folkard (1976b) found noise and suppression increased the time taken over word sorts and decreased it over hue sorts on the Stroop test. He attributed these results to reduced subvocalization in noise and under suppression which is not entirely consistent with the view that noise increases rehearsal or inner speech.

In view of the experimental evidence it appears that noise does not necessarily increase rehearsal or reduce semantic processing in general but onlyunder certain experimental conditions or for certain types of tasks. The type of question which needs to be answered therefore is when does noise induce a change in strategy and for what sort of tasks does it produce an increase in rehearsal?

Daee & Wilding (1977) found that responding to a word with the word which immediately followed it in the original list (sequence recall), was superior in 75dBC white noise relative to a quiet and 85dBC noise condition. This non-monotonic effect of noise occurred in situations where subjects expected a free recall or sequence recall test regardless of test type (they were tested on sequence recall, free recall and a recognition test where all words were made available and the subject required to place them in their original position in the list). No effect of noise was obtained when subjects were instructed to perform a position or sequence recognition test and were presented with these at the test stage, suggesting the performance of recall- and not recognition-instructed subjects were influenced by the noise. This explanation is rather different from that proposed by Daee & Wilding (1977) however, who suggested that "increased noise or arousal level increases the duration of traces of the stimuli. In the quiet condition traces are shortest lived and connections between the traces of succeeding items are rare and weak. Consequently it is difficult to retrieve the following item in response to a word and providing the possible words in the recognition task proves helpful. At an intermediate level of noise, traces are of optimal duration to establish a connection with the trace of the next item when it arrives, without becoming connected to traces of later items. The probability of retrieving the correct item therefore increases and adding other competing candidates in the recognition task causes interference. At still higher levels of noise, traces last longer, and more interconnections develop and therefore compete with each other," (p 345-346).

The first experiment to be reported in this section is essentially a replication of the No Suppression, No Practice conditions of Experiment 5 and 6 except that noise is used instead of time of day.

The purpose of the present study is to compare the effect of noise on tasks with different rehearsal requirements, namely recall and recognition test expectations, in order to see if and how they may be affected differentially.

6.2. EXPERIMENT 7. NOISE AND TEST EXPECTATIONS IN RECALL AND RECOGNITION.

Method

Subjects

The subjects were forty sixth-formers who were assigned randomly to one of four experimental conditions and tested in four groups of ten subjects each.

Apparatus and Materials

Forty unrelated nouns with a frequency of 13 - 100 per million were selected from the Thorndike & Lorge (1944) word count. Word frequency according to Kucera & Francis (1967) ranged from 10 - 83.

Half of the words were presented for two seconds each by means of a Kodak Carousel S-AV 2000 projector with an attached timer. The other half were used as fillers in a recognition test where subjects were asked to rate 40 words on a four point scale previously described in Experiment 6. The recognition and target items were approximately matched for frequency, word length and the first letter of each word. During the presentation of the words subjects were listening to 65 or 85 dBC white noise. The noise was recorded on tape from a white noise generator (Dawe Instruments type 419C) with a frequency range from 40-16000 HZ, and played back through headphones on an Uher 500 tape-recorder.

In addition to a recall and recognition test subjects were asked to indicate whether they used one or more of the following learning strategies:

1. Rehearsed the words in groups of two or more.
2. Concentrated on one word at a time.
3. Connected the words by making up a story.
4. Made up images of each word.

Methods one and two are most relevant to the present hypothesis and their order of presentation in the questionnaire was counterbalanced across the experimental conditions.

Design and Procedure

A 2 x 2 factorial design was used with two types of instructions (Recall versus Recognition) and two levels of white noise (65 and 85 dBC).

Four groups of ten subjects were shown a list of twenty unrelated nouns whilst simultaneously listening to 65 or 85 dBC white noise.

First, each subject was seated at a desk with a pair of headphones and the necessary writing material. The group as a whole was then informed of the experimental procedure and presented with the recall- or recognition instructions described in Experiment 6 where the recall-instructed subjects were led to expect a free recall test and the recognition-instructed subjects to expect a word recognition test.

Subjects in the recognition condition were presented with the word-recognition test in a brown envelope which was to be opened at the test stage, and a 'blank' copy of the recognition sheet was shown to the subjects in order to make sure they understood the test requirements.

Following list presentation all subjects were allowed six minutes in which to carry out a free recall and a subsequent recognition test. On completion of the two tests subjects were given a brief questionnaire on processing strategies.

Results

The numbers of words recalled from four serial position blocks of five words was calculated for each experimental condition and the mean scores are shown in Table - and Figure 7.1.

A 2 x 2 x 4 analysis of variance (Instruction by Noise by Serial Position), performed on these results produced a highly significant main effect of instruction [$F(1,36) = 27.666$ $p < .005$] with the recall-instructed subjects recalling significantly more words than the recognition-instructed subjects. A significant main effect of serial position was also obtained [$F(3,108) = 4.606$ $p < .01$].

The interactions between instruction and noise [$F(1,36) = 4.997$ $p < .05$], and between instruction, noise and serial position [$F(3,108) = 3.524$ $p < .05$], were significant, indicating that noise improved the performance of recall-instructed subjects particularly in serial position block one, whilst generally impairing the recall performance of subjects expecting a recognition test.

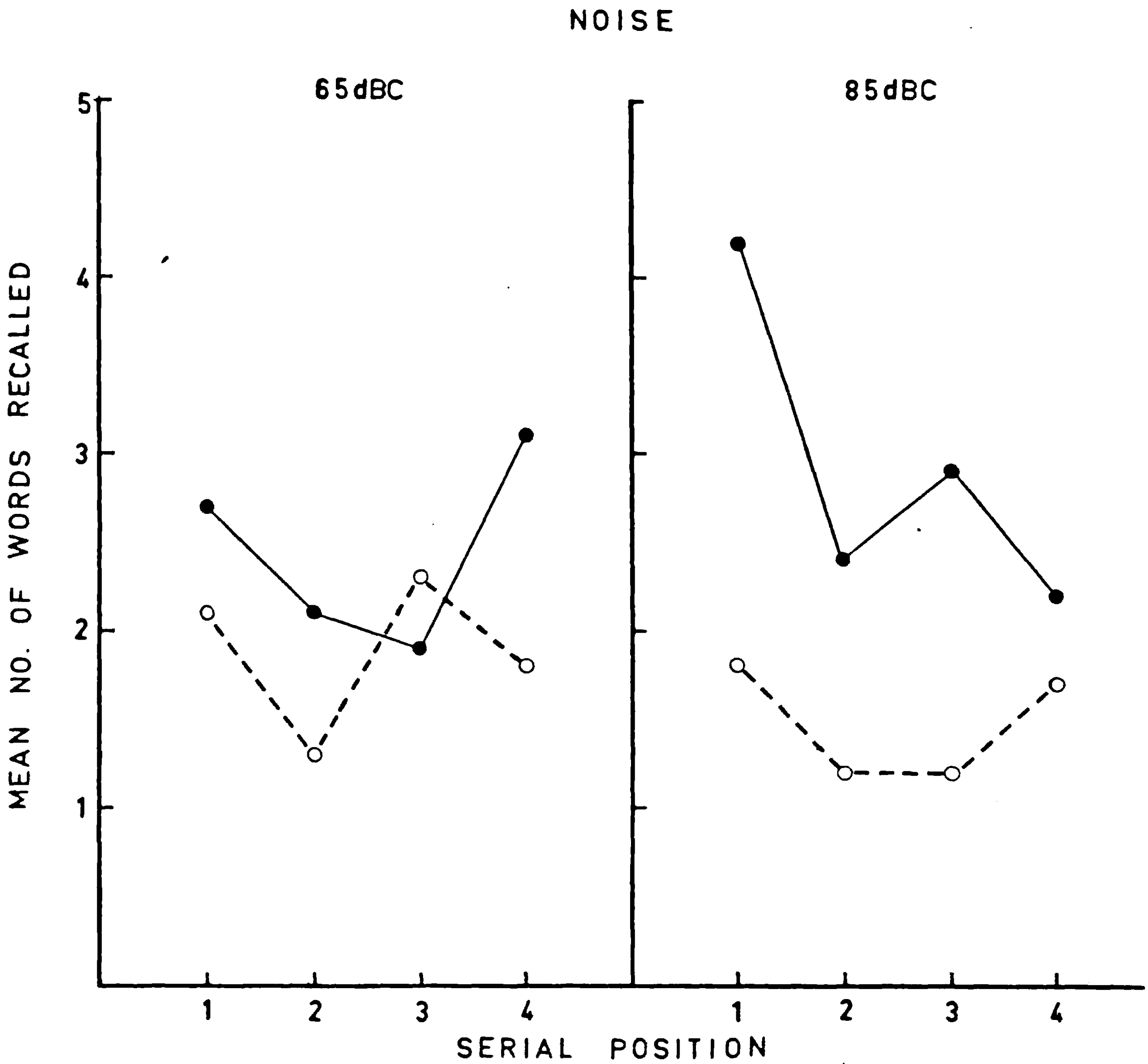

FIGURE 7.1
Mean number of words recalled from four serial position blocks of five words following Recall (●——●) and Recognition (○- - -○) Instructions.

This was further supported by the outcome of separate t-tests performed on the results. Thus the difference between noise levels for recall-instructed subjects in serial position block one was significant at the .01 level of significance [t (18) = 3.21]. However, the overall difference for recall-instructed subjects between the two noise conditions failed to reach statistical significance [t(18) = 1.52 $p > .05$], while that for subjects expecting a recognition test was significant at the .05 level of significance by a one-tailed test [t(18) = 1.744].

In contrast to the morning results of Experiment 5 and 6 there appears to be a difference between recall- and recognition-instructed subjects throughout the list in the 65dB 'quiet' noise condition suggesting the low intensity noise may perhaps have influenced performance to a certain extent. When tested by a t-test for independent groups this difference just reached significance at the .05 level of significance with a t of 2.12 and 18 degrees of freedom.

TABLE 7.1

Mean number of words recalled from four serial position blocks of five words.

Noise	65 dBC				85 dBC			
Serial Position	1	2	3	4	1	2	3	4
Recall Instructions	2.7	2.1	1.9	3.1	4.2	2.4	2.9	2.2
Recognition Instructions	2.1	1.3	2.3	1.8	1.8	1.2	1.2	1.8

TABLE 7.2

Mean number of words recognized from four serial position blocks of five words.

Noise	65 dBC				85 dBC			
Serial Position	1	2	3	4	1	2	3	4
Recall Instruction	4.7	3.9	3.4	4.2	4.7	4.7	4.4	4.2
Recognition Instruction	4.0	3.6	3.9	3.9	4.5	3.4	3.8	3.4

The mean number of words recognised from four serial position blocks of five words are presented in Table 7.2

A 2 x 2 x 4 analysis of variance (instruction by noise by serial position), performed on these results, produced a significant main effect of instruction [$F(1,36) = 6.387$ $p<.05$], and serial position [$F(3,108) = 4.169$, $p<.01$]. Similarly, a 2 x 2 analysis (instruction by noise), on the total number of words recognized minus false-alarms yielded a significant main effect of instruction [$F(1,36) = 13.033$ $p<.005$], with the recall-instructed subjects performing significantly better than the recognition-instructed subjects.

The recognition data was also analysed in terms of d' and β and a 2 x 2 analysis of variance (Instruction by Noise) performed on the values of β yielded no significant effects of instruction [$F(1,36) = 1.485$ $p>.05$] or noise [$F(1,36) = .287$], and the interaction was not significant [$F(1,36) = 2.587$ $p>.05$]. However, a significant main effect of instruction [$F(1,36) = 11.491$ $p<.01$] and noise [$F(1,36) = 4.736$ $p<.05$] was obtained for values of d' suggesting noise enhanced the recognition performance of subjects expecting a recall test. Again the interaction between noise and instruction was not statistically significant /$\bar{F}(1,36) = .024$/. Table 7.3 and 7.4 give the mean values of d' and β respectively.

TABLE 7.3

Mean values of d'.

Noise	65dBC	85dBC
Instruction		
Recall	.63	.76
Recognition	.41	.56

TABLE 7.4

Mean values of β .

Noise	65dBC	85dBC
Instruction		
Recall	-.20	.20
Recognition	5.60	1.2

The number of subjects who on the strategy questionnaire claimed to have predominantly rehearsed the items during presentation are shown in Table 7.5 for 65 and 85dBC noise respectively. There appears to be some difference between subjects in the two noise conditions but in view of the results obtained in Experiment 2 it seems likely these results may be due to the type of test used or possibly to differences in level of performance rather than to differences in rehearsal strategies as such.

TABLE 7.5

Responses to the strategy questionnaire by subjects in the four experimental conditions.

Noise	65 dBC		85 dBC	
Instruction	Recall	Recognition	Recall	Recognition
Number of subjects who Predominantly Rehearsed	5	5	6	3
Predominantly used other strategies	5	5	4	7

Discussion

Compared with Experiments 2, 5 and 6 a much larger main effect of instruction ($p<.005$) was obtained in the present experiment suggesting noise may have enhanced further the differences between recall and recognition test expectations. This is supported by the significant difference between the two types of instruction in 65dB noise and the obtained significant main effect of instruction on the recognition scores with improved performance by subjects expecting a free recall test. Also, significant main effects of instruction and noise were found for values of d' but not for β which is contrary to results obtained by Broadbent & Gregory (1965) and Jones & Thomas (1978) who found a change in β rather than d' with noise. However, in the present experiment the improved recognition performance of recall-instructed subjects in 85dBC noise is likely to have been a carry-over effect from their performance on the recall test which was immediately followed by the recognition test.

As in Experiment 5 the interaction between instruction and noise is significant with improved recall of subjects expecting a recall test and impaired performance of recognition-instructed subjects with noise. A consideration of the similarities and differences between the noise and time of day studies however, will be returned to in the concluding chapter.

The improved performance of subjects expecting a recall test appear to be due to an increase in the recall of items from the beginning of the list suggesting noise increases rehearsal for subjects in this condition. Thus noise appears to increase rehearsal when this is required by the task, presumably by focussing attention on the most dominant strategy or task requirement, which in turn may help to shut out any distracting effects of the noise.

The most surprising element of the present findings is the impaired performance of the recognition-instructed subjects in 85dBC noise. In an attempt to confirm these results a second experiment (Experiment 8), was designed to test whether noise would impair the retention of order for subjects expecting a recognition test.

Since order recall is rather more difficult than free recall of unrelated words any effects of noise on rehearsal should tend to be in the beginning of the list, a suggestion which is supported by the results and conclusions drawn from Experiments 1 and 2.

6.3. EXPERIMENT 8. NOISE AND ORDER RECALL

Method

Subjects

Twenty-four undergraduate and postgraduate students from Bedford College, London, none of whom had taken part in any of the previous experiments, were assigned randomly to one of two experimental conditions. Eight males and four females were tested in each condition, four males and two females in the morning (10 am - 1 pm), and afternoon (2 - 5 pm) respectively.

Apparatus and Materials

Twenty unrelated nouns with a frequency of 50 per million were selected from the Thorndike & Lorge (1944) word count. Word frequency according to Kucera & Francis (1967) ranged from 2 - 130. Each word was printed in uppercase letters and presented on the screen of a Commodore PET microcomputer with a presentation rate of one word every two seconds. Following list presentation the same words were shown on individual 7.6 x 6.4 cm cards.

During the presentation of the words subjects were listening to 65 or 85 dBC white noise. The reader is referred to Experiment 7 for further details about the noise.

Design and Procedure

Two groups of 12 subjects were presented with a list of 20 words whilst simultaneously listening to 65 or 85 dBC white noise.

Each subject was seated at a desk and given the following instructions to read; "In this experiment you will be shown 20 words (one word every two seconds), after which you will be given a word-recognition test. That is, you will be shown a number of words (printed on cards) and then asked to pick out those words you recognize as having been presented previously on the screen.

During the experiment you will be listening to a hissing noise which will be turned off after the presentation of the last word."

Following list presentation, all subjects were shown the same 20 words typed on cards and arranged randomly on a tray with slots numbered from 1 - 20. They were then asked to place the words in their original order of presentation and allowed approximately three minutes to do so.

At the end of the experiment when the experimental hypotheses were explained to each subject, two of the 24 subjects revealed they had been trying to remember the words in their original order by making up a story (narrative chaining). These subjects were therefore excluded from the analysis and replaced by two new ones. (On calculation of the data their mean score was found to be 8 compared with a group mean of 2.83 and 2.50 in the 65 and 85 dBC noise condition respectively.)

Results & Discussion

The numbers of words remembered in correct sequence from four serial position blocks of five words were calculated for each experimental condition, and the mean scores are shown in Table 8.1.

TABLE 8.1

Mean number of words remembered in correct sequence

Serial Position		1	2	3	4	Totals
	65dBC	1.50	.42	.33	.58	2.83
	85dBC	.83	.58	.67	.42	2.50

A planned comparison on the difference between the two noise conditions in serial position block one against that in serial position block two, three and four very nearly reached significance at the .05 level of significance [$F(1,66) = 3.947$, and F crit. $(1,65) = 3.99$ $p < .05$], lending some support to the results and conclusions drawn from Experiment 7. Thus it appears noise may to some extent reduce the amount of rehearsal engaged in by subjects anticipating a recognition test.

6.4. EXPERIMENT 9. NOISE AND INSTRUCTIONS TO REHEARSE

Introduction

For subjects in the recall condition of Experiment 7 noise appears to have enhanced recall performance by inducing a more active rehearsal strategy. The next experiment, (Experiment 9), was designed to test if noise interacts with instructions to rehearse by, for example, improving performance on a rehearsed part of the list while impairing it for the rest.

Method

Subjects

Forty undergraduates from Hatfield Polytechnic were assigned randomly to one of four experimental conditions. Nine males and one female were tested in each condition with an equal number of subjects tested in the morning (10 am - 1 pm), and the afternoon (2 - 5 pm).

Apparatus and Materials

Four lists of 20 words were selected from the Thorndike & Lorge (1944) and Kucera & Francis (1967) word counts. Word frequency was approximately evenly distributed across the four lists and ranged from 4 to 100 per million and from 1 to 897 in Kucera & Francis.

List 1	8 - AA(T-L)	2-760(K-F)
2	6 - AA	7-897
3	13 - AA	10-547
4	4 - AA	1-660

Each word was presented for two seconds each by means of a Kodak Carousel S-AV 2000 projector with an attached timer.

During the presentation of the words subjects were listening to 65 or 85 dBC white noise. The white noise was recorded on tape from a white noise generator (Dawe Instruments Type 419C) and played back through headphones on a Phillips Cassette Recorder.

Design and Procedure

A 2 x 2 factorial design was used with two levels of white noise (65 and 85 dBC), and two types of recall instructions (rehearsal of items in serial position block one or two).

Each subject was seated at a desk and shown four lists of 20 words presented in a counterbalanced order across subjects and conditions, after he/she had been given the appropriate instructions to rehearse selectively items in serial position block one or two.

The subjects were informed they would be shown four lists of 20 words whilst listening to white noise over the headphones and they were told they would be given a free recall test following the presentation of each list. Subjects in the 'Primacy' condition were specifically asked "to rehearse as many of the words in the beginning of the list as you can. By rehearse I mean silently repeating two three or more words together as the list proceeds.

The list is divided into four blocks of five words each with a blank slide separating each block. You should start rehearsing as soon as you see the first word and continue to rehearse out this block and maybe some of the words in the next block if you can."

Subjects in the 'Middle' condition were asked to rehearse the items in the middle of the list and they were told "the list is divided into four blocks of five words each with a blank slide separating each block.

You should start rehearsing as soon as you see the first word of the second block and continue to rehearse out this block and maybe some of the words in the next block if you can."

Following the presentation of each list subjects were allowed 1½ minutes to complete a free recall test and one minute's 'rest' period before the presentation of the next list.

Results and Discussion

The number of words recalled from four serial position blocks of five words was calculated for each experimental condition. The mean scores pooled across the four lists, are shown in Table 9.1 and Figure 9.1.

A 2 x 2 x 4 analysis of variance (instruction by noise by serial position), performed on these results yielded a significant main effect of serial position [$F(3,108) = 17.466$ $p < .001$], and a significant interaction between serial position and instruction [$F(3,108) = 46.525$ $p < .001$]. None of the effects involving noise was statistically significant suggesting noise does not necessarily increase capacity for rehearsal following instructions to rehearse.

A 2 x 2 x 4 analysis of variance on instruction by noise by list, and on instruction by noise by presentation trial (the first, second, third or fourth trial), produced no significant effects further suggesting that the type of list and the order of presentation have not significantly

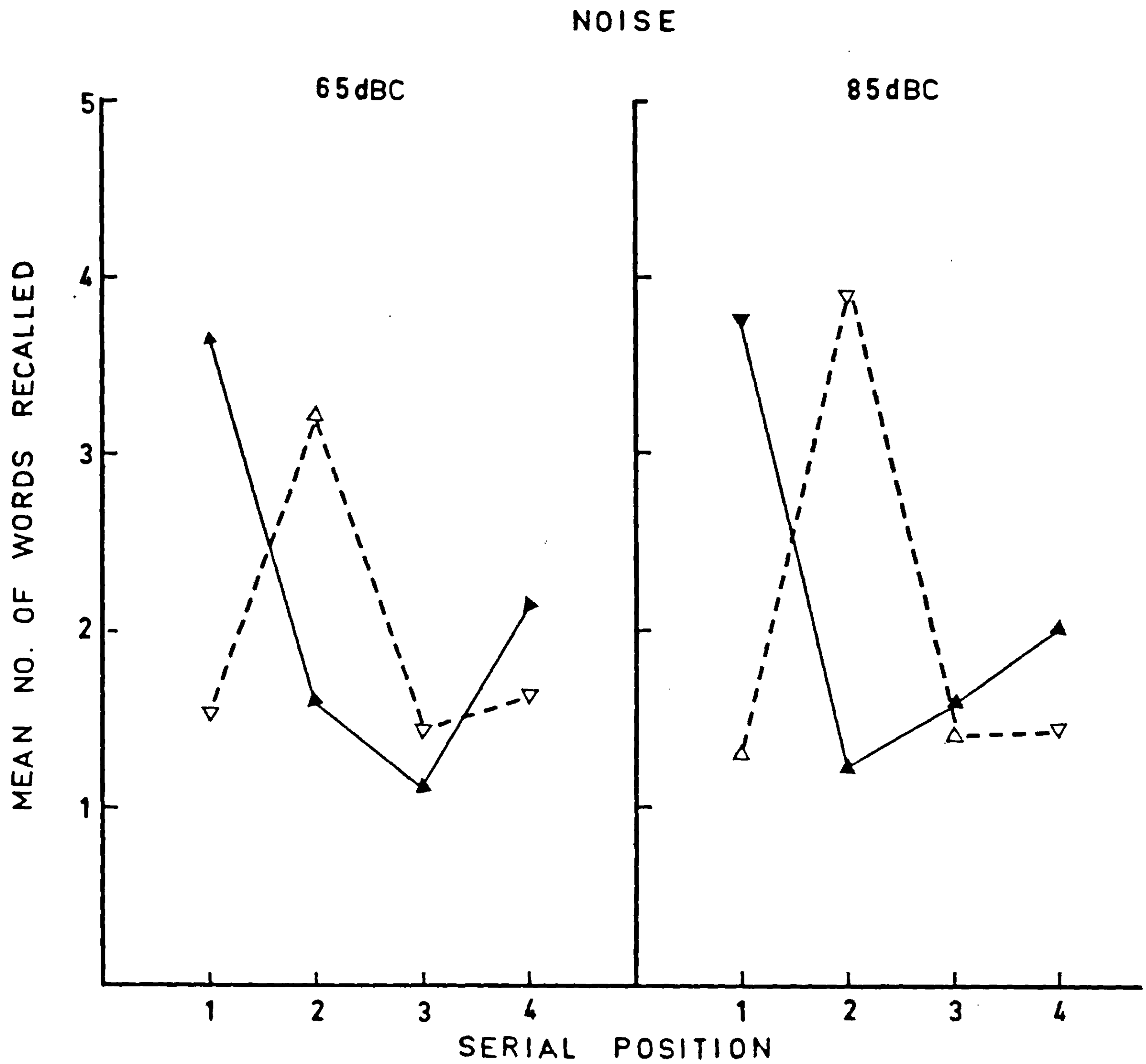

FIGURE 9.1
Mean number of words recalled following two sets of instructions;
Rehearse Primacy ▲——▲
Rehearse Middle △- -△

influenced the experimental results.

TABLE 9.1

Mean number of words recalled from four serial position blocks of five words.

Noise	65dBC				85dBC			
Serial Position	1	2	3	4	1	2	3	4
Instruction								
Primacy	3.65	1.60	1.13	2.15	3.78	1.23	1.60	2.03
Middle	1.58	3.23	1.48	1.68	1.30	3.90	1.40	1.45

The number of words recalled in correct sequence from four serial position blocks of five words was also calculated and the mean scores are shown in Table 9.2.

TABLE 9.2

Mean number of words recalled in input sequence from four serial position blocks of five words.

	65dBC				85dBC			
Serial Position	1	2	3	4	1	2	3	4
Instruction								
Primacy	1.98	.30	.10	.55	2.25	.05	.15	.40
Middle	.38	1.75	.20	.50	.18	2.35	.35	.43

A 2 x 2 analysis of variance on noise by rehearsal was performed on the numbers of words recalled in correct sequence following rehearsal of items in serial position block one and two. (The rest of the scores were not included in this analysis because of the number of missing data points in the unrehearsed serial position blocks.)

No significant effects of noise were obtained indicating that order information is not better retained following instructions to rehearse in 85 compared with 65 dBC white noise. This further supports the notion that noise affects the information processing strategies which subjects spontaneously adopt rather than induces an increase in their rehearsal capacity as such.

A consideration of the total scores obtained in Experiment 7 and 9 (Table 9.3) seem to suggest that subjects perform rather better in Experiment 7. This may be due to the different types of population used (i.e. 'A' level students and undergraduates at the Hatfield Polytechnic) although a more likely explanation would seem to be in terms of the rehearsal instructions having interferred with the subjects' own method of rehearsal and organization.

TABLE 9.3

Mean number of words recalled in Experiment 7 and 9.

EXPERIMENT		7		9	
Noise		65	85	65	85
Instruction					
	Standard Recall	9.80	11.70		
Recall	Rehearse Primacy			8.53	8.63
	Rehearse Middle			7.95	8.05
Recognition		7.50	6.00		

6.5. EXPERIMENT 10. NOISE AND SEMANTIC PROCESSING.

Introduction

Daee & Wilding (1977), Hörmann & Osterkamp (1966) and Smith (1978) obtained less category clustering in noise suggesting subjects are less able to process information semantically. Similarly, Schwartz (1974a) found noise directs attention towards physical rather than semantic characteristics of the stimuli. He found that noise had no effect on the recall of semantically similar items but improved performance on unrelated and phonemically related words. However, when subjects were forced to process information semantically, Eysenck & Eysenck (1979) and Wilding & Mohindra (paper submitted) found no effect of noise suggesting it does not necessarily impair semantic processing.

The results of the present Experiments 7 and 8 also raise the possibility as to whether noise may not enhance semantic processing when this is required by the task. The final experiment (Experiment 10), which was conceived and carried out jointly with John Wilding and Naresh Mohindra, attempted to test this hypothesis. Thus the effect of noise on the recall of high and low associates were considered in a condition where subjects were forced to process information semantically and a condition where they were not. Semantic orienting tasks are generally thought to involve semantic processing and Walsh & Jenkins (1973) found it enhanced performance on a free recall test relative to two nonsemantic orienting tasks where subjects were required to estimate the number of syllables contained in each word or to look for words which included an 'e' or a 'g' in its spelling. In the semantic orienting condition subjects were asked to rate each word for pleasantness which improved their performance to the same level as that of an intentional control group who knew they would be tested by recall.

Thus according to the dominance hypothesis advanced previously in this chapter noise should improve performance in the condition with the most semantic features i.e. the condition involving a semantic orienting task and a list of high associates while possibly impairing it in the condition requiring an orienting response to a list of non-associated words. It is assumed therefore, that the semantic orienting task is more compatible with the processing of high than low associate lists.

If noise directs attention towards the most dominant strategy one would expect an increase in recall generally and of items in their original sequence with noise for subjects in the no-orienting non-associated list condition since the nature of the task should tend to encourage subjects to produce associative links between the items.

Category clustering on the other hand, may possibly be enhanced by noise in the orienting relative to the no orienting task condition, although the nature of the associative list may enhance the clustering of items generally thus producing a ceiling effect.

Method

Subjects

The subjects were 120 undergraduate and post-graduate students from Bedford College, London, who were assigned randomly to one of 24 experimental conditions.

Apparatus and Material

Two lists of 30 words; an associative list* selected from Postman & Keppel's (1970) "Norms of word association" and a non-associative list selected from the Postman & Keppel (1970) and Kucera & Francis (1967) word counts, were approximately matched for frequency, word length and the first letter of each word.

Both lists were printed in uppercase letters and presented on the screen of a Commodore PET micro-computer with a presentation rate of one word every three seconds. The computer randomized the words for each subject and recorded the pleasantness ratings produced by subjects in the orienting condition.

During the presentation of the words subjects were listening to 65,75 or 85 dBC white noise. The reader is again referred to Experiment 7 for further details about the noise.

*The list of high associates included the following words; BABY, BOY, BULB, CANDLE, CHILD, CHOP, COURT, DARK, ENVELOPE, GIRL, JUDGE, JURY, JUSTICE, LAMB, LAMP, LAW, LAWYER, LETTER, LIGHT, MAIL, MAN, MEAT, MUTTON, NIGHT, PAPER, SHEEP, STAMP, WOMAN, WOOL, WRITING.

Design and Procedure

Two experimenters tested an approximately matched number of subjects in 24 experimental conditions. A 2 x 2 x 2 x 3 factorial design was used with list (associative - non-associative), task (orienting- no orienting), time of day (morning-afternoon) and three levels of white noise (65, 75 and 85dBC) as the main factors.

Each subject was seated at a desk and shown a list of 30 high or low associates whilst listening to 65, 75 or 85 dBC white noise in the morning or afternoon.

Subjects in the orienting and no orienting conditions were given the following instructions to read.

Orienting: "You will be shown a list of 30 words one at a time on the screen. Each word will be presented for 3 seconds, and you will be asked to recall the words afterwards.

As each word is presented please judge quickly how pleasant that word is on a three point scale:

1 Not Pleasant

2 Neutral

3 Pleasant

Make your response by pressing the appropriate key on the keyboard. Do not spend a lot of time on this, just try to give your first impression.

Please wear the headphones throughout the experiment. You will hear a hissing noise through them while the words are being presented."

No orienting: "You will be shown a list of 30 words one at a time on the screen. Each word will be presented for 3 seconds, and you will be asked to recall the words afterwards.

Please wear the headphones throughout the experiment. You will hear a hissing noise through them while the words are being presented."

Following list presentation all subjects were allowed approximately four minutes in which to complete a free recall test.

Results and Discussion

The numbers of words recalled in each experimental condition was calculated and the mean scores pooled across time of day, are shown in Table 10.1 and Figure 10.1.

A 2 x 2 x 2 x 3 analysis of variance (list by task by time of day by noise) performed on these results produced a significant interaction between list, orienting task and noise [$F(2,96) = 4.39$ $p < .05$], with improved performance for subjects in the 85dBC associative and orienting condition relative to the 65 and 75 dBC noise conditions and to the non-associative-orienting condition where performance was impaired by 85dBC white noise at presentation.

Although noise appears to have improved the recall of items in the no orienting non-associative condition the effect of noise is smaller than that obtained in Experiment 7. However, this may be due to differences in list length

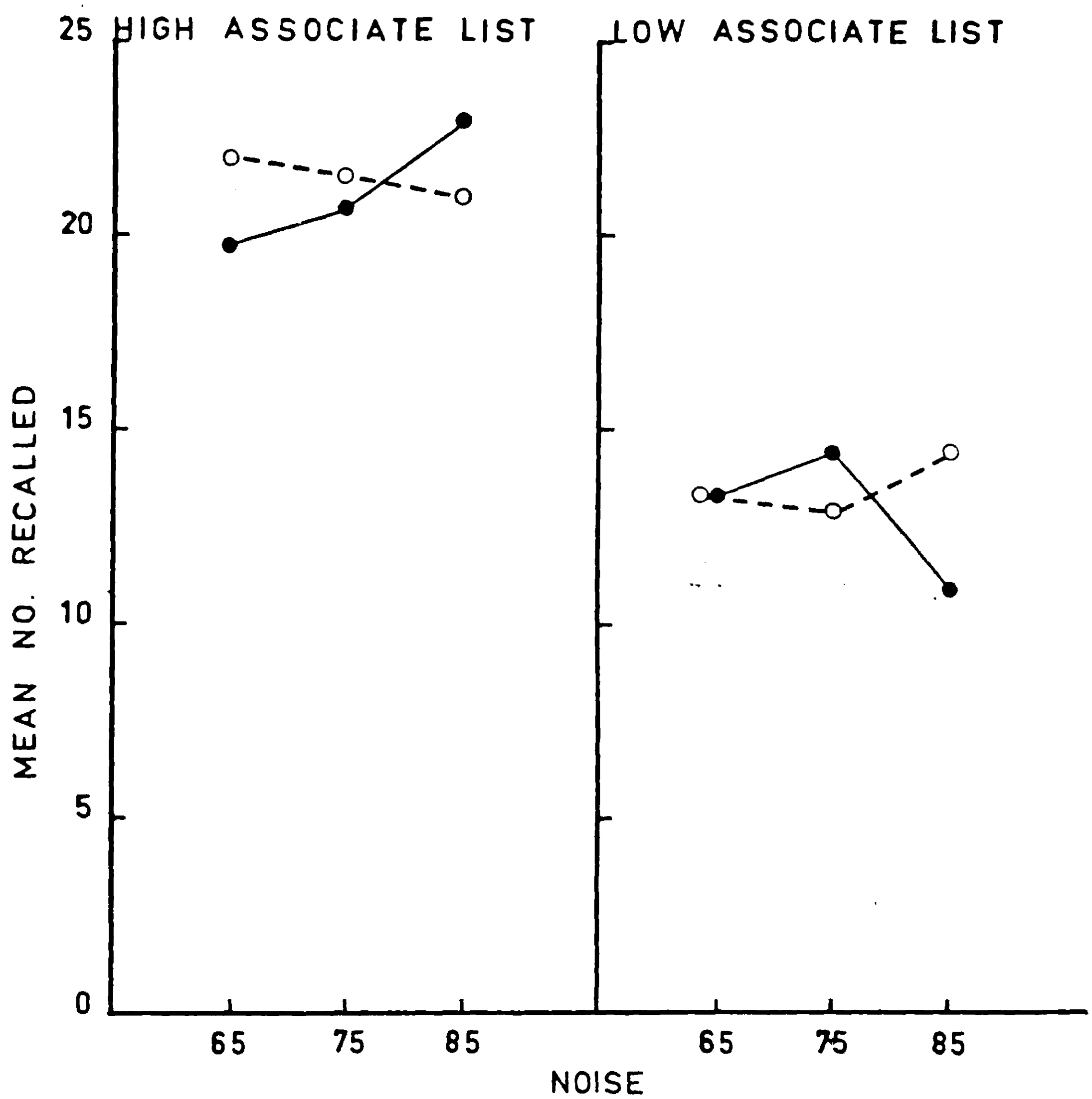

FIGURE 10.1
Mean number of words recalled in an Orienting ●——● and No Orienting ○- - -○ condition.

or possibly to the slower presentation rate used in the latest study where subjects were presented with one word every three seconds. This is to some extent supported by studies performed by Glanzer & Cunitz (1966) who found they were able to reduce the primacy effect in free recall simply by increasing the rate of presentation.

TABLE 10.1

Mean number of words recalled by subjects in twelve experimental conditions.

List	Associative Words			Non-associative Words		
Noise	65	75	85	65	75	85
Orienting	19.7	20.7	22.9	13.3	14.4	10.9
No Orienting	22.0	21.5	21.0	13.3	12.9	14.4

The amount of category clustering in free recall was calculated by using the Dalrymple-Alford (1970) category measure. Also the number of words recalled in original sequence was calculated for the twelve experimental conditions and the mean scores are presented in Tables 10.2 and 10.3 respectively.

A 2 x 2 x 3 analysis of variance (time of day by task by noise) performed on the amount of category clustering in the associative condition produced no significant effects of noise, time or task. A similar analysis performed on the number of words recalled in correct sequence yielded a significant main effect of task only /$F(1,48) = 8.905$ $p<.01$/ with subjects in the no-orienting condition tending to recall more words in their original sequence.

A planned comparison on the difference in trend from 65 to 85 dBC noise yielded an $F(1,48) = 2.89$ which is significant at the .05 level of significance for a one tailed test. Thus recall in sequence increased with noise in the no-orienting condition but decreased for subjects in the orienting condition.

TABLE 10.2

Mean category clustering in free recall as measured by the Dalrymple-Alford (1970) C score.*

Noise	65	75	85
Orienting	.81	.72	.82
No Orienting	.78	.76	.70

TABLE 10.3

Mean number of words recalled in original sequence

List	Associative Words			Non-associative Words		
Noise	65	75	85	65	75	85
Orienting	.01	.02	.00	.07	.07	.02
No-orienting	.05	.05	.07	.10	.14	.17

According to these results it appears noise does not necessarily impair semantic processing but does in fact enhance the processing of semantic features when

*Reference note: Dalrymple-Alford, E.C. (1970). Measurement of clustering in free recall. Psychol. Bull., 74, 32-34.

this is required by the task.

Also noise appears to increase the use of sequence in the no orienting condition while the reverse is true for subjects in the orienting group. This suggests the orienting task may have interferred with the strategy originally adopted by subjects in anticipation of a free recall test.

this is required by the task.

Also noise appears to increase the use of sequence in the no orienting condition while the reverse is true for subjects in the orienting group. This suggests the orienting task may have interferred with the strategy originally adopted by subjects in anticipation of a free recall test.

CHAPTER 7

CONCLUDING REMARKS

The results of Experiments 1 to 4 have shown that recall-instructed subjects spontaneously rehearse more than subjects expecting a recognition test. In terms of the arousal literature this is a useful distinction to make because it allows a comparison of the effects of noise and time of day on tasks which require different strategies.

In the following sections the main body of results will be summarized and discussed in terms of the arousal literature. Also possible follow-up studies of noise and time of day effects will be considered in the final section of the thesis.

7.1 TIME OF DAY

Time of day was manipulated in two experiments where it was assumed the free recall performance of subjects expecting a recognition test would indicate the extent to which they spontaneously rehearsed when rehearsal was not required by the task.

The results of the recognition group supported Folkard (1976; 1979; 1981) and Folkard & Monk's (1979) suggestion that there is a tendency for subjects to engage in maintenance rehearsal in the morning relative to the afternoon.

However, the improved performance of recall-instructed subjects in the afternoon compared with morning suggests that they rehearsed less in the morning than the afternoon, unless there is a greater tendency for subjects to engage in elaboration rather than maintenance rehearsal at this time of day.

The obtained interaction between time of day and instruction in Experiment 5 seem to suggest the differences in strategies between recall and recognition test expectations are enhanced in the afternoon with recall-instructed subjects performing better and recognition-instructed subjects performing worse on a test of free recall than subjects tested in the morning. The improved performance of recall-instructed subjects may possibly be due to both increased rehearsal and elaboration processing at this time of day. However, it is difficult to explain why elaboration should improve the performance of subjects expecting a recall test yet impair that of subjects anticipating a recognition test unless of course the recall-instructed subjects engaged in a different type of elaboration which was perhaps more compatible with the expectation of a free recall test.

In Experiment 6 the interaction between instruction, time of day and practice was not statistically significant. The results of the subjects in the No Practice condition however, do seem to go in the same direction as those obtained in Experiment 5 with improved recall for subjects expecting a recall test and impaired performance for subjects expecting a recognition test in the afternoon. Although the effect of practice was not statistically significant it appears to have impaired the performance of recall-instructed subjects in the afternoon and in the beginning of the list possibly because subjects engaged in an optimal strategy at this time of day and were thus more easily affected by 'overload' or interference from the learning of a previous list.

7.2 NOISE

A significant noise by task interaction was obtained in Experiment 7 suggesting noise also enhances differences in strategies between recall- and recognition test expectations. Thus noise appears to induce an optimal strategy for those subjects expecting a recall test while impairing the recall of subjects anticipating a recognition test. The results of Experiment 8 further suggest it may have reduced the amount of rehearsal engaged in by subjects in the recognition condition.

When asked to engage in active rehearsal of items in the beginning and middle of each list no difference between 65 and 85 dBC noise was obtained in any of the four serial position blocks for subjects expecting a recall test. This would seem to support the notion that the results of Experiment 7 are due to a change in strategy with noise rather than an increase in capacity for rehearsal or ability to process more associative links between items. However, the conclusions derived from the present results and from similar studies where attempts have been made to investigate the strategies which subjects spontaneously adopt are to some extent tentative

(i) because laboratory studies of this kind are exploring the underlying processes particular to a specific paradigm (in this case recall- and recognition test expectations) while ignoring possible interactions with related and possibly equally important processes which are not observable within the particular paradigm used, and

(ii) because the strategies which subjects are thought to adopt are mostly inferred experimentally since it is almost impossible to know the extent to which they are processing information by rehearsal, elaboration or both. To some extent this may explain why some investigators have obtained contradictory results. Thus subjects who have learned the advantage of using mnemonic techniques may engage in associative imagery or narrative chaining regardless of the type of test which they are expected to perform. Their performance therefore, should be relatively impervious to experimental manipulations of instruction, test expectation and arousal if the effect of these is primarily to induce a change in strategy. In a paper by Folkard & Monk (1979) it was indeed suggested that once subjects had adopted a particular strategy at a certain time of day they tended to use the same strategy at different times of day, thus confounding the effect of 'preferred' strategy with influences of time of day. It is possible therefore, that the interaction between instruction and time of day is statistically non-significant in Experiment 6 partly because of subjects adopting "inappropriate" strategies at different times of day or even for recall and recognition test expectations.

However, one way of reducing individual differences in preferred strategy is to control the type of processing which subjects adopt by directing their attention towards physical or semantic aspects of the task. Thus for example, noise was found to enhance semantic processing when this was required by the task in Experiment 10. These results are important in that they suggest the assumption of reduced semantic processing in noise is not necessarily true.

What these results seem to suggest therefore, is that noise does not necessarily increase rehearsal or reduce semantic processing in general, but only under certain experimental conditions or for certain types of task. One possibility is that noise biases attention towards the most dominant strategy which in turn is influenced by the task requirements. Similar results were obtained for time of day although there appear to be certain discrepancies between the two types of manipulations and these will be returned to in the following sections of the thesis.

7.3 NOISE AND TIME OF DAY

(i) Recall Data

A comparison of the effects of noise and time of day in the present studies suggests they both produce a change in strategy. However, the difference between recall- and recognition-instructed subjects appears to be greater for 65 dB noise than for morning presentation indicating that noise may have influenced performance even at this low level of exposure. This further suggests that the effects produced by low level noise and morning presentation are not necessarily compatible and it is possible that this may also be true for 85 dB noise and afternoon presentation.

According to the results of Experiment 5 and 7 a difference between recall- and recognition instructions occurred for both noise levels while the instructional set seems to have little or no effect in the morning compared with the afternoon. Thus subjects may engage in more active processing in the morning irrespective of instructions but become more sensitive to test expectations in the afternoon.

Another difference between the two types of manipulations appears to be found in the serial position data.

Studies by Baddeley & Hitch (1977) and Seamon & Murray (1976) suggest that incidental learners initiate their output with the final input items and d'Ydewalle (1979) obtained similar results for subjects expecting a recognition test. The output order on a first recall test by recall-instructed subjects tended to follow input order although on a later test also these subjects tended to start their recall with the items presented last in the list. In view of the limited capacity available to subjects one would expect a certain decrease in the primacy effect with an increase in the recall of items from the recency part of the list. In Experiment 7, recall-instructed subjects in the 65dBC noise condition did indeed show a smaller primacy effect than for example that obtained under no noise in

Experiment 2, which is compensated for by an increase in the recall of items from the end of the list. However, 85 dBC noise appears to significantly increase the recall of items from the beginning of the list while afternoon compared with morning presentation predominantly improves performance in serial position blocks two, three and four. A recent paper by Lorsbach & Mueller (1979) on "Encoding tasks and free recall in children" appear to be of some relevance here. They obtained results where deep processing tasks led to the greatest middle and recency recall while the no-orienting task condition produced the greatest primacy recall. Thus it is possible that while subjects may spontaneously rehearse more with noise they tend to engage in elaboration processing to a greater extent in the afternoon than for example in 85 dBC white noise.

Influences of noise and time of day on the recall of subjects expecting a recognition test strike one as being rather similar across Experiments 5, 6 and 7 with impaired performance tending to occur towards the end of the list with both noise and time of day. Thus following morning presentation in Experiments 5 and 6 the recognition-instructed subjects show a relatively larger recency effect than subjects expecting a free recall test suggesting they are more likely to rely on a limited capacity short-term store at this time of day, a tendency which also seems to be reduced in noise.

(ii) Recognition Data

Not much can be said about the recognition data since the recall test was immediately followed by a recognition test and performance on the latter is likely to have been influenced by subjects' performance on the recall test. However, assuming the recognition scores represent a carry-over effect a comparison of the results obtained in Experiments 5, 6 and 7 does seem to suggest that the effect of noise is relatively stronger than that of time of day. Thus for example an instruction by noise by serial position analysis produced a significant main effect of instruction, and a 2 x 2 analysis on values of d' yielded a significant main effect of instruction and of noise on the recognition scores. Similar analyses performed on the time of day results however, only yielded a significant main effect of instruction for values of β in Experiment 6.

The relatively improved performance of recall-instructed subjects on a recognition test support the notion that the type of coding engaged in by these subjects produces better retention on both a recall and recognition test suggesting they have learned the material to a greater extent than subjects anticipating a recognition test, possibly because they were actively manipulating and producing associative links between the items at presentation.

7.4 STRATEGIC CHANGES IN NOISE AND WITH TIME OF DAY

Apart from pointing out that the effects of noise and time of day are influenced by qualitative differences between tasks these results do not shed any further light on the underlying mechanisms of arousal. However, in terms of the present paradigm they do suggest that loud noise and afternoon presentation affect performance in a similar manner by directing attention towards the most dominant strategy. This is consistent with one time of day finding obtained by Folkard (1980) where the immediate memory results showed improved retention of dominant or important information in the afternoon. It is also supportive of Easterbrook's (1959) hypothesis and Davies & Jones (1975) and Hockey & Hamilton's (1972) suggestion that arousal directs attention towards dominant sources of information by restricting the range of cue utilization although in the present studies it is the dominant strategy and not information or source of information which is the relevant factor.

More recently Smith (1980) concluded that "A major effect of noise is to bias the allocation of effort towards the operations which appears to best repay the investment of more effort". Similarly, it was suggested that "The effect of noise in a complex task does not take the form of a passive bias towards a primary source but is determined by a complex combination of such factors as the dominance set by instruction, difficulty of each part of the task, and the salience of the stimuli involved in the task". In one experiment Smith extended Hockey & Hamilton's (1970) results by demonstrating that the noise-induced bias towards the primary task occurred whether order or location was primary.

Thus from the point of view of Smith's results and the present findings an explanation purely in terms of increased elaboration in the afternoon and reduced semantic processing in noise is too simplistic. A more thorough investigation of task parameters may possibly explain some if not all, of the discrepancies obtained in the arousal literature.

An attempt to unravel the effect of noise on the underlying processes of Stroop performance was for example made by Broadbent (1978) who examined the speed with which subjects could read printed colour names without interference. He found that after a 20 minute exposure to noise subjects did indeed, name coloured inks faster than they read printed colour names suggesting the possibility that the effects obtained in the interference condition may be secondary to this change.

More recently Schwartz & Hartley (personal communication) have looked at individual differences in preferred strategies. They identified subjects whose preferred strategy on a sentence-picture verification task was either verbal or spatial <u>prior</u> to the experimental procedure and found that noise produced a bias towards the use of the preferred strategy.

A rather interesting and important question in this area therefore is <u>why</u> do noise and afternoon presentation bias attention towards the most dominant (or preferred) strategy. The most obvious explanation would of course, tend to be in terms of arousal. It seems unlikely however, that noise and time of day should have a similar effect on performance since time of day is relatively endogeneous while noise is more of a distracting stimulus. Also, noise appears to have different effects depending on the exposure duration. Thus in the present experiments the rather short duration of noise may have acted primarily as a distracting stimulus inducing subjects to concentrate harder on the primary task requirements in an attempt to attenuate the distracting effect of the noise.

The differential effects of noise at short and long exposure durations may possibly be due to a diminishing effect of distraction and an increase in arousal over time. It would be interesting therefore, to compare the changes in strategy with noise over short and long exposure durations in order to see whether they remain the same.

Evidence for the suggestion that noise influences physiological processes has been obtained from a number of behavioural studies concerned with the effects of noise and blood glucose level on skilled performance. Thus for example, Murrell (1971) obtained results where performance was improved by the prior administration of glucose while noise impairs it (Davies 1968). Similarly Davies & Gill (1980) looked at the combined effects of noise and glucose on the performance of a problem solving task of varying complexity levels. They found that the administration of glucose reduced the effect of 92 dBA white noise for all levels of complexity further suggesting there is a relationship between the effects of blood glucose level and noise.

In comparison with noise however, time of day may be considered more of a natural arouser particularly since time of day effects appear to be strongly related to circadian rhythms in body temperature and possibly to other rhythms which at present have been less extensively researched. Thus a shift in temperature has been found to produce a similar shift in the performance rhythms of a number of tasks (Colquhoun 1971). A number of recent findings also seem to suggest there may be at least two underlying rhythms of performance both of which adjust at different rates to a change in the sleep-waking cycle (Folkard & Monk 1981) and recover at different rates from the administration of different anaesthetic agents (Folkard, Simpson & Glynn 1979).

7.5 SUGGESTIONS FOR FURTHER STUDIES

Unlike noise in Experiment 10, time of day did not appear to influence performance in the orienting condition suggesting (a) the influence of the task was more important than the time of day manipulation or (b) subjects are equally capable of processing semantically in the morning and the afternoon when this is required by the task.

According to the time of day results reported in Chapter 5 there appears to be an effect of instruction in the afternoon but not in the morning. Apart from suggesting that the time of day manipulation overrides the effect of instruction in the morning this also supports the notion that there is a change in the strategy which subjects spontaneously adopt at different times of day. The first of these hypotheses could be tested further by presenting subjects with different types of instructions at different times of day although the observed changes in strategy over the day may possibly be masked by individual differences in preferred strategy or possibly even by practice on a previous list as suggested by the results of Experiment 6.

Also, it may be worth looking at influences of noise and time of day on recognition latencies following recall and recognition test expectations. Thus if the performance of recall-instructed subjects relative to subjects expecting a recognition test is still enhanced by noise and afternoon presentation this would support further the notion that the difference between recall and recognition test expectations is primarily quantitative rather than qualitative in nature.

Additional experimental manipulations could be in terms of list length or for example word frequency. Balota & Neely (1980) found that the recall and recognition performance of recall-instructed subjects compared with subjects expecting a recognition test was enhanced for high frequency words while little or no effect of test expectations was obtained on performance involving memory for low frequency words. This supports the notion that the encoding of high frequency relative to low frequency words is more compatible with the associative and organizational encoding thought to be engaged in by subjects expecting a recall test. The encoding possibilities of low frequency words however, may be limited and thus remain the same for both recall- and recognition-instructed subjects. Alternatively, low frequency words may have their greatest effect at the test and even decision stage in which case no effect of test expectations or noise presented during input should be obtained while noise introduced at the test stage and possibly afternoon presentation may enhance performance involving the recognition of low frequency words relative to high frequency ones.

Another slightly more applied version of the present experiments would be to consider influences of test expectations in relation to memory for information presented in prose. Clearly, it is of educational importance to determine (i) the extent to which test-specific study strategies may lead to differential learning and retention of information and (ii) whether subjects are indeed less sensitive to manipulations of test expectations in the morning than the afternoon.

Although further research in this area is obviously required, the results of the present studies seem to suggest that subjects should learn the material better in anticipation of an open-ended (free recall) test relative to a multiple choice recognition test. There is also some suggestion that this is true for information presented in prose (d'Ydewalle, Swerts & De Corte 1980; and Meyer 1934; 1935 and 1936). Thus for example, d'Ydewalle et. al. (1980) showed that subjects expecting an open-ended free recall test tended to use more study time, and perform better on both a recall and multiple choice test than subjects anticipating a multiple-choice recognition test. Given these results therefore, it would be of some interest to test the relationship between noise, time of day and test expectations in prose learning and possibly also length of the retention interval i.e. whether subjects expect to perform an immediate or a delayed retention test.

A P P E N D I X

Analysis of variance summary tables

Unless otherwise stated

** = $p < .01$ (two-tailed test)

* = $p < .05$ (" ")

x = $p < .05$ (one-tailed test)

EXPERIMENT 1

Analysis of Variance Summary Tables

2 x 2 analyses on the total number of words remembered in correct sequence, correct position and correct sequence and position.

Correct Sequence and Position

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
KNOWLEDGE	1	1.012	.93	1.012	.795
INSTRUCTION	1	6.612	6.07	6.612	5.194*
KNOWL. x INSTR.	1	4.512	4.14	4.512	3.545[x]
RESIDUAL	76	96.750	88.85	1.273	
TOTAL	79	108.887	100.00	1.378	

Correct Sequence

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
KNOWLEDGE	1	.613	.26	.613	.209
INSTRUCTION	1	.612	.26	.612	.209
KNOWL. x INSTR.	1	10.512	4.48	10.512	3.587[x]
RESIDUAL	76	222.750	94.99	2.931	
TOTAL	79	234.487	100.00	2.968	

Correct Position

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
KNOWLEDGE	1	2.450	1.28	2.450	1.026
INSTRUCTION	1	3.200	1.67	3.200	1.340
KNOWL. x INSTR.	1	4.050	2.12	4.050	1.696
RESIDUAL	76	181.500	94.93	2.388	
TOTAL	79	191.200	100.00	2.420	

EXPERIMENT 2

Analysis of Variance Summary Tables.

RECALL DATA

SOURCE	DF	SS	SS:	MS	VR
INSTRUCTION	1	5.625	2.28	5.625	4.332*
TEST ORDER (TO)	1	.025	.01	.025	.019
INSTR. X TO.	1	.000	.00	.000	.000
RESIDUAL	36	46.750	18.97	1.299	.951
TOTAL	39	52.400	21.27	1.344	.984
SERIAL POSITION	3	38.900	15.79	12.967	9.497**
SERPOS. X INSTR.	3	4.475	1.82	1.492	1.093
SERPOS. X TO.	3	1.475	.60	.492	.360
SERPOS. X INSTR. X TO.	3	1.700	.69	.567	.415
RESIDUAL	108	147.450	59.84	1.365	
TOTAL	120	194.000	78.73	1.617	
GRAND TOTAL	159	236.400	100.00		

RECOGNITION DATA

SOURCE	DF	SS	SS:	MS	VR
INSTRUCTION	1	.0250	.02	.0250	.014
TEST ORDER (TO)	1	.0000	.00	.0000	.000
INSTR. X TO.	1	.2250	.14	.2250	.128
RESIDUAL	36	63.2500	38.22	1.7569	2.133
TOTAL	39	63.5000	38.37	1.6282	1.977
SERIAL POSITION	3	5.1500	3.11	1.7167	2.084
SERPOS. X INSTR.	3	2.0250	1.22	.6750	.820
SERPOS. X TO.	3	1.5500	.94	.5167	.627
SERPOS. X INSTR. X TO.	3	4.3250	2.61	1.4417	1.750
RESIDUAL	108	88.9500	53.75	.8236	
TOTAL	120	102.0000	61.63	.8500	
GRAND TOTAL	159	165.5000	100.00		

EXPERIMENT 3

Planned Comparison Summary Tables

RECALL DATA

SOURCE	DF	SS	VAR. EST.	F
BETWEEN	6	13.775		
COMPARISON	1		8.44	5.21*
WITHIN	54	87.475	1.62	
TOTAL	60	101.250		

RECOGNITION DATA

SOURCE	DF	SS	VAR. EST.	F
BETWEEN	6	379.79		
COMPARISON	1		6.34	3.28 NS
WITHIN	54	104.10	1.93	
TOTAL	60	483.89		

EXPERIMENT 4

Analysis of Variance Summary Tables.

RECALL DATA

SOURCE	DF	SS	SS:	MS	VR
INPUT INSTRUCTION	1	0.756	0.32	0.756	0.618
TEST INSTRUCTION	1	1.406	0.60	1.406	1.149
INPUT X TEST INSTR.	1	0.756	0.32	0.756	0.618
RESIDUAL	36	44.075	18.66	1.224	0.950
TOTAL	39	46.994	19.89	1.205	0.935
SERIAL POSITION	3	24.069	10.19	8.023	6.224**
SERPOS X INPUT INSTR.	3	16.269	6.89	5.423	4.207**
SERPOS X TEST INSTR.	3	4.619	1.96	1.540	1.194
SERPOS X INPUT X TEST INSTR.	3	5.069	2.15	1.690	1.311
RESIDUAL	108	139.225	58.93	1.289	
TOTAL	120	189.250	80.11	1.577	
GRAND TOTAL	159	236.244	100.00		

RECOGNITION DATA

SOURCE	DF	SS	SS:	MS	VR
INPUT INSTRUCTION	1	3.906	1.48	3.906	1.688
TEST INSTRUCTION	1	1.056	0.40	1.056	0.456
INPUT X TEST INSTR.	1	1.406	0.53	1.406	0.608
RESIDUAL	36	83.325	31.63	2.315	2.201
TOTAL	39	89.694	34.05	2.300	2.187
SERIAL POSITION	3	44.919	17.05	14.973	14.238**
SERPOS X INPUT INSTR.	3	7.369	2.80	2.456	2.336
SERPOS X TEST INSTR.	3	6.619	2.51	2.206	2.098
SERPOS X INPUT X TEST INSTR.	3	1.269	0.48	0.423	0.402
RESIDUAL	108	113.575	43.11	1.052	
TOTAL	120	173.750	65.95	1.448	
GRAND TOTAL	159	263.444	100.00		

EXPERIMENT 5

Analysis of Variance Summary Tables

RECALL DATA

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
SUBJ. STRATUM					
INSTRUCTION	1	4.050	0.78	4.050	4.084*
SUPPRESSION	1	3.200	0.62	3.200	3.227^{x}
TIME	1	0.113	0.02	0.113	0.113
INSTR. SUPPRESS.	1	1.800	0.35	1.800	1.815
INSTR. TIME	1	6.612	1.28	6.612	6.668*
SUPPRESS. TIME	1	0.113	0.02	0.113	0.113
INSTR. SUPPRESS. TIME	1	1.012	0.20	1.012	1.021
RESIDUAL	72	71.400	13.82	0.992	0.697
TOTAL	79	88.300	17.09	1.118	0.786

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
SUB. POSN. STRATUM					
POSN.	3	90.650	17.54	30.217	21.246**
POSN. INSTR.	3	11.300	2.19	3.767	2.648*
POSN. SUPPRESS.	3	2.950	0.57	0.983	0.691
POSN. TIME	3	6.738	1.30	2.246	1.579
POSN. INSTR. SUPPRESS.	3	3.450	0.67	1.150	0.809
POSN. INSTR. TIME	3	0.938	0.18	0.313	0.220
POSN. SUPPRESS. TIME	3	2.438	0.47	0.813	0.571
POSN. INSTR. SUPPRESS. TIME	3	2.837	0.55	0.946	0.665
RESIDUAL	216	307.200	59.44	1.422	
TOTAL	240	428.500	82.91	1.785	
GRAND TOTAL	319	516.800	100.00		

EXPERIMENT 5

Analysis of Variance Summary Tables.

RECOGNITION DATA

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
SUBJ STRATUM					
INSTRUCTION	1	0.703	0.15	0.703	0.353
SUPPRESSION	1	4.753	1.02	4.753	2.388
TIME	1	1.953	0.42	1.953	0.981
INSTR. SUPPRESS.	1	0.078	0.02	0.078	0.039
INSTR. TIME	1	3.003	0.65	3.003	1.509
SUPPRESS. TIME	1	0.903	0.19	0.903	0.454
INSTR. SUPPRESS. TIME	1	1.653	0.36	1.653	0.830
RESIDUAL	72	143.325	30.81	1.991	1.733
TOTAL	79	156.372	33.62	1.979	1.723
SUBJ. POSN. STRATUM					
POSITION	3	41.309	8.88	13.770	11.985**
POSN. INSTR.	3	4.034	0.87	1.345	1.170
POSN. SUPPRESS.	3	2.184	0.47	0.728	0.634
POSN. TIME	3	1.084	0.23	0.361	0.315
POSN. INSTR. SUPPRESS.	3	5.809	1.25	1.936	1.685
POSN. INSTR. TIME	3	2.084	0.45	0.695	0.605
POSN. SUPPRESS. TIME	3	1.984	0.43	0.661	0.576
POSN. INSTR. SUPPRESS. TIME	3	2.084	0.45	0.695	0.605
RESIDUAL	216	248.175	53.36	1.149	
TOTAL	240	308.750	66.38	1.286	
GRAND TOTAL	319	465.122	100.00		

EXPERIMENT 5

Analysis of Variance Summary Tables.

RECOGNITION SCORES

β

SOURCE OF VARIATION	DF	SS	SS%	MS	VR
UNITS STRATUM					
INSTRUCTION	1	26.45	0.65	26.45	0.502
SUPPRESSION	1	76.05	1.86	76.05	1.444
TIME	1	14.45	0.35	14.45	0.274
INSTR. SUPPRESS.	1	6.05	0.15	6.05	0.115
INSTR. TIME	1	36.45	0.89	36.45	0.692
SUPPRESS. TIME	1	92.45	2.26	92.45	1.756
INSTR. SUPPRESS. TIME	1	54.45	1.33	54.45	1.034
RESIDUAL	72	3791.60	92.52	52.66	
TOTAL	79	4097.95	100.00	51.87	
GRAND TOTAL	79	4097.95	100.00		

d'

SOURCE OF VARIATION	DF	SS	SS%	MS	VR
UNITS STRATUM					
INSTRUCTION	1	0.00112	0.02	0.00112	0.020
SUPPRESSION	1	0.46513	9.49	0.46513	8.243**
TIME	1	0.12482	2.55	0.12482	2.212
INSTR. SUPPRESS.	1	0.00722	0.15	0.00722	0.128
INSTR. TIME	1	0.05724	1.17	0.05724	1.015
SUPPRESS. TIME	1	0.00144	0.03	0.00144	0.026
INSTR. SUPPRESS. TIME	1	0.18050	3.68	0.18050	3.199
RESIDUAL	72	4.06270	82.91	0.05643	
TOTAL	79	4.90018	100,00	0.06203	
GRAND TOTAL	79	4.90018	100.00		

EXPERIMENT 5

Analysis of Variance Summary Tables.

EXTRAVERSION SCORES

SOURCE OF VARIATION	DF	SS	SS%	MS	VR
UNITS STRATUM					
INSTRUCTION	1	0.61	0.03	0.61	0.026
SUPPRESSION	1	3.61	0.20	3.61	0.151
TIME	1	66.61	3.61	66.61	2.778
INSTR. SUPPRESS.	1	35.11	1.90	35.11	1.464
INSTR. TIME	1	12.01	0.65	12.01	0.501
SUPPRESS. TIME	1	2.81	0.15	2.81	0.117
INSTR. SUPPRESS. TIME	1	0.01	0.00	0.01	0.001
RESIDUAL	72	1726.70	93.46	23.98	
TOTAL	79	1847.49	100.00	23.39	
GRAND TOTAL	79	1847.49	100.00		

NEUROTICISM SCORES

SOURCE OF VARIATION	DF	SS	SS%	MS	VR
UNITS STRATUM					
INSTRUCTION.	1	7.20	0.33	7.20	0.247
SUPPRESSION	1	39.20	1.78	39.20	1.347
TIME	1	0.05	0.00	0.05	0.002
INSTR. SUPPRESS.	1	0.45	0.02	0.45	0.015
INSTR. TIME	1	57.80	2.62	57.80	1.986
SUPPRESS. TIME	1	0.20	0.01	0.20	0.007
INSTR. SUPPRESS. TIME	1	4.05	0.18	4.05	0.139
RESIDUAL	72	2095.00	95.06	29.10	
TOTAL	79	2203.95	100.00	27.90	
GRAND TOTAL	79	2203.95	100.00		

EXPERIMENT 6

Analysis of Variance Summary Tables.

RECALL DATA

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
SUBJ. STRATUM					
INSTRUCTION	1	8.778	1.53	8.778	4.700*
PRACTICE	1	5.778	1.00	5.778	3.094
TIME	1	0.903	0.16	0.903	0.484
INSTR. PRACTICE	1	0.253	0.04	0.253	0.136
INSTR. TIME	1	1.378	0.24	1.378	0.738
PRACTICE.TIME	1	0.703	0.12	0.703	0.376
INSTR. PRACTICE.TIME	1	0.903	0.16	0.903	0.484
RESIDUAL	72	134.475	23.37	1.868	1.378
TOTAL	79	153.172	26.62	1.939	1.422
SUBJ. POSN. STRATUM					
POSITION	3	88.284	15.34	29.428	21.589**
POSN. INSTR.	3	12.034	2.09	4.011	2.943*
POSN. PRACTICE	3	6.234	1.08	2.078	1.525
POSN. TIME	3	9.759	1.70	3.253	2.387
POSN. INSTR. PRACTICE	3	2.809	0.49	0.936	0.687
POSN. INSTR. TIME	3	2.334	0.41	0.778	0.571
POSN. PRACTICE.TIME	3	3.509	0.61	1.170	0.858
POSN. INSTR. PRACTICE.TIME	3	2.859	0.50	0.953	0.699
RESIDUAL	216	294.425	51.17	1.363	
TOTAL	240	422.250	73.38	1.759	
GRAND TOTAL	319	575.422	100.00		

EXPERIMENT 6

Analysis of Variance Summary Tables.

RECOGNITION DATA

SOURCE OF VARIATION	DF	SS	SS%	MS	VR
SUBJ. STRATUM					
INSTRUCTION	1	0.0000	0.00	0.0000	0.000
PRACTICE	1	0.8000	0.26	0.8000	0.463
TIME	1	0.8000	0.26	0.8000	0.463
INSTR. PRACTICE	1	0.0000	0.00	0.0000	0.000
INSTR. TIME	1	0.0500	0.02	0.0500	0.029
PRACTICE.TIME	1	0.0000	0.00	0.0000	0.000
INSTR. PRACTICE.TIME	1	0.8000	0.26	0.8000	0.463
RESIDUAL	72	124.5000	40.69	1.7292	2.356
TOTAL	79	126.9500	41.49	1.6070	2.190
SUBJ. POSN. STRATUM					
POSITION	3	2.8500	0.93	0.9500	1.295
POSN. INSTR.	3	3.6000	1.18	1.2000	1.635
POSN. PRACTICE	3	5.0000	1.63	1.6667	2.271
POSN. TIME	3	1.5000	0.49	0.5000	0.681
POSN. INSTR. PRACTICE	3	1.5000	0.49	0.5000	0.681
POSN. INSTR. TIME	3	2.8500	0.93	0.9500	1.295
POSN. PRACTICE.TIME	3	0.7000	0.23	0.2333	0.318
POSN. INSTR. PRACTICE.TIME	3	2.5000	0.82	0.8333	1.136
RESIDUAL	216	158.5000	51.81	0.7338	
TOTAL	240	179.0000	58.51	0.7458	
GRAND TOTAL	319	305.9500	100.00		

EXPERIMENT 6

Analysis of Variance Summary Tables.

RECOGNITION SCORES

β

SOURCE OF VARIATION	DF	SS	SS%	MS	VR
UNITS STRATUM					
INSTRUCTION	1	151.25	5.18	151.25	4.066*
PRACTICE	1	22.05	0.76	22.05	0.593
TIME	1	14.45	0.50	14.45	0.388
INSTR. PRACTICE	1	4.05	0.14	4.05	0.109
INSTR. TIME	1	31.25	1.07	31.25	0.840
PRACTICE.TIME	1	8.45	0.29	8.45	0.227
INSTR. PRACTICE. TIME	1	8.45	0.29	8.45	0.227
RESIDUAL	72	2678.00	91.78	37.19	
TOTAL	79	2917.95	100.00	36.94	
GRAND TOTAL	79	2917.95	100.00		

d'

SOURCE OF VARIATION					
UNITS STRATUM					
INSTRUCTION	1	0.09661	2.78	0.09661	2.126
PRACTICE	1	0.00265	0.08	0.00265	0.058
TIME	1	0.00722	0.21	0.00722	0.159
INSTR. PRACTICE	1	0.00364	0.10	0.00364	0.080
INSTR. TIME	1	0.02450	0.70	0.02450	0.539
PRACTICE.TIME	1	0.00338	0.10	0.00338	0.074
INSTR. PRACTICE.TIME	1	0.06962	2.00	0.06962	1.532
RESIDUAL	72	3.27194	94.03	0.04544	
TOTAL	79	3.47955	100.00	0.04404	
GRAND TOTAL	79	3.47955	100.00		

EXPERIMENT 7

Analysis of Variance Summary Tables.

RECALL DATA

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
SUBJ. STRATUM					
INSTRUCTION	1	40.000	13.87	40.000	27.666**
NOISE	1	0.100	0.03	0.100	0.069
INSTR. NOISE	1	7.225	2.51	7.225	4.997*
RESIDUAL	36	52.050	18.05	1.446	1.067
TOTAL	39	99.375	34.46	2.548	1.880
SUBJ. SERPOS STRATUM					
SERPOS.	3	18.725	6.49	6.242	4.606**
SERPOS. INSTR.	3	3.950	1.37	1.317	0.972
SERPOS. NOISE	3	5.650	1.96	1.883	1.390
SERPOS. INSTR. NOISE	3	14.325	4.97	4.775	3.524*
RESIDUAL	108	146.350	50.75	1.355	
TOTAL	120	189.000	65.54	1.575	
GRAND TOTAL	159	288.375	100.00		

RECOGNITION DATA

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
SUBJ. STRATUM					
INSTRUCTION	1	8.5562	5.13	8.5562	6.387*
NOISE	1	1.4062	0.84	1.4062	1.058
INSTR. NOISE	1	2.7562	1.65	2.7562	2.058
RESIDUAL	36	48.2250	28.93	1.3396	1.681
TOTAL	39	60.9437	35.56	1.5627	1.961
SUBJ. SERPOS STRATUM					
SERPOS.	3	9.9688	5.98	3.3229	4.169**
SERPOS. INSTR.	3	2.9188	1.75	0.9729	1.221
SERPOS. NOISE	3	2.7687	1.66	0.9229	1.158
SERPOS. INSTR. NOISE	3	4.0187	2.41	1.3396	1.681
RESIDUAL	108	86.0750	51.64	0.7970	
TOTAL	120	105.7500	63.44	0.8813	
GRAND TOTAL	159	166.6937	100.00		

EXPERIMENT 7

Analysis of Variance Summary Tables.

RECOGNITION DATA

β

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
UNITS STRATUM					
INSTRUCTION	1	62.50	3.68	62.50	1.485
NOISE	1	12.10	0.71	12.10	0.287
INSTR. NOISE	1	108.90	6.41	108.90	2.587
RESIDUAL	36	1515.60	89.20	42.10	
TOTAL	39	1699.10	100.00	43.57	
GRAND TOTAL	39	1699.10	100.00		

d'

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
UNITS STRATUM					
INSTRUCTION	1	0.43890	21.99	0.43890	11.491**
NOISE	1	0.18090	9.06	0.18090	4.736*
INSTR. NOISE	1	0.00090	0.05	0.00090	0.024
RESIDUAL	36	1.37499	68.90	0.03819	
TOTAL	39	1.99570	100.00	0.05117	
GRAND TOTAL	39	1.99570	100.00		

EXPERIMENT 8

Planned Comparison Summary Table.

SOURCE	DF	SS	VAR. EST.	F	F.CRIT.
BETWEEN	6	11.50			
COMPARISON	1	2.72		3.947	< 3.99
WITHIN	66	45.50	.689		
TOTAL	72	57.00			

EXPERIMENT 9

Analysis of Variance Summary Table.

NUMBER RECALLED

SOURCE OF VARIATION	DF	SS	SS%	MS	VR
SUBJ. STRATUM					
INSTRUCTION	1	13.23	0.33	13.23	0.977
NOISE	1	0.40	0.01	0.40	0.030
INSTR. NOISE	1	0.00	0.00	0.00	0.000
RESIDUAL	36	487.15	12.13	13.53	1.181
TOTAL	39	500.77	12.47	12.84	1.120
SUBJ. SERPOS STRATUM					
SERPOS	3	600.47	14.95	200.16	17.466**
SERPOS. INSTR.	3	1599.48	39.82	533.16	46.525**
SERPOS. NOISE	3	15.40	0.38	5.13	0.448
SERPOS. INSTR. NOISE	3	63.00	1.57	21.00	1.833
RESIDUAL	108	1237.65	30.81	11.46	
TOTAL	120	3516.00	87.13	29.30	
GRAND TOTAL	159	4016.78	100.10		

EXPERIMENT 10

Analysis of Variance Summary Table.

Number of words recalled

SOURCE OF VARIATION	DF	SS	SS:	MS	VR
SUBJ. STRATUM					
NOISE	2	1.95	0.06	0.97	0.087
ASSOC.	1	1968.30	58.16	1968.30	174.895
ORIENTING (OR)	1	8.53	0.25	8.53	0.758
TIME	1	20.83	0.62	20.83	1.851
NOISE. ASSOC.	2	21.65	0.64	10.83	0.962
NOISE. OR	2	12.32	0.36	6.16	0.547
ASSOC. OR	1	0.53	0.02	0.53	0.047
NOISE. TIME	2	45.42	1.34	22.71	2.018
ASSOC. TIME	1	5.63	0.17	5.63	0.501
OR. TIME	1	34.13	1.01	34.13	3.033
NOISE. ASSOC. OR.	2	98.82	2.92	49.41	4.390*
NOISE. ASSOC. TIME	2	37.32	1.10	18.66	1.658
NOISE. OR. TIME	2	15.32	0.45	7.66	0.680
ASSOC. OR. TIME	1	13.33	0.39	13.33	1.185
NOISE. ASSOC. OR. TIME	2	20.02	0.59	10.01	0.889
RESIDUAL	96	1080.40	31.92	11.25	
TOTAL	119	3384.50	100.00	28.44	

References

AKERSTEDT, T. (1977). Inversion of the sleep/wakefulness pattern: effects on circadian variations in psychophysiological activation. Ergonomics, 20, 459-474.

AKERSTEDT, T. & LEVI, L. (1978). Circadian rhythms in the secretion of cortisol, adrenalin and nor-adrenalin. European J. Clin. Investigation, 8, 57-58.

ANDERSON, J.R. & BOWER, G.H. (1972). Recognition and retrieval processes in free recall. Psychol. Rev. 79,3, 97-123.

ANDERSON, J.R. & BOWER, G.H. (1974). A propositional theory of recognition memory. Mem. & Cogn., 2, 406-412.

ARCHER, B.U. & MARGOLIN, R. (1970). Arousal effects in intentional recall and forgetting. J. Exp. Psychol., 86, 8-12.

ATKINSON, R.C. & SHIFFRIN, R.M. (1968). Human Memory: A proposed system and its control processes. In K.W. Spence & J.T. Spence (Eds.) The Psychology of Learning and Motivation. Vol. 2. NY: Academic Press.

BADDELEY, A.D. (1966). Short-term memory for word sequences as a function of acoustic, semantic and formal similarity. Quart. J. Exp. Psychol., 18, 362-365.

BADDELEY, A.D., HATTER, J.E., SCOTT, D. & SNASHALL, A. (1970). Memory and time of day. Q.J.Exp. Psychol. 22, 605-609.

BADDELEY, A.D. & HITCH, G.J. (1974). Working memory. In G.H. Bower (Ed.), Recent Advances in Learning and Motivation, Vol. VIII, 47-89.

BADDELEY, A.D. & HITCH, G.J. (1977). Recency reexamined. In S. Dornic (Ed.) Attention and Performance VI. Hillsdale, New Jersey: Lawrence Erlbaum Assoc.

BAHRICK, H.P. (1969). Measurement of memory by prompted recall. J. Exp. Psychol. 79, 213-219.

BAHRICK, H.P. (1979). Broader methods and narrower theories for memory research. In L.S. Cermak & F.I.M. Craik (eds.) Levels of processing in human memory. Hillsdale, N.J.: Erlbaum.

BAHRICK, H.P. & BAHRICK, P.D. (1964). A re-examination of the interrelations among measures of retention. Quart. J. Exp. Psychol., 16, 318-324.

BAHRICK, H.P., FITTS, P.M. & RANKIN, R.E. (1952). Effect of incentives upon reactions to peripheral stimuli. J. Exp. Psychol. 44, 400-406.

BAKAN, P., BELTON, J.A. & TOTH, J.C. (1963). Extraversion-introversion and decrement in an auditory vigilance task. In: D.N. Buckner and J.J. McGrath (Eds.): Vigilance: A Symposium. New York: McGraw Hill.

BALOTA, D.A. & NEELY, J.H. (1980). Test-expectancy and word-frequency Effects in Recall and Recognition. J. Exp. Psychol.: Hum. Learn. & Mem. 6, 5, 576-587.

BERLYNE, D.E. (1967). Arousal and reinforcement. In D. Levine (Ed.), Nebraska Symposium on Maturation. University of Nebraska Press, Lincoln.

BERLYNE, D.E., BORSA, D.M., CRAW, M.A., GELMAN, R.S. & MANDELL, E.E. (1965). Effects of stimulus complexity and induced arousal on paired-associate learning. J. verb. Learn. verb. Behav. 4, 291-299.

BLACK, R.W. (1964). Heart rate response to auditory stimuli of varying duration. Psychonom. Sci. 1, 171-172.

BLAKE, M.J.F. (1967a). Time of day effects on performance in a range of tasks. Psychonom. Sci. 9, 349-350.

BLAKE, M.J.F. (1967b). Relationship between circadian rhythms of body-temperature and introversion-extraversion. Nature (Lond.) 215, 896-897.

BOWER, G.H. & CLARK, M.C. (1969). Narrative stories as mediators for serial learning. Psychonom. Sci. 14, 181-182.

BRADLEY, P.B. (1958). The central action of certain drugs in relation to the reticular formation of the brain. In H.H. Jasper, L.D. Proctor, R.S. Knighton, W.C. Noshay, & R.T. Costello (Eds.) Reticular Formation of the Brain. Boston: Little, Brown & Co.

BRADSHAW, J.L. (1968). Load and pupil changes in continuous processing tasks. Brit. J. Psychol., 59, 265-271.

BROADBENT, D.E. (1971). Decision and stress. London, New York: Academic Press.

BROADBENT, D.E. (1978). Low levels of noise and the naming of colours. Paper presented to the Third International Congress on Noise as a Public Health Problem. Team 4: Influence of noise on performance and behaviour. Freiburg, September 25-29, 1978.

BROADBENT, D.E. & GREGORY, M. (1965). Effects of noise and signal rate upon vigilance analysed by means of decision theory. Human Factors, 7, 155-162.

BRUCE, D. & COFER, C.N. (1967). An examination of recognition and free recall as measures of acquisition and long-term retention. J. Exp. Psychol. 75, 283-289.

BRUCE, D. & FAGAN, R.L. (1970). More on the recognition and free recall of organized lists. J. Exp. Psychol. 85, 153-154.

BRUNING, J.L., CAPAGE, J.E., KOZUH, G.F., YOUNG, P.F. & YOUNG, W.E. (1968). Socially induced drive and range of cue utilization. J. Person. Soc. Psychol., 9, 242-244.

BUCHWALD, J.S. & HUMPHREY, G.L. (1972). Response plasticity in cochlear nucleus of decerebrate cats during acoustic habituation procedures. J. Neurophysiol. 35, 864-878.

BURSILL, A.E. (1958). The restriction of peripheral vision during exposure to hot and humid conditions. Quart. J. Exp. Psychol., 10, 113-129.

BUTTER, M.J. (1970). Differential recall of paired associates as a function of arousal and concreteness-imagery levels. J. Exp. Psychol., 84, 252-256.

CALLAWAY, E. & STONE, G. (1960). Re-evaluating focus of attention. In. L. Uhr. & J.G. Miller (Eds.) Drugs and Behaviour. New York: Wiley.

CAREY, S.T. & LOCKHART, R.S. (1973). Encoding differences in recognition and recall. Mem. & Cogn., 1,3, 297-300.

CARR, D. (1971). Introversion-extraversion and vigilance performance. Proc. 79th Ann. Conv. Am. Psychol. Assoc. 6, 379-380. (summary).

CARTERETTE, E.C. (1955). Prestimulatory auditory fatigue for continuous and interrupted noise. J. Acoust. Soc. Am., 27, 103-111.

CHASE, W.G., GRAHAM, F.K. & GRAHAM, D.T. (1968). Components of HR response in anticipation of reaction time and exercise tasks. J. Exp. Psychol., 76, 642-648.

CLEMENTS, P.R., HAFER, M.D. & VERMILLION, M.E. (1976). Psychometric, diurnal and electrophysiological correlates of activation. J. Pers. & Soc. Psychol. 33, 387-394.

COLES, M.G.H., GALE, A. & KLINE, P. (1971). Personality and habituation of the orienting reaction: Tonic and response measures of electrodermal activity. Psychophys., 8, 1, 54-63.

COLQUHOUN, W.P. (1960). Temperament,inspection efficiency and time of day. Ergonomics, 3, 377-378.

COLQUHOUN, W.P. (1971). Circadian variations in mental efficiency. In W.P. Colquhoun (Ed.) Biological rhythms and human performance. London: Academic Press.

COLQUHOUN, W.P., BLAKE, M.J.F. & EDWARDS, R.S. (1968). Experimental studies of shift work. 1: A comparison of rotating and stabilized 4 hour shift systems. Ergonomics, 11, 437-453.

COLQUHOUN, W.P. & CORCORAN, D.W.J. (1964). The effects of time of day and social isolation on the relationship between temperament and performance. Brit. J. Soc. Clin. Psychol., 3, 226-231.

COLQUHOUN, W.P. & FOLKARD, S. (1978). Personality differences in body-temperature rhythm, and their relation to its adjustment to night work. Ergonomics, 21, 10, 811-817.

CONNOR, J.M. (1977). Effects of organization and expectancy on recall and recognition. Mem. & Cogn., 5, 315-318.

CORCORAN, D.W.J. (1962). Noise and loss of sleep. Quart. J. Exp. Psychol., 14, 178-182.

CORCORAN, D.W.J(1963). Doubling the rate of signal presentation in a vigilance task during sleep deprivation. J. Appl. Psychol., 47, 412-41.

CORTEEN, R.S. (1969). Skin conductance changes and word recall. Br. J. Psychol., 60, 81-90.

CRAIG, M.J., HUMPHREYS, M.S., ROCKLIN, T. & REVELLE, W. (1979). Impulsivity, Neuroticism and Caffeine: Do they have additive effects on arousal. J. Res. Pers., 13, 404-419.

CRAIK, F.I.M. (1970). The fate of primary memory items in free recall. J. Verb. Learn. Verb. Behav. 9, 143-148.

CRAIK, F.I.M. (1979). Human memory. Annual Review of Psychology, 30, 63-102.

DAEE, S. & WILDING, J.M. (1977). Effects of high intensity white noise on short-term memory for position in a list and sequence. Brit. J. Psychol., 68, 335-349.

DALE, R.C.A. (1966). When recognition is no better than recall. Nature, 211, 324.

DARLEY, D.F. & MURDOCK, B.B. (1971). Effects of prior free recall testing on final recall and recognition. J. Exp. Psychol., 91, 66-73.

DAVIES, D.R. (1968). Physiological and Psychological effects of exposure to high intensity noise. Applied Acoustics, 1, 215-233.

DAVIES, D.R. & GILL, E.B. (1980). Noise, glucose and problem solving. Paper presented at the Arousal and Memory Workshop, Bedford College, December, 1980.

DAVIES, D.R. & JONES, D.M. (1975). The effects of noise and incentives upon attention in short-term memory. Brit. J. Psychol., 66, 61-68.

DAVIS, R.C. (1938). The relation of muscle action potential to difficulty and frustration. J. Exp. Psychol. 23, 141-158.

DAVIS, R.C. (1957). Response patterns. Transactions of the New York Academy of Sciences, Series 2, 19.

DAVIS, R.C., BUCHWALD, A.M. & FRANKMAN, R.W. (1955). Autonomic and muscular responses and their relation to simple stimuli. Psychol. Monographs, 69, 405.

DEESE, J. (1957). Serial organization in the recall of disconnected items. Psychol. Rep., 3, 577-582.

DOCTOR, R.M. & ALTMAN, F. (1969). Worry and emotionality as components of test anxiety with replication and further data. Psychol. Rep., 24, 563-568.

DORNIC, S. (1973). Order error in attended and non-attended tasks: In Kornblum (Ed.) Attention and Performance, Vol IV, New York: Academic Press.

DRESSLER, F.B. (1892). Some influences which affect the rapidity of voluntary movements. Amer. J. Psychol., 4, 514-527.

DUFFY, E. (1957). The psychological significance of the concept of "Arousal" or "Activation". Psychol. Review, 64, 5, 265-275.

d'Ydewalle, G. (1979). Test expectations in free recall and recognition. Paper presented at the London Conference of the British Psychological Society, December, 1979.

d'YDEWALLE, G., SWERTS, A. & DE CORTE, E. (1980). Study time and test performance as a function of test expectations. Psychological Report No. 24 Lab. of Exp. Psychol. University of Leuven, Belgium.

EASTERBROOK, J.A. (1959). The effect of emotion on cue utilization and the organization of behaviour. Psychol. Rev., 66, 183-201.

EPSTEIN, S. & FENZ, W.O. (1970). Habituation to a loud sound as a function of manifest anxiety. *J. Abn. Psychol.*, *75*, 189-194.

ESTES, W.K. & DAPOLITO, F. (1967). Independent variation of information storage and retrieval processes in paired-associate learning. *J. Exp. Psychol.*, *75*, 18-26.

EYSENCK, H.J. (1967). *The Biological Basis of Personality.* Springfield, Illinois, U.S.A.: Charles C. Thomas Publishers.

EYSENCK, M.W. (1974a). Extraversion, arousal and retrieval from semantic memory. *J. Pers.* *42*, 319-331.

EYSENCK, M.W. (1974b). Individual differences in speed of retrieval from semantic memory. *J. Res. Person.*, *8*, 307-323.

EYSENCK, M.W. (1975a). Effects of noise, activation level and response dominance on retrieval from semantic memory. *J. Exp. Psychol.: Hum. Learn. Mem.*, *104*, 2, 143-148.

EYSENCK, M.W. (1975b). Arousal and speed of recall. *Br. J. Soc. Clin. Psychol.*, *14*, 269-277.

EYSENCK, M.W. (1976a). Arousal, learning and memory. *Psychol. Bull.*, *83*, 389-404.

EYSENCK, M.W. (1977). Human memory: theory, research and individual differences. Oxford: Pergamon Press.

EYSENCK, M.W. & EYSENCK, M.C. (1979). Memory scanning, introversion-extraversion, and levels of processing. *J. Res. in Pers.*, *13*, 305-315.

EYSENCK, M.W. & FOLKARD, S. (1980). Personality, time of day and Caffeine: Some Theoretical and Conceptual problems in Revelle et al. J. Exp. Psychol.: General, 109, 1, 32-41.

FELDMAN, S.M. & WALLER, H.J. (1962). Dissociation of electrocortical activation and behavioural arousal. Nature, 196, 1320-1322.

FISCHLER, I., RUNDUS, D. & ATKINSON, R.C. (1970). Effects of overt rehearsal procedures on free recall. Psychonom. Sci., 19,4 , 249-250.

FISHER, R., GRIFFIN, F. & ROCKEY, M.L. (1966). Gustatory chemoreceptors in man: multi-disciplinary aspects and perspectives. Persp. Biol. Med., 9, 549-577.

FLETCHER, J.L. (1961). T.T.S. following prolonged exposure to acoustic reflex eliciting stimuli. J. Aud. Res. , 1, 242-246.

FLETCHER, J.L. & RIOPELLE, A.J. (1960). Protective effect of the acoustic reflex for impulsive noise. J. Acoust. Soc. Am., 32, 401-404.

FOLKARD, S. (1976a). Time of day effects in cognitive performance. Paper presented to Symposium No. 21, "Biological Rhythms and Behaviour" of the XXIst International Congress of Psychology, Paris.

FOLKARD, S. (1976b). The reduction of subvocal activity under stress, and its effect on information processing and memory. Paper presented to: Symposium No. 26: Information Processing and Stress. XXIst International Congress of Psychology, Paris, 1976.

FOLKARD, S. (1979a). Changes in immediate memory strategy under induced muscle tension and with time of day. Quart. J. Exp. Psychol., 31, 621-633.

FOLKARD, S. (1979b). Time of day and level of processing. Mem. & Cogn., 7, 4, 247-252.

FOLKARD, S. (1980). A note on "Time of day effects in school children's immediate and delayed recall of meaningful material" the influence of the importance of the information tested. Brit. J. Psychol., 71, 1, 95-97.

FOLKARD, S. (1981). Circadian rhythms and human memory. In: F.M. Brown & R.C. Graeber (Eds.) Rhythmic aspects of behaviour. Lawrence Erlbaum Assoc.: Hillsdale, N.J.

FOLKARD, S., GLYNN, C.J. & LLOYD, J.W. (1976). Diurnal variation and individual differences in the perception of intractable pain. J. Psychosomatic Res., 20, 289-301.

FOLKARD, S. & MONK, T.H. (1978). Time of day effects in immediate and delayed memory. In M.M. Gruneberg, P.E. Morris & R.N. Sykes (Eds.), Practical aspects of memory. pp. 303-310. London: Academic Press.

FOLKARD, S. & MONK, T.H. (1979). Time of day and processing strategy in free recall. Quart. J. Psychol., 31, 461-475.

FOLKARD, S. & MONK, T.H. (1980). Circadian rhythms in human memory. Br. J. Psychol., 71, 295-307.

FOLKARD, S. & MONK, T.H. (1981). Circadian rhythms in performance - one or more oscillators. To appear in R. Sinz & M.R. Rozenzweig (Eds.) Psychophysiology 1980 - Memory, Motivation and Event-Related Potentials in Mental Operations Elsevier: North Holland.

FOLKARD, S., MONK, T.H., BRADBURY, R. & ROSENTHALL, J. (1977). Time of day effects in school children's immediate and delayed recall of meaningful material. Brit. J. Psychol., 58, 45-50.

FOLKARD, S., MONK, T.H. & LOBBAN, M.C. (1978). Short and long term adjustment of circadian rhythms in 'permanent' night nurses. Ergonomics, 21, 785-799.

FOLKARD, S., SIMPSON, J.E.P. & GLYNN, C.J. (1979). The short- and long-term memory of mental abilities following minor surgery using different anaesthetic agents. In: D. Oborne, M. Gruneberg and D. Eiser (Eds.) Psychology and Medicine. London: Academic Press.

FORSTER, P.M. & GRIERSON, A.T. (1978). Noise and attentional selectivity: A reproducible phenomenon, Brit. J. Psychol., 69, 4, 489-499.

FORT, A. & MILLS, J.N. (1976). Der Einfluss der Tageszeit und des vorhergehenden Schlaf-Wach-Musters auf die Leistungsfahigkeit unmittelbar nach dem Aufstehen. In G. Hildebrandt (Ed.) Biologische rhythmen und arbeit. Springer-Verlag.

FOWLER, C.J.H. & WILDING, J. (1979). Differential effects of noise and incentives on learning. Brit. J. Psychol., 70, 1, 149-153.

FRANKS, C.M. (1956). Conditioning and Personality: A Study of normal and neurotic subjects. J. Soc. Psychol., 52, 143-150.

FRANKS, C.M. (1957). Personality factors and the rate of conditioning. Brit. J. Psychol., 48, 119-126.

FREEMAN, G.L. & HOVLAND, C. Iver. (1934). Diurnal variations in performance and related physiological processes. Psychol. Bull., 31, 777-799.

FREUND, R.D., BRELSFORD, J.W. & ATKINSON, R.C. (1969). Recognition versus recall: Storage or retrieval differences, Quart. J. Exp. Psychol., 21, 214-224.

FROST, N. (1972). Encoding and retrieval in visual tasks. J. Exp. Psychol., 95, 317-326.

FURCHTGOTT, E. & BLACK, R.W. (1963). Psychophysiological arousal in the rat as a function of age and x-irradiation. Proc. Int. Cong. on Gerontology, Copenhagen.

GATES, A.I. (1916). Variations in efficiency during the day, together with practice effects, sex differences, and correlations. University of California Publications in Psychology, 2, 1-156.

GILLESPIE, C.R. & EYSENCK, M.W. (1980). Effects of introversion- extraversion on continuous recognition memory. Bull. Psychonom. Soc. 15, 4, 233-235.

GLANZER, M. & CUNITZ, A.R. (1966). Two storage mechanisms in free recall. J. verb. Learn. verb. Behav., 5, 351-360.

GORMAN, A.M. (1961). Recognition memory for nouns as a function of abstractness and frequency. J. Exp. Psychol., 61, 23-29.

GRAY, J.A. (1964). Pavlov's Typology. New York: Pergamon.

GREGG, V.H. (1970). Word frequency effects in human memory. Unpublished Ph.D. thesis, Birkbeck College, University of London.

GREGG, V. (1976). Word frequency, recognition and recall. In J. Brown (Ed.), Recall and Recognition. London: Wiley.

GRINGS, W.W. & SCHELL, A.M. (1969). Magnitude of electrodermal response to a standard stimulus as a function of intensity and proximity of prior stimulus. J. of Comp. Phys. Psychol., 67, 77-82.

HALL, J.F. (1954). Learning as a function of word frequency. Am. J. Psychol., 67, 138-140.

HALL, J.W., GROSSMAN, L.R. & ELWOOD, K.D. (1976). Differences in encoding for free recall vs. recognition. Mem. & Cogn., 4,5 , 507-513.

HALL, J.W. MISKIEWICZ, R. & MURRAY, C.G. (1977). Effects of test expectancy (recall vs. recognition) on children's recall and recognition. Bull. Psychonom. Soc., 10,5, 425-428.

HAMILTON, P., HOCKEY, G.R.J. & QUINN, J.G. (1972). Information selection, arousal and memory. Br. J. Psychol., 63, 181-189.

HAMILTON, P., HOCKEY, B. & REJMAN, M. (1977). The place of the concept of activation in human information processing theory: An integrative approach. In S. Dornic (Ed.) Attention and Performance, Vol VI. Hillsdale, N.J.: Erlbaum.

HARTLEY, L.R. & ADAMS, R.G. (1974). Effect of Noise on the Stroop Test. J. Exp. Psychol., 102, 1, 62-66.

HASHER, L. & ZACKS, R.T. (1979). Automatic and effortful processes in memory. J. Exp. Psychol. General, 108, 356-388.

HASLAM, D.R. (1967). Individual differences in pain threshold and level of arousal. Brit. J. Psychol., 58, 139-142.

HAVEMAN, J. & FARLEY, F.H. (1969). Arousal and retention in paired associate, serial, and free learning. (Tech. Rep. 91). Madison: Wisconsin Research and Development Centre for Cognitive Learning.

HEALY, A.F. (1975). Coding of temporal-spatial patterns in short-term memory. J. verb. Learn. Verb. Behav., 14, 481-495.

HEBB, D.O. (1955). Drives and the C.N.S. (Conceptual Nervous System). Psychol. Rev., 62, 4, 243-254.

HOCKEY, G.R.J. (1970a). Effect of loud noise on attentional selectivity. Quart. J. Exp. Psychol., 22, 28-36.

HOCKEY, G.R.J. (1970b). Signal probability and spatial location as possible bases for increased selectivity in noise. Quart. J. Exp. Psychol., 22, 37-42.

HOCKEY, G.R.J. (1970c). Changes in attention allocation in a multicomponent task under loss of sleep. Brit. J. Psychol., 61, 473-480.

HOCKEY, R. (1978). Attentional selectivity and the problems of replication: A reply to Forster & Grierson. Brit. J. Psychol., 69, 4, 499-505.

HOCKEY, G.R.J., DAVIES, S. & GRAY, M.M. (1972). Forgetting as a function of sleep at different times of day. Quart. J. Exp. Psychol., 24, 386-393.

HOCKEY, G.R.J. & HAMILTON, P. (1970). Arousal and information selection in short-term memory. Nature, 226, 866-867.

HOGAN, R.M. & KINTSCH, W. (1971). Differential effects of study and test trials on long term recognition and recall. J. verb. Learn. verb. Behav., 10, 562-567

HOOD, J.D. (1950). Studies in auditory fatigue and adaptation. Acta Oto - Laryngologica Suppl. No. 92.

HORMANN, H. & OSTERKAMP, U. (1966). Uber den Einfluss von kontinuierlichem Läarm auf die Organisation von Gedachtnisinhalten. Z. exp. angew. Psychol., 13, 31-38.

HOWARTH, E. & EYSENCK, H.J. (1968). Extraversion, arousal and paired-associate recall. J. exp. Res. Person., 3, 114-116.

HUGHES, D.G. & FOLKARD, S. (1976). Adaptation to an 8-hr shift in living routine by members of a socially isolated community. Nature, 264, 232-234.

INGLEBY, J.D. (1969). Decision-making processes in human perception and memory. Unpublished doctoral dissertation, University of Cambridge.

JONES, D.M., DAVIES, D.R., HOGAN, K.M., PATRICK, T. & CUMBERBATCH, W.G. (1978). Short term memory during the normal working day. In M.M. Gruneberg, P.E. Morris & R.N. Sykes, (Eds.) Practical Aspects of Memory. London: Academic Press.

JONES, D. & THOMAS, R. (1978). Memory for prose items in noise. Paper presented at the Cardiff Conference on 'Practical Aspects of Memory'.

KAHNEMAN, D. (1973). Attention and Effort. New Jersey: Prentice-Hall Inc. Englewood Cliffs.

KEISTER, E. & McLAUGHLIN, J. (1972). Vigilance performance related to extraversion-introversion and caffeine. J. Exp. Res. in Pers., 6, 5-11.

KINTSCH, W. (1968). Recognition and free recall of organized lists. J. Exp. Psychol., 78, 3 , 481-487.

KINTSCH, W. (1970). Models for free recall and recognition. In D.A. Norman (Ed.) Models of human memory. New York: Academic Press.

KLEIN, K.E., WEGMANN, H.M. & HUNT, B.I. (1972). Desynchronization of body temperature and performance circadian rhythm as a result of outgoing and homegoing transmeridian flights. Aerospace Medicine, 43, 119-132.

KLEINSMITH, L.J. & KAPLAN, S. (1963). Paired-associate learning as a function of arousal and interpolated interval. J. Exp. Psychol., 65, 109-193.

KLEITMAN, N. (1939, revised 1963). Sleep and wakefulness. Chicago: Univ. Chicago Press.

KRUPSKI, A., RASKIN, D.C. & BAKAN, P. (1971). Physiological and personality correlates of commission errors in an auditory vigilance task. Psychophys, 8, 304-311.

KUCERA, H. & FRANCIS, W.N. (1967). Computational analysis of present day American English. Providence Rhode Island: Brown University Press.

LACEY, J.I.(1959). Psychophysiological approaches to the evaluation of psychotherapeutic process and outcome. In E.A. Rubinstein and M.B. Parloff (Eds.) Research in Psychotherapy, Washington, D.C. American Psychological Association.

LACEY, J.I. (1967). Somatic response patterning and stress: Some revisions of activation theory. In M.H. Appley & R. Trumbull (Eds.), Psychological Stress. New York: Appleton Century-Crofts.

LACEY, J.I., KAGAN, J., LACEY, B.C. & MOSS, H.A. (1963). The visceral level: Situational determinants and behavioral correlates of autonomic response patterns. In P.H. Knapp (Ed.), Expression of the Emotions in Man. New York: International Universities Press.

LAIRD, D.A. (1925). Relative performance of college students as conditioned by time of day and day of week. J. Exp. Psychol., 8, 50-63.

LAZAR, G. & BUSCHKE, H. (1972). Successive retrieval from permanent storage. Psychonom. Sci. 29, 388-390.

LEVONIAN, E. (1967). Retention of information in relation to arousal during continuously presented material. Am. Educ. Res. J., 4, 103-116

LIBBY, W.L. Jr., LACEY, B.C. & LACEY, J.I. (1973). Pupillary and cardiac activity during visual attention. Psychophys., 10, 270-294.

LIEBERT, R.M. & MORRIS, L.W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. Psychol. Rep., 20, 975-978.

LIGHT, L.L. & CARTER-SOBELL, L. (1970). Effects of changed semantic context on recognition memory. J. verb. Learn. verb. Behav., 9, 1-11.

LINDSLEY, D.B. (1952). Psychological phenomena and the Electroencephalogram. Electroencephalography Clin. Neurophysiol., 4, 443-456.

LOFTUS, G. (1971). Comparison of recognition and recall in a continuous memory task. J. Exp. Psychol., 91, 2 , 220-226.

LORSBACH, T.C. & MUELLER, J.H. (1979). Encoding tasks and free recall in children. Bull. Psychonom. Soc., 14, 3, 169-172.

MAISTO, S.A., DEWAARD, R.J. & MILLER, M.E. (1977). Encoding processes for recall and recognition: The effect of instructions and auxiliary task performance. Bull. Psychonom. Soc., 9,2 , 127-130.

MALMO, R.B. (1957). Anxiety and behavioural arousal. Psychol. Rev., 65, 5, 276-287.

MALMO, R.B. & DAVIS, J.F. (1956). Physiological gradients as indicants of 'arousal' in mirror tracing. Can. J. Psychol., 10, 231-238.

MALTZMAN, I., KANTOR, W. & LANGDON, B. (1966). Immediate and delayed retention, arousal, and the orienting and defensive reflexes. Psychonom. Sci., 6, 445-446.

MATTHEWS, W.A. (1966). Continued word associations and free recall. Quart. J. Exp. Psychol., 18, 31-38.

McLEAN, P.D. (1969). Induced arousal and time of recall as determinants of paired-associate recall. Br. J. Psychol., 60, 57-62.

McNAMARA, H.J. & FISCH, R.I. (1964). Effects of high and low motivation on two aspects of attention. Percept. & Mot. Skills, 19, 571-578.

MEYER, G. (1934). An experimental study of the old and new types of examinations: I. The effect of the examination set on memory. J. Ed. Psychol., 25, 641-661.

MEYER, G. (1935). An experimental study of the old and new types of examination: II. Methods of study. J. Ed. Psychol., 26, 30-40.

MEYER, G. (1936). The effect on recall and recognition of the examination set in classroom situations. J. Ed. Psychol., 27, 81-99.

MILLAR, K. (1979a). Word recognition in loud noise. Acta Psychologica, 43, 225-237.

MILLAR, K. (1979b). Noise and the 'rehearsal-masking hypothesis'. Brit. J. Psychol., 70, 4, 565-577.

MILLAR, K., STYLES, B.C. & WASTELL, D.G. (1980). Time of day and retrieval from long-term memory. Brit. J. Psychol., 71, 407-414.

MILLER, E. (1978). Retrieval from long term memory in presenile dementia: Two tests of an hypothesis. Brit. J. Soc. Clin. Psychol., 17, 2, 143-149.

MORRIS, L.W., BROWN, N.R. & HALBERT, B.L. (1977). Effects of symbolic modeling on the arousal of cognitive and affective components of anxiety in pre-school children. In C.D. Spielberger & I.G. Sarason (Eds.), Stress and Anxiety (Vol. 4) New York: Halsted.

MORUZZI, G. & MAGOUN, H.W. (1949). Brain stem reticular formation and activation of the EEG. EEG and Clin. Neurophysiol., 1, 455-473.

MUELLER, J.H. (1979). Anxiety and encoding processes in memory. Pers. & Soc. Psychol. Bull., 5, 288-294.

MUELLER, J.H., CARLOMUSTO, M. & MARLER, M. (1977). Recall as a function of method of presentation and individual differences in test anxiety. Bull. Psychonom. Soc., 10, 447-450.

MUELLER, J.H. & COURTOIS, M.R. (1980). Test anxiety and breadth of encoding experiences in free recall. J. Res. in Pers., in press.

MURDOCK, B.B.Jr. (1963). Interpolated recall in short-term memory. J. Exp. Psychol., 66, 525-532.

MURRAY, D.J. (1965). The effect of white noise upon the recall of vocalized lists. Canad. J. Psychol. 19, 333-345.

MURRAY, D.J. (1967). The role of speech responses in short-term memory. Canad. J. Psychol., 21, 263-276.

MURRELL, K.F.H. (1971). Blood sugar level and performance: Laboratory studies of repetitive work: V, Occup. Psychol., 41, 273-280.

NIEMI, P., VON WRIGHT, J.M. & KOIVUNEN, E. (1977). Arousal and incidental learning: A reappraisal. Report from the Institute of Psychology, University of Turku, No. 44.

OBRIST, P.A. (1963). Cardiovascular differentiation of sensory stimuli. Psychosomatic Medicine, 25,450-459

OBRIST, P.A., WEBB, D.M. & SUTTERER, J.R. (1969). Heart rate and somatic changes during aversive conditioning and a simple reaction-time task. Psychophys., 5, 696-723.

PAIVIO, A. & MADIGAN, S.A. (1970). Noun imagery and frequency in paired-associate and free recall learning. Can. J. Psychol., 24, 353-361.

PATTERSON, K.E. (1972). Some characteristics of retrieval limitation in long-term memory. J. verb. Learn. verb. Behav., 11, 685-691.

POSTMAN, L. & JENKINS, W.O. (1948). An experimental analysis of set in rote learning: The interaction of learning instruction and retention performance. J. Exp. Psychol., 38, 683-689.

POSTMAN, L. & KEPPEL, G. (Eds.)(1970). Norms of word association. New York: Academic Press.

POULTON, E.C. (1977). Continuous intense noise masks auditory feedback and inner speech. Psychol. Bull., 84, 977-1001.

RABINOWITZ, J.C., MANDLER, G. & PATTERSON, K.E. (1977). Determinants of recognition and recall: accessibility and generation. J. Exp. Psychol. 106, 302-329.

RAFFEL, G. (1936). Two determinants of the effect of primacy. Amer. J. Psychol., 48, 654-657.

REEVES, F.B. & BERGUM, B.O. (1972). Perceptual narrowing as a function of peripheral cue relevance. Percept. & Mot. Skills, 35, 719-724.

REVELLE, W.R. (1974). Introversion/extraversion, skin conductance and performance under stress (Doctoral dissertation, University of Michigan 1973). Dissertation Abstracts International, 35, 487B.

REVELLE, W., HUMPHREYS, M.S., SIMON, L., & GILLILAND,K. (1980). The interactive effect of personality time of day, and caffeine: A test of the arousal model. J. Exp. Psychol., General, 109, 1, 1-31.

RICHARDSON, J.T.E. & BADDELEY, A.D. (1975). The effect of articulatory suppression in free recall. J. verb. Learn. & Verb. Beh., 14, 623-629.

ROUTTENBERG, A. (1968). The two-arousal hypothesis: reticular formation and limbic system. Psychol. Rev., 75, 51-80.

RUNDUS, D. (1971). Analysis of Rehearsal Processes in Free Recall. J. Exp. Psychol., 89, 63-77.

SAMPSON, J.R. (1969). Further study of encoding and arousal factors in free recall of verbal and visual material. Psychonom. Sci., 16, 221-222.

SARASON, I.G. (1975). Anxiety and self-preoccupation In. I.G. Sarason & C.D. Spielberger (Eds.), Stress and Anxiety (Vol. 2), London: Wiley.

SCHONPFLUG, W. & BEIKE, P. (1964). Einprägen und Aktivierung bei gleichzeitiger Variation der Absichtlichkeit des lernens und der Ich-Bezogenheit des lernstoffs. Psychol. Forsch., 27, 366-376.

SCHWARTZ, F. & ROUSE, R.D. (1961). The activation and recovery of associations. Psychol. Issues, 3, 1.

SCHWARTZ, S. (1974a). The effects of arousal on recall, recognition, and the organization of memory. Unpublished manuscripts, Northern Illinois University.

SCHWARTZ, S. (1974b). Arousal and recall: Effects of noise on two retrieval strategies. J. Exp. Psychol., 102, 5, 896-898.

SCHWARTZ, S. (1975). Individual differences in cognition: some relationships between personality and memory. J. Res. in Pers., 9, 217-225.

SCHWARTZ, S. (1979). Differential effects of personality on access to various long-term memory codes. J. Res. in Pers., 13, 396-403.

SEAMON, J.G. & MURRAY, P. (1976). Depth of processing in recall and recognition memory: Differential effects of stimulus meaningfulness and serial position. J. Exp. Psychol.: Human Mem. & Learning, 1, 2, 680-687.

SHEPARD, R.N. (1967). Recognition memory for words, sentences and pictures. J. verb. Learn. verb. Behav., 6, 156-163.

SHUELL, T.J. & KEPPEL, G. (1968). Item priority in free recall. J. verb. Learn. verb. Behav., 7, 5 969-971.

SMITH, A.P. (1978). Low levels of noise and performance. Paper presented at the Third International Congress on Noise as a Public Health Problem, Freiburg.

SMITH, A. (1980). The effects of noise on memory for order and location. Paper presented at the Arousal and Memory Workshop, Bedford College, December, 1980.

SMITH, A.P. & BROADBENT, D.E. (1980). Further studies of the effects of noise on recall of categorized lists. (paper submitted).

SMITH, A.P., JONES, D.M. & BROADBENT, D.E. (1980). The effect of noise on recall of categorized lists. (paper submitted).

SMITH, S.L. (1968). Extraversion and sensory threshold Psychophys., 5, 293-299.

SNODGRASS, J.G. & BURNS, P.M. (1978). The effect of repeated tests on recognition memory for pictures and words. Bull. Psychonom. Sci., 11, 4, 263-266.

STENNETT, R.G. (1957). The relationship of alpha amplitude to the level of palmar conductance. Electro encephal. & Clin. Neurophysiol., 9, 131-138.

STERNBERG, S. (1966). High speed scanning in human memory. Science, 153, 652-654.

STEVENSON, R.J., HOCKEY, G.R.J., CROME, V.J. & GUNNELL, A.M. (1979). The effects of time of day and noise on the recall of prose. Draft of paper presented to the Experimental Psychology Society, York, 18-20th April.

TAUB, J.M. & BERGER, R.J. (1974). Diurnal variations in mood as asserted by self-reported and verbal content analysis. J. Psychiatric. Res., 10, 83-88.

THACKERAY, R.I., JONES, K.N. & TOUCHSTONE, M.S. (1973). Personality and physiological correlates of performance decrement on a monotonous task requiring sustained attention. F.A.A. Office of Aviation Med. Rep. No. F.A.A. AM-73-14.

THAYER, R.E. (1967). Measurement of activation through self report. Psychol. Reports, 20, 663-678.

THAYER, R.E. (1978). Towards a psychological theory of multidimensional activation (arousal). Motivation and emotion, 2, 1-34.

THAYER, R.E., ANDERSON, J., SPADONE, A. & WHITE, V. (1970). Stimulus-seeking behaviour and activation level as a function of white noise. Paper presented at the meeting of the Western Phsychological Association, Los Angeles, April 1970.

THOMSON, D.M. & TULVING, E. (1970). Associative encoding and retrieval: weak and strong cues. J. Exp. Psychol., 86, 2, 255-262.

THORNDIKE, E.L. & LORGE, I. (1944). The teacher's word book of 30,000 words. New York: Columbia University, Teachers College, Bureau of Publications.

TULVING, E. (1976). Ecphoric processes in recall and recognition. In J. Brown (Ed.). Recall and recognition. London: Wiley.

TULVING, E. (1967). The effects of presentation and recall of material in free recall learning. J. verb. Learn. verb. Behav., 6, 175-184.

TULVING, E. & ARBUCKLE, T.Y. (1963). Sources of inter-trial interference in immediate recall of paired associates. J. verb. Learn. verb. Behav., 1, 321-324.

TULVING, E. & ARBUCKLE, T.Y. (1966). Input and output interference in short-term associative memory. J. Exp. Psychol., 72, 145-150.

TULVING, E. & PEARLSTONE, A. (1966). Availability versus accessibility of information in memory for words. J. verb. Learn. verb. Behav., 5, 381-391.

TULVING, E. & THOMSON, D.M. (1971). Retrieval processes in recognition memory: Effects of associative context. J. Exp. Psychol., 87, 116-124.

TULVING, E. & THOMSON, D.M. (1973). Encoding specificity and retrieval processes in episodic memory. Psychol. Rev., 80, 5, 352-373.

TVERSKY, B. (1973). Encoding processes in recognition and recall. Cogn. Psychol., 5, 275-287.

TVERSKY, B. (1974). Eye fixations in prediction of recognition and recall. Mem. & Cogn., 2, 275-278.

UNDERWOOD, B.J. & SCHULTZ, R.W. (1960). Meaningfulness and verbal learning. Chicago, Ill: Lippincott.

VON RESTORFF, H. (1933). Uber die Wirkung von Bereichs bildungen im Spurenfeld. Psychol. Forsch. 18, 299-342.

WALKER, E.L. (1958). Action decrement and its relation to learning. Psychol. Rev., 65, 129-142.

WALKER, E.L. & TARTE, R.D. (1963). Memory storage as a function of arousal and time with homogeneous and heterogeneous lists. J. verb. Learn. verb. Behav., 2, 113-119.

WALLACE, W.P. (1978). Recognition failure of recallable words and recognizable words. J. Exp. Psychol. Hum. Learn. & Mem., 4, 5, 441-452.

WALSH, D.A. & JENKINS, J.J. (1973). Effects of orienting tasks on free recall in incidental learning: "Difficulty", "Effort", and "Process" Explanations. J. verb. Learn. verb. Behav., 12, 481-488.

WARRINGTON, E.K. & WEIZKRANTZ, L. (1970). Amnesic syndrome: consolidation or retrieval. Nature, 228, 628-630.

WAUGH, N.C. & NORMAN, D.A. (1965). Primary memory. Psychol. Rev., 72, 89-104.

WEBB, R.A. & OBRIST, P.A. (1970). The physiological concomitants of reaction time performance as a function of preparatory interval series. Psychophys., 6, 389-403.

WESNER, C.E. (1972). Induced arousal and word-recognition learning by mongoloids and normals. Percept. Mot. Skills, 35, 586.

WIKLER, A. (1952). Pharmacologic dissociation of behaviour and EEG "sleep patterns" in dogs: Morphine, N-allylnormorphine, and atropine. Proc. Soc. Exp. Biol. Med., 79, 261-265.

WILDING, J. & MOHINDRA, N. (1980). Effects of subvocal suppression, articulating aloud and noise on sequence recall. Brit. J. Psychol., 71, 247-261.

WILDING, J. & MOHINDRA, N. (1980). Does noise affect the efficiency of semantic processing? (paper submitted).

WILKINSON, R.T. (1963). Interaction of noise with knowledge of results and sleep deprivation. J. Exp. Psychol., 66, 332-337.

WINOGRAD, E. & SMITH, A.D. (1978). When do semantic orienting tasks hinder recall? Bull. Psychonom. Soc., 11, 3, 165-167.

WISEMAN, S. & TULVING, E. (1975). A test of confusion theory of encoding specificity. J. verb. Learn. verb. Behav., 14, 370-381.

YERKES, R.M. & DODSON, J.D. (1908). The relation of strength of stimulus to rapidity of habit formation. J. Comp. Neurol. Psych., 18, 459-482.

ZAFFY, D.J. & BRUNING, J.L. (1966). Drive and the range of cue utilization. J. Exp. Psychol., 71, 382-384.

ZIMMERMAN, J. & UNDERWOOD, B.J. (1968). Ordinal position knowledge within and across lists as a function of instructions in free-recall learning. J. Gen. Psychol., 79, 301-307.

TABLES OF RAW DATA

EXPERIMENT 1

Number of words remembered in correct Position, correct Sequence and correct Sequence & Position.

KNOWLEDGE	INSTRUCTION	POSITION	SEQUENCE	POSITION & SEQUENCE
NO KNOWL.	RECALL	2	4	1
"	"	3	3	2
"	"	4	2	1
"	"	4	1	0
"	"	2	4	0
"	"	2	1	3
"	"	5	3	0
"	"	1	2	0
"	"	1	0	2
"	"	4	2	0
"	"	3	3	3
"	"	5	6	0
"	"	1	0	0
"	"	1	1	0
"	"	1	1	3
"	"	5	4	0
"	"	2	1	1
"	"	2	1	0
"	"	2	1	1
"	"	4	1	1
"	RECOGN.	1	1	0
"	"	2	1	0
"	"	6	2	2
"	"	6	2	2
"	"	2	4	0
"	"	1	2	0
"	"	3	3	0
"	"	3	2	0
"	"	1	1	1
"	"	2	3	3
"	"	4	7	1
"	"	2	5	0
"	"	3	0	2
"	"	5	3	0
"	"	1	0	2
"	"	3	5	2
"	"	4	6	0
"	"	2	0	0
"	"	1	3	0
"	"	3	2	1
KNOWL.	RECALL	2	0	0
"	"	3	2	1
"	"	5	7	3

EXPERIMENT 1 cont.

KNOWLEDGE	INSTRUCTION	POSITION	SEQUENCE	POSITION & SEQUENCE
KNOWL.	RECALL	2	4	1
"	"	2	1	0
"	"	1	1	0
"	"	5	0	0
"	"	5	4	3
"	"	2	2	0
"	"	6	4	4
"	"	1	3	0
"	"	3	2	2
"	"	4	5	3
"	"	6	4	4
"	"	6	3	3
"	"	3	1	1
"	"	3	2	2
"	"	3	3	2
"	"	4	0	0
"	"	4	4	3
"	RECOGN.	1	1	0
"	"	2	3	1
"	"	2	1	0
"	"	1	0	0
"	"	3	1	0
"	"	5	1	1
"	"	2	4	0
"	"	2	1	0
"	"	2	1	0
"	"	1	0	0
"	"	2	2	0
"	"	3	1	1
"	"	4	1	0
"	"	3	1	1
"	"	5	3	1
"	"	3	3	1
"	"	2	2	0
"	"	4	3	2
"	"	6	5	3
"	"	0	0	0

EXPERIMENT 2

Number of words recalled following Recall- and Recognition Instructions.

RECALL INSTRUCTIONS

RECALL - RECOGNITION TEST					RECOGNITION - RECALL TEST				
Serial Position					Serial Position				
1	2	3	4	Total	1	2	3	4	Total
3	2	3	2	10	4	3	1	1	9
1	5	1	1	8	3	0	0	1	4
5	1	4	3	13	2	2	2	2	8
4	1	2	2	9	4	4	0	3	11
4	2	3	1	10	3	1	2	3	9
3	2	2	0	7	3	5	4	3	15
2	2	2	2	8	5	3	1	1	10
4	1	3	2	10	3	2	3	1	9
3	3	1	1	8	4	2	2	3	11
4	1	2	4	11	3	0	1	3	7
X3.3	2	2.3	1.8	9.4	3.4	2.2	1.6	2.1	9.3

RECOGNITION INSTRUCTIONS

4	2	1	1	8	3	0	0	1	4
3	3	2	2	10	1	4	2	1	8
2	3	1	2	8	3	2	1	3	9
3	1	2	2	8	2	2	1	4	9
3	3	1	4	11	4	2	1	1	8
2	0	1	4	7	2	2	4	4	12
2	1	1	3	7	3	1	0	1	5
1	2	3	1	7	3	3	2	1	9
2	2	0	2	6	4	0	2	4	10
4	1	2	0	7	1	1	1	1	4
X2.6	1.8	1.4	2.1	7.9	2.6	1.7	1.4	2.1	7.8

EXPERIMENT 2

Number of words recognized following Recall- and Recognition Instructions.

RECALL INSTRUCTIONS

RECALL - RECOGNITION TEST					RECOGNITION - RECALL TEST				
Serial Position					Serial Position				
1	2	3	4	Tot.	1	2	3	4	Tot.
4	3	5	5	17	5	4	4	5	18
2	5	4	5	16	3	2	3	3	11
5	3	5	5	18	2	4	3	4	13
5	3	3	4	15	5	5	2	4	16
5	2	4	4	15	3	4	3	3	13
4	3	2	2	11	5	5	5	5	20
5	3	4	4	16	5	4	4	4	17
5	4	4	3	16	4	2	3	4	13
5	4	5	3	17	5	5	5	5	20
3	5	3	4	15	4	4	1	3	12
4.3	3.5	3.9	3.9	15.6	4.1	3.9	3.3	4.0	15.3

RECOGNITION INSTRUCTIONS

4	5	4	2	15	4	4	4	4	16
5	4	5	4	18	5	5	5	3	18
4	4	3	4	15	5	5	3	5	18
3	4	3	3	13	5	2	5	4	16
5	5	4	5	19	5	4	4	3	16
3	3	4	5	15	5	5	5	5	20
4	3	2	3	12	4	1	1	3	9
3	5	5	3	16	4	4	3	4	15
3	5	3	5	16	3	3	3	4	13
4	5	4	2	15	4	5	4	3	16
3.8	4.3	3.7	3.6	15.4	4.4	3.8	3.7	3.8	15.7

EXPERIMENT 3

Number of words recalled and recognized following Recall- and Recognition Instructions.

RECALL SCORES

RECALL INSTRUCTIONS					RECOGNITION INSTRUCTIONS				
Serial Position					Serial Position				
1	2	3	4	Tot.	1	2	3	4	Tot.
3	4	1	1	9	0	1	1	3	5
4	2	0	1	7	1	1	2	3	7
0	5	3	0	8	5	0	2	2	9
3	3	0	3	9	3	1	2	3	9
3	4	2	4	13	2	4	2	1	9
3	3	2	1	9	1	0	0	1	2
2	1	2	3	8	1	2	2	2	7
2	1	1	2	6	3	1	1	4	9
2	1	1	3	7	1	1	1	1	4
1	5	5	2	13	2	2	2	3	9
2.3	2.9	1.7	2.0	8.9	1.9	1.3	1.5	2.3	7.0

RECOGNITION SCORES

3	3	2	3	11	3	5	3	3	14
5	4	2	2	13	4	4	4	4	16
2	5	3	0	10	5	2	5	4	16
4	3	1	3	11	4	2	5	5	16
5	5	5	5	20	4	5	3	5	17
4	3	3	1	11	5	3	5	4	17
2	2	4	3	11	4	3	4	4	15
3	3	2	3	11	4	2	4	4	14
5	3	4	4	16	1	1	1	3	6
4	5	5	3	17	4	3	3	5	15
3.7	3.6	3.1	2.7	13.1	3.8	3.0	3.7	4.1	14.6

EXPERIMENT 4

Number of words recalled following four different sets of instructions.

STANDARD RECALL INSTRUCTIONS

FOCUSSED TEST					STANDARD TEST				
	Serial Position					Serial Position			
1	2	3	4	Tot.	1	2	3	4	Tot.
5	3	1	2	11	5	2	2	3	12
2	1	2	3	8	4	1	1	1	7
2	2	1	3	8	2	1	2	2	7
3	1	0	0	4	2	3	0	1	6
3	2	0	3	8	2	3	2	0	7
4	1	1	3	9	1	2	3	1	7
2	4	1	1	8	5	3	4	1	13
1	0	1	3	5	1	0	1	3	5
3	4	1	3	11	2	2	1	2	7
2	3	1	3	9	2	2	2	2	8
2.7	2.1	.9	2.4	8.1	2.6	1.9	1.8	1.6	7.9

FOCUSSED RECALL INSTRUCTIONS

3	2	1	2	8	2	3	1	0	6
3	3	4	3	13	2	2	3	3	10
3	3	1	2	9	2	3	2	3	10
3	3	3	1	10	2	0	2	2	6
2	3	1	1	7	2	2	0	2	6
4	5	0	1	10	2	5	2	1	10
1	3	2	1	7	1	4	2	0	7
2	5	1	2	10	0	3	3	3	9
3	4	4	1	12	4	1	2	0	7
1	2	2	1	6	1	4	1	2	8
2.5	3.3	1.9	1.5	9.2	1.8	2.7	1.8	1.6	7.9

EXPERIMENT 4

Number of words recognized following four different sets of instruction.

STANDARD RECALL INSTRUCTIONS

FOCUSSED TEST					STANDARD TEST				
	Serial Position					Serial Position			
1	2	3	4	Tot.	1	2	3	4	Tot.
5	5	2	3	15	5	3	3	4	15
3	2	5	1	11	5	2	1	1	9
4	3	1	3	11	4	2	4	2	12
4	3	0	0	7	4	3	2	2	11
4	2	1	2	9	3	6	4	2	15
5	5	4	5	19	3	2	3	2	10
1	4	3	1	9	5	5	4	3	17
4	3	3	3	13	3	2	3	4	12
4	4	2	3	13	3	3	3	2	11
5	5	4	3	17	3	5	2	3	13
3.9	3.6	2.5	2.4	12.4	3.8	3.3	2.9	2.5	12.5

FOCUSSED RECALL INSTRUCTIONS

4	5	4	5	18	3	4	2	1	10
5	4	5	3	17	5	3	4	3	15
5	4	4	4	17	5	3	5	4	17
4	5	4	3	16	2	3	3	2	10
4	4	2	2	12	3	4	5	2	14
5	5	1	1	12	3	4	3	2	12
1	4	3	1	9	3	5	4	2	14
4	5	2	2	13	0	3	3	2	8
5	4	4	2	15	4	3	4	3	14
4	5	4	2	15	3	5	4	4	16
4.1	4.5	3.3	2.5	14.4	3.1	3.7	3.7	2.5	13.0

EXPERIMENT 5

Number of words recalled in the morning and afternoon in four experimental conditions; Recall (RC), Recall Suppression (RCSR), Recognition (RN) and Recognition Suppression (RNSR).

	MORNING				AFTERNOON			
Serial Position	RC	RCSR	RN	RNSR	RC	RCSR	RN	RNSR
Block 1	4	3	3	3	5	4	3	3
"	3	1	2	1	4	3	2	2
"	4	3	2	1	3	3	3	2
"	4	3	2	4	2	3	1	4
"	4	1	3	2	2	5	3	3
"	4	1	2	2	4	2	2	4
"	2	3	3	1	3	5	3	2
"	3	2	4	1	4	3	1	2
"	1	3	2	2	3	3	2	0
"	4	4	4	3	4	2	4	0
Block 2	1	0	1	0	4	4	3	2
"	1	2	1	0	5	0	1	4
"	3	1	1	3	2	0	1	1
"	0	2	0	1	3	3	0	2
"	1	3	2	0	1	1	1	0
"	0	0	2	4	1	1	2	0
"	1	2	1	2	1	2	2	0
"	0	2	1	1	0	2	0	4
"	2	1	2	1	3	1	1	1
"	4	1	3	1	0	0	2	2
Block 3	2	2	2	2	1	2	1	1
"	3	2	0	0	2	1	0	0
"	2	0	1	2	0	2	1	1
"	3	4	1	3	1	0	2	0
"	0	1	1	2	3	1	0	1
"	2	3	1	0	2	0	0	0
"	2	0	3	2	3	1	0	1
"	3	2	2	3	1	0	3	2
"	0	0	0	2	0	2	0	1
"	1	0	2	4	4	3	0	3
Block 4	2	1	1	1	1	2	2	1
"	1	1	2	3	2	4	2	1
"	0	2	3	4	3	1	2	2
"	1	3	1	1	2	0	1	1
"	1	0	3	2	2	3	0	2
"	2	4	3	1	3	2	3	2
"	2	3	3	2	2	1	2	4
"	2	1	4	3	4	1	3	3
"	4	3	3	2	2	2	2	2
"	2	0	5	2	2	2	2	1

EXPERIMENT 5

Number of words recognized in the morning and afternoon in four experimental conditions; Recall (RC), Recall Suppression (RCSR), Recognition (RN) and Recognition Suppression (RNSR).

	MORNING				AFTERNOON			
Serial Position	RC	RCSR	RN	RNSR	RC	RCSR	RN	RNSR
Block 1	5	3	5	5	5	5	5	4
"	5	2	4	3	5	5	5	2
"	3	4	5	1	4	3	3	5
"	5	5	5	5	5	4	2	5
"	4	6	4	3	4	5	4	4
"	5	5	5	5	5	5	4	5
"	4	4	4	4	4	5	4	4
"	4	3	5	5	5	5	1	5
"	4	5	3	4	4	5	5	5
"	5	5	5	4	4	4	4	4
Block 2	4	3	3	3	5	5	4	4
"	3	5	4	4	5	1	4	5
"	5	3	4	4	4	0	4	1
"	1	3	3	5	5	3	1	4
"	5	4	5	1	4	3	4	3
"	5	4	3	5	3	4	3	4
"	4	4	3	4	5	5	3	5
"	3	4	5	3	1	3	3	4
"	5	5	3	3	4	3	4	4
"	5	1	3	4	3	5	3	3
Block 3	5	3	4	3	4	5	3	2
"	5	5	1	0	5	3	3	2
"	2	2	5	2	1	1	2	3
"	3	5	4	4	1	3	3	0
"	3	5	4	4	4	4	3	3
"	2	4	5	2	4	3	3	1
"	3	4	4	3	5	4	3	4
"	3	3	4	5	2	2	2	5
"	2	2	4	3	5	4	4	3
"	4	2	5	4	4	4	4	4
Block 4	5	3	3	5	1	2	4	2
"	4	4	2	4	5	4	5	5
"	3	3	5	4	5	2	4	4
"	2	3	3	5	5	2	4	0
"	4	2	5	4	3	4	4	2
"	3	5	5	2	3	4	3	2
"	4	5	5	4	3	4	4	4
"	2	2	5	4	2	4	3	3
"	4	4	4	2	4	4	4	4
"	5	1	5	3	5	4	4	5

EXPERIMENT 6

Number of words recalled in the morning and afternoon in four experimental conditions; Recall (RC), Recall Practice (RCP), Recognition (RN) and Recognition Practice (RNP).

	MORNING				AFTERNOON			
Serial Position	RC	RCP	RN	RNP	RC	RCP	RN	RNP
Block 1	4	4	3	2	4	0	3	2
"	4	5	1	3	4	1	2	3
"	4	2	3	3	3	2	2	3
"	3	2	3	0	4	3	3	2
"	4	4	2	5	3	3	3	0
"	3	4	4	2	4	3	4	0
"	5	2	1	3	5	3	2	4
"	5	4	1	3	5	3	4	1
"	3	3	4	1	2	4	3	0
"	4	3	4	3	5	2	1	4
Block 2	0	3	1	0	1	2	2	2
"	1	2	1	1	2	0	0	1
"	0	1	2	2	1	1	5	0
"	3	2	0	2	3	2	0	1
"	1	1	0	1	1	2	1	1
"	3	0	1	2	3	4	1	1
"	0	1	4	0	3	2	3	3
"	2	1	3	1	3	1	2	1
"	1	2	1	1	2	2	0	4
"	4	1	0	0	1	2	0	2
Block 3	5	3	3	1	3	3	2	3
"	2	3	2	2	2	0	0	2
"	2	1	4	2	3	2	1	3
"	2	3	1	4	1	3	1	2
"	3	2	3	4	1	3	1	1
"	2	2	4	1	2	2	3	0
"	2	1	1	2	1	2	3	2
"	2	0	2	4	4	2	2	1
"	2	3	2	4	1	2	2	1
"	2	1	2	0	2	1	0	0
Block 4	4	1	1	2	5	2	4	5
"	2	3	2	4	1	3	1	2
"	1	2	3	3	2	1	4	4
"	4	3	4	3	5	1	1	2
"	2	3	2	2	2	3	2	3
"	2	3	3	3	4	2	2	1
"	1	1	5	2	5	1	4	4
"	0	5	3	2	3	4	0	3
"	1	2	3	1	1	4	4	0
"	3	4	3	2	0	3	3	0

EXPERIMENT 6

Number of words recognized in the morning and afternoon in four experimental conditions; Recall (RC), Recall Practice (RCP), Recognition (RN) and Recognition Practice (RNP).

	MORNING				AFTERNOON			
Serial Position	RC	RCP	RN	RNP	RC	RCP	RN	RNP
Block 1	4	5	3	4	5	3	5	5
"	5	3	5	4	5	2	2	4
"	5	3	4	4	5	5	5	5
"	5	3	5	5	5	4	5	4
"	5	5	5	5	4	4	4	4
"	4	4	5	5	5	4	4	1
"	5	4	4	5	5	5	5	5
"	4	5	4	5	5	4	5	2
"	4	4	4	4	4	4	3	4
"	5	4	5	3	4	5	5	4
Block 2	4	5	3	4	4	4	5	5
"	4	5	4	5	5	4	3	4
"	3	4	5	3	4	5	5	4
"	5	4	5	5	4	3	4	2
"	4	4	3	5	4	4	3	5
"	5	4	4	3	5	5	3	2
"	3	5	5	2	4	4	5	5
"	4	5	5	5	5	4	4	4
"	5	4	3	1	3	4	3	5
"	5	4	4	1	4	3	5	5
Block 3	5	5	4	3	4	5	5	5
"	3	4	5	3	3	1	2	5
"	5	5	5	5	5	3	5	5
"	5	4	5	5	5	4	3	4
"	4	2	5	5	2	5	2	4
"	4	3	5	4	5	4	3	1
"	2	3	5	5	4	4	5	3
"	4	4	4	5	5	5	5	4
"	4	4	3	5	3	4	4	4
"	5	5	3	4	3	4	5	4
Block 4	5	5	1	3	5	5	5	5
"	4	3	5	5	4	3	5	4
"	4	5	5	5	4	5	4	5
"	5	4	5	4	5	4	3	5
"	4	4	5	4	2	4	4	4
"	3	5	4	5	5	4	4	4
"	3	3	5	5	5	5	4	5
"	2	5	5	3	5	3	3	5
"	4	5	5	3	5	3	5	5
"	4	5	3	5	0	5	4	3

EXPERIMENT 7

Number of words recalled in four experimental conditions.

RECALL INSTRUCTIONS

65 dBC NOISE Serial Position					85 dBC NOISE Serial Position				
1	2	3	4	Tot.	1	2	3	4	Tot.
4	3	2	2	11	5	3	4	3	15
3	3	2	2	10	4	3	3	0	10
4	2	2	4	12	4	0	1	1	6
2	3	2	3	10	5	1	4	0	10
1	0	0	5	6	3	3	3	2	11
2	3	0	3	8	2	5	2	5	14
4	2	3	4	13	5	3	3	3	14
3	3	4	4	14	5	2	1	4	12
2	1	2	2	7	4	1	3	2	10
2	1	2	2	7	5	3	5	2	15
2.7	2.1	1.9	3.1	9.8	4.2	2.4	2.9	2.2	11.7

RECOGNITION INSTRUCTIONS

2	1	3	2	8	0	0	1	2	3
2	1	1	1	5	2	1	2	3	8
3	1	3	0	7	3	3	1	0	7
3	1	3	4	11	1	2	1	1	5
2	2	0	2	6	3	0	2	1	6
2	1	1	2	6	2	2	1	1	6
3	3	2	1	9	1	1	1	2	5
2	1	3	4	10	2	1	1	4	8
2	0	2	1	5	1	2	1	4	8
0	2	5	1	8	3	0	1	-	4
2.1	1.3	2.3	1.8	7.5	1.8	1.2	1.2	1.8	6.0

EXPERIMENT 7

Number of words recognized in four experimental conditions.

RECALL INSTRUCTIONS

65 dBC NOISE					85 dBC NOISE				
Serial Position					Serial Position				
1	2	3	4	Tot.	1	2	3	4	Tot.
5	5	3	3	16	5	5	5	5	20
5	5	5	5	20	4	4	4	3	15
5	2	2	5	14	5	4	5	4	18
5	3	3	3	14	5	5	5	3	18
4	3	1	5	13	5	5	3	5	18
5	5	3	3	16	4	5	5	5	19
4	5	5	5	19	5	5	5	5	20
5	5	5	4	19	5	4	3	4	16
5	3	4	4	16	4	5	4	4	17
4	3	3	5	15	5	5	5	4	19
4.7	3.9	3.4	4.2	16.2	4.7	4.7	4.4	4.2	18.0

RECOGNITION INSTRUCTIONS

3	3	3	3	12	5	1	4	3	13
5	4	3	2	14	3	4	4	3	14
5	4	5	4	18	4	3	3	2	12
4	4	4	5	17	5	5	5	2	17
3	3	3	3	12	4	5	5	3	17
2	1	4	4	11	5	4	4	4	17
4	5	4	4	17	5	2	4	5	16
5	4	4	5	18	4	5	2	4	15
5	4	4	5	18	5	3	5	5	18
4	4	5	4	17	5	2	2	3	12
4.0	3.6	3.9	3.9	15.4	4.5	3.4	3.8	3.4	15.1

EXPERIMENT 8

Number of words remembered in their original sequence.

65 dBC NOISE Serial Position				85 dBC NOISE Serial Position			
1	2	3	4	1	2	3	4
2	0	0	1	0	0	0	0
1	0	0	1	0	0	0	2
3	0	0	1	1	2	1	0
0	0	0	0	2	1	0	1
2	0	0	0	3	1	1	0
1	0	1	0	1	2	0	0
2	1	0	0	0	0	1	0
3	0	0	0	1	0	2	0
1	1	1	0	1	0	1	0
0	0	0	3	1	0	1	0
1	1	2	1	0	1	1	2
2	2	0	0	0	0	0	0
1.50	.42	.33	.58	.83	.58	.67	.42

EXPERIMENT 9

Number of words recalled in four experimental conditions following instructions to rehearse items in the middle of the list.

	65 dBC NOISE				85 dBC NOISE			
Serial Position	1	2	3	4	1	2	3	4
List 1	2	2	1	4	1	1	2	2
"	1	5	0	1	0	4	2	0
"	2	5	3	1	0	4	2	4
"	1	4	2	2	1	5	0	0
"	3	4	3	1	2	3	1	0
"	3	4	0	0	3	3	1	0
"	2	1	2	1	1	4	1	0
"	4	1	3	5	5	5	0	3
"	2	4	1	2	2	5	0	3
"	4	4	1	0	0	5	2	0
List 2	1	2	2	2	1	0	5	2
"	1	5	1	0	0	5	1	1
"	3	4	2	1	4	4	1	1
"	2	4	3	2	0	5	2	1
"	0	5	1	2	1	3	0	1
"	0	1	2	4	1	5	2	2
"	2	4	0	0	3	5	1	1
"	0	3	1	5	2	4	1	0
"	3	3	1	1	0	5	0	2
"	2	5	1	0	0	4	1	0
List 3	1	1	1	5	0	4	0	5
"	2	4	0	2	1	5	3	2
"	1	0	1	1	0	3	3	2
"	2	3	1	1	1	4	1	0
"	1	4	0	1	0	3	0	1
"	1	2	1	3	0	5	1	2
"	1	4	2	1	3	4	0	1
"	2	4	2	4	4	4	1	4
"	1	3	1	1	2	5	0	2
"	3	3	1	2	0	5	1	0
List 4	0	2	4	1	2	2	2	3
"	2	4	1	1	3	5	2	1
"	2	3	1	0	1	3	2	2
"	2	2	2	2	1	0	4	3
"	1	4	1	0	0	4	2	2
"	0	1	2	1	1	4	1	0
"	1	3	1	0	3	5	1	1
"	1	3	4	4	2	5	2	3
"	1	4	1	1	1	5	2	1
"	0	5	2	2	0	2	3	0

EXPERIMENT 9

Number of words recalled in four experimental conditions cont. following instructions to rehearse items in the beginning of the list.

	65 dBC NOISE				85 dBC NOISE			
Serial Position	1	2	3	4	1	2	3	4
List 1	5	2	0	0	4	1	0	1
"	2	0	0	5	5	2	3	2
"	3	0	1	0	3	0	0	1
"	2	3	0	4	4	1	2	2
"	3	1	1	4	5	0	0	3
"	5	0	0	2	5	1	0	2
"	4	3	1	3	5	1	2	2
"	4	5	5	4	2	2	3	3
"	2	0	0	4	4	1	2	0
"	5	1	1	1	2	1	0	4
List 2	5	1	0	0	3	1	0	5
"	3	0	1	5	4	1	1	3
"	2	1	1	1	0	2	3	1
"	3	1	2	2	4	0	0	5
"	3	1	2	1	3	0	1	1
"	5	4	0	1	5	1	0	2
"	5	2	2	3	5	1	2	1
"	5	5	3	5	3	4	2	3
"	4	2	0	1	4	2	2	2
"	5	2	1	3	3	2	1	2
List 3	5	1	1	0	5	0	0	0
"	5	3	0	0	5	2	4	1
"	0	0	1	4	3	2	1	2
"	3	3	1	1	4	0	4	1
"	2	2	1	4	4	3	2	0
"	5	1	2	1	3	0	3	1
"	4	1	2	4	4	1	0	1
"	3	2	1	3	4	3	1	5
"	0	3	2	0	5	1	2	1
"	5	2	0	0	1	0	2	1
List 4	5	1	0	1	5	0	2	1
"	4	1	1	1	5	1	3	5
"	4	0	0	5	5	0	0	2
"	2	3	1	3	5	2	3	4
"	3	3	3	1	5	2	1	2
"	4	1	0	1	2	3	4	0
"	5	2	2	2	5	2	1	1
"	3	0	1	1	2	3	5	3
"	4	0	2	3	5	0	1	1
"	5	1	3	2	1	0	1	4

EXPERIMENT 10

Number of words recalled following an Orienting (OR) and No Orienting (NOR) task under three levels of noise and for a list of high-associate (HA) and non-associate (NA) words.

		MORNING			AFTERNOON		
		NOISE					
		65	75	85	65	75	85dBC
NOR	NA	6	17	14	17	10	11
"	"	16	15	14	12	12	12
"	"	11	10	14	17	7	16
"	"	14	13	14	14	19	12
"	"	16	16	19	10	10	18
"	HA	24	27	18	20	15	22
"	"	21	21	24	17	27	22
"	"	23	24	24	24	11	23
"	"	23	23	18	22	22	15
"	"	24	27	24	22	18	20
OR	NA	11	10	8	13	11	12
"	"	15	14	16	11	13	7
"	"	14	18	15	14	17	7
"	"	16	11	11	16	20	10
"	"	10	14	10	13	16	13
"	HA	14	17	25	20	16	20
"	"	14	22	19	19	21	26
"	"	26	26	25	19	24	21
"	"	17	24	24	26	15	24
"	"	19	21	20	23	21	25

EXPERIMENT 10

Category clustering and number of words recalled in correct sequence following an Orienting (OR) and No Orienting (NOR) task under three levels of noise.

		MORNING			AFTERNOON		
		NOISE					
CLUSTERING		65	75	85	65	75	85dBC
NOR	ASSOC. LIST	1.00	.55	.77	.60	.55	.61
"	"	.88	.63	.68	.46	.95	1.00
"	"	.83	.95	.74	.90	.56	.95
"	"	.83	.94	.23	.56	.94	.33
"	"	.84	.82	.84	.94	.69	.88
OR	"	.50	.62	.90	.69	.83	.73
"	"	.90	.61	.71	.80	.76	.90
"	"	.76	.67	.95	1.00	.79	.78
"	"	.92	.75	1.00	.90	.64	.85
"	"	.86	.65	.67	.74	.88	.75

CORRECT SEQUENCE

NOR	NONASSOC.LIST	0	.06	.14	0	0	0
"	"	.07	.13	.38	.18	.33	.18
"	"	.10	.18	0	.19	.33	0
"	"	.19	.14	.08	.15	.17	.09
"	"	0	.06	.67	.10	0	.17
"	ASSOC.	0	.04	0	.10	.21	.18
"	"	.05	.05	.09	.06	.04	0
"	"	.05	0	.04	0	.08	.04
"	"	0	.05	.12	.14	0	.19
"	"	0	0	0	.05	0	0
OR	NONASSOC.LIST	0	.09	0	0	0	0
"	"	.29	.15	0	.09	.08	0
"	"	0	0	0	.08	.06	0
"	"	0	.10	0	0	.05	0
"	"	.11	.08	.10	.08	.07	.08
OR	ASSOC.	0	0	0	.05	0	0
"	"	0	0	0	0	.05	0
"	"	0	0	0	.05	.04	0
"	"	0	.04	0	0	0	0
"	"	0	.05	0	0	.05	.04