STUDIES IN RECOGNITION MEMORY AND CONCEPTUAL PROCESSES

A THESIS PRESENTED TO THE
DEPARTMENT OF PSYCHOLOGY
OF THE UNIVERSITY OF
CAPE TOWN
AS PART-FULFILMENT FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

by

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OCTOBER 1971

DEPARTMENT OF PSYCHOLOGY

ACKNOWLEDGEMENTS

Acknowledgements are due to Dr Peter Du Preez, my supervisor for advice and consideration shown during the writing and analysis of the difficult parts of this thesis. My thanks are due to Dr Donald McNicol formerly of the University of Adelaide (now at the University of New South Wales) for helpful advice whilst the author held a Commonwealth Postgraduate Award at the University of Adelaide.

Mr Robert F. Garton, my co-author on earlier papers, is to be thanked as well as Mrs P. Bennet for the arduous task of typing, especially the tables and appendices.

Acknowledgements are due to the many hundreds of post graduate and honours physics, chemistry and arts students who performed as subjects during the numerous experiments that required specialists for the criterion groups.

Finally, my gratitude is extended to the Human Sciences Research Council who financed most of this thesis and to the University of Cape Town Grants Committee for financial assistance from the University Research Grant Fund.

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DECLARATION

I declare that this thesis is all my own work except for the assistance granted to me by my co-author on some earlier papers; Mr. R.F. Garton, tutor, Department of Psychology, University of Melbourne. Credit is given in the text (where appropriate) for advice and assistance.

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SUMMARY

Experiment 1:

This experiment was conducted in an attempt to separate the effects of word-frequency and word-knowledge in recognition memory. Operating characteristics supported previous findings that it was easier for subjects to distinguish between old and new words having a low-frequency word count than between old and new common words. A knowledge of the meaning of a rare word was found to facilitate the discrimination of old from new low-frequency words.

Experiment 2:

The puzzling aspect of Experiment One, namely the arts students' performance on physics words (a superior performance compared with common words) was investigated in Experiment Two. Should some physics words be little better than nonsense syllables to arts subjects why do they perform better on these terms? A stricter and more controlled rating procedure was used for the stimuli of Experiment Two. Using a new group of rare and common words Experiment One was replicated. Fifty postgraduate students were used as subjects, twenty-five arts postgraduates and twenty-five physics postgraduates. It was shown that arts students, on very rare physics terms, performed badly compared with common terms (all the words were physics terms) (d' 1.32 c.f. 1.76). The physics postgraduates performed better on rare terms than on common terms (d' 2.40 c.f. 1.72).

Experiment 3:

This experiment utilized three different recognition lists with a constant inspection series viewed by three groups of physics and arts students. The groups viewed twenty physics words (PWs) and twenty common words (CWs) in a randomly ordered inspection sequence. The subjects were then allocated to one of three recognition test conditions where the inspection items were embedded within different sequences of one hundred and twenty additional words thus :-

(1) 60 PWs + 60 CWs

(2) 100 PWs + 20 CWs

(3) 20 PWs + 100 CWs

Both signal detection theory (STD) and Luce analyses were used to analyse the data. All subjects found the detection of physics words easier than common words. However, these judgments varied according to the properties of the recognition sequences. This supported the theory that the subjects adopted a conservative and probabilistic strategy for the recognition task as a whole rather than utilizing different strategies for the physics and common words separately, where these would result in superior overall performance.

Experiments 4 and 5:

These two experiments were performed for the purpose of ascertaining the effects of two processes in recognition memory: the subjects' actual viewing time of verbal material and the experimenter's feedback. Recognition-memory performance was found to be superior for an experimenter-induced feedback over the subject's own "subjective", induced feedback (query loops), even though the time for total rehearsal was kept constant for each condition. The actual viewing time was not found to be a critical factor. Several hypotheses are advanced to account for this result. (These experiments were published in Perception and Psychophysics).

Experiment 6:

This experiment varied the time available for retrieval decisions in recognition memory. The results indicated that although the discrimination of old from new items in a recognition test was independent of the time available for decision responses, additional processing time significantly reduced the number of false-positive identifications for low-frequency words but not for common words. These findings were viewed as supporting expectations from signal detectability theory.

Experiment 7:

This experiment was designed to investigate any bias differences that may be existent among common words compared with rare words. The stimuli used were chemistry terms in particular elements of the Periodic Table as this is a close-knit finite population of words; a complete category in the real sense.

The subjects used were arts and chemistry students, the latter would be familiar with most if not all of the elements, whereas the former would know only a few elements: the rest would be completely rare items.

The one hundred and three elements were typed on sheets with instructions requesting the rater to use a six point scale of familiarity. Thirty chemistry post-graduates and thirty arts postgraduates rated the elements. Means and standard deviations were obtained for the rating task for both groups. From this data populations of rare and common elements were obtainable. The subjects used in the actual experiment were twenty chemists and twenty post-graduate arts students. The inspection stimuli were seven common and eight rare words (it was difficult to obtain many stimuli with good distractors). A four page recognition booklet contained the signal and noise items on each page, randomly allocated: each item and its distractor was present four times in the complete test. The subjects were tested in groups of two or three, being requested to remember the words viewed on the screen (fifteen elements viewed for 2.67 seconds each). After the inspection list the subjects were allowed three minutes to familiarize themselves with the recognition book instructions: then they commenced the recognition test.

It was found that the arts students were better at discriminating common elements than rare elements (delta m 1.86 c.f. 0.86), transformed area scores (0.7110 c.f. 0.6097, t (38 df) = 3.56** (2-tailed) This would appear to support the results of experiment two. However, the chemistry students also performed better on common elements than on rare ones. (t (38) = 3.01** (2-tailed). This is contrary to Experiment Two but of course the <u>testing</u> procedure is different (four repetitions). The rate of forgetting could be different for rare and common words. The experimental results though instructive are not conclusive. The bias measures were interesting: the chemistry subjects were more biased to NO responses on common elements compared with rare elements. The arts subjects were biased towards NO for both common and rare elements but these results were not significant. All the subjects were cautious in their responses to the elements; the chemistry students displayed some laxity on rare elements (bias = 1.8809) but this was far from significant.

Experiment 8: A consideration of bias tendencies among rare and common words.

In order to induce reasonable bias tendencies (should such exist) the distractor word must have a similar appearance to the stimulus item. Two hundred words (100 word-pairs were administered in book form to fifty-four English students and forty-four non-English students. The words were culled from dictionaries with a view to obtaining very rare word-pairs with similar appearances and preferably words of the same length. The English-student population was comprised of mainly English Literature and Language fourth year and postgraduate students from Adelaide and Cape Town Universities, whilst the non-English students were Chemistry, Mathematics and Physics, Honours and Postgraduate students from the same two Universities. The booklet had a first page of instructions, the following pages displayed the lists of words, each word followed by a bracket. The instruction page asked the student to rate each item on familiarity. The continuum allowed 1 for a completely familiar word to 6 for a word that was completely 'foreign', one that the subject had never seen before. Examples were given to ellucidate the procedure.

Subjects: The subjects for this experiment were twenty-one English Honours students from the second and subsequent years of study, and twenty-one students who had not studied English since their matriculation. The subjects in this group were Science students. All subjects were paid for their participation.

The use of two criterion groups (English and Non-English subjects) was considered desirable as the bias tendencies for both together can be compared with the tendencies for each one separately. The skilled group, dealing with words may well exhibit differing biases from the non-English group even though the rare words were rare for both groups and the common words were common for both groups.

Materials and Procedure: From the list of two hundred words the fourteen best rare pairs and the fourteen most common pairs were chosen. Care was taken to choose only items that had suitable distractors. Both distractor and stimulus words had to possess (as close as possible) the same means and standard deviations.

The words were either common for both populations or rare for both populations.

Slides were made of the twenty-eight stimulus words; being fourteen rare and fourteen common English words. The words were projected onto a screen using a Kodak Carousel automatic projector (Model 550R). Two seconds viewing was allowed for each word. The subjects were tested in small groups. Each subject viewed the randomly ordered stimulus items (seven rare and seven common words in each half of the inspection series) and then was allowed two minutes to read the instruction page of a test booklet. Fourteen rare words and fourteen common words were present on each page of the recognition booklet. Each half page consisted of seven rare and seven common words. Care was taken in the randomising process to ensure that equal number of distractor and signal words were present in each quarter of the test sequence, lest biases be introduced due to a sequence of rare or common word strings. There was a tendency for the 'verbally-skilled' to be better at rare word performance ($\underline{t}$ = 1.59) but this was not significant.

It was found that both groups of subjects recognized rare words better than common words. The English result was significant at the one percent level $\bar{x}$ (TA) 0.7737 for rare, $\bar{x}$ (TA) 0.6656 for common words, $\underline{t}$ = 3.77**. Though the non-English result was not significant the rare word performance was still superior (0.7276 vs. 0.6828). The actual performance on this verbal task for both groups <u>on all words</u> was comparable ($\bar{x}$ 0.7197 vs. 0.7052 $\underline{t}$ = 0.66 Table 17). Though the 'skilled' verbal subjects perceived rare words better than common it was not done at the expense of common word performance ($\underline{t}$ = 0.65 between English and non-English students on <u>common</u> words).

The molar verbal task showed no subject-group differences for sensitivity and bias. The overall performance, rare + common (R + C) words, produced biases of 2.073 and 2.0719 for English and non-English subjects respectively,

$\underline{t}$ = 0.0089; these bias values hardly differ from the null hypothesis of no bias where B = 2.000. When the word population was split up there were the following bias tendencies:-

English subjects were biased to say YES on rare words, $\underline{t} = 2.183^{*}$ $\bar{x}$ (B) 1.6837 c.f. null hypothesis of 2.00 no expected bias. They were also biased to say NO on common words $\bar{x}$ (B) 2.4637 c.f. 2.00 $\underline{t} = 3.922^{**}$.

The non-English students showed comparable bias tendencies:-

Yes to rare ($\underline{t}$ = 1.148 n.s. $\bar{x}$ (B) 1.8638)

No to common ($\underline{t}$ = 2.076 n.s. $\bar{x}$ (B) 2.2799).

When the two populations were treated as a whole the rare vs common word bias result was as follows:- $\underline{t} = 4.61^{**}$ (Table 16) a definite tendency to say <u>YES PRESENT</u> on <u>rare</u> words c.f. common words. In brief, both groups were biased to say Yes present, when confronted by rare words and to say No absent on common words, (compare with the chemistry element experiment; where the chemists were biased to say <u>YES</u> on rare elements). Where other biases existed in Experiment Seven, the biases were in the same direction as in Experiment Eight, (compare with Experiment Three; where arts subjects were biased towards saying <u>Yes</u> for <u>physics words</u> on the mainly physics-term list. In addition, in Experiment Three, the arts subjects always had a high false alarm rate (FAR) on all lists compared with the physics subjects: so rare items encouraged a bias tendency to say YES irrespective of the proportions of rare to common items in the test lists).

<u>Experiment 9</u>: This experiment attempted to investigate the role of pronounceability in recognition memory; to re-examine the role of pronounceability among <u>very rare</u> English words

presented visually and tested by the utilization of a recognition memory procedure. Previous experiments have mainly concentrated on the use of nonsense syllables or trigrams and have used recall procedures.

Rating Procedure: All the rare words from the rating norms (used in Experiment Eight) were rated by forty University House (U.C.T.) students. All the students possessed English as a first language. One hundred and forty-six rare words were typed on two sheets to form a three page booklet, the first page being the rating instructions which requested the rater to assess each word's degree of pronounceability on a four point scale: examples were given.

From the one hundred and forty-six words, fourteen easy to pronounce pairs were extracted as well as fourteen hard to pronounce pairs.

The subjects were from the Arts and Science Faculties; a comparable proportion to that of the rating population (N = 27). The subjects were paid for their participation in this experiment.

Apparatus and Stimuli: The apparatus was the same as that used for Experiment Eight. The twenty-eight stimulus words were typed on cards and photographed: twenty-eight slides were made from these.

The test booklet consisted of all the inspection and distractor words. Care was taken to ensure that equal proportions of easy and hard to pronounce words were present on each sheet and that an equal number of stimulus and noise items were present on each page of the three page booklet.

As before, the first page was a page of instructions requesting surety judgments on a four point scale.

The subjects were tested in groups of three. They viewed the slides which were presented at two second intervals as in the previous experiment. Then they read the instruction page and worked through the two pages of fifty-six words.

The results showed no support for pronounciation aiding recognition memory (Sensitivity measure (A)) in this experiment ($\bar{x}$ (A) hard 0.7131 vs. $\bar{x}$ (A) easy 0.7073). Nor can one claim any bias tendencies in favour of any word-group ($\bar{x}$ (B) 1.9671 vs. 1.9306; hard vs. easy). It does not appear that given a nearly constant word frequency (at least at very low values of frequency) that ease of pronounceability is of any aid in recognition.

Experiment 10:

This small experiment was performed in order to establish that the differences between the rare and common word performances is Experiments Two and Seven were not a function of the rare stilumi used (rare chemistry words and rare physics words). Eighteen arts subjects were used, recruited among third year honours History and English students, they were paid for being subjects. The inspection series consisted of the eight signal chemistry elements employed and of eight of the rare physics terms. All words possessed good distractor items, an important prerequisite as the number of stimuli used was regretably small and unfortunately unavoidable.

A recognition booklet, similar to that utilized in the three prior experiments, contained the sixteen signal items and their equivalent distractors. Equal numbers of chemistry and physics terms (signal and noise) were assigned to each quarter of the booklet. A four point judgement scale was used as before : from absolutely sure present to absolutely sure absent. The subjects were tested in groups of three. They viewed the words, and read the instructions, these being similar to those of the previous experiments. After inspecting, and attempting to learn the words displayed, the subjects read the instructions and worked through the test booklet. Area and bias measures were obtained from the individual signal and noise profiles. The results showed that the chemistry terms were not harder to learn than the physics terms ($\underline{t}$ = 1.71 n.s.). It is perhaps unlikely that the differences between Experiments Two and Seven were due to the difficulty of the chemistry elements in this recognition task.

However, there were interesting bias differences. The subjects were biased to say YES (exhibiting laxity) on the chemistry items compared with the physics terms ($\underline{t} = 3.22^{**}$, 1% level two-tailed test); also compared with the null hypothesis of no expected bias ($\underline{t} = 3.63^{**}$). This supports the result for Experiment Seven (for chemistry students), but not for the non-chemistry subjects.

Experiment 11:

This experiment investigated the perception of repeated words (physics and common English words) embedded within a series of physics and English words as contextual, background, noise.

Sixty-four subjects were :d in this study, they were paid for their participation. ›ur groups of sixteen students viewed one of four different lists : the latter being comprised of :-

LIST A - 32 Physics words (PWs)

LIST B - 32 English words (CWs)

LIST C - 18 CWs + 14 PWs

LIST D - 18 PWs + 14 CWs

Each list (A - D) possessed 18 critical words, some repeated as follows :-

<u>Lists A and D</u>

Three appearances of: SECOND, TONIGHT and COLUMN.

Two appearances of: CAPTAIN, DINNER, and MIRROR.

One appearance of: CREATURE, VILLAGE, and INSTANCE.

Thus eighteen critical words (3 x 3 + 3 x 2 + 3) appeared on each list: Common words on Lists B and C and physics words on Lists A and D.

An inspection list (slide) was comprised of the 32 words plus filler items (5 in number) at each end of the inspection series; making 42 slides to be viewed in all.

A test list consisted of a booklet of instructions plus twelve critical words (nine viewed on the screen plus three which made <u>no</u> appearance in the inspection list).

The subjects were tested in groups of eight.

The results indicated a general under estimation of the thrice presented items. An over estimation of the 'zero appearance words', especially on lists C and D, the mixed lists. The number estimation for the twice and singly presented items was generally accurate, with the possible exception of twice and singly viewed words on list C: the critical common word list.

The degree of surety (confidence) results were interesting. On list A more confidence was shown for singly viewed words compared with those viewed twice (the all physics word list). For list B the confidence displayed was higher (all common words on this list). While on list C, critical words embedded in physics words, the confidence was generally low : even compared with list B where the critical words were also CWs. The different context had impaired performance on the (identical) critical words. For list D, again confidence was low especially compared with list A where again the critical words were identical. The principal cause being a low confidence for words with two viewings compared with single showings and zero appearance items.

The degree of surety for incorrect responses (degree of false alarm analysis): little laxity was shown on the all common word list, (B). For list A (all CWs) a false confidence was shown for "two appearances" stimuli. Overall laxity was shown for list C compared with list B, the mixed list again producing divergent results. List D showed once more that multiple repetitions caused a high false confidence ($\bar{x}$ 3.875 (three) 4.375 (two), c.f. 1.625 (one) and 1.5 for zero showings.

Between lists there were no significant differences for 3, 2, 1 and zero appearances. However, the mean surety values for the four lists and for correct and incorrect responses (molar analysis) produced no subject differences on surety ratings for correct and incorrect responses.

The order of accuracy for the critical words showed that high accuracy on critical words was exhibited for lists A and D only (Table 29, page 178). That is, high scores for critical words on list A produced similar high scores on list D, and vice versa.

In conclusion, the greater laxity (bias to yes) was shown for the mixed lists (c.f. Tulving and Thomson (1971) in a different experiment on context). More caution was shown for list B (all CWs), redolent of earlier experiments, no laxity was present for this pure, common word, list. Whereas list C (critical CWs) produced laxity; the presence of the physics context had caused this drop in caution. It was concluded that the context within which the critical words were buried, especially common critical words, was important for the ultimate surety ratings and accuracy for these critical words.

Experiment 12:

This experiment (following Tulving and Thomson (1971)) attempted to show that recognition tasks do not of necessity by-pass retrieval processes as is voiced abroad by many memory students in particular, Kintsch (1970) and Murdock (1968) Tulving and Thomson (1971) had used strongly and weakly associated doublets and used these as input stimuli or testing stimuli for single items as well as control conditions where the input (paired or single items) is tested as paired or single terms respectively).

Experiment Twelve follows from this important experiment of Tulving's and uses very strong stimuli evident in the

Periodic Table. It is a clearly established fact that given the properties of say Lithium and Potassium the properties of sodium can be stated with a high degree of accuracy as the three elements (Li., Na., K.) are in the same group of the periodic table. There can be no strong associations in norms of verbal learning experiments and it would be foolish not to use this important property, provided one's subjects were honours chemistry students at a University. There are many cases of very strong associations in the Periodic Table for example; Helium, Neon, Argon, Krypton (Noble Gases), Beryllium, Magnesium, Calcium (Group II); Arsenic, Antimony and Bismuth (Group V): to name but a few.

This experiment investigated the recognition memory performances of third year honours chemistry students on doublets and single elements as stimuli (inspection) and test items: both weak and strong associations.

Twenty honours students from the chemistry laboratories acted as subjects, they were paid for their participation. The inspection series consisted of single and doublet elements and the testing booklet consisted of these (signal) items plus weak or strong distractors: depending upon which of the eight conditions was investigated. The doublets were shown for four seconds and the singles for two seconds. The subjects were instructed to learn the elements shown and to also use the second element of a doublet as a cue to aid memory. After viewing the subjects read a test instruction booklet. They worked through a list of elements; some paired some single. By using a four point scale of surety of presence or absence (similar to previous experiments) the subjects were requested to consider the first element of a doublet or the single element itself (for single elements): some of these would be present in the slide series others would be noise or distractor items. For example :-

(1) Bromine - chlorine

(2) Tin

Should the subject be absolutely sure that Bromine was present in the slide series either as Bromine alone or as say a doublet Bromine - Fluorine they were to mark the first of the four boxes under surety of judgment. Again, should they feel that Tin was probably present either as Tin alone or as say the left hand side (L.H.S.) member of, for example: Tin - Lead (strong association pair), or Tin - nitrogen (weak pair). The eight conditions allowed for doublets and singles in the inspection and test lists for these could be tested as doublets when doublets appeared or as single elements and vice versa: i.e.

(a) DsD - (tested as) DsD (S), DsD (N)

(b) DsD - Ss (S); Ss (N)

(c) Ss - DwD (S), DwD (N), etc

similarly for weak association. Where Dsd is a strong doublet, DwD a weak doublet. Thus (d) is a single element tested as the L.H.S. member of a weak doublet with weak doublet (DwD (N)) noise.

The results were analysed in several ways. Following Garton and Allen (1968), and Tulving and Thomson (1971) a corrected score was obtained by considering the signal total and subtracting the noise total. For example, a profile such as :-

S

2	1	0	0

8(2x3+2)

N

0	0	2	1

2
(2x1)

C = 8 - 2 = 6

Experiment 13:

This experiment replicated some of the conditions of Experiment Twelve. In particular the bias measures were replicated for these conditions as this is an important aspect of the subjects' ability to perform the recognition task where the testing stimuli varies from the input (coding) stimuli. In brief, does the alteration of context cause a corresponding degree of caution and hence alter the bias (B) values for certain conditions and not for others?

The subjects were twenty, third year honours chemistry students as before (not the same subjects as for Experiment Twelve) they were paid for their participation. A new set of materials from the periodic table were used: however, the conditions were the same (with one exception), consequently instead of say Sodium - Potassium being a strong doublet Sodium - Lithium was used. The procedure was identical to that of Experiment Twelve as were the scoring and methods of analysis. The results showed, once more, strong support for Tulving and Thomson (1971). Impairment in recognition memory resulted whenever an alteration in the initial coding stimuli was performed. Of great interest was the caution shown in all cases for conditions where a doublet was tested as a single element or a single element was tested in a doublet, e.g. :-

(i) <u>D</u>wD - Sw(S), Sw(N)

(ii) S - <u>D</u>wD(S), DwD(N)

(iii) <u>D</u>sD - <u>S</u>s(S), Ss(N)

These were significant for both Experiments Twelve and Thirteen; and is one of the important results of these experiments using the Periodic Table.

An analysis of variance across the eight conditions produced an overall $\underline{F}(7,133) = 3.868^{**}$ for corrected scores but not for individual means (Scheffé) analyses. The area (A) analyses ($\underline{t}$ tests) produced enough significant results to substantiate Tulving and Thomson (1971). The principal results arising from the strong associations which is not surprising. The bias (B) results show undue caution being enhibited for changed test and input conditions. The bias results were replicated across Experiments Twelve and Thirteen and are evidently strong evidence for changes in strategies for the mixed (test and inspection) conditions. The doublet situation will be discussed in detail in Experiment Fourteen.

<u>Experiment 14</u>:

Following Experiments Twelve and Thirteen this experiment has used the elements of the Periodic Table as a source of stimuli. The intriguing results (with doublets) of the two prior experiments have been pursued by using only doublets as inspection and test items. The analysis of results was identical to that employed in Experiments Twelve and Thirteen, the only difference in materials being the use of pairs and fewer conditions. There were two dimensions of doublets (DwD or DsD) with both inspection and test series variations; leading to a 2 x 2 or four conditions of interest, namely:-

(i) DsD - DsD

(ii) DsD - DwD

(iii) DwD - DwD

(iv) DwD - DsD

Thus leading to two conditions of "non-contamination" of conditions during testing ((i) and (iii)) and two of alteration of inspection and test sequences ((ii) and (iv)). Does the, Tulving and Thomson (1971), postulate about recognition not by passing retrieval hold for doublets? This was the prime purpose of Experiment Fourteen.

The procedure and materials were as for the two previous experiments. Four pairs of signal and four pairs of distractor items were possible for each condition. The inspection items and test items were doublets only, otherwise the experimental procedure, analysis and mode of discussion was identical to the previous experiments. The results completely supported Tulving and Thomson (1971). Impairment of recognition memory was evident for 'mixed' conditions ((ii) and (iv)), corrected scores were similar to Tulving's corrected scores and the area and transformed area results also supported their contentions about retrieval and accessibility factors. There were no bias variations however, to contaminate (if at all likely) the extremely significant results in support of Tulving and Thomson (1971). Bearing in mind that the stimuli were elements of the Periodic Table (not (possibly) dubious association norms) that specialist groups (honours chemistry students) were used and that the results have now been replicated three times using varying stimuli and conditions it must now be clear that recognition does <u>not of necessity</u> bypass any retrieval processes and that the "cognitive situation, or context" of initial learning conditions is of prime importance for recognition as it is for recall.

PART ONE

CHAPTER ONE

INTRODUCTION

This part of the thesis starts off from the hypothesis that much of the confusion existing in the area of verbal learning and the perception of words generally may be due to unexplored assumptions being made about the independent variables. The independent variables in word-recognition experiments are usually words, or nonsense words. These words are typically put into a category, such as 'frequently-occurring' (e.g. Howes & Solomon, 1951): or 'meaningful' (e.g. Hershenson & Haber, 1965): or 'pronounceable' (e.g. Gibson, Pick, Osser & Hammond, 1962). The category name is then typically assumed to represent the relevant factor accounting for whatever findings appear. These category names may, in fact, be useful as operational definitions of the independent variables, but when they assume explanatory status, clearly questions are being begged.

In the experiments to be reported in Part 1, each of the above examples of category names will be taken up and examined further, with the hope of clarifying the nature of the variables actually operating, in typical experiments in which the categories have been employed. Thus the raison d'être of these experiments is not to produce yet more wearisomely 'controversial' data on word-recognition, but rather to attempt to explore and clarify the terms that they themselves, together witn the countless other experiments in the literature, are using. In particular, to attempt to ascertain the role of familiarity and the word frequency effect in recognition memory. In addition, to examine the strategies and biases employed by subjects when they are presented with varying proportions of familiar and unfamiliar materials.

MEANINGFULNESS, FAMILIARITY, AND THE WORD-FREQUENCY EFFECT.

It has long been commonplace that, in tachistoscopic word-recognition, familiar words are perceived more easily than unfamiliar words. Vernon (1931), for instance, reported that "unfamiliar words, such as 'atop', 'alun', etc., were misread more often than familiar words." (p.123). This finding, however, first gained the status of a contentious issue in the early 1950's, when it was rediscovered by experimenters attempting to question the 'New Look' assumptions.

Postman, Bruner & McGinnies (1948), for instance, had found that words related to high-value areas of interest as measured by the Allport-Vernon scale of values, had lower recognition thresholds than words related to low-value areas of interest. This was interpreted as evidence for the role of personal needs and values in 'perceptual selectivity'. In similar vein, McGinnies (1949) had reported that socially 'taboo' words, or words with sexual connotations, had higher identification thresholds than neutral words. This was interpreted as evidence for a perceptual 'defence mechanism' operation to ward off the perception of anxiety-provoking stimuli. Howes & Solomon (1951), and Solomon & Howes (1951) suggested that the above findings could be explained not in terms of 'personality' variables, but in terms of a general property of the <u>words</u> used in the experiments - their degree of familiarity. That is subjects would come into contact more often with words related to areas in which they were highly interested, than with words from low-value areas of interest, and taboo words, by their very nature, have a lower frequency of occurrence in the language than the socially-acceptable neutral words used by McGinnies (1949).

By way of confirmation of their interpretation, Howes & Solomon (1951) reported a high negative correlation between log-frequency of occurrence of words in adult reading matter (as measured by the Thorndike-Lorge (1944) semantic count), and recognition threshold. Their study has become a paradigm for the "word-frequency effect". Another way of varying 'frequency' has been to give the subjects different amounts of exposure to initially unfamiliar nonsense-words, e.g. Solomon & Postman (1952). The more usual practice, however, has been to rely on the Thorndike-Lorge (1944) word count as an index of 'word-frequency': and this practice has produced several replications - e.g. Haber (1965); Broadbent (1967) - of the 'word-frequency effect'.

Howes (1954) offered a theoretical discussion of the interpretation of the word-frequency effect, He argued that it was illogical to assume that sheer frequency of exposure to words was the relevant factor lowering recognition thresholds, since :-

(a) the effect was typically obtained with college students, whose childhood and adolescent exposure to words - which made up the major part of their total linguistic histories - was of a different order from word-counts based on <u>adult</u>

reading habits;

(b) in human learning situations, the learning function is typically asymptotic - and the asymptote for 'word-learning' probably occurs after only a few repetitions. Even relatively rare words, then, may well be as thoroughly 'learned' as words which occur frequently.

Howes (1954) puts forward an alternative, statistical interpretation of the word-frequency effect. He suggests that the 'momentary probability' of a word is the probability that a subject will limit that word rather than any other at a given time. This 'momentary probability' fluctuates widely over time, and its average value over a period of time represents the word's 'base probability'. This 'base probability' corresponds to the "frequency with which subjects would have used that word at the time the duration thresholds are measured, if the measurements had not been made" (p.112). In practice, Howes found college students' rankings of the frequency with which certain words were used in their own college community, and the Thorndike-Lorge (1944) frequencies, served as highly correlated estimates of the 'base probabilities' (as indicated, circularly, by their recognition thresholds), of words. Howes theorized that when a word is flashed tachistoscopically, its 'momentary probability' has two components - one due to the fact of that word's having been flashed, and the second due to the word's 'base probability'. "The duration threshold will thus be lower for words with high base probabilities" (p.106).

This account of the word-frequency effect, however, seems to beg several crucial questions - no account is given of how 'base probabilities' are formed, other than through a high average frequency of usage (an explanation the dubious qualities of which Howes himself had pointed out); nor is it explained how, in psychological as opposed to probabilistic terms the 'base probabilities' affect recognition.

More specifically psychological accounts of the word-frequency effect are given by Bruner (1957) and Osgood (1957) (page references in the following discussion are to the articles as they appear reprinted in Harper et al. 1964). Bruner (1957a) proceeds from the working assumption that "all perception involves an act of categorization (p.225) and discusses 'perceptual readiness' in terms of the accessibility of categories in the perceiver for use in coding or identifying stimuli. Accessibility of categories is accounted for in terms of frequency of exposure to the relevant class of stimuli - "the more frequently in a given context instances of a given category occur, the greater the accessibility of the category". (p.234). The more accessible a category, the less the input necessary for the categorization of a stimulus in terms of this category. Thus, given that frequently-occurring words have more accessible categories, it follows that they will be perceived more readily than rare words. This argument, in effect, rests on assumptions closely parallel to Howes' (1954) concepts of 'base' and 'momentary probabilities'; while it does have the additional features of being more detailed on the phenomenological level and providing an interesting functionalist emphasis, it, too, ties the 'word-frequency effect' down to sheer frequency of occurrence of the stimulus words.

Osgood (1957) too, stresses the effect of frequency of exposure in determining the habitual 'integrations' made by the organism in perception. "The greater the frequency with which stimulus events _A_ and _B_ are associated in the input to an organism, the greater will be the tendency for the central correlates of one, _a_ to activate the central correlates of the other, _b_ (p.187). This past history of signal pairing results in stored information, in the form of hierarchies of 'predictive integrations' typically made in perceiving - thus the organism tends to "fill out sketchy sensory information, and predict events in proportion to their environmental probabilities." (p.204). Osgood gives as an example of this the fact that it is easier to follow a familiar juke-box tune than an unfamiliar one in a noisy room - a phenomenon essentially similar to the 'word-frequency effect', and depending on frequency of exposure to the stimulus.

Osgood, however, with his characteristic interest in semantics, suggests a second source of 'stored information' affecting perception. Given that "identifying or recognizing something requires that sensory signals activate a representational process (i.e. a cognitive awareness of significance or meaning)" (p.204), the availability of representational processes themselves can be specified as a variable affecting recognition. "Where certain cognitive states have accompanied some but not all integrations within competing hierarchies, the self-stimulation arising from such cognitive states will facilitate or increase the probability of these perceptual integrations against others" (p.204). Put more simply, "_significance_", is "values, attitudes, previous rewards or punishments, and the like" (p.205). (This is essentially a

'New Look' postulate). But there is a second way in which the term 'significance' is being used - that is, simply knowledge of the semantic meaning of the stimulus. Osgood gives the example of listening to an unfamiliar Gilbert and Sullivan chorus. While the listener is following a printed libretto, the auditory information is intelligible, the words easily recognized. Yet without the knowledge given by the printed text of what the sounds mean, the auditory information degenerates into indistinguishable 'gibberish'. Here, knowledge of the words' meaning ('significance') directly affects the ease with which they are perceived - a variable of a different order from sheer 'frequency of past exposure'.

This second suggestion of Osgood's - that (put in the context of tachistoscopic word-recognition) knowledge of a word's meaning will facilitate recognition of that word - this suggestion was considered worth investigation in relation to the word-frequency effect, for the following reason: if 'frequency of exposure' is the only important variable operating in the word-frequency paradigm, it is patently surprising that the word-frequency effect has so often been replicated with the Thorndike-Lorge (1944) norms defining the independent variable, 'frequency of occurrence'. Criticisms of the use of the 1944 norms in terms of their inevitably limited sampling of texts, their exclusion of frequencies in spoken language, their (by now) out of date nature, and their applicability strictly to American populations, are well known. Equally important is the fact that an individual's experience with words - especially with relatively rare words, as Howes (1954) points out - is essentially idiosyncratic, while the norms can only refer to population averages. (Adkins (1956);

Daston (1957)).

Eriksen (1954) provides interesting support for the suspicions that, firstly, what the Thorndike-Lorge norms are providing is not solely a measure of the frequency with which individual subjects have been exposed to the stimulus words; and secondly, that, consequently, 'frequency of exposure' is not the only variable operating in word-frequency experiments. Re-analyzing Howes and Solomon's (1951) data, he found that variation in frequency beyond a range of 1 to 10 occurrences per million words, bears little relationship to recognition threshold. That is, the high negative correlation obtained between frequency and threshold, was due almost entirely to the relationship within the <u>extremely low frequency</u> range.

This finding could, on the one hand, merely support Howes' (1954) contention that the word-frequency effect is asymptotic with respect to frequencies. But, on the other hand, it is open to an alternative interpretation. Words that occur more than ten times per million according to the Thorndike-Lorge norms appear, on inspection, to be generally well within the vocabulary range of normal adults - almost certain within the vocabularies of the conventional experimental subjects, university students. It is only as one enters the extremely low frequency ranges that one encounters words whose meanings subjects are not likely to know. Thus the question can be asked: do rare words have higher thresholds <u>only</u> because of their lower frequencies of past exposure to subjects, or is the factor of 'significance', or 'knowledge of meaning', as suggested by Osgood (1957), also involved in the independent variable defined by Thorndike-Lorge frequency norms?

This latter factor will be referred to, for convenience's sake, as 'meaningfulness'. As this is an overworked term in the literature, it may be helpful to insist that it is being used here simply to refer to how well-known the 'definition', the semantic denotation, of a word is. The term is not intended to have motivational implications, where 'meaningful' means 'emotionally or affectively toned'; it is also intended to be distinct from Noble's (1963) concept of 'meaningfulness', m, which refers to connotative value, or tendency for a word to evoke rapid associations.

It is obviously difficult to separate out 'meaningfulness' and 'frequency' with relatively rare words, because the more frequently an individual comes across a word, the more likely it is that he will try to find out its meaning. There are, however, at least two important experiments in the literature which have claimed to assess the importance of 'meaningfulness' in word-recognition; the first yielded negative, the second positive, results.

The first, by Taylor (1958), attempted to control 'frequency' while contrasting 'meaningfulness' by giving two groups of subjects equal numbers of exposures to a set of nonsense syllables, but showing one group a picture of a familiar object, such as a chair, with each syllable. That group was given instructions to learn that that syllable meant, say, 'chair'. Recognition thresholds were then compared for the two groups on the list of syllables - and no significant differences were found. However, the conclusion that meaningfulness is not a significant variable in the word-frequency effect may be limited by the procedural flaw that subjects in the 'meaningful' group may have had their attention distracted from the syllables to the pictures, thus rehearsing the syllables less often than the control group, and therefore having, in a sense, lower 'frequencies of exposure'. The conclusion is also, perhaps inevitably, limited by the artificiality of the design - an association between a nonsense word and a picture-name does not fully represent the close semantic association between the referent and the object of reference; it is not quite what one means by 'meaning'.

The second study on the role of 'meaningfulness' in word-recognition is one of an interesting series being conducted by Haber and his colleagues - a series examining the increase in the perceptual clarity of stimuli flashed repeatedly with exposure duration kept constant, instead of being increased on successive presentations, as is the usual practice in determining recognition thresholds. Hershenson & Haber (1965) found that 'meaningful' words - i.e. "seven-letter English words that appeared not infrequently in print" (p.43) - were perceived more easily than 'meaningless' words, which were seven-letter Turkish words. While this design succeeds more forcefully than Taylor's (1958) did, in providing a contrast between words which have meaning for a subject and words which do not, two serious criticisms can be made of it:

(i) 'Meaningfulness' and 'frequency of exposure' are completely confounded. No objective measure of the frequencies of the English words is given but in any case it is highly probable that the English words would have been encountered more often than the unfamiliar Turkish words.

(ii) The authors claim to be studying the perception of stimuli that "represent nonsense to the subject even if the structural contingencies of a language are inherent in the stimulus" (p.42). Just how do the 'structural contingencies of a language' affect the recognition threshold? It can simply be suggested that the 'structural contingencies' of Turkish may not exist at <u>all</u> as 'contingencies' for English-speaking subjects. That 'inherent contingencies' are relative to one's native language, is supported by Bruner's (1957b) report that nonsense words based on the spelling patterns of various European languages - e.g. MJOLKKOR, KLOOK, GERLANCH, OTIVANCHE, TRIANODE, FATTALONI - had lower thresholds for subjects who spoke the language that a given word was constructed to resemble (p.298 in Harper et al (1964)). Thus, in Hershenson & Haber's (1965) experiment 'meaningfulness' is confounded with the existence of 'structural language contingencies'.

The careful tachistoscopic experiments of Tulving and Gold (1963) can be regarded as providing full support for the hypothesis that sources of stimulus information are interchangeable with sources of contextual information. "The role of the discriminative stimulus in experiments on tachistoscopic identification of verbal material, therefore, is simply to provide information about the response to be selected that is not available from other sources. In Goldiamond and Hawkins' (1958) Vexierversuch, according to the present argument, "background" information was sufficient in many cases to provide all the information necessary for veridical response selection and the subjects were, therefore, capable of correctly "identifying" non-existent stimulus words. Under some other conditions, such as when the forced-choice method (Blackwell, 1953) is used, nonstimulus sources of information are eliminated, and the subjects performance is completely determined by the availability of perceptual information. In many tachistoscopic experiments in which the ascending method of limits is used to measure thresholds, however, information from several sources jointly determines the level of performance.

The findings of the present experiments are relevant to the hypothesis theory of perception (Bruner, 1951; Postman, 1951). According to this theory, perception depends upon two classes of variables - (a) stimulus factors, and (b) expectancies or hypotheses of the organism. Two basic theorems relate strength of hypothesis to perceptual information. The first says that the greater the strength of the hypothesis, the less the amount of appropriate information necessary to confirm it. The second states that the greater the strength of the hypothesis, the more the amount of inappropriate or contradictory information necessary to infirm it. (Tulving and Gold, 1963)".

Sperling (1967) has also examined briefly exposed stimuli (arrays of letters, presented at 1/20th of a second). His memory model has emphasis upon a rehearsal component "the rehearsal component executes the rehearsal, which then is entered and remembered temporarily in auditory storage. The memory of the rehearsal in <u>auditory storage</u> is scanned, the auditory image is converted to motor-instruction in the recognition-buffer, and a second rehearsal is executed. This loop continues until the response is called for and the letters are written down".

A feature of Sperlings model of memory systems (Sperling, 1967) is the introduction of an auditory store after information has been extracted ("scanned") from the visual information storage. Although the point is not discussed, auditory storage is still a temporary mechanism. There are psychologists who disagree with Sperling, they feel that there is little value in making distinctions among different memory processes, as memory is considered a single phenomenon which appears to be different when examined by different experimental techniques. However, an increasing body of evidence does seem to favour the interpretation of human memory as part of a complex chain of processes similar to those proposed by Sperling, which are involved in the handling of information from its sensory representation to its permanent storage. "These processes appear to have different functional modes of excitation, although the issue of whether different physical structures are involved is not yet settled (Norman 1969)". These modes represent the distinction between the various memory systems, e.g. a sensory memory, a primary (or short-term) memory, and a secondary (or permanent memory). Acoustic coding (Conrad, 1964) articulatory and acoustic coding (Wickelgren, 1969) appear to be important for short term memory, precategorical acoustic storage (Crowder and Morton, 1969) or sensory memory but not especially important for long term memory where language (semantic) factors, the stimulus bizarre appearance and word 'salience' appear to be better coding variables.

Melton (1963) has argued for a single mechanism underlying short-term and long-term memory for verbal material. His argument was based in part on the apparently similar effects of interference over short and long retention intervals. Since then it has been suggested (Waugh & Norman, 1965; Atkinson & Shiffrin, 1967) that independent short-term and long-term stores exist but that both stores contribute to the output after short-term retention. Since some material is retrieved from long-term store (LTS) after both long and short intervals, recall will reflect the characteristics of that store in both cases.

Evidence supporting the existence of two memory stores has come from the observation that a large number of errors after short-term retention are acoustically similar to correct stimuli (Conrad, 1964). Baddeley (1966) has since shown that the difficulty involved in short-term storage of acoustically similar material does not apply to longer-term retention. Also, Conrad (1967) reported an experiment in which subjects attempted to recall four consonants after either 2.4 or 7.2 sec of digit naming. He found that errors tended to be acoustically similar to correct letters for both retention intervals, but the distribution of errors tended more towards random for the longer interval. These findings suggest that verbal material is coded in a short-term store (STS) on an acoustic basis but that this type of coding is not so important in LTS.

It is also possible that some acoustic errors are errors of perception rather than memory: also from observations of the "tip of the tongue" phenomenon (Brown & McNeill, 1966) it seems likely that the long-term store may employ acoustic coding to some extent and that these errors are in part at least errors of storage or retrieval (Craik, 1968).

One of the reasons why Ebbinghaus thought so highly of nonsense syllables was the belief that they would be free from meaning and the effects of language experience; memory could thus be studied uncontaminated by verbal habit. That the assumption was false has long been recognised, and for 40 years or more no verbal learning experiments have used nonsense syllables without controlling for association value or meaningfulness, and more recently Underwood & Schulz (1960) have shown that <u>pronunciability</u> is also an important determinant of ease of learning letter groups. These measures, though without doubt reliable predictors, are limited by the fact that norms are required before they can be used, that such norms are only available for certain types of letter sequence (e.g. CVCs, CCCs etc.), and that the norms are based on consensus of opinion which needs to be laboriously determined for each type of letter sequence. (Conrad, Freeman and Hull, 1965). Again Conrad et al op cit) have as Miller before them reported "that ease of recall of letter sequences was a function of letter sequence redundancy thus including, probably, most of the earlier measures in one which obviates the need for independently established norms, and which can be applied to any length of sequence. Di Mascio (1959) reported that even single letter frequency was related to memorizability, and Underwood & Schulz (1960) reported significant correlations between ease of learning single letters as response terms in paired-associate learning, and frequency of occurrence in English. Baddeley (1964) showed that a simple-to-use approximation to second order letter sequence redundancy, which he called predictability, was a highly effective predictor of ease of learning, and since it was based on published tables of digram frequency (Baddeley, Conrad & Thomson, 1960) required no prior testing.

Baddeley, Conrad & Hull (1965) measured the predictability of 40 6-consonant sequences and obtained a highly significant correlation with ease of short-term memorizing. But when second-order effects were partialled out, a Di Mascio (1959) single-letter frequency measure did not correlate significantly with ease of memorizing."

It seems adequately shown by Conrad (1963, 1964) that for short-term storage of consonant sequences, encoding of presented material depends much more on what the individual letters sound like, than on the frequency with which they have previously been met in the course of using language. Single-letter frequency seems irrelevant to the task and the results sharply qualify the SPEW hypothesis of Underwood & Schulz (1960) which asserts that the availability of verbal units as responses in new associative connections depends on the frequency with which they have previously been experienced. However, when the index of experience is based on higher order sequence relationships it does become more important for memory. Nevertheless, Conrad (1963) has shown that when letter sequence redundancy is very high and relatively homogeneous, as with common words, the acoustic properties of the word still dominate. The subject's encoding strategy is probably dependent on the time he has available for it (Conrad, Freeman and Hull, 1965).

The previous studies on rapid stimulus presentation (tachistoscopic and STM experiments) allow little time for stimulus organization and the effects of <u>long term memory</u>.

There are two plausible ways in which organization might affect recognition. One model suggests that the two-factor theory is operative in both recall and recognition. The two processes, in both cases, are a retrieval and a decision mechanism. In the case of recall, retrieval precedes decision, which then screens out false retrievals and repetitions. In the case of recognition, the decision process precedes a quasi-retrieval process. Following a recognition decision, particularly with a low level of confidence, this retrieval process could be used to determine whether the word is retrievable, i.e., whether the retrieval programme appropriate to that list can generate the address of the word that has been recognized. In that case, the structure of the retrieval program or organization would affect the number of words that are finally called Old or New in recognition.

Another plausible model for the influence of organization on recognition suggests that during recognition an item is first categorized and then the category to which it has been assigned is checked for the presence of the item. This model provides two possible outcomes: In the case where few broad categories make categorization of items difficult, the wrong category might be searched, but in the case of a large, well defined number of categories, allocation can be made more easily. "Thus, we would predict a positive relation between number of categories and recognition. On the other hand, a large number of conflicting categories may be confusing when uncertain items are being examined and may result during recognition in the placement of an item into the "wrong" category, thus producing a negative relation between numbers of categories and recognition." (Mandler, Pearlstone and Koopmans, 1968).

In any case it might be noted that retrieval and recognition may not be based exclusively on semantic features. Finding the proper address for an item in storage involves continuous comparisons and retrievals on the basis of other features as well (Mandler, 1969). Thus, words are unique perceptual as well as semantic events. This perceptual uniqueness may override semantic similarity. Further explorations of the role of perceptual (e.g., acoustic) similarity in long-term recognition are clearly indicated. Finally, the data are consistent with a notion that storage consists of the identifying addresses of "whole" words. If words from well-organized lists that have been given extended exposure are stored and recognized as such, then recognition should be generally unaffected by similarity of semantic (or acoustic) features. "Such features would, however, still operate in the organization and retrieval of the items. But in recognition, it is the <u>word</u> or its unique pattern of <u>perceptual</u> and <u>semantic</u> features that is identified by list tags and recognized as such. Under conditions of less intensive organization or exposure, or where other factors demand stress on specific features, the pattern may not be uniquely identified or some features may be stressed or ignored. (Mandler, Pearlstone and Koopmans, 1968)".

Despite the utilization by theorists of two mechanisms of memory, short term memory (STM) and long term memory (LTM), there is no clear division or agreement. Functional similarities appear to include some common influences of degree of learning and interference on forgetting, but some differences have been determined, e.g. interference by acoustic similarity seems to influence STM but not LTM (e.g. Conrad's experiments mentioned earlier), and semantic similarity apparently affects LTM more than STM. Some theorists have suggested that the heavier influence of simple decay processes in STM than LTM provides a critical distinction, but the decay process is difficult to establish, and there is no general agreement concerning its influence on retention of verbal learning.

A consideration of recognition behaviour in general and recognition memory specifically using traditional analyses attempted to apply a correction for guessing which consisted of an adjustment of the hit rate downward for false alarms. Such a procedure has the limitation of assuming that recognition is an all or none process and that, consequently, the subject's hits consist of those items which he does truly recognize and those which he gets correct simply by guessing. Signal detection analysis, on the other hand, approaches the problem from a different viewpoint, an assumption is made that the subject arrives at his decision on the basis of mediating processes which are <u>continuous</u> rather than <u>discrete</u>. It is possible to apply a decision-theory analysis to recognition memory while maintaining the tenet that the nature of the basic memory process is discrete rather than continuous. Thus, the memory process is separated from the decision process and only the latter is considered continuous (see for example Bernbach, 1967).

CHAPTER TWO

THE INFLUENCE OF WORD-KNOWLEDGE ON THE WORD-FREQUENCY EFFECT IN RECOGNITION MEMORY

INTRODUCTION

The experiment[1] to be reported here was designed to examine the role of 'word-frequency' in word-recognition, with the following objective (based on the criticisms made of Taylor's (1958) and Hershenson & Haber's (1965) experiments) in view: to avoid resorting to the use of nonsense syllables to create an artificial 'unfamiliar - familiar' dichotomy.

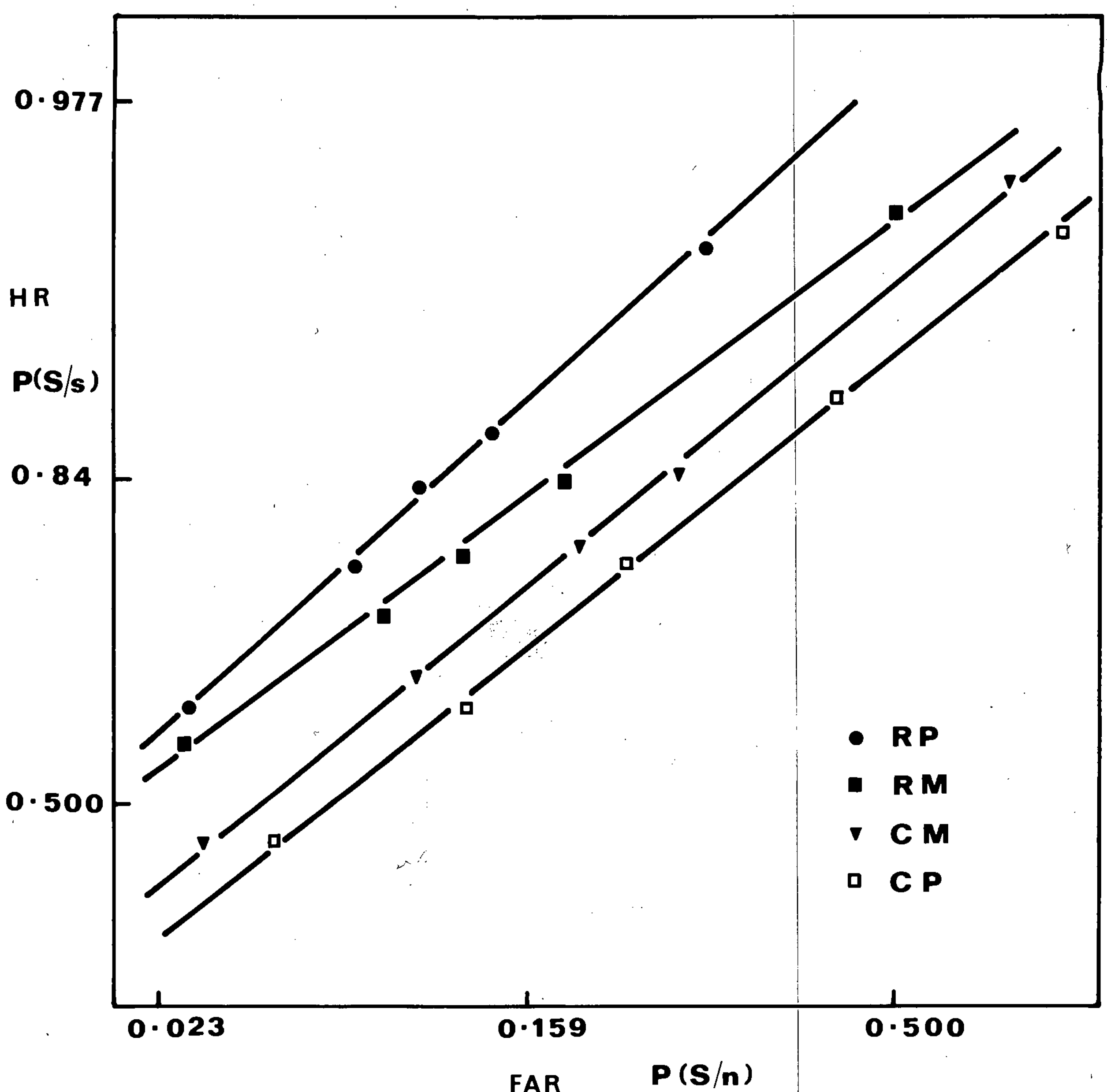
The experiment consisted of two parts: firstly, the collection of suitable stimulus words and indices of their 'familiarity' and 'frequency of occurrence' (rare or common), and, secondly, the testing of recognition performance.

There exists, in the university set-up, an ideal situation whereby sets of English words can be obtained, the meaning of which it can be safely predicted that some sets of subjects will know and other sets of subjects will not know. This situation stems from the fact of specialization and the use of rare, technical or jargon words in different fields of study.

Thus it is reasonable to suppose that honours physics students would possess a vocabulary of technical terms which though familiar to them would be unfamiliar or even unheard of words for honours arts students. Rather than resorting to the Thorndike-Lorge (1944) word-count for the extraction of both rare and common words (where the rare words are not unfamiliar to university students) it was decided to inves-

1. This experiment was performed with the help of R.F. Garton and published in Psychonomic Science (Allen & Garton, 1968a).

Fig. 1: **SCHULMAN'S RECOGNITION MEMORY GRAPHS**



Operating characteristics on double-probability paper. (R = Rare, C = Common, M = Monosyllabic, P = Polysyllabic). Each OC, fitted by eye, is based on the ratings assigned by nine Ss to 25 old and 25 new words.

Lorge frequency of A or AA) to identify as old or new; but, as Schulman has noted, the rare words used in his experiment were by no means unfamiliar ones. The experiment reported here uses OCs in an attempt to separate the effects of rarity defined in terms of the subjects inability to define the meaning of a word and rarity meaning of low word count in the general literature. This is achieved by assessing the recognition performance of two groups of subjects physics and arts students, on a sequence of test words containing both technical physics words and common words. In such a situation a physics word, e.g. "tetrode", is rare (low word count) for both physics and arts students, yet its meaning is likely to be rare (word knowledge) only for arts subjects.

In order to demonstrate a word-frequency effect as reported by Schulman, (see figure 1), the OC curves of both physics and arts subjects would be expected to indicate that physics words, rather than common words, were easier to differentiate as being either old or new. In order to demonstrate a word-knowledge effect, significant differences would be expected in the OC curves of physics and arts subjects for physics words but <u>not</u> for common words. The superior discrimination of physics words by physics subjects would suggest that a knowledge of word meaning facilitates recognition while a superior performance by arts students on physics words would suggest that their rarity aided discrimination as in word-frequency effect.

Method:

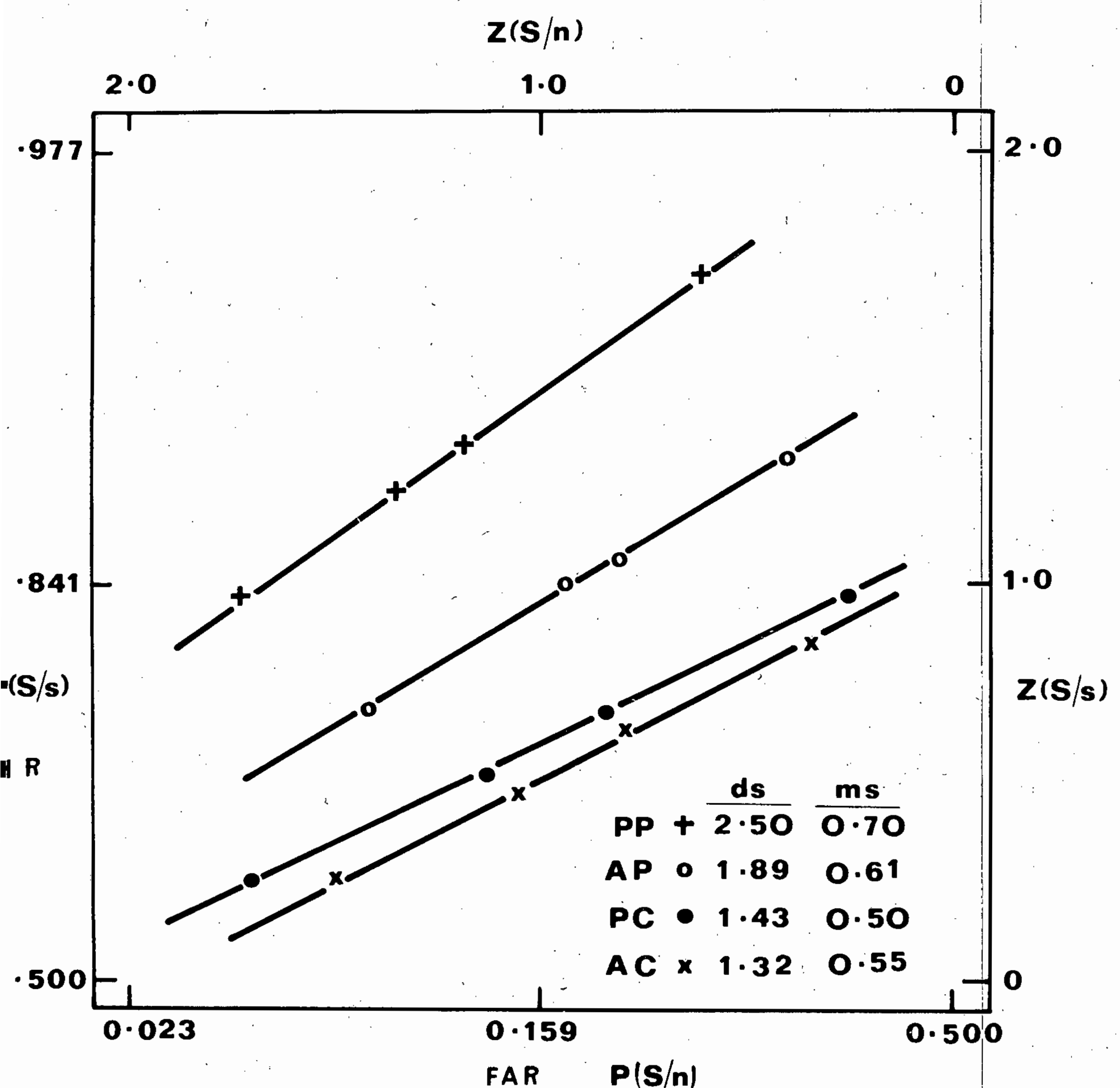
The subjects, tested in small groups, were fifty university students, twenty-five having completed at least one year of an honours physics course and twenty-five honours arts subjects having little if any science training at high school.

An inspection sequence of sixty words contained thirty common words (Thorndike-Lorge rating of thirty or more), and thirty physics words. The latter were chosen in order that they would be very familiar to second year university students enrolled for a major in physics while at the same time they would not be a part of the arts subjects ordinary vocabulary. Each word was projected onto a screen for three seconds using a Kodak Carousel automatic projector (Model 550R) with a 0.5 second interval between words. The subjects were instructed to try to remember the words appearing on the screen. There was a three minute interval between the completion of the inspection task and the start of the recognition test. A recognition booklet contained 120 words in random order: Sixty physics and sixty common words, including all the inspection items. The subjects marked these words according to whether or not they thought a word had been previously presented by marking a 5-point scale ranging from absolutely sure a word was seen before to absolutely sure a word was new.

RESULTS AND DISCUSSION:

The group results and *z* scores are given in Appendix 11

On a double-probability plot linear OCs were drawn, for each of the four groups (N = 1500), through the four points obtained for the old-new discriminations. The effects of the two variables on recognition performance are evident from Fig. 2. It is apparent that physics words are easier to identify as old or new than common words, illustrated by the separation of the top two graphs from the lower two. This is true of both g.2: ALLEN and GARTON (1968 a) RECOGNITION MEMORY GRAPHS



Operating characteristics on a double probability plot (PP= physics Ss, physics words; AP= arts Ss, physics words; PC= physics Ss, common words; AC= arts Ss, common words) populations of subjects (d_s's of 2.50 and 1.89 vs 1.32 and 1.43). This is comparable to Schulman's experimental findings. However, the separation of the top two graphs shows that physics students found the identification of physics words an easier task than the arts students (d_s 2.50 vs. 1.89). The superior recognition of physics words for physics subjects has not significantly aided the recognition of common words for this population (d_s 1.43 vs 1.32). That is, the two lower graphs show that the physics subjects have not found the common words much easier to recognize nor has the inferior performance of arts subjects on physics words been a result of a superior performance on common words.

These findings offer clear support for the importance of word-frequency in word recognition since the physics words were easier to recognize than very common words. What is of particular interest is that a knowledge of the meaning of low-frequency words, rather than unfamiliarity with their meaning, apparently facilitates recognition. Schulman has suggested that low-frequency words are easier to recognize because they tend to be more distinctive semantically, since they share fewer associations than do common words. However, it seems reasonable to suppose that physics students would have more associations to physics words than do arts students. Consequently, while shared associations may inhibit recognition for common words, they apparently increase the distinctiveness of low-frequency words only in the case where their precise meaning is known.

CHAPTER THREE

A REAPPRAISAL OF THE WORD-KNOWLEDGE EFFECT

INTRODUCTION

The results of the previous experiment (Allen and Garton, 1968a) exhibit one puzzling feature. Why is the 'arts students' performance on physics words superior to their performance on common words? Allowing for the fact that unusual words may be more 'salient' and thus they may stand out in a background of noise, or distractor items, there is the vexing question that some at least of the physics terms must mean nonsense to the arts student with no training in physics. Words such as ADIACTINIC may be but a pronounceable nonsense word. Should this be so then performance on physics terms would be expected to be inferior to performance on common words.

The procedure undertaken in experiment 1 has certain flaws. The rating procedure for the terms used was inadequate. For though all the physics terms are uncommon compared with words of a rating of A, AA or 30 in the Thorndike-Lorge there are certainly some which are familiar to the arts student: or at least there are likely to be some terms, which though not part of their everyday vocabulary, are none the less fairly familiar to arts students. For example, FLUX, COSINE, DIFFRACTION, to name but a few. The terms are unfamiliar (undefinable) but they would certainly have common associations.

In any case it is necessary to repeat the experiment with a new population of subjects and a stricter more controlled rating procedure for 'familiarity' of the items.

Experiment 2

Rating Procedure:

A booklet of ninety-three physics terms was administered to thirty physics post graduates and thirty arts post graduates.

The subjects were obtained at the University of Melbourne School of Physics. An instruction sheet formed the first page of each booklet (for details see Appendix III). Briefly, the instructions allowed the rater six categories of response for each physics term ranging from (1) a highly familiar word, you could define the term accurately, to (6) a totally unfamiliar word you have never seen or heard of the word before. Means and standard deviations were computed for each word across the two subject groups (see Appendix IV). Thus an accurate assessment was obtained concerning rare and common physics terms for both arts and physics post graduates.

Sixty words were chosen from the ninety-three such that twenty were common to both populations (CT), twenty were rare for both populations (RT) and twenty were fairly common for physics students but still quite rare for arts students (CRT). The three lists of twenty words are given in Appendix V.

Method:

Subjects: The subjects were fifty postgraduate students, twenty five were tutors, masters and doctoral students in the English literature, Philosophy and History departments. Twenty-five were M.Sc. and Ph.D students in the Physics School.★

Postgraduates were chosen in an attempt to isolate, still further, the arts students from their distant school science days.

★ Acknowledgements are due to Miss R. Russon and Miss F. Fearon of the English and History departments of the University of Melbourne for help in obtaining subjects. Dr. J. Evans and Mr. O. Mace of the Physics School helped to organize their laboratory colleagues; testing took place in situ during their lunch breaks.
The Physics School, though very large, could not supply an inexhaustible supply of subjects for both the rating and testing sessions. Consequently five subjects were used for both. However, the testing sessions took place three months after the rating procedure; it is unlikely that the results would be contaminated.

<u>Materials</u>: A single inspection list of ten common (CT), ten rare (RT) and ten common-rare words (CRT) was produced. The words were typed on plain cards and made into photographic slides.

A single test booklet contained the sixty words with the proviso that each fifth of the booklet had 4 CT, 4RT and 4 CRTs.

<u>Procedure</u>: All the students were tested in small groups, with the same inspection series. The slides being randomly assigned in the slide-tray with the constraint that 5CT, 5RT and 5CRTs appeared in each half of the slide series. Each word was projected onto a screen using a Kodak Carousel automatic projector (Model 550R) equipped with a timer so that each slide was exposed for 1.9 seconds. The subjects were instructed to try and remember all the words presented on the screen. There was a two minute interval between the completion of the inspection task and the start of the recognition task. The subjects read instructions typed on the cover on the test booklet during the interval. The instructions urged the subjects to work steadily and not to deliberate over any particular word. Beside each word in the booklet was a six-point scale on which the subject indicated how certain he was that the word was present or absent.

<u>Scoring</u>: The six-point scale in the test booklet enabled the subjects to indicate that they were absolutely sure the word was present, almost sure that the word was present, the word was probably present, the word was probably absent, almost sure the word was absent and absolutely sure that the word was absent (categories 1 – 6).

Results:

The individual data are given in Appendix $\overline{\text{Vl}}$. The group data are given in Table 1. Where S refers to the inspection words (signal) and N to the distractor (noise) items.

Appendix $\overline{\text{Vlll}}$ contains the z scores based on the area (probability) scores for the group data (see Appendix $\overline{\text{Vll}}$).

ROC curves were calculated from these z scores and plotted (Figure 3): from the curves the d'_s, delta m, and slope of the curve values were calculated. The magnitude of d'_s (or delta m) is a measure of the degree of sensitivity of the subjects to the various stimuli groups.

Delta m (Δm) is supposed to give a better estimation than d'_s when the slopes of the curves are not the theoretical value of one (McNicol, Ingleby (1969) personal communication)[2]. However, it can be seen that the Δm end the d'_s values are in one - one correspondence (Table 2, page 32). Henceforth in this chapter d'_s will be referred to in a discussion of sensitivity scores, though Δm would be just as applicable.

2. Delta m is the value of z $(\frac{S}{n})$ for each curve when z $(\frac{S}{s})$ is zero. That is, the intercept on the x - axis. The curves were actually drawn on large graph paper and scaled down for diagrammatical purposes (Figure 3): an accuracy of two decimal places is easily obtained.

TABLE 1

GROUP DATA FOR PHYSICS TERMS: EXPERIMENT 2

Category	Physics Postgraduates (N=25)					
	S	N	S	N	S	N
1	151	03	192	11	180	09
2	14	10	16	02	19	12
3	18	14	07	10	15	05
4	11	18	10	12	09	08
5	29	49	11	51	16	53
6	27	156	14	164	11	163
	CT		RT		CRT	
	List A		List B		List C	

Category	Arts Postgraduates (N=25)					
	S	N	S	N	S	N
1	157	17	166	34	169	32
2	26	07	14	27	24	8
3	13	07	7	16	11	17
4	9	19	15	18	9	13
5	11	54	17	43	22	47
6	34	146	31	112	15	133
	CT		RT		CRT	
	List A		List B		List C	

TABLE 2

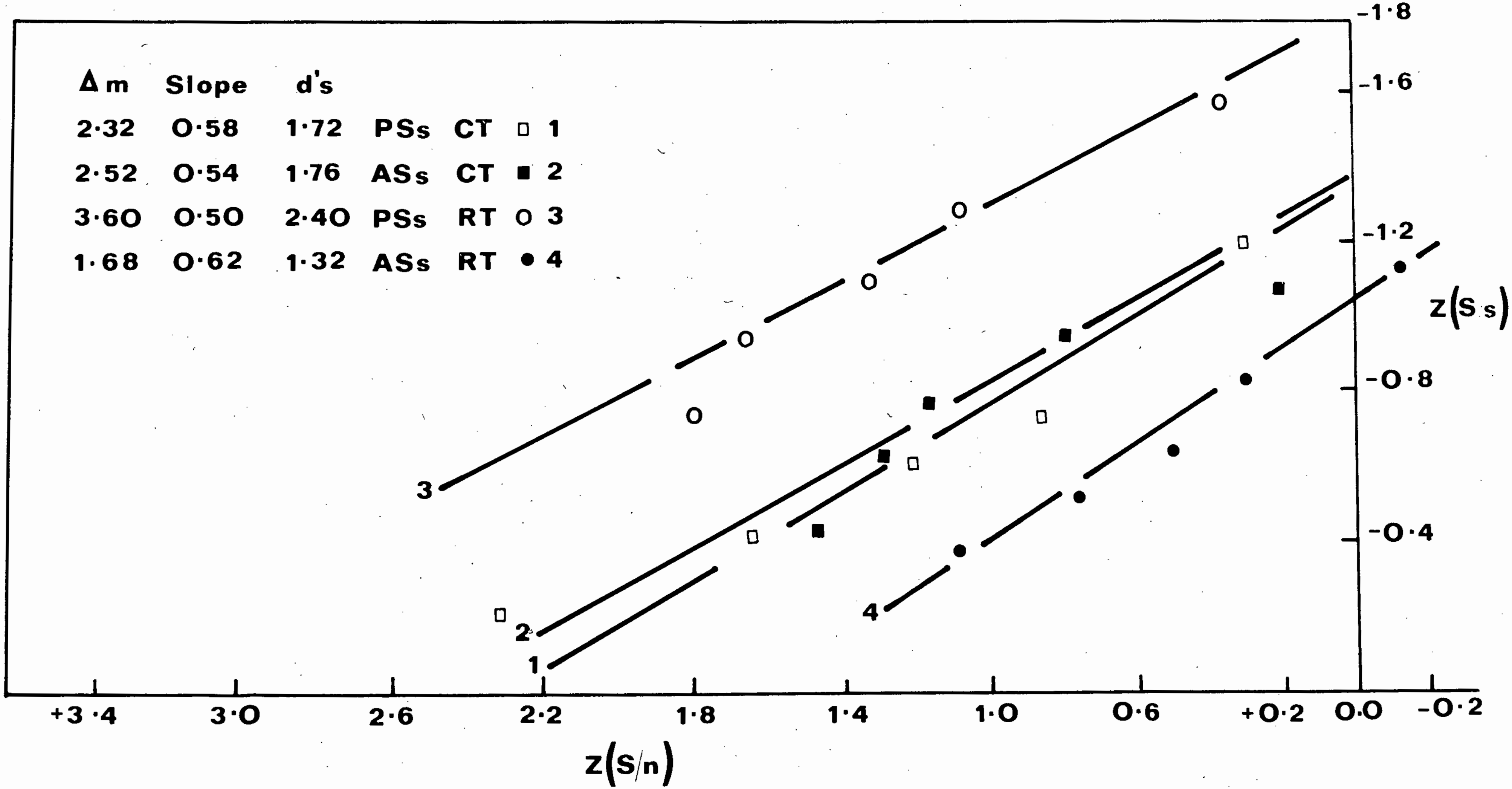
SIGNAL DETECTION THEORY PARAMETERS
FOR PHYSICS TERMS

m	Slope	d's	List[Φ]	Subjects
2.32	0.58	1.72	A	Physics
2.52	0.54	1.76	A	Arts
3.60	0.50	2.40	B	Physics
1.68	0.62	1.32	B	Arts
2.62	0.72	2.28	C	Physics
2.16	0.65	1.68	C	Arts

For clarity: List C (CRTs) curves were omitted from Figure 3.

Φ (Where A refers to common terms, B to rare terms and C to CRT).

Fig. 3: ROC CURVES FOR COMMON AND RARE PHYSICS TERMS (Lists A and B)



Discussion:

From figure 3, page 33, it can be seen that the arts postgraduates performed better on common terms than on rare terms (d'$_s$ of 2.52 vs. 1.68). This would seem to obviate, to some degree, the puzzling aspect of experiment 1. Secondly, the results for physics and arts students on common terms (List A) were almost identical (d'$_s$ of 1.72 c.f. 1.76) replicating the result in experiment 1. Though no significance tests are available for signal Detection Theory curves,$^{\Phi}$ this result would hardly be significant, especially as the curves have similar slopes.

Again, the physics subjects were better at rare words that the arts subjects, as was found in Experiment 1.

Though all terms are rare for arts students it is clear that some have more connotations or have been seen before. The rare terms used in List B are certainly different in structure from the common terms in List A. ADIACTINIC, EUTECTIC, AUTOCLAVE, TROCHOTRON (List B) must surely be closer to nonsense words than say: COSINE, PERMEABILITY, VALENCY, CALORIMETER and FLUX of List A.

The results for List C seem to confirm the findings for Lists A and B. The non-physics subjects' performance being close to that of List A (d'$_s$ of 1.68 being closer to 1.76 than 1.32). The physics students result for List C produced a d'$_s$ of 2.28 lying between 1.72 (CT) and 2.4 for rare terms. It would be expected that the sensitivity measure would be closer to the common term result: this was not the case. Though of small consequence, it is difficult to see how this result did

Φ At the time of writing this chapter.

not lie in the expected direction as the words used were certainly common for physics postgraduates.ΦΦ

Though the results are encouraging there are interesting corollaries to be drawn from the data. What does a person mean by familiar: the stimuli were rated on a 'familiarity' basis and this must surely be a question of prime importance? Remembering that all the words used were rare (of low word-count) how does a typical physics and arts subject view familiarity?

It is generally agreed that nonsense words which are structured like English words are more easily perceived by English speaking subjects (Bruner 1957b) than nonsense words which are merely random strings of letters. This effect has been interpreted in two different ways in the literature:

(1) The first approach,taken by Miller, Bruner & Postman (1954), stresses the '<u>redundancy</u>' of nonsense syllables which incorporate English spelling patterns. Their stimulus words were 'letter-by-letter approximations to English' - a zero-order approximation being a string of letters drawn at random from the alphabet; a first-order approximation being still random, but taking into account the frequencies with which letters naturally occur in written English; a second-order approximation taking into account the probability of any <u>pair</u> of consecutive letters occurring in written English; and so on. Examples of Miller, Bruner & Postman's (1954) stimulus words are:

ΦΦ. For example: to name a few, Meson (1.567) Maser (1.767) Triode (1.000) Tetrode (1.033) Cursor (1.700) and Colloid (1.667): where the values in brackets are the means of the ratings. A rating of 1 being common and 6 being rare.

Zero-order : YRULPZOC

First-order : VTYEHULO

Second-order : THERARES

Fourth-order : VERNALIT

Miller, Bruner & Postman found that the higher a word's order of approximation to English was, the lower was its recognition threshold. However, estimating and correcting for 'redundancy' as defined by Shannon (1948), they found that a roughly constant amount of information was being processed at any given duration for all orders of approximation. That is, although more letters were correctly reported at higher orders of approximation, each letter represented correspondingly fewer 'bits'. The effect, then, is interpreted in terms of the degree of redundancy within a word acting as the independent variable affecting the amount of information a subject has to process, and hence affecting his recognition threshold.

(2) The second interpretation of the independent variable involved when nonsense words more or less closely resemble English words - an interpretation offered by Gibson and her associates - stress <u>pronounceability</u> rather than redundancy. Gibson, Bishop, Schiff & Smith (1964) suggest that reading consists essentially of coding written letters into units of spoken language. "Since the readers must code written letters into functional speech units, pronounceable letter combinations will obviously facilitate his task" (p. 181).

This hypothesis is somewhat ambiguous, and could be asserting either, or both, of two things:

(a) Firstly, pronounceability might affect not 'perception' but the auditory storage involved in short-term memory. Thus subjects would 'perceive' all the letters of pronounceable and unpronounceable words equally well, but would more easily be able to 'code', and rehearse, the former. Pronounceable words would thus be less likely to be forgotten before the actual response is produced for the Experimenter.

That this is not entirely the explanation of the effect of pronounceability, is suggested by the finding of Gibson, Bishop, Schiff & Smith (1964), that the effect holds even with three-letter trigrams, which would not over-load short-term memory at all. It might well, however, be a factor to be reckoned with in Miller, Bruner & Postman's (1954) experiment where the stimulus words were eight letters long; as possibly in Experiment 2, where the words are certainly greater than three letters.

(b) Secondly - and this is the hypothesis most strongly put forward in Gibson, Pick, Osser & Hammond's (1962) article - it is possible that reading typically involves an isomorphism between visual perception of words and a sequence of fractional <u>articulatory</u> responses. Because these articulatory responses are easier when a word is pronounceable, pronounceable words are more easily perceived.

Assessment of the relative validities of Miller, Bruner & Postman's (1954) and Gibson et al's (1962: 1964) interpretations, is complicated by the fact that pronounceability and redundancy are in practice highly correlated. That is, when words that more or less closely 'resemble' English words are used as independent variables, they are to the same extent pronounceable and redundant. Garner (1962) points out that this is necessarily the case, since phonetic considerations have much to do with determining sequential constraints in language in the first place. "Twenty percent of the sequential constraint in printed English is due to the vowel-consonant alternation tendency ... (This tendency) is largely a matter of phonetics, in that words without vowels are generally unpronounceable." (p.241). Thus, Miller, Bruner & Postman's (1954) interpretation could be applied to Gibson et al's (1962: 1964) independent variables, and vice versa.

Thus like many abstract words, 'meaningfulness' and 'familiarity' have several connotations. Whilst it may be true that meson has more meaning to a physicist, an educated non-physicist may have no difficulty in remembering such a word: easy to pronounce, and capable of forming associations with common words. It is bizarre in the Delin (1968) sense but hardly foreign.

Finally, Experiments 1 and 2 have indicated the inadequacy of the word-frequency count and the problems of rarity of stimuli. The problem of pronounceability will be raised again in a later chapter.

CHAPTER FOUR

The previous experiments have utilized signal detection theory (TSD), as the 'operating characteristic' provides independent measures of the observer's sensitivity and of the criterion he uses in making decisions about signal existence. The emphasis has been upon sensitivity, bias being eliminated in the analysis as being a nuisance to be removed, before the variable sensitivity can be discussed. However, it is of equal psychological importance to discuss bias (or strategies) that a subject may utilize in his perception of differing word groups. The prior chapters have assigned to the subjects a secondary status - being used as criterion groups defining aspects of stimulus rarity. There being an almost exclusive concentration on stimuli as the independent variables. The kinds of questions asked are: is word perception in recognition memory affected when the stimulus words are meaningful or familiar or of low word-count? Of course, these terms are defined only in relation to the perceiver - stimuli are meaningful etc. for certain subjects or subject groups. But the prior concerned interest how variations in the stimuli affect responses (S - R variables), not in how variations in the subjects, the perceivers, affect responses (R - R variables).

An exception in the literature to this trend is evident in the area of 'perceptual defence', where much work has been done on different kinds of responses to 'emotional' stimuli - on 'repression' and 'vigilance' (e.g. Eriksen (1958)). It is unfortunate, however, that 'perceptual defence' is perhaps also the field which has been most beset by ambiguities in interpretations in what the necessary features of the <u>stimuli</u> are. This area, then, illustrates the point that detailed examination of S-R variables, even if limited, is an essential aspect of R-R experimentation.

Of course, it is not immediately obvious why an S-R approach is limiting: indeed, it could be validly argued that the area of tachistoscopic word recognition can <u>afford</u> to assign subjects a secondary status, because it has behind it the fruitful <u>Bartlett-Bruner conception of schemata</u>, or categories, in the subjects, perceptual processes. It could be argued that the overall picture of the subject is a given datum, and that the examination of almost exclusively S-R variables constitutes the perfectly legitimate, and adequate, study of the defining features of schemata.

To return to the word-frequency effect Goldiamond and Hawkins (1958) have used the term <u>response bias</u> to imply that the word-frequency effect was not a 'perceptual' one at all, but was merely an artifact of 'response' tendencies. As most theorists of perception point out, however, (Bruner (1957a): Neisser (1967): Broadbent (1967)), if perception is recognized as a <u>constructive</u> process, involving both sensory and cognitive, decision-making elements, then the distinction between 'actual perceptions' and 'artificial response biases', becomes meaningless. The question of at what <u>stage</u> in the perceptual process - the 'sensory' or the 'decision-making' stage - <u>is</u>, of course, still a meaningful one. Broadbent (1967) has shown that the problem can profitably be studied in Signal Detection Theory terms.

The interaction between cognitive processes (whether they be a tendency to think of familiar or meaningful words rather than unfamiliar ones, or to guess words of an unexpected rather than an unexpected category) - between these processes and sensory processes, seems, therefore, to be very close. To dismiss the cognitive aspects of the process as a 'response artifact' (as Goldiamond & Hawkins (1958) would suggest), or even to separate them out as decision-making, rather than perceptual, variables (as even Broadbent (1967) to a certain extent tends to do) is, perhaps, to artificially polarize two processes that are in practice inextricably shaded into one another.

Analysis of human behaviour has often been interpreted as demonstrating that subjective probability, not actual probability and subjective value or utility, not pay-offs, determine the subjects' decisions. The sensitivity measures (d') of STD do not change for different pay-offs, just the bias (beta) value. Although the particular interior value for likelihood ratio may be altered, a likelihood - ratio criterion is still the optional decision rule (Green & Swets, 1966). In less mathematical terms, an important use of signal detection theory is the case whereby one may separate the subjects' true sensitivity in an experiment from the bias factors such as a tendency towards response bias or systematic biases due to perhaps the nature of the task, the instructions to the subject or the proportion of signal to noise items.

The next three chapters will leave aside for the moment the word-frequency effect and problems of stimulus categorization of a narrow (<u>molecular</u>) kind. Rather the <u>molar</u> aspect of word recognition tasks will be investigated. Treating physics words as simply familiar for physics subjects and unfamiliar for arts subjects, how will the criterion groups perform on tasks which use varying proportions of familiar to unfamiliar words? This molar aspect of the task will be analysed by concentrating not only upon sensitivity but also upon bias or 'response tendency' measures. When do subjects use a strict as opposed to a lax criterion? What happens when an inspection series of words is tested in different test lists with varying proportions of familiar to unfamiliar words; will the bias (beta) paramter alter? Alternatively, if differing inspection sequences are used and tested in a constant test series, how will beta alter?

CHAPTER FIVE

As a preliminary to Experiment 3 a published paper (Gavton and Allen, 1968b)Φ will be repeated here. The paper investigated the role of familiarity in word recognition using three inspection lists of varying proportions of familiar to unfamiliar words, and a constant test list.

FAMILIARITY AND WORD RECOGNITION

Summary:

Word recognition was examined for physics and non-physics students after a single visual presentation of a series of sixty words. Physics words likely to be familiar only to physics subjects were used to vary the prior familiarity of the two groups with the inspection material and the ratio of physics to common words (salience) was varied for each of the three inspection series. Common words, which were expected to have greater salience than physics words in one of the inspection series, were not found to be recognized better than the control pairings of physics words by either group of subjects. The absence of differences between physics and non-physics students in the number of inspection list words (positive instances) correctly identified supports the view that prior familiarity is not a critical variable when all inspection items are presented in a recognition set. Physics students made fewer errors than non-physics students in identifying both physics and common words in the recognition test which were not in an inspection series (negative instances).

Φ. This paper was used as supporting evidence for the M.Sc. degree at Melbourne University. Both authors contributed equally to this work, the order of authorship being determined on a chance basis.
The words used are given in Appendix IX

It is suggested that the correct identification of negative instances involves a scanning of a subject's "internal store" of previously experienced inspection items and that this is more efficient when the meaning of all the items in this "store" is known.

Introduction:

The role of familiarity in the recall of complex material has interested psychologists since the classic work of Bartlett (1931). He stressed that recall was directly influenced by the way in which a person organized and interpreted perceived material. The importance he attributes to existing cognitive structures ("schemata") is clear from his statement that a "particular response is possible only because it is related to other similar responses which have been serially organized yet which operate not simply as individual members coming one after another, but as a unitary mass" (p.201). This cognitive function of ordering incoming information has been elaborated by Bruner (1957) in terms of categorizing stimulus input. The extent to which a person is equipped through past experience with appropriate modes of coding information determines his ability to organize his environment in a variety of cognitive tasks.

It may also be argued, however, that the ratio of familiar to unfamiliar material is of importance. If, for example, the task is the recognition of words presented visually, the proportions of familiar and unfamiliar words may be varied. In a series such as "religion, soldier, difference, dynatron, government," the word "dynatron" may be subsequently recognized with ease even if it is not part of the subject's everyday vocabulary. Such an observation could be regarded as an example of the von Restorff (1933) effect.

A modern analogy of this effect would be one borrowed from Signal Detection Theory (Swets, 1964). One may view "dynatron" in the above example as a more discriminable "signal" amid a series of signals of common words. Similarly, in a series such as "solenoid, tetrode, hysteresis, religion, dynatron" perhaps "religion" would have a higher threshold and be recognized more easily. Though a common word, its presence in this list is unusual. Consequently, this von Restorff effect would cover the cases where familiar and unfamiliar words may stand out depending upon which of the two classes was in the minority.

The viewing of familiar and unfamiliar words with a context of other words may be regarded as a problem in detection. A subject knows that in a recognition test he may be confronted by a signal (i.e. previously presented item) or by noise, (i.e. extraneous words), and he is to report which he believes it to be (see Luce, 1959: Green and Swets, 1966). Alteration of the ratio of familiar to unfamiliar items in an inspection list may induce a variation of recognition strategy.

The exploratory investigation reported here examines the relative effects of familiarity and salience when these attributes are varied systematically in a word-recognition test.

Method:

Subjects: The subjects were 150 university students, 75 having completed at least one year of a physics course and 75 having little, if any, science training at secondary school.

Materials: Three inspection lists were prepared consisting of physics and non physics words.

The physics words (P) were chosen in order that they would be very familiar to second year university students reading physics for a degree: at the same time they would not be within the ordinary vocabulary of non-physics students. Staff members of the Physics Department★ assisted in the selection of a pool of 70 suitable words. Physics and non-physics students then rated these words according to whether they were familiar with their meaning. Subsequently, on the basis of these ratings, eight critical physics words (CP) were identified which, although highly familiar to physics students, were of minimal familiarity to non-physics students.

Seventy common words (C) were chosen each having a frequency rated greater than 30 in the Thorndike-Lorge Word Count (1944). Each of these was paired, on the basis of word length and initial letter, with one of the 70 physics words. The eight common words paired with CP words are designated CC. The eight critical pair-words were coulomb-column, dipole-dollar, isomer-island, meson-merit, oersted-opinion, rheostat-religion, solenoid-soldier, tetrode-tonight.

The three inspection lists of 60 words contained different proportions of P and C words: the eight critical pairs appearing on each list. Using a table of random numbers the 16 critical words were allocated to the same serial positions in all three lists. The remaining 44 positions were filled by words taken at random from the two pools of common and physics words to form three lists as follows:

★Physics Department, University of Melbourne, Australia.

List X contained 8 CP, 8 CC and 44 P words.

List Y contained 8 CP, 8 CC and 44 C words.

List Z contained 8 CP, 8 CC, 22 P and 22 C words.

A single test booklet contained the 70 P and their equivalent C words in a randomly determined order. Beside each word was a 5 point scale on which the subject indicated how certain he was that the word was present or absent.

Procedure: Twenty-five physics students and 25 non-physics students were assigned to each of the three inspection list conditions. Each word from the list was projected on to a screen using a Kodak Carousel automatic projector (Model 550R). The exposure time was 3 seconds with a 0.5 second interval between words. Subjects were instructed to try to remember the words appearing on the screen. There was a 3 minute interval between the completion of the inspection task and the start of the recognition task. During this time subjects read instructions which were typed on the cover of the test booklet, and which urged them to work steadily without deliberating over any particular word.

Scoring: The 5-point scale in the test booklet enabled subject to indicate that they were absolutely sure the word was present, almost sure it was present, not sure, almost sure it was absent, and absolutely sure it was absent. Three measures of scoring were used:

(a) Number of the 60 List words correctly recognized as having been present (allowing both "absolutely sure was present" and "almost sure was present").

(b) Error score on the critical 8 CP and 8 CC words (using the weighting: "not sure" = 1, "almost sure absent" = 2, "absolutely sure absent" = 3).

(c) Number of the 140 test words incorrectly recognized (present words rated "almost wure absent" and "absolutely sure absent"; absent words rated "almost sure present" and "absolutely sure present").

Results:

Correct recognition of inspection words.

The mean numbers of inspection words correctly recognized by the physics and non-physics students are shown in Table 3. A 2 x 3 analysis of variance was carried out on these data, and the inspection list was the only significant source of variance ($F(2,144) = 9.88$, $p < 0.01$).

TABLE 3

Mean Number of Inspection List Words Correctly Recognized.

	List		
Subjects	X	Y	Z
Physics	47.16	39.12	42.36
Non-physics	46.46	40.12	39.64

Each mean is based upon 25 subjects' responses.

Error scores in recognition of critical words.

The means of the weighted scores for errors made in recognizing the 8 CP and the 8 CC words are shown in Table 4. An analysis of variance of these data, summarized in Table 5 revealed that both the class of critical word (W) and subject group (G) were significant. The effect of inspection list (L) was indicated in the W x L and L x S interactions. To examine significant interactions, t values were calculated. When List

X and Y were employed, both groups made fewer errors on CP words than on CC words ($p < 0.05$ in each case). However, this difference was not significant for List Z. Physics subjects made fewer errors than non-physics subjects in identifying words from List Y and in identifying critical words of both classes from List Z.

TABLE 4

Mean Weighted Error Scores

Group:	Physics			Non-physics		
List	X	Y	Z	X	Y	Z
8 CP ...	3.24	1.80	2.72	4.44	4.76	6.88
8 CC ...	7.20	8.76	4.20	7.44	7.64	7.16

TABLE 5

Analysis of Mean Weighted Error Scores

Source	d.f.	MS	F
Word class (W)	1	718.00	20.9 ++
List (L)	2	5.52	0.28
Subject group (G) ..	1	223.33	11.14++
W x L	2	104.70	10.47++
W x G	1	81.01	4.05+
L x G	2	63.44	3.17
W x L x G	2	19.37	0.97
Within cell	288	20.03	

\+ $p < 0.05$

++ $p < 0.01$

Number of test words incorrectly recognized.

This analysis separated two types of errors. A type 1 error occurred when a word present on an inspection list was reported absent: a type 2 error was made when a word not appearing on an inspection list was reported present. The mean number of type 1 and type 2 errors per subject for the 70 physics and 70 common words is shown in Table 6.

TABLE 6

Mean Number of Errors per Subject for
70 Physics and 70 Common Words

List	Error Type	Physics Subjects P Words	Physics Subjects C Words	Physics Subjects Total	Non-Physics Subjects P Words	Non-Physics Subjects C Words	Non-Physics Subjects Total
X	1	7.28	2.01	9.29	8.77	2.01	10.78
	2	0.75	0.89	1.64	2.66	5.83	8.49
Y	1	0.51	14.75	15.26	1.31	13.16	14.47
	2	2.85	3.03	5.88	5.51	4.11	9.62
Z	1	4.06	10.69	14.75	5.69	9.61	15.30
	2	4.43	6.58	11.01	7.33	7.42	14.75

The total of type 1 errors showed little variation between physics and non-physics subjects (9.29 vs. 10.78 for List X; 15.26 vs. 14.47 for List Y; 14.75 vs. 15.30 for List Z). The total of type 2 errors showed greater differences between physics and non-physics subjects (for example 1.64 vs. 8.49 for List X), and between inspection lists (for example, 1.64 vs. 11.01 for physics subjects). Such comparisons suggest that physics subjects made relatively fewer type 2 errors for each list, and that both groups made least errors for List X, more errors for Y, and most errors for Z.

Comparisons for type 1 errors made to P and C words indicated no large differences between physics and non-physics subjects (for example, for C words: 2.01 vs. 2.01 for List X; 14.75 vs. 13.16 for List Y; 10.69 vs 9.61 for List Z). Both subject groups made fewer type 1 errors to P words than to C words for List Z and to words in minority class for fewer type 1 errors to P words than to C words for List Z and to words in minority class for Lists X and Y. Physics and non-physics subjects were found to differ in the number of type 2 errors made to P and C words. Physics subjects made fewer type 2 errors than non-physics subjects for each of the P and C word comparisons (for example, 0.75 vs. 2.66 and 0.89 vs. 5.83 for List X) and the groups differed also in the proportion of P to C word errors for each inspection list (for example, 0.75 vs. 0.89 and 2.66 vs. 5.83 for List X).

Discussion:

There are two findings which are clearly opposed to the expected effects of familiarity and salience. The first, the absence of differences between physics and non-physics students in the number of inspection list words correctly identified (Table 3), is contrary to the expectation that familiarity facilitates recognition. The other, that a few common words among many physics words are not recognized better than their paired physics words (Table 4, List X), is not in accordance with a von Restorff effect.

Both findings seem to provide supporting evidence for Dale's (1967) conclusion that prior familiarity is not a critical variable when all inspection items are presented in a recognition test. It may be argued, for example, that physics students recognize physics words by utilizing "schemata" or organization imposed upon such items during their initial presentation; but that non-physics students rely more heavily upon the array of alternatives in the recognition booklet to supplement imperfectly organized material. Thus physics and non-physics students may employ different strategies during the presentation or retrieval of inspection list material to obtain apparently similar recognition success.

The analysis of types of error (Table 6) provides a means of examining whether different recognition strategies were employed by the two groups. The measure of errors made in reporting "absent" a word appearing on an inspection list (type 1) is a converse index of the amount of inspection materials correctly identified (Table 3), and similarly reveals no significant differences between the groups for each list. It is not until errors made to words not on the inspection list (type 2) are considered that important differences between physics and non-physics students become apparent. Physics students were found to make noticeably fewer errors of this type and not only to physics words but to common words as well. As the superiority of physics students cannot be attributed solely to their making fewer errors to physics words, it is clear that they benefit from being familiar with the meaning of all the inspection list words.

An explanation of the role of familiarity in this experiment is suggested by comparing the different problems encountered in the processing of positive and negative instances. A positive instance occurs when an item in the recognition booklet is identical with a previously presented item for the inspection list: the recognition item is a negative instance if it did not appear in the inspection list. The task of accurately identifying a positive instance only requires that a subject perceives a particular item in the recognition booklet as having appeared as an inspection item. Although physics students were familiar with more of the inspection list items, they were not superior to non-physics students in the identification of positive instances. This is consistent with Dale's (1967) finding that unfamiliar items within each of his lists were just as likely to be correctly recognized as familiar items. The task of accurately identifying a negative instance requires a subject to compare an item in the recognition booklet with his "internal list" of previously experienced inspection items in order to eliminate it correctly. Wason (1959) has stated (in different context) that "the utilization of negative information would seem to be a relatively mature and sophisticated activity because it implies a store of positive information which can be used as a standard" (p.103). Hence, the superiority of physics students in identifying negative instances suggests that the scanning of stored information is more efficient when the meaning of all the items in the store is known.

CHAPTER SIX

Detection and criterion change associated with different test contexts in recognition memory.

The paper discussed in Chapter 5 showed that type 2 errors (errors on noise items) differentiated the performance of the two subject groups. In signal detection terms it was not so much the P(s/s) but the P(s/n) that caused the differences. The physics subjects made fewer false alarms P(s/n) than did the art subjects. The paper indicated varying strategies being used by the two groups of students.

Before discussing Experiment 3 it may be pertinent to examine two possible mechanisms for recognition memory. The first model is essentially based upon the theory of signal detectability. It was first applied to "Yes-No" types of tests of recognition memory by Egan (1958) and has recently been examined in connection with forced-choice tests, as well, by Nachmais and Sternberg (1963). It is assumed that the subjects responses during the test are based upon an internal quantity associated with each stimulus which might be interpreted, simply, as its subjective familiarity. In a forced-choice test, then, the subject is assumed to choose (as "old") that one of the stimuli for which this hypothetical quantity is the greater. In a Yes-No test, on the other hand, the subject is assumed to respond "Yes, the stimulus is old" if and only if that quantity (for a single test stimulus) exceeds some fixed criterion value. For simplicity, the old and new stimuli in the test will be assumed to be normally distributed with equal variances on the continuum of subjective familiarity and, for purposes of estimating information retained, the criterion will be assumed to be fixed at its optimum value (i.e. without response bias).

The second model is the two-state model for recognition memory which Nachmias and Sternberg (1963) examined as one alternative to the model (just mentioned) based on the standard theory of signal detectability. Formally, it is the same as the threshold model proposed still earlier by Luce (1963) for experiments on sensory detection. This model is based on the assumption that each stimulus in the test series is in one of only two states (e.g. familiar or unfamiliar). Errors are explained by assuming that each truly old stimulus has a certain probability of having become unfamiliar while each truly new stimulus has a certain probability of having (mistakenly) become familiar. In the test, the subjects responses are supposed to be directly determined by the state of the appropriate stimulus (or stimuli) except in the case in which both test stimuli in a forced-choice pair are in the same state. Then the subject is considered simply to guess at random. This discrete, two-state model is of interest here because it represents, in a sense, an extreme opposite to the continuous model (considered above). The two models thus bracket between them the results that might be obtained with a variety of more complicated, intermediate models, (Shepard, 1965).

Although the two-state model is undoubtedly an oversimplification in view of recent evidence for all-or-none processes in recognition (Techtsoonian, 1964) it is not wholly implausible as a first approximation.

EXPERIMENT 3[1]

This experiment utilizes three different recognition lists with a constant inspection series viewed by three groups of physics and arts students. The reverse of the experimental situation in the Garton and Allen (1968b) paper.

Summary:

Three groups of physics subjects and three groups of arts subjects viewed 20 physics words (PWs) and 20 common words (CWs) in a randomly ordered inspection sequence. Subjects were then assigned to one of three recognition test conditions where the inspection items were embedded in different sequences of 120 additional words (60 PWs + 60 CWs; 100 PWs + 20 CWs; 20 PWs + 100 CWs). Signal-detection and Luce analyses examined the effects of the different test contexts on subjects true sensitivity and response bias. While all subjects found detection of PWs easier than CWs, these judgments varied according to the properties of the recognition sequences. This latter finding was interpreted as indicating that the subjects adopted a conservative and probabilistic strategy for the recognition task as a whole rather than utilizing different strategies for PWs and the CWs where these would result in superior overall performance.

Several studies (Murdock, 1965, 1966; Parks, 1966) have indicated that various assumptions and parameters of Signal Detection Theory (TSD), (Green & Swets, 1966; Swets, Tanner & Birdsall, 1961) may readily be applied to the phenomena of recognition memory. In a recent experiment, Donaldson and Murdock (1968) have employed the TSD model in examining the

1. This experiment was published in Perception and Psychophysics (Allen and Garton, 1969).

subjects Yes-No response decisions according to whether or not recognition-test item had previously appeared in an inspection sequence.

The Luce two-choice model (Luce, 1959, 1963), which has been applied to visual recognition and detection tasks (e.g. Munsinger & Gummerman, 1968) would also appear to be a logical choice for examining data generated in a Yes-No recognition memory task. Both the Luce and the TSD approaches are fundamentally concerned with separating a subject's true sensitivity to a set of stimuli from the influence of various task conditions which bias his Yes-No responses.

Two recent studies (Schulman, 1967; Allen & Garton, 1968a), applying a TSD analysis to verbal recognition data, have indicated that subjects are able to discriminate more easily old (signal) from new (noise) items in a recognition sequence if they are words of low frequency count as opposed to common words. While this suggests that differences in sensitivity to particular items within a word-recognition task may be manipulated by varying the characteristics of word items, it is not at all clear whether such properties influence bias parameters as both the inspection sequences and recognition test series contained an equal proportion of rare and common words.

This present study examines the subjects Yes-No detection responses for three variations in the composition of recognition test items using two classes of stimuli-physics words (PW), which are rare in general publications, and common words (CW). An inspection sequence viewed by all the subjects contained an equal proportion of PW and CW items (signals). Three different recognition series (Lists A, B and C) contained all inspection words together with varying proportions of PW and CW noise items. Thus, for the recognition task as a whole the signal-to-noise ratio is 1 to 3, while PW and CW signal-to-noise ratios vary within the recognition lists as shown in Table 7.

As can be seen from Table 7, it would be predicted that the subjects may vary response criterion (the bias measure) where differences in signal-to-noise ratios are indicated. Since this measure is independent of sensitivity, the expectation from previous findings (Allen & Garton, 1968a), Garton & Allen, 1968b) would be that the subjects true detection will always be higher for PWs than for CWs. The present study is designed to test these predictions. Both physics and arts subject groups are included in the design since it could be contended that data obtained from either group alone may be confounded by the subjects degree of familiarity, with the meaning of PWs. For it may be assumed that arts subjects will be familiar with the CWs only, whereas the physics subjects will be familiar with all the words used in the study. Thus any effect common to both populations will be due to the variation in the proportions of the two different word-groups used rather than to the intrinsic unfamiliarity of the PWs for arts subjects. Further, the study will examine whether the Subject by Recognition conditions will yield consistent patterns of sensitivity and bias estimates according to both TSD and Luce analyses in a Yes-No word-recognition task.

Method:

Subjects: The subjects were ninety-six paid male undergraduate and postgraduate students, forty-eight having completed at least two years of an honours course in physics and forty-eight arts subjects having little, if any, high school science training.

TABLE 7

Proportion of Signal to Noise Items
(All Words, PWs and CWs)
Contained in Lists A, B and C

List	All Words	PWs	CWs
A	.33	.33	.33
B	.33	.20	1.00
C	.33	1.00	.20

TABLE 8

TSD (d' and Beta) and Luce (Alpha and v)
Sensitivity and Bias Parameters

List	Parameter	PWs		CWs		TWs	
		Phys Ss	Arts Ss	Phys Ss	Arts Ss	Phys Ss	Arts Ss
A	d'	1.84	1.56	1.27	.85	1.61	1.20
	beta	.81	.81	1.05	.97	.95	.91
	alpha	4.62	3.56	2.82	1.99	3.55	2.60
B	d'	1.69	1.08	.66	.77	1.27	.94
	beta	.89	.78	1.00	1.02	1.06	.89
	alpha	3.96	2.39	1.70	1.88	2.81	2.11
C	d'	1.82	1.22	.82	.72	1.26	.92
	beta	.62	.69	1.29	1.00	1.10	.87
	alpha	4.43	2.71	1.95	1.71	2.74	2.10
	v	.63	.60	1.67	.94	1.14	.77

Materials:

The test stimuli were 120 physics words (PW) and 120 common words (CW). The selection of these items is described elsewhere (Garton & Allen, 1968b). Briefly, the PWs were chosen in order to be very familiar to advanced-level physics subjects while having minimal familiarity for arts subjects. A CW (having a Thorndike-Lorge (1944) rating of 30 or more) was paired with each PW on the basis of initial letter and word length.

The inspection sequence contained 20 PWs and their 20 paired CWs, the order of presentation of these 40 items being randomly determined.

Three different recognition lists (A, B and C) contained PWs and CWs in the proportions 1:1, 3:1 and 1:3, respectively. Thus, the composition of these lists was as follows:

List A - 80 PWs and 80 CWs.

List B - 120 PWs and 40 CWs.

List C - 40 PWs and 120 CWs.

Each list contained the 40 inspection items together with the required number of additional PW and CW items selected from the remaining stimulus items. The recognition-list items were randomly allocated to list positions with the following constraints: (a) each of the 40 inspection items occupied the same serial position in each of the three lists, and (b) the proportion of PW to CW items within each of the four quarters of the recognition series remained constant (that is, 20:20 for List A, 30:10 for List B, and 10:30 for List C). This second restriction was imposed in order to prevent spurious results as a consequence of the subjects adopting changes in criterion in different stages of the recognition task (Donaldson & Murdock, 1968).

Procedure:

The subjects were tested in small groups. Prior to the presentation of the inspection items, the subjects were instructed to attempt to remember the words which would appear on a screen. Each of the 40 inspection items was presented for 2 seconds using a Kodak Carousel automatic projector (Model 550R) with a 0.5 second inter-item presentation interval. Eighteen physics subjects and eighteen arts subjects were assigned to each of the three recognition list conditions. There was a 2 minute interval between the completion of the inspection sequence and the start of the recognition task. The subjects were instructed that they would be presented with a list of words and that they must record a Yes-No decision in a box beside each word according to whether or not a word was judged to have previously appeared in the inspection sequence.

Results:

The proportion of inspection-list words correctly identified as present (HR) and the proportion of false-positives (FAR) were obtained. The HR and FAR measures were also determined for PWs and CWs separately. The TSD estimates, d' and beta, were obtained from tables constructed by Freeman (1964). The corresponding Luce estimates, alpha and v, were calculated using the formulae derived from Shipley (1965, p.280) and Broadbent (1965, pp. 153-154).

$$\text{alpha}^2 = \left\{HR(1 - FAR)\right\} \div \left\{(1 - FAR)\times(FAR)\right\}$$

$$v^2 = \left\{(1 - HR)\times(1 - FAR)\right\} \div \left\{(HR)\times(FAR)\right\}$$

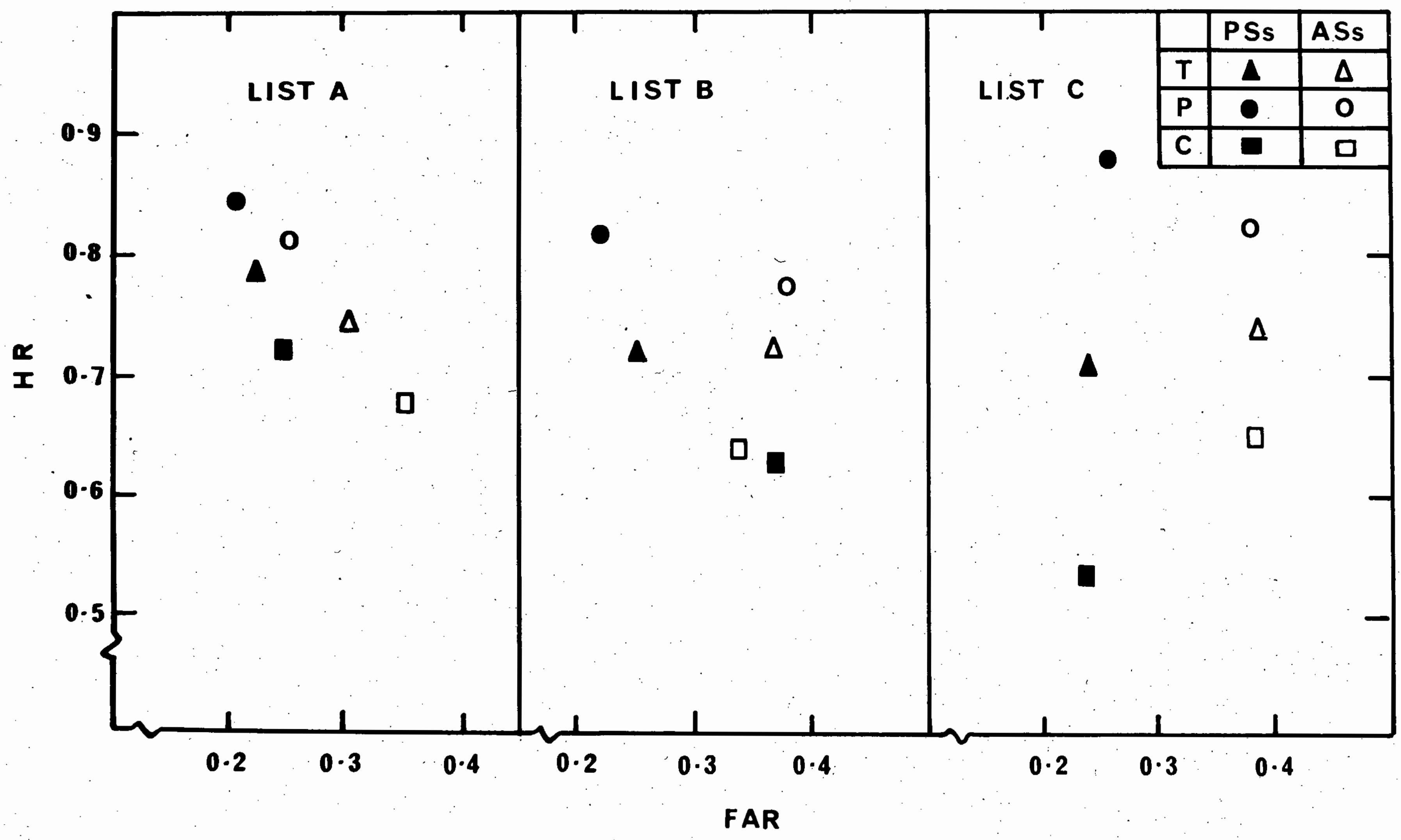
The TSD and Luce parameters for physics and arts subjects are shown in Table 8 as a function of the particular recognition list employed.

An inspection of Table 8 will show that in all cases a direct correspondence exists between d' and alpha and between beta and v. Thus, both TSD and Luce analyses have revealed the same pattern of relationships between sensitivity and bias within the whole set of word-recognition data. Consequently in the following exposition the TSD measures only will be used to clarify the argument, although the Luce measures would be equally acceptable.

The major analysis is concerned with the effects of varying the composition of recognition-list items. In terms of the physics subjects overall performance for the total 160 recognition-list items, the List A condition resulted in best discrimination of old from new items (d' of 1.61, Table 8), while there was no significant difference in discrimination between Lists B and C (1.27 and 1.26). Similarly for arts subjects. List A discrimination was superior (1.20) to that of either List B or List C (.94 and .92). Table 8 clearly shows that PWs were generally better recognized than CWs for both groups of subjects. Moreover, the d' for each PW comparison is higher for physics subjects than for arts subjects.

From Figure 4 where HRs and FARs are plotted, it is apparent that the superiority of physics subjects on PWs is not so much the result of higher HRs for physics subjects but rather due to arts subjects having higher FARs on all lists.

Fig. 4: ALLEN and GARTON (1969a)



Hit rate plotted against false-alarm rate for physics and arts Ss on the three recognition lists, A, B, and C, where T refers to all words, C to common words, and P to physics words.

This is particularly noticeable in List B where the arts subjects have a FAR of approximately .4 compared with .2 for physics subjects. Now, should a subject be uncertain whether a particular List B PW were old or new, the logical response would be "No" (new) since the proportion of old to new PWs is 3:1. However, both groups tend to respond "Yes" (old) when unsure (betas of .78 and .89 in Table 8). This phenomenon does not occur where the proportion of old to new subjects is 3:1 within List C. Here arts subjects show no bias for "Yes" or "No" (1.00) while physics subjects show a bias to respond "No" (1.29) as might be expected if a logical approach were adopted. The only other finding reflecting logical bias tendencies occurred for CWs on List B where the proportion of old to new CW items is 1:1 (betas of 1.02 and 1.00).

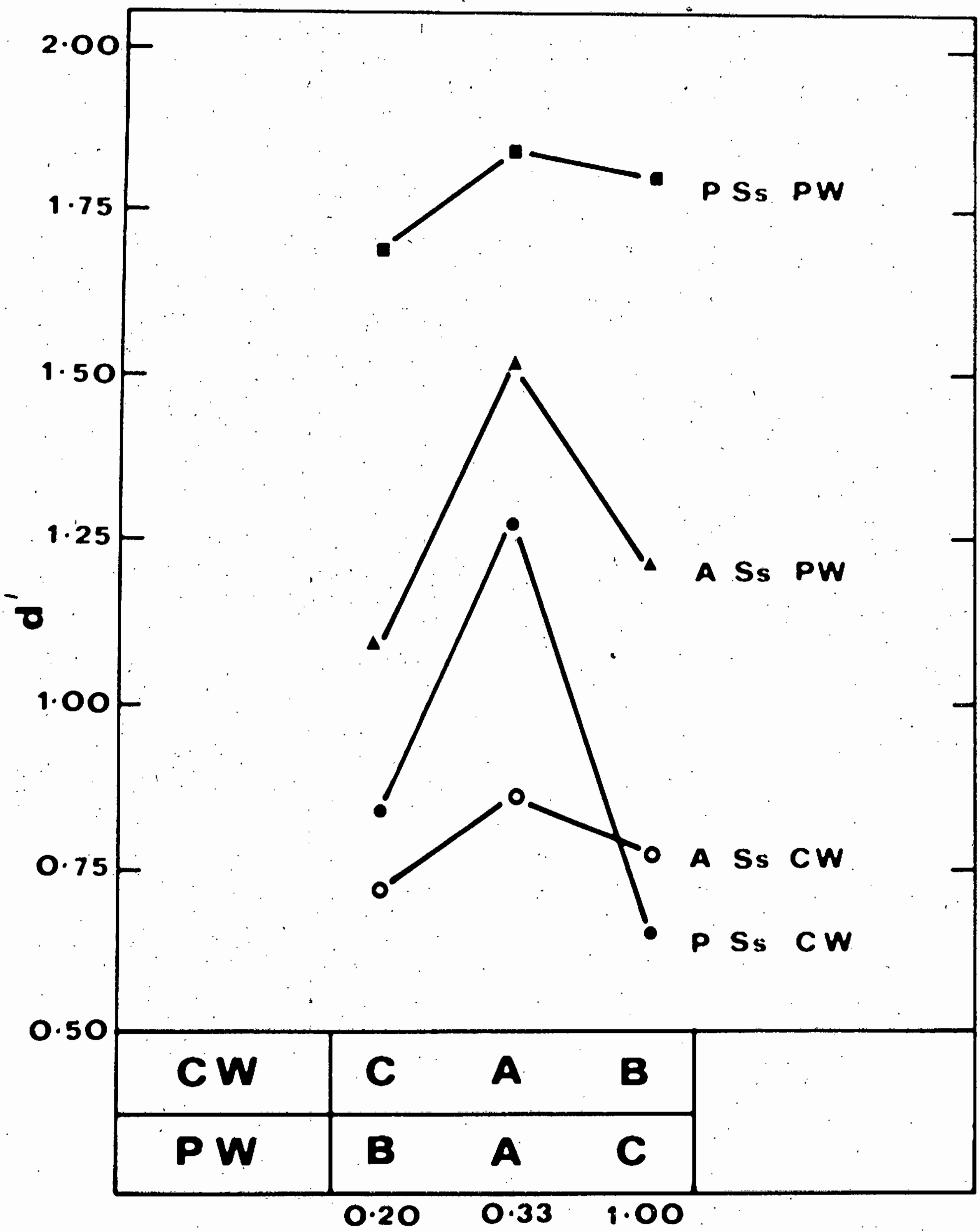
The d' measures for PWs and CWs are presented in Figure 5 as a function of the proportion of signal to noise for each recognition condition. It can be seen that for both PWs and CWs, better recognition occurred for both physics and arts groups on List A where the signal to noise proportion is identical (.33) for both word classifications.

Discussion:

One of the more general questions raised in this study concerned the conditions affecting the superior detection of rare words compared with common words when the proportions of these items were varied in a recognition-test sequence. It seems clear that considerable flexibility in such characteristics of the context or noise items in recognition test has not vitiated the suggestion that the subjects were better able to detect old from new items if they were PWs rather than CWs (Allen & Garton, 1968a). For each of the possible paired comparisons of PW and CW detections in Table 8, both physics and arts subjects displayed superior PW detectability.

The demonstrated relationship between sensitivity and bias for the three recognition conditions, however, is complex. Of particular interest is the apparently counter-intuitive result which appears contrary to the findings of Markowitz and Swets (1967), that the higher the proportion of signal-to-noise items, the higher would be the value of d'. Stated in terms of this research, it would be expected that the detection of 20 out of 40 items would be superior to detecting 20 out of 80 items provided that the items were of comparable difficulty. However, an inspection of Figure 5 will show that this is not the case. While subjects found the detection of 20 items from 120 harder than detecting 20 out of 80, the detection of 20 out of 40 items proved to be more difficult than the detection of 20 out of 80. That this was not due to chance, or an artifact of a particular recognition list, is apparent when it is considered that this trend was evident for both physics and arts subjects and also for both word groups. Nor is this finding a function of differing biases being adopted for PWs or for CWs considered separately. For example, bias estimates were similar for the greatest CW sensitivity difference in Figure 5 (physics subjects responding to CWs on Lists A and B have betas of 1.05 and 1.00): they were also similar for the arts subjects PW difference on Lists A and C (betas of .81 and .69).

Fig. 5: ALLEN and GARTON 1969



Proportion of signal to noise items where A B and C refer to the three test lists.

One suggestion which may clarify these findings is that a subject may set his criterion such that he will probably designate as cases of signal a proportion of instances approximately equal to the à priori probability of signal occurrence (Creelman & Donaldson, in press). Table 7 has indicated a constant signal-to-noise for the three recognition conditions while PW and CW ratios were varied within each recognition sequence. It may be suspected that such manipulations of recognition-list items would result in the subjects adopting a different Yes-No criterion for PWs and for CWs on Lists B and C. However, it would appear that subjects have in fact responded to CWs on List B and to PWs on List C with a similar task bias as their overall bias on these lists. Should this be so, then a subject reduces his hit rate, and consequently d' considerably; for if his Yes-No responses are approximately in the proportion 40:120 or 1:3, he must miss a lot of old words as the true ratio is 1:1. It seems incredible, yet nevertheless evident from the right hand side of Figure 5, that the subjects were oblivious of the true probability of occurrence of CWs on List B and PWs on List C. It would seem that the only likely conclusion would be that the subject acts as an "intuitive statistician", as Brunswik (1956) has proposed, only for the molar or complete task. That is, the subject is unable to adopt two different strategies during a single recognition task when these would be required in order to maximize success for particular subtask conditions.

One may conclude that man is a conservative processor of information, for he utilizes a probabilistic sampling strategy, as Peterson, DuCharme and Edwards (1968) have shown.

CHAPTER SEVEN

Let us depart from the problems of stimulus parameters and consider the role of feedback in the perception of words and its effect upon the facilitation, or otherwise, of recognition memory. If biases and noise affect the decision prior to a response (Norman, 1969a - see Figure 6), then the opportunity to check the correctness or incorrectness of a subject's response must aid in the elimination of biases and the reduction of noise, thus aiding a correct decision. This can be seen in Norman's (1969a) model (Figure 6) facing page 67. This may seem trivial (and obvious) bearing in mind the results of experiments on the repeated tachistoscopic presentation of words by Haber and Hershenon (1965). However, it is not so obvious if the total time of repeated exposures is compared with a single exposure of a duration equal to the repeated presentations. That is, what results would be obtained if the stimuli (words) are shown for x seconds and compared with two exposures of the list for x/2 seconds, or even three exposures of the words for x/3 seconds? The total viewing time is a constant so the <u>rehearsal time</u> is identical for all conditions.

Experiments 4 and 5 will investigate this situation.

Manipulation of study trials in recognition memory. [1,2]

1. Accepted for publication in <u>Perception and Psychophysics</u> June 17, 1969.
The experiments were planned, analysed and interpreted by the author. Mr. R.F. Garton helped to collect some of the data, and his name appears as a junior author because of complications arising from a joint grant from the University of Melbourne where the experiment was carried out.

2. This research was supported in part from the General Research Grant Department of Psychology, University of Melbourne. The author wishes to thank Professor O.A. Oeser for making these funds available. Acknowledgments are also due to Mr. Daryl Owen for his very able technical advice.

FIG.6

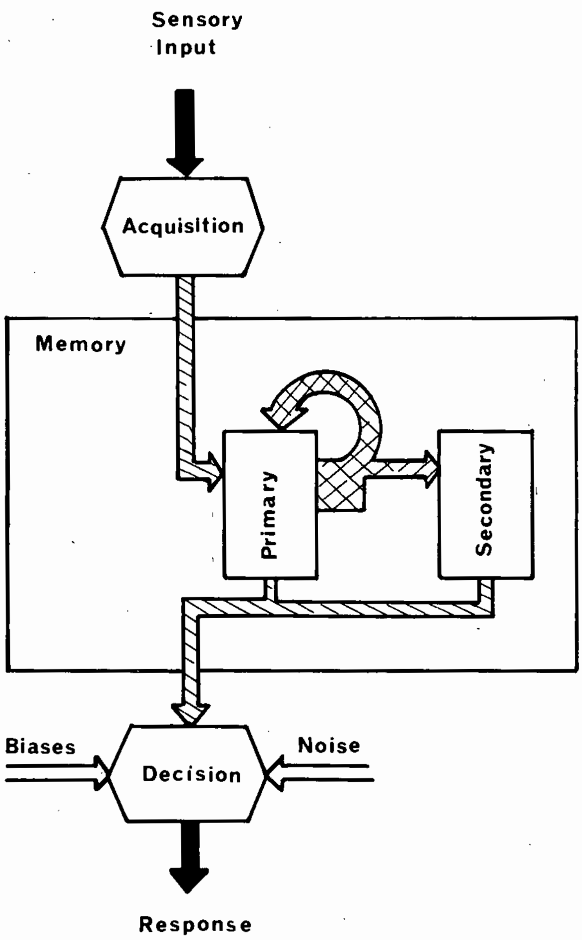


Fig. 6: Interactions among the three different processes affecting the subject's actions in a memory experiment. In the acquisition process, the sensory input is encoded for the memory process. Items in primary memory are rapidly forgotten, whereas items in secondary memory can be retained for long periods of time. In the decision process, the output of the memory is combined with the biases to determine his response. Noise can be considered to enter the process at this point.

Experiments 4 and 5

Summary:

Two experiments were performed for the purpose of ascertaining the effects of two processes in recognition memory: the subjects actual viewing time of verbal material and the Experimenter's feedback. Recognition-memory performance was found to be superior for an experiment-induced feedback over the subjects own "subjective", induced feedback (query loops), even though the time for total rehearsal was kept constant for each condition. The actual viewing time was not found to be a critical factor.

Introduction:

Bugelski (1962) has shown that with increased stimulus-presentation time (TP), the number of trials (N) needed to learn paired-associate lists decreased exponentially. Fischer (1966) has shown that a similar relationship existed for serial lists of nonsense syllables; both authors have shown that TP multiplied by N is a constant. Brewer (1967), using short exposure times (between 1 and 17 seconds) for meaningful material, has also shown that the same relationship exists between TP and N. However, the quantity (TP), as Fischer (1968) has illustrated, may be made up of two time components: the first, which she calls the interstimulus interval (ISI), and the second, the true presentation time, the time the stimulus was actually seen by the subject.

Thus, if six words are presented visually, there would be six presentation times and five interstimulus intervals. Fischer (1968) showed that if the TP was replaced by the true presentation time plus the ISI, then the constant learning-time formula was still true (in her experiment, a constant 2-second rate of presentation was used with different ISI times).

This variation in viewing time has interesting possibilities for investigating the role of experiment-induced feedback in verbal learning. Consider, for example, the situation where the subjects view a list for a constant total time, K. By varying the speed of presentation of the stimulus items, groups of subjects may see the stimulus items more than once yet still see the total list for the same time K. Thus, for a constant ISI and a variable stimulus-presentation time (SPT), it is possible to have subjects viewing, and attempting to learn, lists of words with varying degrees of feedback or repetition. The learning of verbal items may be facilitated not so much by time per se but by the number of repetitions, as Haber and Hershenson (1965) and Dainoff and Haber (1967) have shown in a different, but not too dissimilar, task (tachistoscopic presentation of words).

Thus, there are two active processes in this verbal-memory situation, the subjects "rehearsal" time and the number of study trials.

The present study investigated the independent effects of rehearsal time and number of study trials in recognition memory.

Experiment 4

Subjects:

In this experiment, the subjects were divided into three equal groups (A, B, and C), each consisting of twenty-eight second year university students. Some of the students volunteered to perform the experiment, while the others were paid for their participation. The paid subjects were divided equally between the three groups.

Materials and Procedure:

Slides were made of sixty common words chosen from the Thorndike-Lorge word count (1944): each word possessed a frequency of thirty or more (for details see Experiments 1 and 2). Ten words were used for the inspection series and these, together with the other fifty words, comprised the subsequent test series; all words were projected onto a screen using a Kodak Carousel automatic projector (Model 550R). Each of the three groups of subjects viewed the 10 inspection words, after which there was a 2 minute period during which the subjects read instructions that were printed on the first page of a test booklet. Then there followed the visual presentation of the 60 randomly allocated test words. Each word was presented on the screen at the rate of one every 3 seconds, with the exception that after every 10th word the gap was 4 seconds.

The subject rated the confidence of each decision on a 5-point scale, ranging from absolutely sure present to absolutely sure absent. The task was thus experimenter-paced, and the testing phase lasted the same period of time for each of the three conditions.

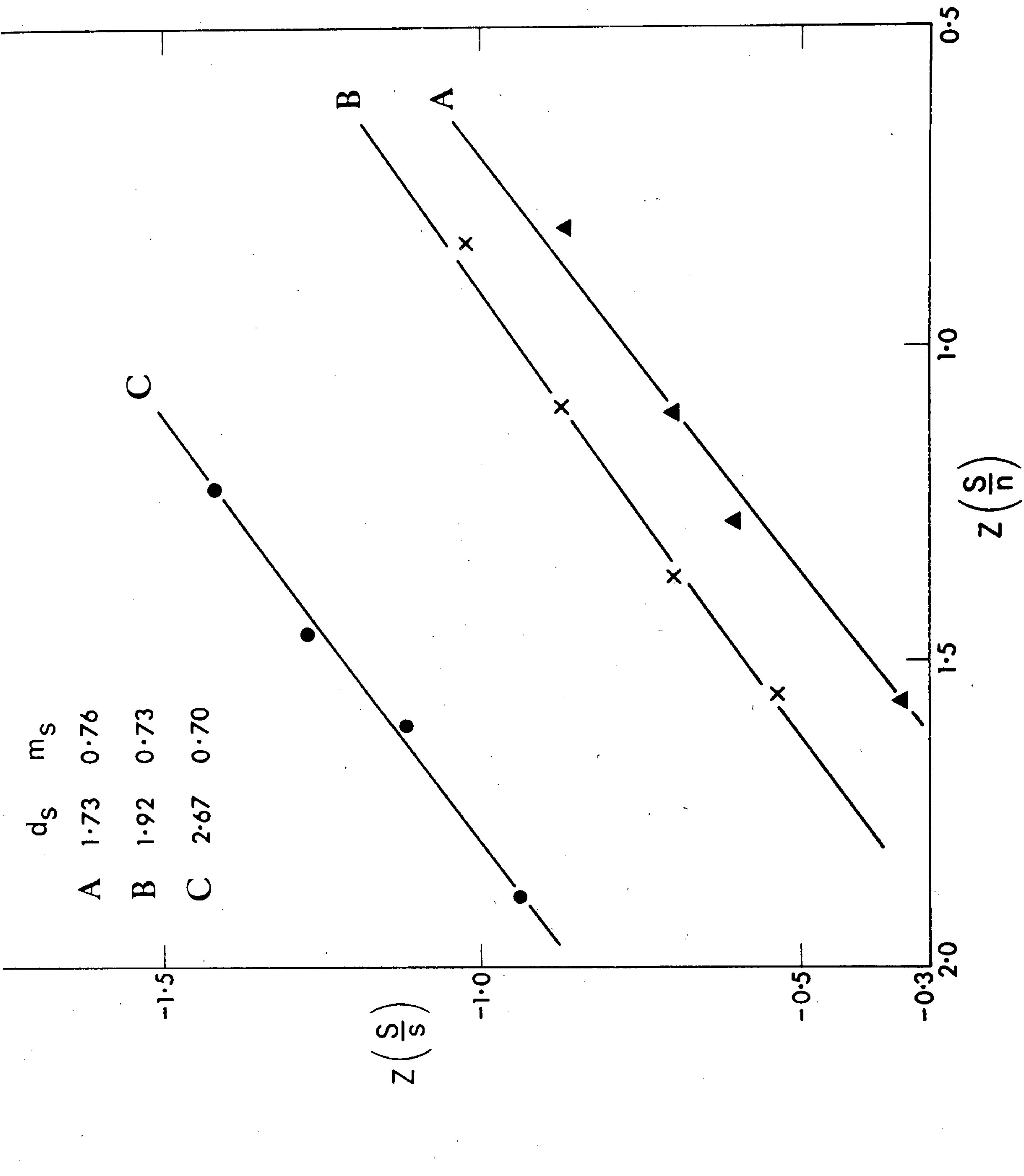
All subjects viewed the same 10 inspection words. However, the exposure time (SPT) varied for each of the three conditions, as shown below. The ISI was 0.90 seconds, as measured by a Tektronix No. 502A oscilloscope, for all inspection conditions in this experiment, and in Experiment 5 thus, the ISI was a constant 0.90 second. The three presentation conditions for the 10 inspection slides were as follows: Condition A, one presentation of each slide for 0.50 seconds; Condition B, one presentation of each slide for 1.40 seconds; Condition C, two presentations of each slide for 0.25 seconds, which was achieved by repeating the list of 10 slides again, with an interlist interval of 0.90 seconds.

The total possible rehearsal time for Conditions B and C was equal, that is 22.10 seconds. The slide-viewing times for Conditions A and C were equal (10 at 0.50 seconds being equal to 20 at 0.25 seconds). With 10 slide times of 0.50 seconds plus nine ISIs of 0.90 seconds, the total rehearsal time during viewing for Condition A was 13.10 seconds. Consequently, it was possible to compare two types of timings. In the first (Condition A vs C), the slide-viewing time was a constant, though the rehearsal times varied for each list. For the second (B vs. C), the rehearsal time during the inspection series was a constant, though the slide-viewing times were different. In summary, the inspection times consisted of the following: Condition A, 10 x 0.5 seconds + 9 x 0.90 seconds = 13.10 seconds; Condition B, 10 x 1.40 seconds + 9 x 0.90 seconds = 22.10 seconds; Condition C, 20 x 0.25 seconds + 19 x 0.90 seconds = 22.10 seconds. The testing time for the 60 slides was constant for all three conditions, and all subjects viewed the same 60-slide test series.

Experiment 5

This experiment was designed to investigate the effects of the number of presentations upon the subsequent recognition performance of the subjects.

FIG.7



d_s m_s
A 1·73 0·76
B 1·92 0·73
C 2·67 0·70
A
B
C
$Z\left(\frac{S}{n}\right)$
$Z\left(\frac{S}{s}\right)$
0·5
1·0
1·5
2·0
-1·5
-1·0
-0·5
-0·3

Subjects:

Three equal groups of subjects were used for three experimental conditions, 1, 2, and 3. There were sixteen subjects in each group, giving a total of forty-eight subjects, all of whom were paid for participation.

Materials and Procedure:

An inspection series of 30 common words was used, and these words were later tested in a series of 60 words composed of the original 30 plus 30 additional new words. The words were mixed randomly, and all subjects viewed the same test sequence of 60 words. The signal (old words) to noise (new words) ratio was 1:1; thus, guessing on the part of the subjects would not improve their performance, in general.

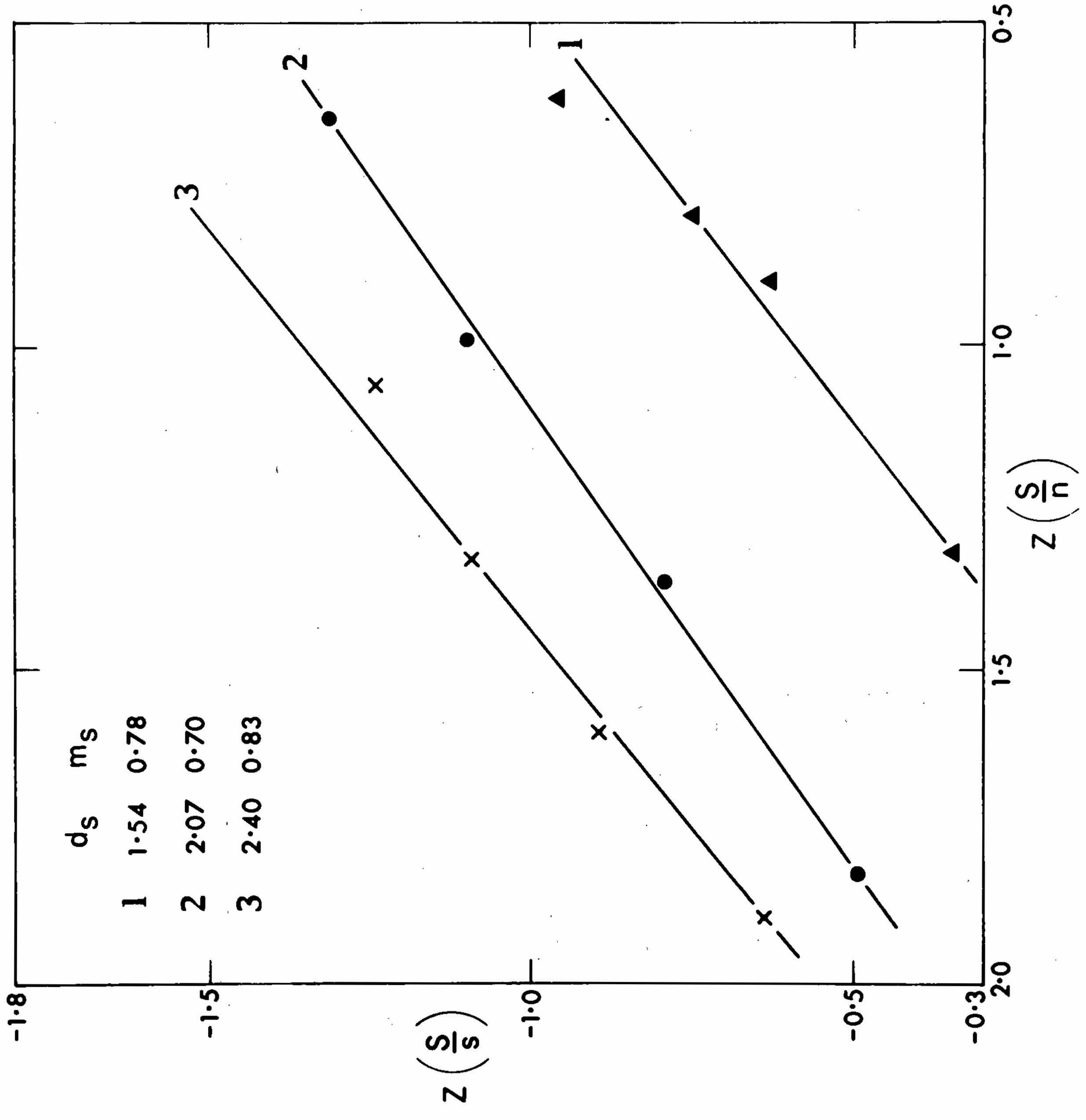
The testing procedure was exactly the same as for Experiment 4. The three initial presentation conditions were as follows: Condition 1, one presentation of the 30-word sequence for 2.9 seconds for each slide (this plus .29 interstimulus intervals made the total viewing and rehearsal time 113.1 seconds); Condition 2, two presentations of the slide series for 1.00 second per slide and 59 interstimulus intervals; Condition 3, three presentations of the slides for 0.367 seconds each and 89 interstimulus intervals. The total viewing and rehearsal time was, thus, a constant for all conditions, being 113.1 seconds.

Results and Discussion[1]

ROC curves for both experiments were constructed from the six sets of data. From the five decision categories used by the subjects four points were plotted on a double probability plot to produce linear OCs (for details of the technique see

1. The group results are shown in Appendix X

FIG.8



d_s m_s
1 1·54 0·78
2 2·07 0·70
3 2·40 0·83
1
2
3
$Z\left(\frac{S}{n}\right)$
$Z\left(\frac{S}{s}\right)$
0·5
1·0
1·5
2·0
-1·8
-1·5
-1·0
-0·5
-0·3

Sidowski, 1966, p.235). The curves for Experiment 4 are shown in Figure 7.

The worst recognition performance was clearly evident for Condition A. Perhaps this is not surprising, as a total time of 13.10 seconds would not allow much rehearsal time even for only 10 stimulus words. Of more interest are the results for Conditions B and C. In spite of the very long stimulus presentation time for B (1.40 seconds), the performance was little better than that for Condition A. The best result was clearly for the double presentation of the stimulus items, i.e. for Condition C. On comparing B with C, C was superior (d_s = 2.67), and this superiority must be due to the experimenter-induced feedback, as the time for rehearsal of items was a constant for both conditions, namely 22.10 seconds.

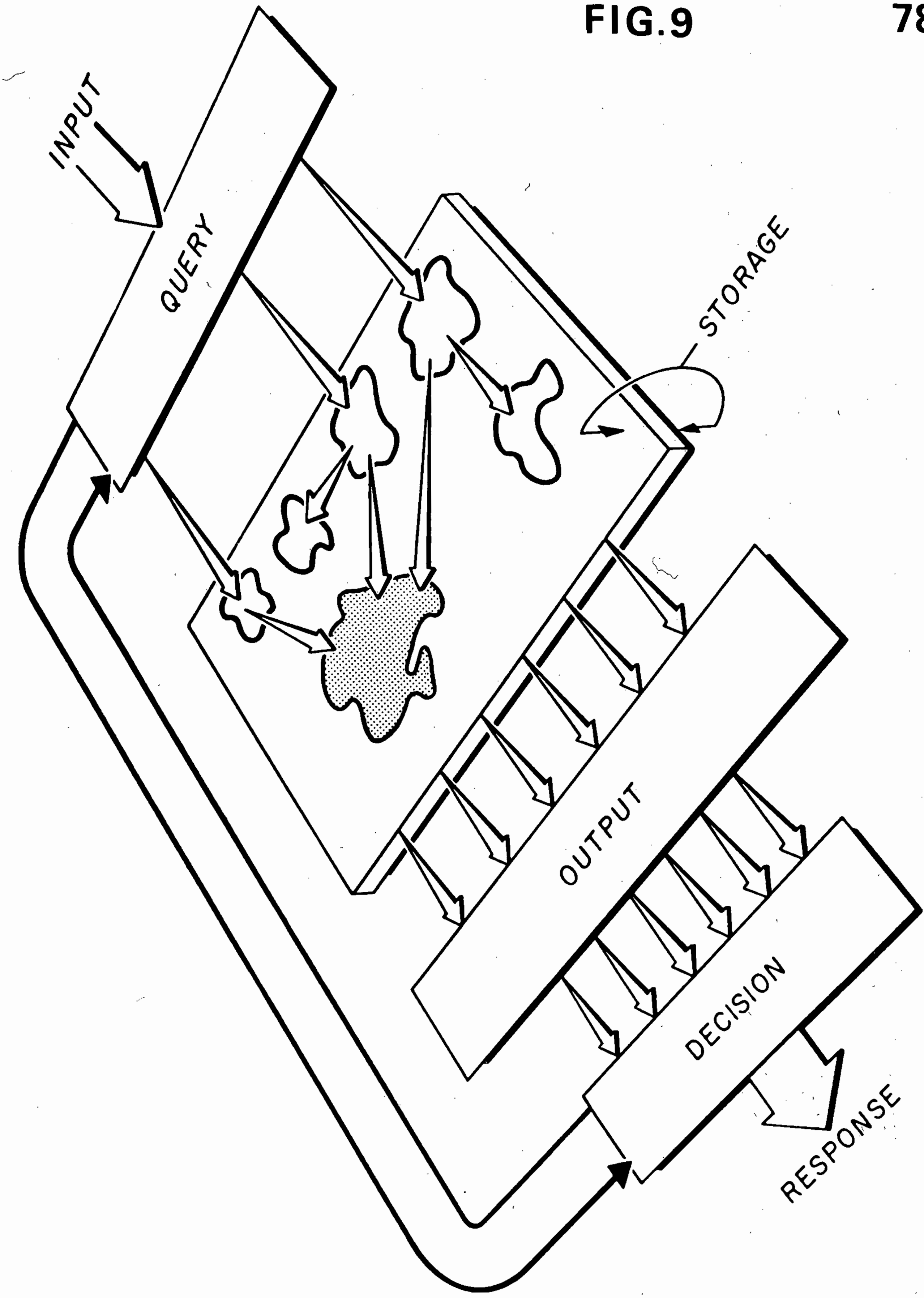
The results of the fifth experiment are shown in Figure 8. Recognition performance was directly related to the number of stimulus presentations. The use of a 1:1 signal-to-noise ratio for the three conditions under Experiment 5, though it does not necessarily eliminate response bias in the usual sense of the term, does ensure that accuracy of performance is independent of response bias. The fifth experiment was run in order to better assess the generality of the results of Experiment 4 as well as to unconfound response bias and performance level.

It is clear from both experiments that the total-time law is not sufficient to account for the present results, although time does affect performance. (Conditions A vs B of Experiment 1). The present findings are also pertinent to the time-honoured law that spaced learning is superior to massed learning, for both experiments have shown that repeated study trials aid performance. There is no à priori reason to suppose that the subjects <u>own</u> rehearsal strategies should be inferior to the feedback given by the Experimenter, for it must be remembered that the <u>total</u> time for rehearsal was identical for all three conditions in Experiment 5. Why is it easier to learn verbal material when it is presented in a multiple fashion, even when the presentation time is equated?

One important suggestion by Atkinson and Shiffrin (1968a), though related by them to paired-associate learning, seems plausible here; if, on a second or subsequent presentation of the stimulus item, the item was correctly and easily retrieved from the long-term memory store, then the item would not need to be entered into a rehearsal buffer as the item was known already, the rehearsal buffer being a rehearsal span under the complete control of the subject. Consequently, repeated presentations will allow the subject to drop known words from the buffer and replace them with forgotten or partially remembered words. Thus, "easy" words will be "checked" and difficult ones will re-enter the buffer for more "subjective" rehearsals. In the case of a single presentation, the subject cannot assess in the absence of further study trials which items will be easy and which will be difficult.

The results of the current experiments show that the repeated feedback enables some comparisons to be made which, in terms of Norman's (1968) synopsis, may highlight the role of multiple query loops, loops that return to the storage system (see Figure 9).

FIG.9



Norman's (1968) outline of retrieval shows that a query of storage excited some combination of stored representatives. The decision process tests the item that received the greatest activation (the shaded item in Figure 9) by re-entering it into storage as if it were a query. If the output, used as a query, leads to the original query, the retrieval process is terminated (p.532). This is akin to the TOTE mechanism of Miller, Galanter, and Pribram (1960).

The more efficient retrieval for repeated presentations of the stimulus may require, as Norman postulated, that the distance from the query to the stored information decreases with each cycle of interrogation of the storage system. This is analogous to Bruner's (1957) accessibility of categories for use in coding, or identifying, environmental events. A tentative categorization of the stimulus leads to a desire for a "trial and check", in Woodworth's (1947) terminology, of a "confirmation-check", in Bruner's terms (p.135). Consequently, though study trials do not guarantee perfect performance, it does give the subject extra opportunities to match his queries with the correct response.

However, one must agree with Atkinson and Shiffrin (1968b) when they state that a recognition does not necessarily separate retrieval from storage effects in memory. The fact that repeated presentations of stimuli and recognition performance seems to suggest, as Norman has implied, if not overtly stated, that retrieval of information does require a recursive query of storage until the decision process is satisfied.

CHAPTER EIGHT

The previous chapter attempted to investigate the experimenters' feedback of information and its effect upon recognition memory. The experiment to be described in this chapter will explore the effects of restraints upon the response period of the subject. Information retrieval may be more efficient if the subject himself controls the response time or it may be that giving the subject more time to decide would result in more 'noise-influence' taking place with a consequent reduction in performance. Some of the factors governing the termination of various search mechanisms involved in the retrieval of stored information have been suggested in two recent speculative outlines of memory process (Atkinson and Shiffrin, 1968: Norman, 1968). In both of these accounts, retrieval decisions may vary according to whether the response period is internally or externally imposed. This variation in the time available for a memory search would seem to imply that retrieval of information should be superior when the subject himself controls the response period. It is possible, however, that time *per se* may not be the critical variable. For example, Atkinson and Shiffrin (1968) have indicated that the value of a prolonged search may depend on the nature of the stimulus material concerned. These authors also argue that when there is recovery of only partial information, retrieval decisions are further complicated by the subjects' reliance on "guessing strategies".

It has been suggested that information retrieval may be expected to improve when the subject controls the search time. Hence, fewer recognition errors would be predicted in this situation. Using the false-positive rate index (FAR) as an estimate of the subjects' reliance upon guessing strategies, the hypothesis that the self-paced condition would be associated with fewer false-positive errors than the experimenter-paced condition will be examined.

<u>Experiment 6</u>

<u>Method</u>:

<u>Subjects</u>: The subjects were thirty-six paid male undergraduate and post-graduate students who had little, if any, high school science training.

<u>Materials</u>: The data analyses were performed on responses to 80 critical test stimuli, 40 of which were physics words (PW) chosen as likely to be unfamiliar to the subjects and 40 of which were common words (CW) having a Thorndike-Lorge (1944) rating of 30 or more. The choice of items has been described earlier in Chapter Six. The 40 critical physics words were selected as being familiar to physics students and unfamiliar to arts students. A common word (having a Thorndike-Lorge rating of 30 or more) was paired with each physics word on the basis of initial letter and word length.

The inspection sequence contained 20 critical PWs and their paired CWs, the order of presentation of these 40 items being randomly determined.

The 160 item recognition test contained the 40 inspection words together with remaining 20 critical PWs and 20 critical CWs and an additional 40 PWs and 40 CWs. The recognition items were randomly allocated to serial list positions with the constraint that each quarter of the recognition list contained 5 critical test stimuli in each of the following classes;

positive PWs, negative PWs, positive CWs, negative CWs (a positive instance being an item presented in both inspection and test sequences).

Procedure: The experimenter-paced subjects were tested in small groups and the self-paced subjects were tested individually. The recognition task procedure was demonstrated using a practice inspection and test sequence.

Each word in the inspection sequence was presented for 2 seconds using a Kodak Carousel automatic projection with a 0.5 second inter-item presentation interval. The subjects were instructed to attempt to remember the words.

As each test word appeared on the screen, the subjects recorded a response decision utilizing a 7-point rating scale ranging from 'absolutely sure the word was present' in the inspection series to 'absolutely sure the word was absent'. The experimenter-paced subjects were required to make a rapid response as each test item was presented. The inter-item interval was 4 seconds during which the subject recorded the response, located the rating scale for the next response, and fixated the screen in preparation for the viewing of the next test item. Each subject in the self-paced condition pressed a key which manipulated the presentation of the subsequent test item. Although the inter-item interval varied, in the latter condition, the subjects were instructed not to deliberate for a long time over any particular word.

Results:

As in recent studies (e.g. Schulman, 1967; Allen & Garton, 1968a), linear operating characteristics (ROCs) were fitted to the data points on a double probability plot as shown in Figure 10. In terms of the discrimination index d_s, it is apparent that PWs were more readily identified as 'old' or 'new' than were CWs for both response decision rates. It is also clear that within each stimulus set, similar d_s values were obtained for speeded and subject-paced response rates (PWs d_s = 2.14 vs 2.07; CWs 1.17 vs 1.29).

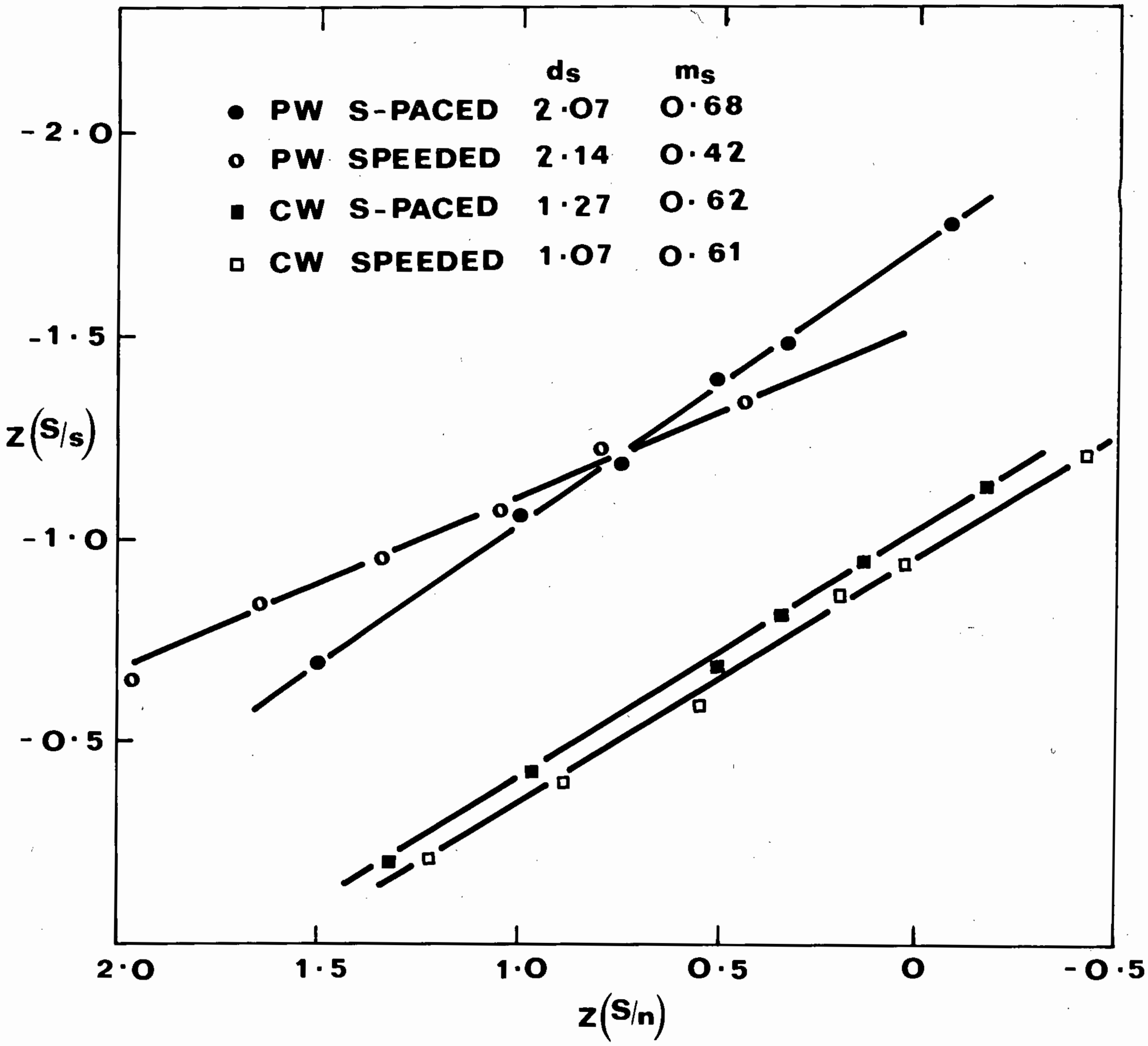
From Figure 10 it is clear that the PW curves differed noticeably in gradient (m_s = 0.42 vs 0.68) while almost parallel ROCs were obtained for the two CW curves (m_s = 0.61 vs 0.62).

An analysis of the contribution of false-positive responses to the obtained ROC curves revealed that differing FARs could account for both d_s and slope differences. A $\underline{z}$ test (Freund, 1967) of differences in proportions of false-positive identifications indicated that significantly fewer PW errors than CW errors occurred under each response rate condition (speeded, $\underline{z}$ = 2.08, $p < 0.05$; subject-paced, $\underline{z}$ = 5.70, $p < 0.01$) and that the subject-paced condition reduced errors for PWs but not for CWs ($\underline{z}$ = 4.12, $p < 0.01$ and $\underline{z}$ = 0.31, $p < 0.10$ respectively).

Discussion:

As in a previous study (Allen &Garton, 1968a), the subjects were able to discriminate more easily old from new items in a recognition sequence if they are PWs as opposed to CWs. The results indicated that although the obtained discrimination values were largely independent of the retrieval time available for decision responses, additional processing time significantly reduced the number of false-positive identifications for PWs but not for CWs.

Fig. 10:


ds
ms
PW S-PACED 2·07 0·68
PW SPEEDED 2·14 0·42
CW S-PACED 1·27 0·62
CW SPEEDED 1·07 0·61
-2·0
-1·5
-1·0
-0·5
z(S/s)
2·0
1·5
1·0
0·5
0
-0·5
z(S/n)

Why should an increment in the available response time affect response uncertainty only in the case of rarely occurring material? The approximately parallel CW ROCs may indicate that CWs induce associative confusions among similar words which do not substantially diminish during a prolonged memory search. However, assuming that PWs are initially more difficult to organize, a continued scanning of the PW store (analogous to Norman's (1968) (Figure 9) recursive search process) may facilitate the location of certain PWs and hence reduce response uncertainty.

Finally, the obtained PW data clearly support expectations from signal detectability theory; although S/N remains constant as indicated by the similar d_s values, the different slopes reflect a varying of the response criterion placement under the different response conditions.

Summary[1]:

Experiment 6 varied the time available for retrieval decisions in recognition memory. The results indicated that although the discrimination of old from new items in a recognition test was independent of the time available for decision responses, additional processing time significantly reduced the number of false-positive identifications for low-frequency words but not for common words. These findings were viewed as supporting expectations from signal detectability theory.

1. This experiment was performed with R.F. Garton at the University of Melbourne in 1968.

Fig. 11: MORTON'S FLOW DIAGRAM FOR THE LOGOGEN MODEL

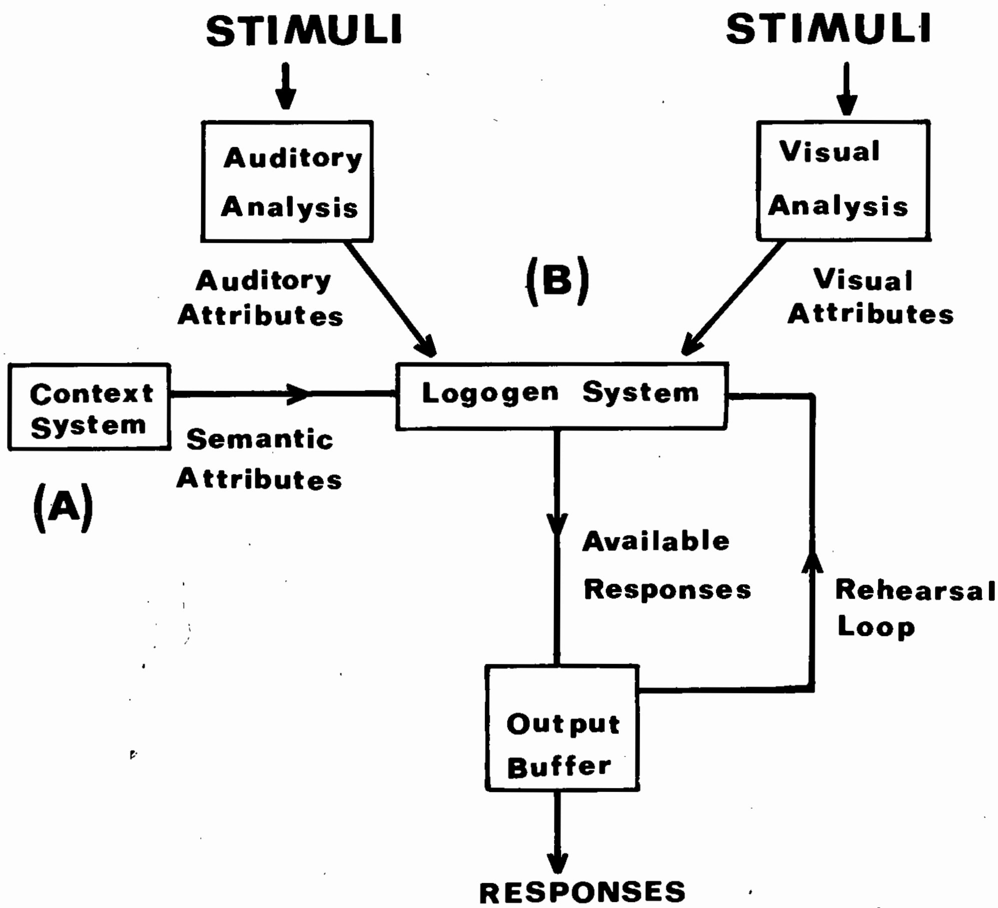


Fig. 12: MEDIAN CURVES FOR CHEMISTRY AND ARTS POSTGRADUATES FOR RARE AND COMMON ELEMENTS OF THE PERIODIC TABLE.

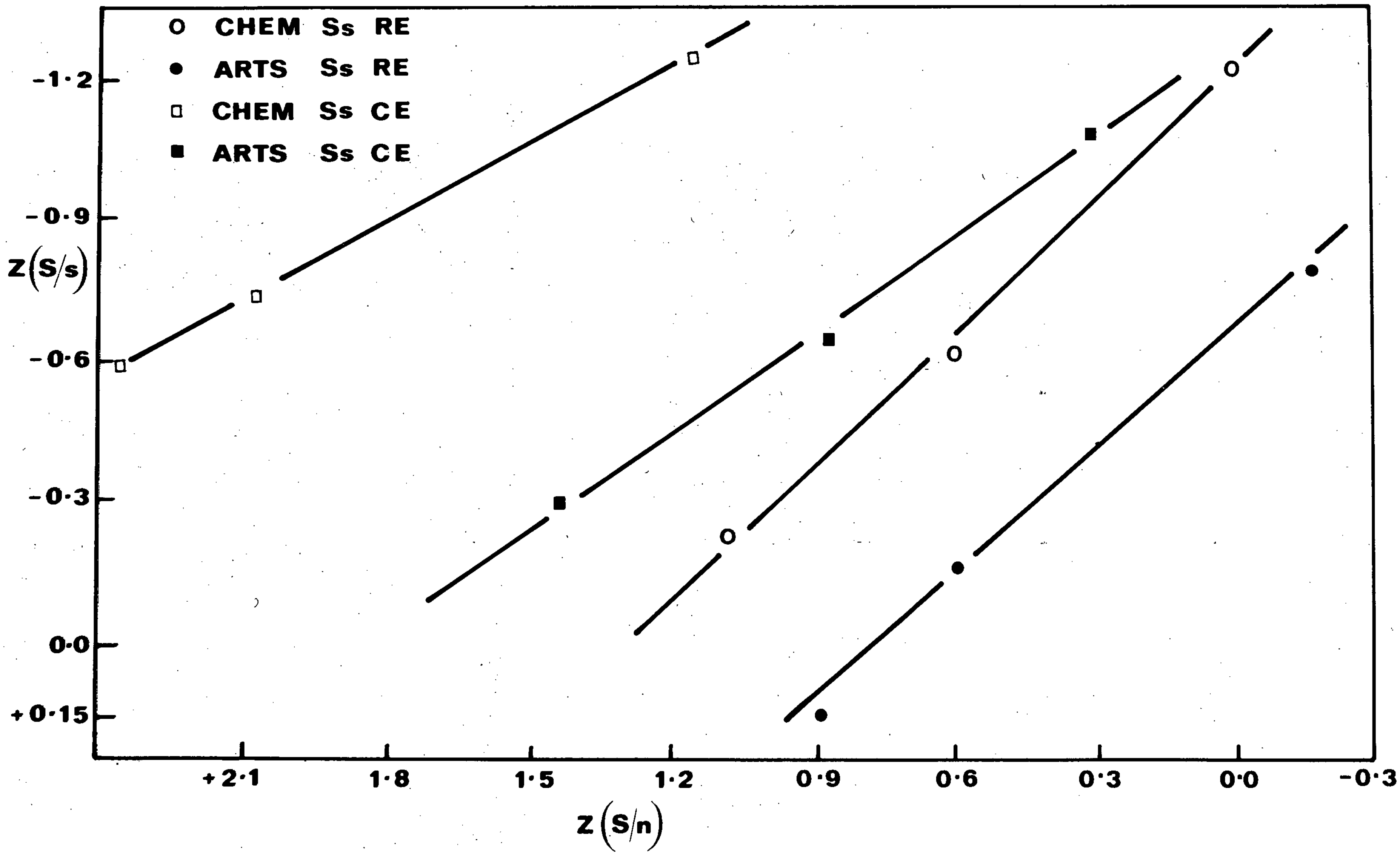
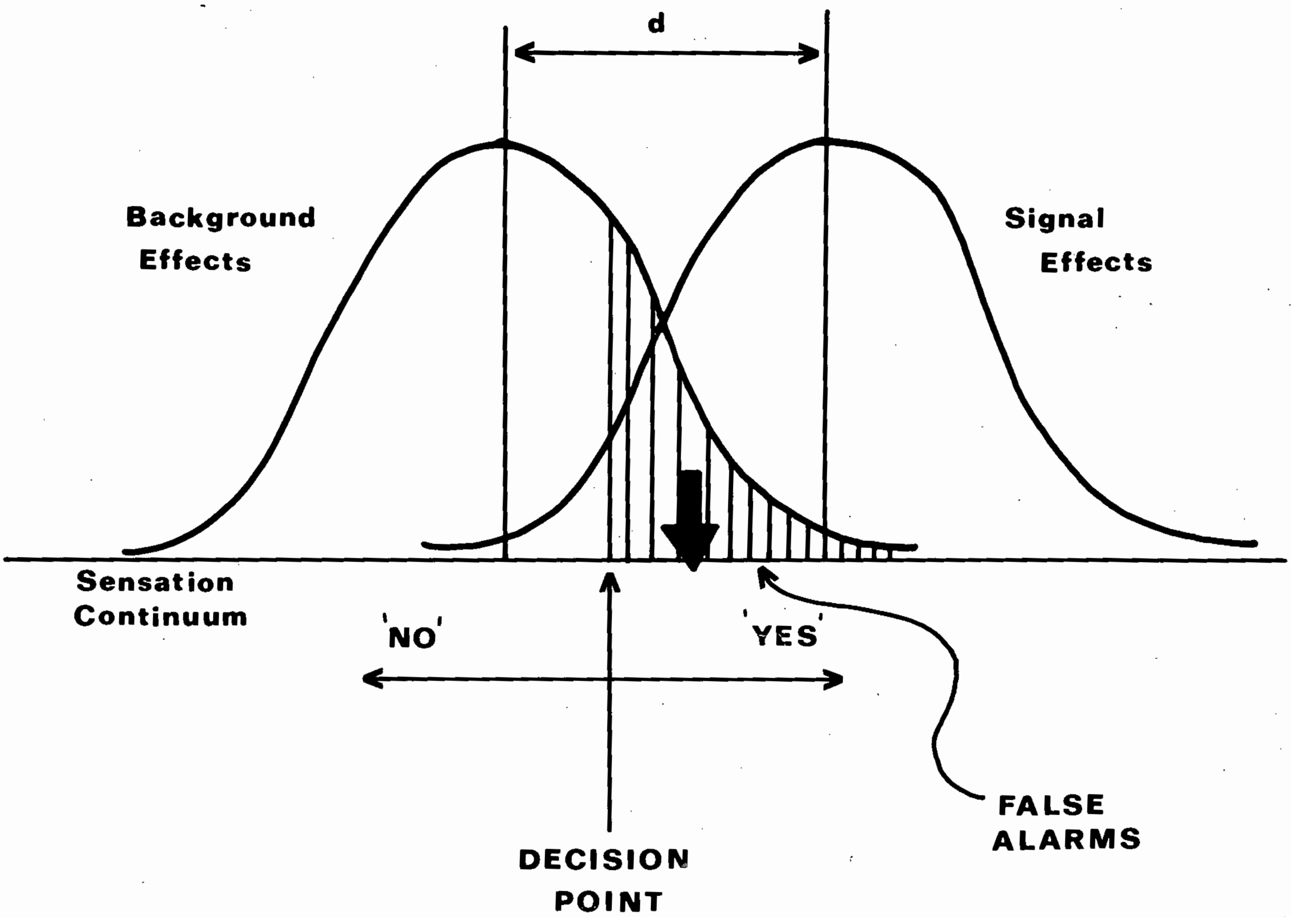


FIGURE 13



A geometric representation of the hypothetical mechanisms of the theory of signal detectability.

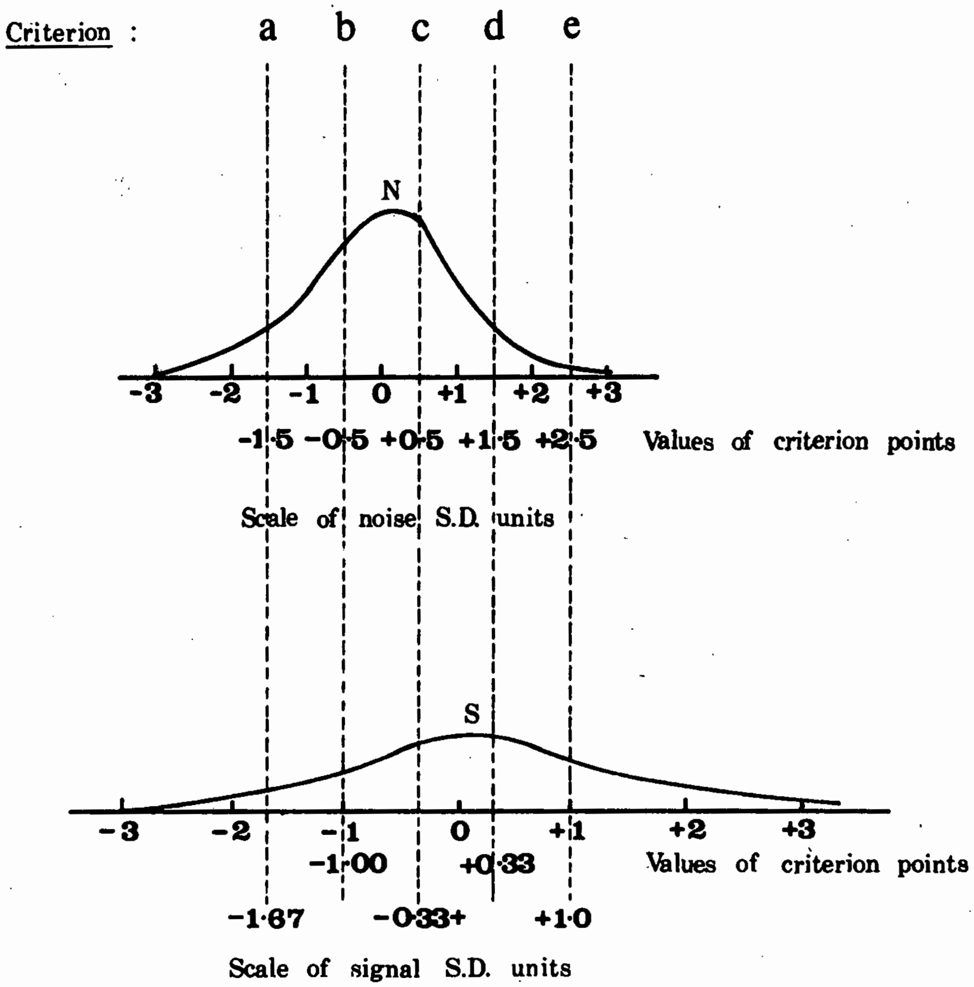
CHAPTER NINE

Generally, in psychophysical studies, the experimenter's concern is whether a given performance change represents a change in sensory (or Mnemonic) capacity or whether it represents a change in the subject's criterion or response bias. A change in sensitivity of recognition memory would be evaluated non-parametically by the index A, the area under the ROC curve. The area under this curve generated by plotting $P(\frac{S}{s})$ against $P(\frac{S}{n})$ for rating data may be conceived of as a series of trapezia (see Figure 14). The sum of these trapezia will give the area under the curve, a direct measure of sensitivity with areas ranging from 0.5 (guessing) to 1.0 (perfect performance).

Not all psychological experiments are interested in measuring the observer's sensitivity alone. Often one would like to know whether a certain experimental treatment affected the observer's bias, that is, the strictness of his criterion for accepting a piece of evidence as signal or noise. The bias parameter (beta) is obtained by measuring the height of the signal distribution at a (see Figure 14), and also the height of the noise distribution at that point and then calculating the ratio (height of signal distribution) ÷ (height of the noise distribution). Thus for point c (Figure 14) which lies mid-way between the signal and noise distributions, the bias is zero, and if the observer adopts this criterion he will make as many 'Signal' as 'Noise' responses. Criteria a, and b, show biases for calling events 'Signal', and d and e biases for calling events 'Noise'. At c there is no bias, the heights of the signal and noise distributions are equal and give rise

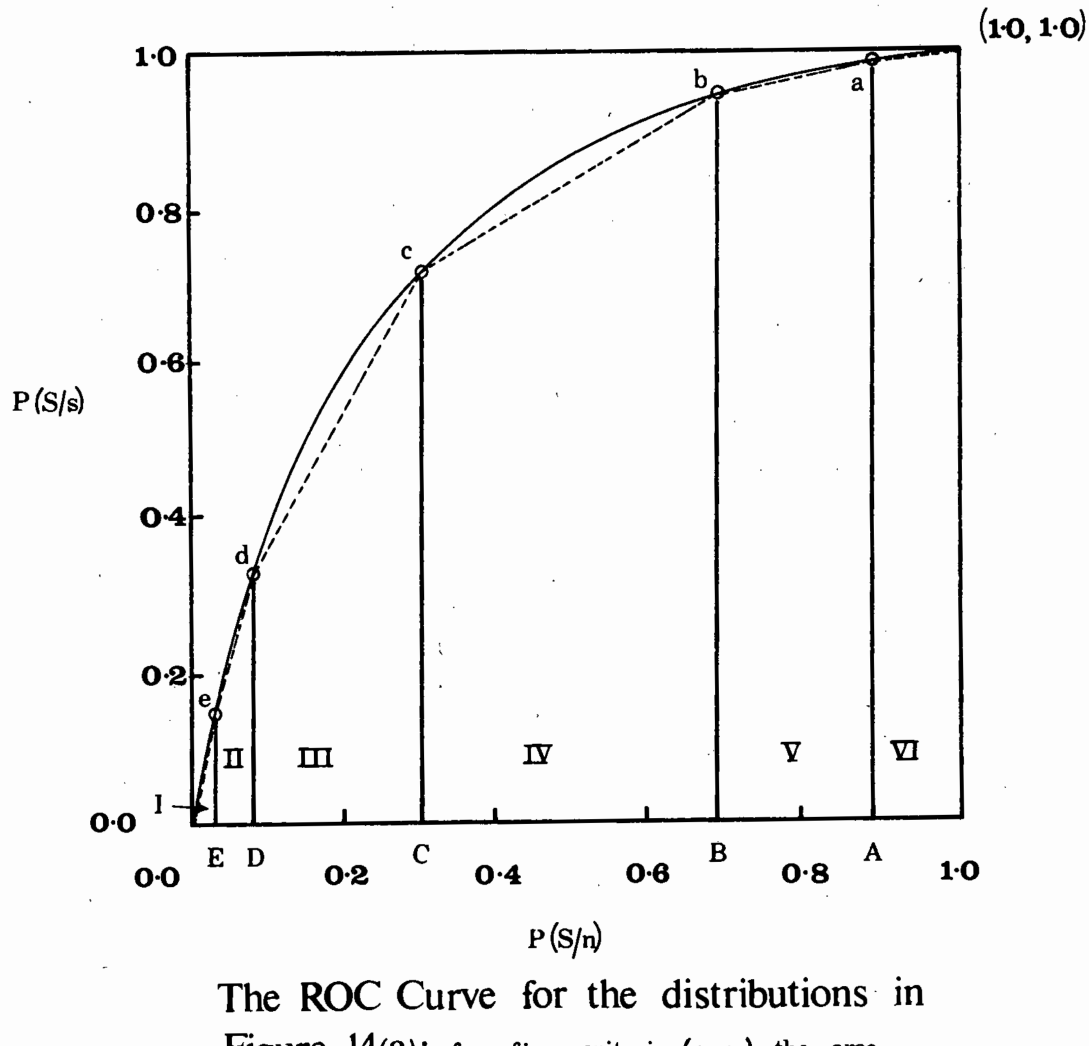
Figure 14 (a)

Signal Detection Theory Signal and Noise Distributions : ROC Curve



Signal and noise distributions of different variance.
Each distribution has been drawn on a scale of its own standard deviation units. The signal mean is 1 noise S.D. unit above the noise mean (Mc Nicol 1969)

Figure 14(b)



The ROC Curve for the distributions in Figure 14(a): for five criteria (a–e) the area under the curve is an indication of sensitivity (accuracy) It is a close approximation to the sum of the six trapezia (I – VI): This is the basis of Mc Nicol's Area Programme.

to a beta of one. When beta is less than one there is a tendency to say 'Signal' and when beta is more than one there is a tendency for 'Noise' responses. Using the ratio Beta instead of the actual z values of criterion points makes it more easy to compare biases from different distributions of signal and noise. Unfortunately, not all detection tasks involve signal and noise distributions of equal variance. In these cases one cannot infer the entire ROC curve from a single pair of hit and false alarm probabilities but need a set of points for the ROC curve. One of the limitations of Experiment 3 was the reliance upon one set of probabilities (forced-choice procedure) rather than several sets. This means that a simple Yes-No task is sufficient for estimating d' and beta in the equal variance case, but a rating-scale experiment is desirable for estimating sensitivity and bias when variances are not equal.

In the rating scale task the subject may be induced to give more information than a simple Yes-No response. Several response categories may be used, e.g. from: "absolutely sure that the word was seen before" down to "absolutely sure that the word was absent", or some such similar continuum.

The subject is asked to record the confidence that he has in his judgement. Each step in the continuum thus corresponds to a criterion level, and there will be (n-1) points on the ROC curve: where n is the number of categories used. Because the subject can completely alter his behaviour simply by shifting his criterion without any change in what he actually has remembered, the number of correct responses is as much a function of his decision processes as it is of his memory process.

What factors affect this decision process, are subjects biased towards the familiar as Bartlett's studies on Schema have shown or will rarity or bizarrerie (dissimilarity) affect or bias the decision? Many experiments on memory use a vocabulary of possible responses which is already well established, such as letters, numbers or words. Even in rare cases where nonsense symbols are used, these are made up of letters which are themselves familiar, and Melton (1963) has shown that in some ways a single nonsense syllable of three letters behaves rather like three words that are already known. In retrieving material which has been selected from a known vocabulary of this sort, a good deal obviously depends upon the preferences between the various items which the learner has before he does any learning at all: his 'response bias' in favour of some alternatives rather than others.

Dale (1967) has conducted a study on memory for lists of items with one group of subjects, each item being the name of an English county. The names of some counties are remembered better than the names of others. Other groups of subjects were simply asked to produce as many counties as they could think of, without particularly having to learn a special list. The counties which were best remembered were those which were given by a high proportion of people who had done no learning at all and were merely asked to think of the counties.

It is clear from Dale's result that recall of the names of English counties is being affected by a response bias in favour of the names of some counties rather than others, which exists even before any learning whatever has taken place. Similar biases may exist for numbers, letters and words.

Baddeley has shown that with his subjects (housewives and naval ratings) the digits zero, one and two were reproduced especially frequently when they were asked to continue sequences of digits (Broadbent, unpublished paper, 1966).

In perceptual experiments, there have recently been advances of technique which have allowed a proper correction for such biases. "The traditional guessing correction is undoubtedly inadequate, in the perceptual case, since it is quite clear that the easier perception of probable rather than improbable words is not due simply to the random guessing of probable words whenever nothing at all has really been perceived. A more complex theory is necessary, in which neural activity is viewed as analogous to a statistical decision: but in the perceptual case, such a theory can adequately separate response bias and the basic efficiency of the senses. Using such methods of analysis, it has now been possible to make much more reliable psychophysical measurements than were previously possible, since individual differences in response bias are responsible for a good deal of the unreliability of traditional sensory thresholds (Broadbent, op.cit)."

Several laboratories have shown that similar methods of analysis can be applied to memory experiments, and it immediately becomes of interest to know whether the deterioration produced in memory by interfering activity is due to a genuine change in memory itself, or rather to some temporary change in response bias. Ingleby has carried out a study (unpublished Ph.D. 1968) in which subjects were asked to recall lists of numbers, each of which was presented at an interval of ten or twenty seconds following a previous list. In such a situation, it is of course known that intrusions tend to occur from one list into the next list, so that mistakes at any position in the list are especially likely to be of a particular digit which would have been correct at that particular position in the previous list. Ingleby found that the presence of a particular digit at a particular position in the previous list produced a response bias in favour of that digit, this bias becoming less as the time interval between lists increased. If we take the other parameter from a decision theory analysis which corresponds to sensory efficiency in perceptual experiments, and in Ingelby's case may be regarded as memory efficiency, then the presence of a particular item in a previous list actually <u>increased</u> the value of this parameter rather than decreasing it. "Thus it seems clear that these methods of analysis discriminate different features of the recall process: the temporary change in response bias shown in Ingleby's experiment is not necessarily a drop in the true efficiency of memory, nor is either parameter necessarily identical with the changes that occur in memories that have been well established and have been present for some time. (Broadbent op.cit)".

Experiment 3 has shown that different biases exist for arts and physics students when varying proportions of physics and common words were used in a subsequent test booklet even though the inspection list was constant for all groups of subjects. The subjects appeared to adopt a conservative strategy in the test sequence. This would appear to modify statements of detection theory which have proposed an expected value (EV) model which locates the criterion at that point which maximizes the expected gain (Tanner and Swets, 1954). Tests of the EV model have indicated that criterion location is not sufficiently responsive to unequal payoffs or unequal base-rate probabilities to yield maximum gain, implying a tendency towards conservatism (Green, 1960; Ulehla, 1966).

The results of Experiment 3 are interesting but the consideration of bias measures is confounded in part as a forced choice technique was used, giving rise to only one point on the ROC curve. The tables used to obtain d' and beta have assumed operating characteristics of unit slope. Alternatively a non parametric method of obtaining sensitivity would be more desirable. A method has been obtained by McNicol (personal communication, 1969) based on a computer programme developed by Ingleby (1968). This programme measures the area of the trapezia under the ROC curve obtained by plotting $P(\frac{s}{n})$, see Figure 14. The principal advantage of the area measure is that individual as opposed to group data may be analysed and significance tests performed (there are at present no satisfactory significance tests for d'). There would also be the added advantage that no assumptions are made concerning the variances of the signal and noise distributions.

Experiment 7

Introduction:

This experiment was designed to investigate the bias differences that may exist towards common words as opposed to rare words. The stimulus items used were the elements of the Periodic Table. It was thought that a completely known category of words with rare as well as common items was a desirable source of stimuli. Dale (1967) using a complete category (English Counties) has shown that formal recognition tests in which the complete category is listed are of no advantage if the category is known but do enhance performance with an imperfectly known category. Thus the array of alternatives on the recognition test supplements the subject's internal list and is beneficial when this list is incomplete and where internal scanning would therefore be imperfect. This is probably the reason for the results of the experiment by Garton and Allen (1968a) on familiarity and word recognition (see Chapter Five). The physics and non-physics subjects did not differ in recognition performance in inspection list words correctly identified. Physics students, however, were superior to arts students in the correct detection of distractor or noise items. These items were <u>all</u> known by the physics stubjects whereas arts students were only really familiar with the non-physics terms.

Additional evidence for this scanning is supplied by Dale and Baddeley (1966). Analysis of the order of recall showed a tendency for subjects, who perceived two-digit numbers as stimuli, to write out their responses in ascending order even though no such ordering was employed during presentation.

In a recognition task using the Periodic Table only, Chemistry Students would have access to the complete Table assuming that the arts subjects with no chemistry do not know the complete classification. The subject will combine information from his memory traces with any other information provided by the experimenter about the constraints that exist in the experimental task.

A complete category such as the Periodic Table will contain both common and rare words for both chemistry and non-chemistry students. Thus a disadvantage exhibited in some of the previous experiments utilizing physics and common words is removed. It is probably difficult to confuse HYSTERIS and GOVERNMENT but easier to confuse SODIUM and LITHIUM. To obtain rare and common words with similar 'appearances' has always been a vexed question in the previous experiments but a question of no great importance before as biases were not the main consideration.

Consider the experimental situation where both chemistry and arts postgraduates view an inspection sequence of common and rare elements (rated as common and rare by samples of the two populations). In a subsequent recognition task the subjects are required to pick out the inspection items from distractors. Will the non-chemists be biased in their choice on the recognition test towards common elements? On the other hand, will chemists, by virtue of knowing the Periodic Table, find the task easier amd adopt a lax criterion on rare elements and generally find the perception of common elements easier? Perhaps the knowledge of the elements is completely irrelevant to the task and the chemists will be no better than the arts students, perhaps the biases will be the same for both common and rare elements for both populations?

Rating Procedure: The 103 elements were typed on sheets with instructions requesting the rater to rate the familiarity of the elements using a six point scale from absolutely familiar to completely unfamiliar, the procedure being similar to the rating task for Experiment 2. Thirty chemistry postgraduates and ten fourth year History, English and Philosophy students plus twenty postgraduate arts students rated the elements. Thus two criterion groups of thirty people were formed. Means and standard deviations were calculated for each element for each group. The lower the mean the commoner (more familiar) the element was deemed to be: The complete lists of these ratings are given in Appendix XI. Though there were 103 elements it was still difficult to obtain a list of common and rare signal and distractor pairs which were similar in appearance. In spite of the large list only seven pairs of common elements and eight pairs of rare elements were obtainable. Pairs which had some semblance to each other and were of comparable word length. These pairs are given in Table 9.

Method:

Subjects: The subjects were twenty chemistry postgraduates and twenty arts postgraduates, the latter being mainly Masters students in English, Philosophy and History in the University of Cape Town. None of the arts subjects had any chemistry training beyond the year before their Matriculation year.

Materials: The inspection stimuli were the seven common and eight rare words from the signal group of Table 9.

A recognition booklet was composed of four pages; on each page the fifteen inspection elements were typed together with their paired distractor elements. Thus each item and its distractor was present four times in the complete test. The elements were randomised allowing as far as possible equal numbers of rare and common elements in each half of each page. An instruction page was present at the front of each booklet. The test booklet allowed four responses for each element, ranging from absolutely sure the word was present in the inspection series through to absolutely sure that the word was absent (for details see Appendix XII. The subjects were requested not to turn over to previously worked pages, this was necessary in order to induce errors on such a small number of inspection items.

Procedure: The subjects were tested in groups of two or three. Prior to the presentation of the fifteen inspection items the subjects were requested to remember the words that would appear on the screen. Each item was presented for 2.67 seconds using a Kodak Carousel projector with a timing device to allow a uniform presentation time. Twenty chemistry postgraduates and twenty arts postgraduates were assigned to each criterion group. The subjects were instructed that they would be required to give their degree of surety concerning each element in a subsequent recognition task. After the inspection series the subjects were allowed three minutes to familiarize themselves with the recognition book instructions after which they commenced the recognition test.

TABLE 9

INSPECTION ITEMS (S) AND DISTRACTORS (N)
FOR RARE AND COMMON ELEMENTS OF THE
PERIODIC TABLE (EXPERIMENT 7).

COMMON

S	N
BORON	ARGON
FLUORINE	BROMINE
HYDROGEN	NITROGEN
COPPER	SILVER
CHROMIUM	CALCIUM
MAGNESIUM	MANGANESE
SODIUM	SILICON

RARE

S	N
PROTACTINIUM	PRAESEODYMIUM
YTTERBIUM	YTTRIUM
FRANCIUM	FERMIUM
ERBIUM	EUROPIUM
NEODYMIUM	NEPTUNIUM
HOLMIUM	HAFNIUM
LAWRENCIUM	LUTETIUM
THULIUM	TECHNETIUM

Results:

The complete individual data for all the forty subjects are given in Appendix XIII. From this the group data were produced, see Appendix XIV. The area measures (sensitivities) and bias measures are given in Appendix XV. The bias measure is one produced by McNicol (1969) which gives the position of the 50:50 judgement for each subject for the four categories. Thus a bias measure of 2.0 would indicate no special bias for Yes or No, one of less than 2.0 would indicate a tendency to say YES, (laxity), one of more than 2.0, a tendency to say NO (caution). All these measures are present in Appendix XV

The median value** (best central tendency measure for this sort of examination) for each category was ascertained from the individual data for categories (Appendix XIII) for both element groups and both subject groups. This is given in Table 10. Thus the median of the responses for Category 1 (absolutely sure that the word was present) for chemistry subjects on rare elements, for elements actually in this inspection list was 19, giving a probability of 0.594 and z of -0.24.* These values are given at the top of Table 10. In the individual data (Appendix XIII, page 275) subject 3 actually produced this value.

**The median values gives a better measure than the group data analysis used in previous experiments as they are not prone to distortion by bizarre results from one or two subjects.

* The value of 0.594 is the proportion of responses in Category 1. That is 19÷32, where 32 is the total number of responses for rare elements present in the recognition booklet. This is an example of the standard SDT analysis of rating data (see Sidowski, 1966) for details and Appendix XIV

TABLE 10

MEDIAN DATA

Non-Chemists: Rare Elements

	S				N			
Category:	1	2	3	4	1	2	3	4
p	0.438	0.563	0.844	-	0.156	0.250	0.531	-
z	+0.16	-0.16	-1.01	-	+1.01	+0.67	-0.08	-

Chemists: Rare Elements

	S				N			
Category:	1	2	3	4	1	2	3	4
p	0.594	0.735	0.891	-	0.141	0.281	0.500	-
z	-0.24	-0630	-1.23	-	1.08	0.580	0.00	-

Non-Chemists: Common Elements

	S				N			
Category:	1	2	3	4	1	2	3	4
p	0.607	0.732	0.857	-	0.071	0.184	0.384	-
z	-0.27	-0.620	-1.07	-	+1.47	+0.90	+0.30	

Chemists: Common Elements

	S				N			
Category:	1	2	3	4	1	2	3	4
p	0.714	0.750	0.875	-	0.00	0.018	0.143	-
z	-0.56	-0.67	-1.15	-	+3.00	+2.10	+1.07	-

Figure 12 was drawn using the z values from this table. (Page 87)

From the median data in Table 10, Figure 12[1] was drawn in the usual way. The group data are given for comparison (see the Table in Appendix XIV). From the group data results, curves were drawn and parameters ds and delta m were calculated. These parameters, together with those for the median data, are present in Table 11.

There is a reasonable fit between group and median data, but as the median is a better measure only one diagram is presented.

Figure 12: Though delta m is supposed to be a better measure than d_s (the equivalent to d^1 when the slope is not unity) there is in all cases in Table 11 a one-to-one relationship between d_s and delta m.

The means and standard deviations for the area and bias measures were calculated and t tests were performed (Tables 12 and 13). Table 12 gives the t test measures between Arts and Science subjects on the area and bias measures for common and rare elements. Table 13 gives the correlated t values for a comparison of rare and common element performance by arts subjects and science subjects respectively.

Discussion:

It is clear from both the median results and the area analysis that the following situations have arisen as far as sensitivity measures are concerned:-

(i) The arts subjects were better at discriminating common elements than rare elements (delta m of 1.86 c.f. 0.86), and transformed area scores of 0.711 c.f. 0.6097, t (38 df) = 3.56** (2-tailed). This supports the experiment 2 (Figure 3) result and it is now clear that the arts subjects benefit from

1 See page 87 for Figure 12

the 'familiar' forms of elements such as SODIUM, HYDROGEN, COPPER, etc. as opposed to the 'nonsense' forms of YTTRIUM, PROTACTINIUM and LUTETIUM for example (see Table 10)*.

(ii) The chemistry students performed better on common elements than on rare elements: delta m of 3.56 c.f. 1.34 and transformed area scores of 0.7818 c.f. 0.6930, t (38 df) = 3.01** (2-tailed). This is contrary to the expectation arising from the results of Experiment 2.

(iii) The chemistry students were better than the arts students at discriminating both common and rare elements.

(a) Common: delta m of 3.56 c.f. 1.86: area 0.7818 c.f. 0.7111
t = 2.14* (2-tailed) (38 df).

(b) Rare: delta m of 1.34 c.f. 0.86: area 0.6930 c.f. 0.6097
t = 3.02** (2-tailed) (38 df).

The clear superiority of the common element over the rare element performance by chemistry students is perplexing and contrary to expectations from Experiments 1 and 2. However, the task does only have a few inspection items and a long repetitive recognition list: hardly comparable to the design of earlier experiments. It is also feasible that the rate of forgetting for common elements is different from that of the rare elements. These limitations of the experiment were unavoidable because of the difficulty in obtaining good distractor items from the 103

* The term Form is used deliberately here to include factors such as degree of pronounceability, amount of familiarity, low or high word count in the general literature and even word length. The ease of perception and subsequent recognition must be a function of all these factors (to a greater or lesser degree) and the pertinence of a particular factor will depend upon the amount of information allowed by the experimenter in any particular experimental situation. Thus the role of 'experimenter-induced strategy' has not yet been clearly defined but will be considered in later chapters.

Figure 16

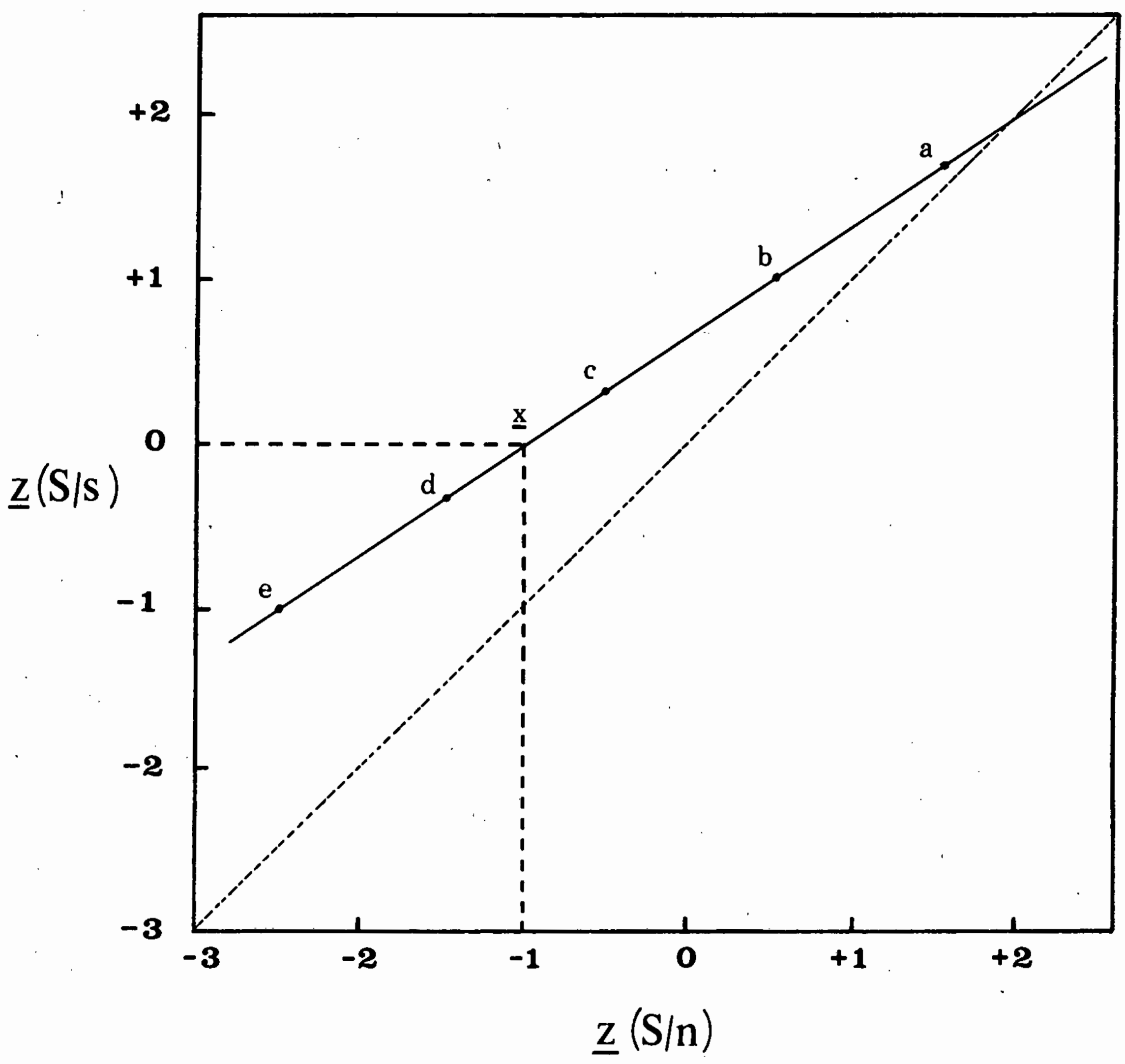


Figure 16: The double-probability plot of the ROC curve for the distributions of Figure 14(c) (Mc Nicol 1969)

CHAPTER TEN

Much research interest during the past few years has concentrated upon the comparison of the perception of words which are common in ordinary language on the one hand, and those which are uncommon on the other. The fact that common words are, other things being equal (not the case in the earlier Experiments two, three and six) more easily perceived is perhaps only a special case of the general influence of probability on perception. From the classic experiments on distortion in perception and remembering, such as those of Bartlett (1932), it has been common ground to most psychologists that a probable event is more easily perceived. Word frequency has its use as it enables one to engage upon quantitative studies of word perception.

Broadbent (1967) discussed "response bias theories" of the perception of uncommon vs. common words. He favours the theory that leads to the prediction that bias on correct responses may be greater than that on errors. This sense of response bias is analogous to the bias of a criteria in a statistical decision.

The previous experiments that investigated sensitivities and bias (2, 3 and 7) have not really answered Broadbent's (1967) pronouncement that common words were easier to perceive than rare words. In Experiment 2, the arts students were better on common physics terms (CT) than on rare terms (RT). The physics students were better on rare terms than were the arts subjects. It seems that in a closed technical vocabulary, which has some common words, that common words are perceived better than rare by subjects unfamiliar with the majority of words. The reverse is clearly true for Physics students who know the complete vocabulary. Their rare term performance (delta m 3.60) is better than their common term result (2.32); see Figure 3.

In Experiment 3, the physics subjects were better at physics terms than common terms for all the lists of varying proportions of rare and common terms. Yet the arts students were better at recognizing physics terms than common terms on all lists too; these results are very clear (Figure 4). That experiment was performed to investigate strategies as well as sensitivities though the latter was the main concern.

In Experiment 7, the reverse was true. Chemistry students were better at common elements than rare elements; a similar result existed for arts students, the arts students performing particularly badly on rare elements. This experiment did utilize difficult technical stimuli, the rare elements were little better than nonsense terms.

When biases are considered for Experiment 7 the chemistry students were biased to say No on common elements compared with rare elements ($\underline{t} = 2.71^{**}$): they were also biased to say NO compared with the null hypothesis of no expected bias. Arts subjects showed no significant bias tendencies.

In order to clarify the role of bias tendencies among common and rare words an experiment is necessary similar to Experiment 2 but utilizing words from the English language, not technical physics or chemistry terms. Will rare English on bias tendencies for both rare and common elements.

However, the chemistry subjects are more biased towards 'NO' responses on common elements than on rare elements (Table 13, $\underline{t}$ = 2.71**). The chemists are also biased towards 'NO' responses for common elements compared with a null hypothesis of no particular bias for YES or NO on common elements, ($\underline{t}$ = 3.26**). The arts subjects are biased towards the 'NO' response category for both common and rare elements but these results are not significant. All subjects are generally <u>cautious</u> in their responses towards the elements of the Periodic Table. The chemists display some laxity on rare elements (bias = 1.8809) but this is far from significant.

Returning to the results for Experiment 3 it can be seen that the arts subjects tend to exhibit laxity (High FAR's in Figure 4) toward physics words on all lists (beta less than one Table 8). The False Alarm Rate for common words is particularly high on a 50:50 list, see Figure 4, List A, for arts students. It is difficult to reconcile these results with those of Experiment 7.

The undue caution displayed by arts and chemistry students on elements of the Periodic Table may be a function of the difficulty of the task. A study of the bias measures has not been very instructive in this experiment. It may be of interest to note that Haber (1969, personal communication) has found that as the signal strength decreased, beta increased; the subject became more cautious. It may be that the recognition task was too difficult or the stimuli were too difficult to process. This is not likely, however, as the mean of the area measures are well above the chance guessing level of 0.5 and the mean transformed area measure for chemistry students on common elements is the <u>highest</u> (0.7818) and this group displayed the <u>greatest</u> caution (bias score of 2.5010). The nature of the stimulus material has an important effect upon the bias tendencies in these tasks. The experimenter is wittingly or otherwise limiting the available strategies that a subject can use for recognition tasks. The rarity of the items probably makes it difficult to formulate unequivocal questions for F1, F2 etc. (see Figure 15). Or to state it otherwise, the experimenter is limiting the semantic attributes (unfamiliar stimuli) limiting the auditory attributes (unpronouceable stimuli), and thus making the processing of incoming stimuli difficult (the logogen system of Morton, Figure 11). The vividness or bizarrerie of the stimuli may <u>only</u> be of use for coding if the semantic and auditory aspects are of an optimum level (system B: Figure 11).

The knowledge of the whole catalogue of elements may be useful for chemistry students for common elements but does not seem to aid the rare element performance (Figure 12 illustrates the clear superiority of the chemists' common element performance). Had Dale's conclusion been applicable one would have expected the rare and common element performance to be comparable for chemistry subjects. Though of course his 'rare' counties would be as easy to learn and pronounce as his 'common' counties. The same cannot be said of the chemistry elements.

Figure 15 a

MILLERS TREE GRAPH

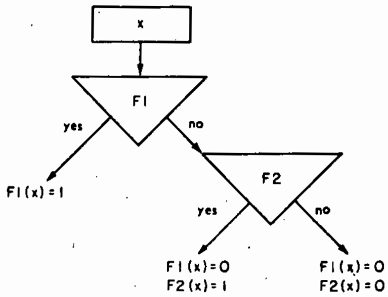


Fig. 15a Tree graph illustrating the dominance of feature F2 by feature F1. (Miller 1968)

Figure 15 b

Peterson (1967) Ratings of recency at 2 rates of presentation

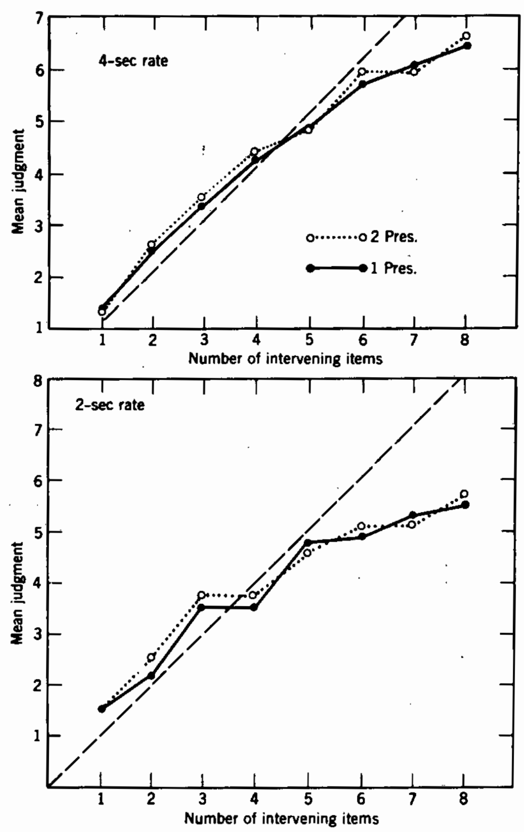


TABLE 11

MEDIAN AND GROUP DATA FOR THE ELEMENTS OF THE PERIODIC TABLE : EXPERIMENT 7

	1	2	3	4	
	RARE ELEMENTS		COMMON ELEMENTS		
d_s	0.87	1.27	1.50	2.25	MEDIAN DATA
Delta m	0.86	1.34	1.86	3.56	
Slope	1.07	0.90	0.68	0.47	
	Arts Ss	Chem. Ss	Arts Ss	Chem. Ss	
d_s	0.70	1.27	1.37	1.90	GROUP DATA
Delta m	0.78	1.26	1.96	2.80	
Slope	0.87	1.0	0.51	0.50	
	RARE ELEMENTS		COMMON ELEMENTS		
	1	2	3	4	

NOTE: ARTS Students results appear in columns 1 and 3, CHEMISTRY Students in columns 2 and 4 (N = 20 for each group).

TABLE 12

MEANS, VARIANCES AND t TEST VALUES FOR THE PAIRED COMPARISONS (EXPERIMENT 7)

Common Elements

Chemistry Students (N = 20)		Arts Students (N = 20)		
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	t
AREA (A)				
0.8601	0.0139	0.7997	0.0084	1.76
TRANSFORMED AREA				
0.7818	0.0151	0.7111	0.0057	2.14*
BIAS				
♣2.5010	0.4733	2.2045	0.6534	1.22

Rare Elements

$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	t
AREA (A)				
0.7722	0.0130	0.6645	0.0109	3.04**
TRANSFORMED AREA				
0.6930	0.0091	0.6097	0.0054	3.02**
BIAS				
1.8809	0.4146	2.2806	0.6560	1.68

** Significant at the 1% level (2-tailed), (Independent t test).

* Significant at the 5% level (2-tailed)

♣ Significantly different from 2.0 (null position): bias to 'NO' responses.

For the 1% level (2-tailed) (t = 2.70). (38 df)

TABLE 13

MEANS, VARIANCES AND CORRELATED t-TEST VALUES FOR THE INTRA-GROUP COMPARISONS (EXPERIMENT 7)

Chemistry Subjects

Common Elements $\bar{x}$	Common Elements S.D.	Rare Elements $\bar{x}$	Rare Elements S.D.	t
TRANSFORMED AREA				
0.7818	0.1229	0.6930	0.0956	3.01**
BIAS SCORES				
2.5010	0.6880	1.8809	0.6439	2.71**

Arts Subjects

Common Elements $\bar{x}$	Common Elements S.D.	Rare Elements $\bar{x}$	Rare Elements S.D.	t
TRANSFORMED AREA				
0.7111	0.0753	0.6097	0.0732	3.56**
BIAS SCORES				
2.2045	0.8083	2.2806	0.8100	0.35

Two-tailed test: ** Significant at the 1% level (38 df).

elements in the Periodic Table. One factor, hinted at before, is the clear difference in appearance between the rare and common elements. The bizarre, vivid, appearance of many of the rare elements would surely aid in their discrimination: then why are the rare elements so difficult to recognize? It seems that when dealing with words, as opposed to nonsense syllables, a complex situation arises: one needs a particulate analysis of the word category - rare. That is, it is insufficient, even naīve, to suppose that because the word frequency is equated in a category that items within that category will also be equated on bizarrerie, salience, pronounceability and the like. A memory should be able to store the values of many different features (aspects of forms) of a single object, word, or whatever. However, following a line of argument made familiar in perceptual psychology by Attneave, Sutherland, Barlow and McKay among others, one may be able to show that some rules for coding would be more reasonable and economical than others. Depending upon the limitations imposed by the experimenter certain coding will be of more importance than others. Should one believe that higher organisms could not have endured such remarkable neurological systems for processing information if they had always ignored reasonable and economic procedures then a discussion of efficient coding schemes may be of interest.

It may be assumed that coding should depend upon relevance for reinforcement but this leads in the wrong direction (see Miller (1968). A coding scheme must be general whereas reinforcement or non-reinforcement can be associated quite arbitrarily with different features in different situations. Coding theory as Miller (1968) suggests provides an alternative approach. "For maximum efficiency of coding, reserve the most expensive forms of coding for the most improbable messages." The number of trials it takes for information to be permanently encoded need have little or nothing to do with the way the code is defined.

Apart from reserving the expensive coding scheme for improbable words the subject may use the degree of correlation between features. Miller (page 369, 1968) has elaborated a case where two features are related in such a way that one takes priority over the other. "If feature F1 partitions things into two categories, and feature F2 applies to only one of those two categories, then F2 takes priority, or dominates F1. One way to represent these priority relations among features is in a tree graph, where a dominated feature may be relevant to one branch of the tree but not to others." (see Figure 15).

"For one of two categories created by dominating features, then the dominated feature is simply irrelevant; how should the dominated feature be coded? One solution would be to use a three-valued coding. For example, if F2(x) = 0, it might mean that F2 is irrelevant; 1 might be the expected value; and 2 might be the unexpected value. This solution is unnecessarily expensive, however, It is easier to let the normal, unmodified state represent both the irrelevant and the expected cases, and to reserve the modified state for the unusual value; the resulting ambiguity of the normal state can always be resolved by reference to the dominating feature F1. The interesting point, however, is that when we code a dominated feature in this way, if any object is assigned the unexpected value on F2 we know immediately what its value must have been on F1. (To use an analogy, if we know that something is a horse, we do not need to ask whether it is a plant or an animal). In order to exploit such redundancy, the encoding process of F2 must be contingent on the value of F1, which greatly complicates the simple model suggested above. But chronometric evidence, summarized by Posner, strongly supports the validity of such classificatory hierarchies. (Miller 1968)".

If x is an element of the Periodic Table F1 (for a chemist) may be, "Is it a metal?" or "Is it a member of group II?" An arts student may ask a simpler but less useful question say, "Does it end in 'IUM'?" "Does it have a peculiar feature, e.g. 'YTT' as its first three letters?" Should YTTERBIUM and YTTRIUM be the signal and noise items used then the answer to either F1 for the arts student may lead to error in a recognition task. A better question may be, is the element short (word length) or long, or if F2 is this question then a combination of F1 and F2 will remove ambiguity. Nevertheless the chemist will have a more efficient series of F's from his knowledge of the Periodic Table, he can use less 'expensive' (less demanding) questions and this will lead to more efficient retrieval if not more efficient storage in the first place.

When in doubt what strategies are adopted by the two criterion groups of subjects? From Table 12 it can be seen that the arts subjects do not differ from the chemistry students words be perceived better than common ones and where will the bias tendencies be?

Experiment 8

The Thorndike-Lorge count (1944) is not very useful as the rare English words present in their sample are not rare; they may have a low word-count in the general literature, but there is no reason to expect University students to view them as rare. What is needed is a complete new list of word-pairs with good distractors of comparable word length and appearance. The Thorndike-Lorge (1944) word count does not give good distractor pairs, especially for rare words.

Method:

The production of stimulus materials.

In order to induce reasonable bias tendencies (should such exist) the distractor word must have a similar appearance to the stimulus item. One would like to see pairs such as Extridate-Extricate, Bergmehl-Bergschrund in the rare list. The word count lists fail to give a good source of rare words; consequently, there is need to obtain a list of items and ratings.

Two hundred words (100 word-pairs) were administered in book form to fifty-four English students and forty-four non-English students. The words were culled from dictionaries with a view to obtaining very rare word-pairs with similar appearances and preferably words of the same length. The English-student population was comprised of mainly English Literature and Language fourth year and Postgraduate students from Adelaide and Cape Town Universities. Whilst the non-

English students were Chemistry, Mathematics and Physics, Honours and Postgraduate students from the same two Universities (see Appendix XXIII for a breakdown of the populations.

The booklet had a first page of instructions, the following pages displayed the lists of words, each word followed by a bracket. The instruction page (see Appendix XVI) asked the student to rate each item on familiarity. The contimuum allowed 1 for a completely familiar word to 6 for a word that was completely 'foreign', one that the subject had never seen before. Examples were given to ellucidate the procedure. The instruction page is shown in Appendix XVI whilst the complete list of items with means and standard deviations is given in Appendix XVII.

Subjects: The subjects for Experiment 8 were twenty-one English Honours students from the second and subsequent years of study, and twenty-one students who had not studied English since their matriculation. The subjects in this group were mainly Science students. All subjects were paid for their participation in this experiment.

The use of two criterion groups (English and Non-English subjects) is desirable as the bias tendencies for both together can be compared with the tendencies for each one separately. The skilled group, dealing with words may well exhibit differing biases from the non-English group even though the rare words were for both groups and the common words are common for both groups.

Materials and Procedure: From the list of two hundred words the fourteen best rare pairs and the fourteen most common pairs were chosen. Care was taken to choose only items that had suitable distractors. Both distractor and stimulus words had to possess (as close as possible) the same means and standard deviations. These word pairs are given in Tables 14(a) and 14(b).

The words were either common for both populations or rare for both populations.

Slides were made of the twenty-eight stimulus words; being fourteen rare and fourteen common English words. The words were projected onto a screen using a Kodak Carousel automatic projector (Model 550R). Two seconds viewing was allowed for each word. The subjects were tested in small groups. Each subject viewed the randomly ordered stimulus items (seven rare and seven common words in each half of the inspection series) and then was allowed two minutes to read the instruction page of the test booklet. The booklet was comprised of three pages: the first the instructions, which urged the subjects to work through the list of words in the booklet giving their degree of surety of the presence or absence of a word from the test list on a four point scale. The scale (or rather four boxes) allowed for absolutely sure the word was present, probably present, probably absent, absolutely sure that the word was absent. Details are given in Appendix XIX. The second and third pages of the booklet contained the twenty-eight words from Tables 14(a) and (b). Fourteen rare words and fourteen common words were present on each page. Each half page consisted of seven rare and seven common words. Care was taken in the randomising process

TABLE 14(a)

ENGLISH WORDS : RARE FOR BOTH POPULATIONS

	SIGNAL	NOISE
1.	EXOGENOUS	ENDOGENOUS
2.	EXCUPATE	EXCORIATE
3.	NEOTERIC	NEOPHYTE
4.	PRORATE	PROROGUE
5.	FARDEL	FERAL
6.	BERGSCHRUND	BERGMEHL
7.	BESPRENT	BESLAVER
8.	CABRIOLET	CABRIOLE
9.	GLAUCOUS	GLABROUS
10.	INELECTABLE	INERRABLE
11.	IMPUISSANT	IMPECCANT
12.	SYNECDOCHE	SYNONYMICON
13.	CONSUETUDE	DESEUTUDE
14.	CONTUMELIOUS	CONTERMINOUS

TABLE 14(b)

ENGLISH WORDS : COMMON FOR BOTH POPULATIONS

	SIGNAL	NOISE
1.	SHEER	SHEEN
2.	DISPERSE	DISPLACE
3.	IMPAIR	IMPART
4.	IMPERVIOUS	IMPERIOUS
5.	CONSOLE	CONSORT
6.	EXTRICATE	EXTRADITE
7.	EPIGRAM	EPITOME
8.	RAMPART	RAMPANT
9.	TENACITY	TEMERITY
10.	TARDY	TARRY
11.	UNTANGLE	UNTAUGHT
12.	VOLUBLE	VOLATILE
13.	DETRACT	DEGRADE
14.	UNION	UNITE

to ensure that equal number of distractor and signal words were present in each quarter of the test sequence, lest biases be introduced due to a sequence of rare or common word strings. The booklet is shown in Appendix XIX.

The subjects having seen the test items and read through the instructions proceeded to work through the two pages but were not allowed to turn over a page and compare previous responses to similar words.

Results:

The individual data is given in Appendix XX for the two groups of twenty-one subjects. On the basis of this the area programme used in Experiment 7 was used to produce the sensitivities and bias tendencies for common words vs. rare words for each group in turn and for the total (R+C) word performance for each group. The rare and common results are given in Appendix XXII.

Table 15 contains the $\underline{t}$ values for the comparison of rare and common word performance between English students and non-English students. None of the $\underline{t}$ values are significant. There is a tendency for the 'verbally-skilled' to be better at rare word performance ($\underline{t}$ = 1.59) but this is not significant.

Discussion:

Both groups of subjects recognized rare words better than common words (see Table 18). The English result was significant at the one percent level, $\bar{x}$ (TA) 0.7737 for rare: $\bar{x}$ (TA) 0.6656 for common words, $\underline{t}$ = 3.77**. Though the non-English result was not significant the rare word performance was still superior (0.7276 vs. 0.6828). The actual performance on this verbal task for both groups on all words was comparable ($\bar{x}$ 0.7197 vs. 0.7052 $\underline{t}$ = 0.66 Table 17). Though the 'skilled' verbal subjects perceived rare words better than common it was not done at the expense of common word performance (Table 15, $\underline{t}$ = 0.65) between English and non-English students on common words).

The molar verbal task showed no subject-group differences for sensitivity and bias. The overall performance, (R + C) words, produced biases of 2.073 and 2.0719 for English and non-English respectively, $\underline{t}$ = 0.0089; these bias values hardly differ from the null hypothesis of no bias where B = 2.000, see Table 17. When the word population is split up there were the following bias tendencies:-

English subjects were biased to say YES on rare words, $\underline{t}$ = 2.183* $\bar{x}$ (B) 1.6837 c.f. null hypothesis of 2.00, no expected bias. They were also biased to say NO on common words $\bar{x}$ (B) 2.4637 c.f. 2.00 $\underline{t}$ = 3.922**.

The non-English students showed comparable bias tendencies :-

Yes to rare (t = 1.148 n.s. $\bar{x}$ (B) 1.8638)

No to common ($\underline{t}$ = 2.076 n.s. $\bar{x}$ (B) 2.2799).

When the two populations were treated as a whole the rare vs. common word bias results was as follows:- $\underline{t}$ = 4.61** (Table 16) a definite tendency to say YES PRESENT on rare words c.f. common words. In brief, both groups are biased to say Yes present, when confronted by rare words and to say No absent on common words, (compare with the chemistry element experiment, where the chemists were biased to say YES on rare elements) Where other biases existed in Experiment 7, the biases were in the same direction as in this present experiment. Similarly in Experiment 3, arts subjects were biased towards saying Yes for physics words on the mainly physics-term list. In addition, in Experiment 3, the arts subjects always had a high false alarm rate (FAR) on all lists compared with the physics subjects: so rare items encourage a bias tendency to say YES irrespective of the proportions of rare to common items in the test lists.

The fact that infrequent words were recognised better than frequent ones was also found by Shepard (1967). Kintsch (1969) in his book has used this evidence for different retrieval processes in recall and recognition. In fact he argues that recognition tests by-pass the need for a retrieval process. This argument, supported by other workers, is shown to be invalid by Tulving (1970) in a series of very stringent experiments. While the difference between recall and recognition is not relevant here it is clearly apparent that in recognition tests rare words are perceived more readily than common words. It may be a function of cues and strategies employed by subjects, different testing procedures requiring different strategies for optimal results. For example Bahrick and Bahrick (1964) and Bruce and Cofer (1967) have shown that the usual superiority of recognition over recall depends upon experimental conditions and may be reversed by making the distractor items on the recognition test similar to the study items.

TABLE 15

ENGLISH STUDENTS AND NON-ENGLISH STUDENTS
RARE AND COMMON WORD PERFORMANCE

RARE WORDS

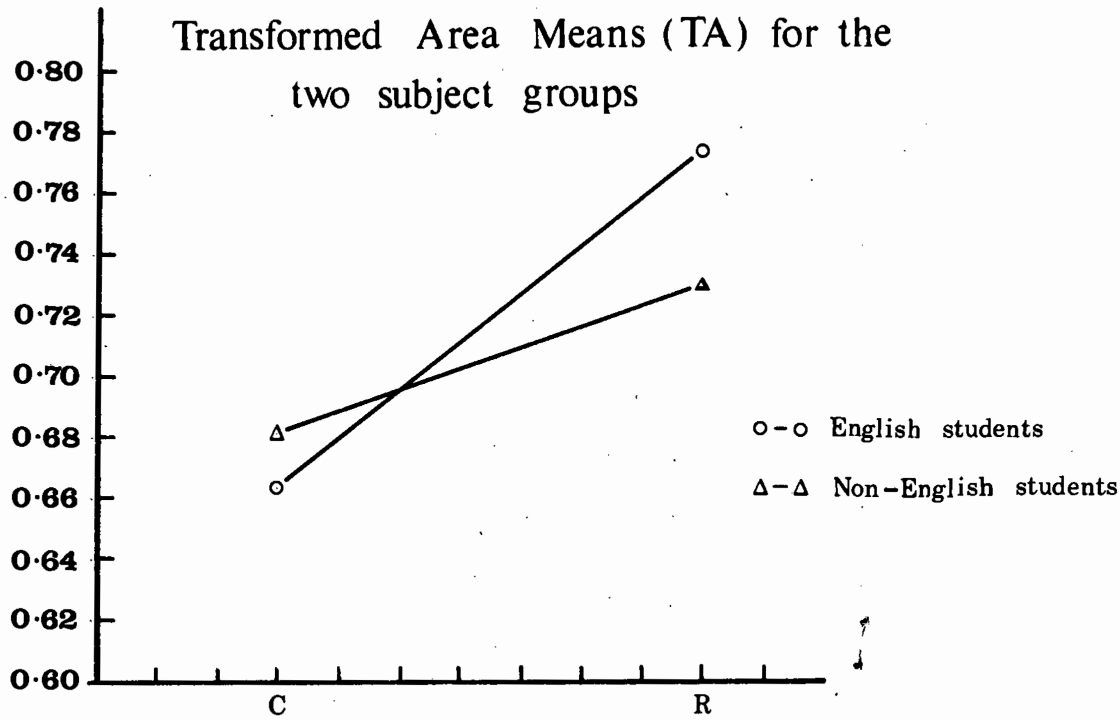
English Students (N = 21)		Non-English Students (N = 21)		
AREA (A)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	t
0.8645	0.0083	0.8129	0.0127	1.59
TRANSFORMED AREA (TA)				
0.7737	0.0082	0.7276	0.0096	1.55
BIAS (B)				
1.6827	0.4428	1.8638	0.2818	0.95

COMMON WORDS

AREA (A)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	t
0.7392	0.0148	0.7623	0.0107	0.65
TRANSFORMED AREA (TA)				
0.6656	0.0082	0.6828	0.0069	0.62
BIAS (B)				
2.4637	0.2934	2.2799	0.3635	1.01

See Figure 17 for graphical details, page 127.

Figure **17**


Transformed Area Means (TA) for the
two subject groups
0·80
0·78
0·76
0·74
0·72
0·70
0·68
0·66
0·64
0·62
0·60
C
R
o–o English students
Δ–Δ Non-English students

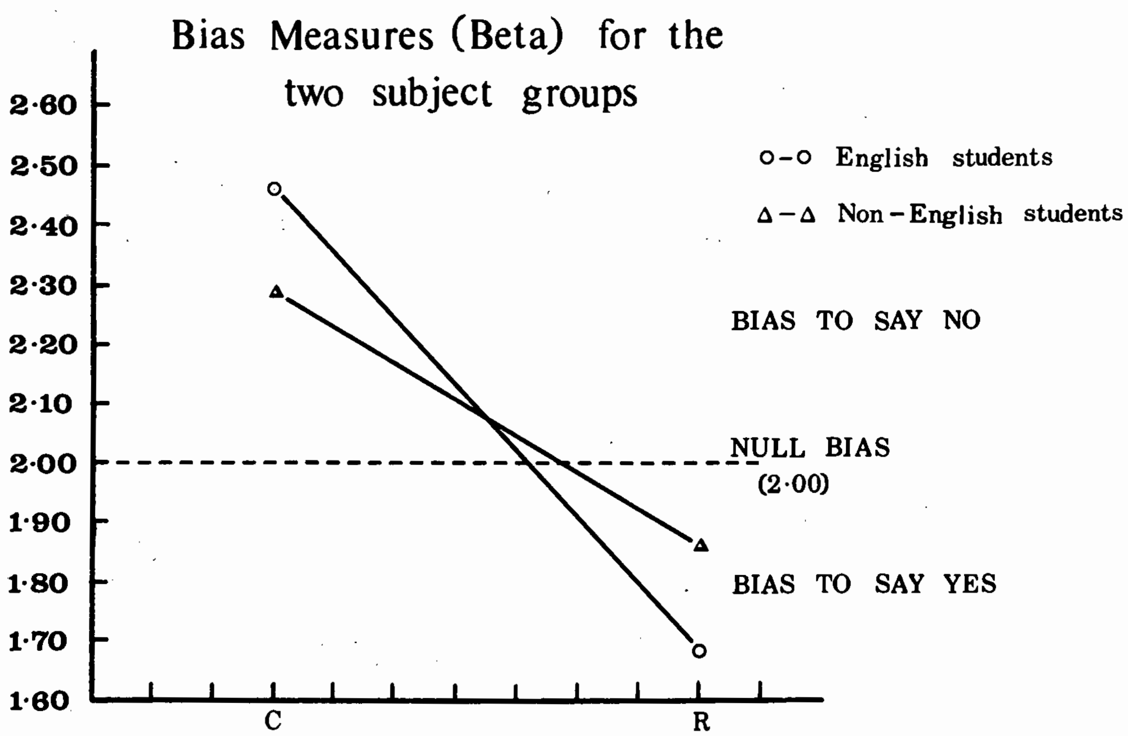

Bias Measures (Beta) for the
two subject groups
2·60
2·50
2·40
2·30
2·20
2·10
2·00
1·90
1·80
1·70
1·60
C
R
o–o English students
Δ–Δ Non-English students
BIAS TO SAY NO
NULL BIAS
(2·00)
BIAS TO SAY YES

TABLE 16

RARE WORD PERFORMANCE AND COMMON WORD PERFORMANCE FOR ALL STUDENTS (N = 42)

RARE WORDS		COMMON WORDS		
AREA (A)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	t
0.8387	0.0109	0.7508	0.0126	3.67**
TRANSFORMED AREA (TA)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	
0.7506	0.0092	0.6742	0.0074	3.80**
BIAS (B)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	
1.7733	0.3619	2.3718	0.3291	4.61**

t values for 82 degrees of freedom : two-tailed tests

** one percent level : * five percent level

TABLE 17

ENGLISH STUDENTS AND NON-ENGLISH STUDENTS TOTAL OF RARE PLUS COMMON WORD PERFORMANCE[1]

English Subjects (N = 21)		Non-English Subjects (N = 21)		t
AREA (A)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	
0.8019	0.0153	0.7876	0.0121	0.55
TRANSFORMED AREA (TA)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	
0.7197	0.0110	0.7052	0.0086	0.66
BIAS (B)				
$\bar{x}$	VARIANCE	$\bar{x}$	VARIANCE	
2.0732	0.5154	2.0719	0.3591	0.009

1 Word performance for each group : Before the word population was divided into Rare and Common (i.e. 28 S, and 28 N words)

TABLE 18

RARE WORD vs COMMON WORD PERFORMANCE

English Students

AREA

RARE $\bar{x}$	RARE VARIANCE	COMMON $\bar{x}$	COMMON VARIANCE
0.8645	0.0083	0.7392	0.0148

t = 3.68**

TRANSFORMED AREA (TA)

RARE $\bar{x}$	RARE VARIANCE	COMMON $\bar{x}$	COMMON VARIANCE
0.7737	0.0082	0.6656	0.0082

t = 3.77**

Non-English Students

AREA

RARE $\bar{x}$	RARE VARIANCE	COMMON $\bar{x}$	COMMON VARIANCE
0.8129	0.0127	0.7623	0.0107

t = 1.48 n.s.

TRANSFORMED AREA (TA)

RARE $\bar{x}$	RARE VARIANCE	COMMON $\bar{x}$	COMMON VARIANCE
0.7276	0.0096	0.6828	0.0069

t = 1.56 n.s.

t values for 40 degrees of freedom in each case.

CHAPTER ELEVEN

What is the role of pronounceability in verbal learning? How does it affect ease of learning when other factors are controlled, e.g. meaningfulness and word-frequency.

Laughery and Pinkus (1968) treated meaningfulness and pronounceability as dichotomies (an item is either meaningful and meaningless) whereas meaningful and pronounceability are often treated as continua, e.g. TAK and EKB may be treated as meaningless yet the former item may well evoke more associations than the latter. Boroskin and Lindley (1970) have studied levels of meaningfulness and pronounceability, the items having been calibrated by independent groups of subjects. Two hundred trigrams were collected so that 50 were meaningful but unpronounceable (e.g. FBI), 50 were meaningful but pronounceable common words (e.g. TRY), 50 were pronounceable but relatively meaningless items (e.g. SLE), and 50 were of low pronounceability and low-meaningfulness (e.g. DBE).

Results in a recall test showed that, unlike Laughery and Pinkus (1968), the pronounceable, meaningless items were not recalled better than unpronounceable, meaningful ones; in fact the latter items had a small but statistically significant advantage over the former. The critical difference between the two studies is that Boroskin and Lindley had more control over form class among the four conditions. The results are compatible with the notion that meaning and pronunciation are alternate modes of coding items into chunks, although pronounceability cannot be considered more important than meaningfulness.

On the other hand, Underwood and Schulz (1960) have adopted the hypothesis that pronounceability rather than frequency is the major variable in learning.

The Underwood and Schulz position has been challenged by a number of investigators. Johnson (1962) and Terwilliger (1962), also using trigrams, found that frequency of occurrence does make a significant contribution to learning even when pronounceability has been controlled.

Hall (1968) performed an experiment which represented a somewhat different approach in the examination of the role of pronounceability in learning. He kept pronounceability constant and the manipulated variable was word-frequency; he used a paired associate experimental situation. Four lists were constructed which used the varying combinations of high and low frequency stimulus and response words (H-H, H-L, L-H, L-L). Results contrary to the Underwood-Schulz position, revealed that learning was most rapid for the high-high combination, followed by L-H, H-L, and L-L.

Gibson, Bishop, Schiff and Smith (1964) have reported the results of an experiment which would appear to be an important contribution to this problem. Their study examined the extent to which pronounceability and meaningfulness served as grouping principles in the perception and retention of visually presented verbal materials. The stimuli used were trigrams in which the same letters could be arranged into a meaningful, pronounceable, or nonsense permutation. The pronounceable items were identified at a lower threshold luminance level, as determined by an ascending method of limits. The authors concluded that pronounceability provided "a better grouping principle for reading or coding to speech units (p.173)".

Thus the result of the Gibson et al (1964) study would appear to indicate the role of a translation into a speech code (giving support to Sperling (1963)). Contrary to this, however, certain lines of evidence have strongly suggested that the recognition of simple stimuli at low energy levels is determined almost entirely by physical properties of the stimulation and by the decision processes in selecting the response (Lappin and Lowe (1969)). Closer examination of the Gibson et al. (1964) experiment indicates that response biases may have contributed to the results. Determination of "thresholds" for an undefined stimulus set by an ascending method of limits with naive subjects allows ample opportunity for the influence of response biases.

Lappin and Lowe (1969) in three fine experiments have shown the importance of the subject's strategy as well as the fact that coding of pronounceable items is more related to overt response processes than is the coding of meaningful items. They disagree with Gibson et al. (1964) though they did show that pronounceability and high meaningfulness do constitute cues on which subjects form concepts as to the class of stimulus items which may be expected to occur. In addition they stress the role of strategies. "The selection of a particular code may depend upon instructions, practice, composition of the stimulus set and/or response model These variables may explain discrepancies obtained with different procedures in many memory studies. For example, the results of the Gibson et al. (1964) study and of Exp. 11 conflict with the results of Baddeley (1966), Laughery and Pinkus (1968, and Exp. 111 probably because of differences in the extent to which potentially pronounceable items were overtly or covertly pronounced by the subjects (Lappin and Lowe, 1969)".

Experiment 9

The purpose of the present study was to re-examine the role of pronounceability among very rare English words presented visually and tested by the utilization of a recognition memory procedure. Previous experiments have mainly concentrated on the use of nonsense syllables or trigrams and have used recall procedures. How does pronunciation affect recognition when all the words are very rare (i.e. the word frequency is very low, or a constant)?

Method:

Rating Procedure: All the rare words from the rating norms (Appendix XV11 used in Experiment 8 were rated by forty University House (U.C.T.) students. All the students possessed English as a first language. One hundred and forty-six rare words were typed on two sheets to form a three page booklet, the first page being the rating instructions, (see Appendix XX1V), which requested the rater to assess each word's degree of pronounceability on a four point scale: examples are given.

From the one hundred and forty-six words, fourteen easy to pronounce pairs were extracted as well as fourteen hard to pronounce pairs (see Tables 19 and 20).

Subjects: Twenty-seven students were used for this experiment. The students were from the Arts and Science Faculties; a comparable proportion to that of the rating population. The subjects were paid for their participation in this experiment.

Apparatus and Stimuli: The apparatus was the same as used for Experiment 8. The twenty-eight stimulus words (see Table 19) were typed on cards and photographed: twenty-eight slides were made from these.[Φ]

The test booklet consisted of all the inspection and distractor words from Tables 19 and 20. Care was taken to ensure that equal proportions of easy and hard to pronounce words were present on each sheet and that an equal number of stimulus and noise items were present on each page of the three page booklet (see Appendix XXVII). As before, the first page was a page of instructions requesting surety judgments on a four point scale (c.f. Experiment 8).

Procedure: The subjects were tested in groups of three. They viewed the slides which were presented at two second intervals as in the previous experiment. Then they read the instruction page and worked through the two pages of fifty-six words.

Results:

The individual results are given in Appendix XXVI whilst the hit and false alarm rates for the four categories for the twenty-seven subjects are given in Appendix XXVIII, the sensitivity and bias measures extracted from the categories are present in Appendix XXIX.

In Table 21 are tabulated the means and variances for the

Φ The stimulus words are actually the left hand column items of Tables 19 and 20.

TABLE 19

EASY TO PRONOUNCE PAIRS

SIGNAL	NOISE
ABROGATE	ABNEGATE
ASPERITY	ACERBITY
DIELECTRIC	DIALECTIC
EXCUPATE	EXCURSUS
EXOGENOUS	ENDOGENOUS
HOMONYM	METONYM
IMMANENT	IMMOLATE
INEFFABLE	INERRANT
MEROSIS	MASQUE
NEOTERIC	NEOPHYTE
PALLINODE	PALLIATE
PRORATE	PROROGUE
PROTEAN	PROTASIS
REDOLENT	RECREANT

TABLE 20

HARD TO PRONOUNCE PAIRS

SIGNAL	NOISE
APOCALYPTIC	ANTITHETICAL
BERGMEHL	BERGSCHRUND
BICAMERAL	BICEPHALOUS
CABRIOLE	CABRIOLET
CONSUETUDE	DESUETUDE
CONTUMACIOUS	CONTUMELIOUS
EXIGEANT	EXIGENT
EXTIRPATION	EXECRATION
PERIPHRASIS	POETASTER
PETRARCHAN	PORTENTOUS
PERSPICUOUS	PERSPICACIOUS
SENESCENCE	SENESCHAL
SYBARITIC	SYCOPHANT
SYNECDOCHE	SYNONYMICON

TABLE 21

BIAS AND SENSITIVITY MEASURES (MEANS AND VARIANCES)
FOR THE HARD vs EASY TO PRONOUNCE WORD-PAIRS :
EXPERIMENT 9, (N = 27).

		HARD	EASY
Sensitivity (A)	$\bar{x}$ (A)	0.8103	0.8051
	VAR	0.0130	0.0133
(TA) (Transformed)	$\bar{x}$ (TA)	0.7121	0.7073
	VAR	0.0115	0.0111
		t = 0.163 n.s.	
Bias Scores	$\bar{x}$ (B)	1.9671	1.9206
	VAR (B)	0.5188	0.3870
		t = 0.249 n.s.	

t values for 52 degrees of freedom.

bias and sensitivity measures. It can be seen that there are no significant differences between the two pronounce-ability measures.

Discussion:

There can be no claim for pronunciation aiding recognition memory (Sensitivity measure (A)) in this experiment ($\bar{x}$ (A) hard 0.7121 vs. $\bar{x}$ (A) easy 0.7073). Nor can one claim any bias tendencies in favour of any word-group ($\bar{x}$ (B) 1.9671 vs. 1.9206; hard vs. easy). The latter is somewhat surprising. It does not appear that given a nearly constant word frequency (at least at very low values of frequency) that ease of pronounceability is of any aid in recognition.

The fact that rare and easy to pronounce words were not more easily perceived in recognition memory than rare and difficult to pronounce words, weighs heavily against the hypothesis of Gibson et al. (1963, 1964) that the pronounce-ability of the words is the relevant factor underlying the independent variable. On the other hand, it does not necessarily follow that an alternative current explanation - Miller, Bruner & Postman's (1954) 'redundancy' hypothesis - is appropriate.

Indeed, many theorists (e.g. Neisser (1967) p.111) have expressed dissatisfaction with an information theory explanation of the effect of spelling patterns on the recognition of words. 'Redundancy' of printed English, as originally defined and measured by Shannon (1948, 1951), involves the probability of subjects correctly guessing consecutive letters, in the absence of stimulus information. The relationship between this guessing performance, and the subject's performance when perceptual cues are present, is not clear.

However, when a subject is asked to make an absolute judgment concerning the ease or difficulty of pronouncing a verbal unit, Hall's (1968) findings suggest that other attributes of the unit, i.e. frequency or association value, may influence his judgment. This position, in keeping with an early statement by Underwood and Schulz (1960) who speculated that such a factor might be operative when they had subjects rate verbal units for pronounceability, also has had recent experimental support from Gorfein (1967).

On comparing the two lists there certainly appear to be some 'pronounceable' items in the unpronounceable category, though of course the word frequency (very rare words) must be close to a constant.

It could be argued that this is a recognition experiment and the studies mentioned earlier were mainly recall experiments. However, is recognition so different from recall?

Recognition, the identification of an event is identical with one that occurred before, depends among other things, upon accessibility of stored information. Many students of memory think the opposite (e.g. Kinsch, 1970). To say that recall is a search process and recognition is not, as Kinsch does, is misleading as Tulving and Thomson (1971) have shown. The assumption is rife that recognition and recall differ radically in the retrieval or search aspect of memory. Recognition tests do not by-pass the search and retrieval processes as Tulving and Thomson (1971) have illustrated. (This will be discussed and elaborated upon at a later stage of this thesis). It is clear that pronounceability is of little importance in recognition of stimuli. In recognition, at least, Underwood and Schulz's (1960) hypothesis that pronounceability rather than frequency is the major variable in learning, does not appear to hold.

CHAPTER TWELVE

It is feasible, but unlikely, that the dissimilar performances on common and rare terms in Experiments 2 and 7 (Figures 3 and 12) is a function of the difference between the rare stimuli used. That is, the chemistry terms may be harder to recognize as they are 'less like English words' than the physics terms. Or indeed, the reverse may be the case; the physics terms may have more 'salience', they may stand out more and consequently be recognized better.

It would be better if an experiment were performed in order to compare both rare chemistry and rare physics terms, and the subsequent recognition performance, without the use of common terms.

Experiment 10

Method:

Subjects: The subjects were eighteen History and English Literature Honours students from the University of Cape Town; they were paid for their participation. None of the students had any physics or chemistry training higher than one year before matriculation.

Materials: Slides were made of the eight signal chemistry elements and of eight out of ten of the rare physics terms. The two physics terms were dropped as they did not possess good distractor items. In fact of the eight physics pairs only six were of comparable appearance (see Table 22).

A recognition booklet similar to that of the previous three experiments contained the sixteen stimulus (signal) items and the sixteen distractor (noise) items; randomly

TABLE 22

RARE TERMS USED IN EXPERIMENT 10

Rare Chemistry Terms

ERBIUM	EUROPIUM
FRANCIUM	FERMIUM
HOLMIUM	HAFNIUM
LAWRENCIUM	LUTETIUM
NEODYMIUM	NEPTUNIUM
PRAESEODYMIUM	PROTACTINIUM
YTTERBIUM	YTTRIUM
THULIUM	TECHNETIUM

Rare Physics Terms

ADIACTINIC	AUTOCLAVE
BEVATRON	BARYON
EUTECTIC	ELECTRET
MAGNETRON	MEGATRON
PARSEC	PARACHOR
TRITON	THERMION
CATENARY	DIPLET
ELASTANCE	ISOTRON

assigned to allow equal numbers of chemistry and physics signal and noise items in each half of the test page (see Appendix XXX).

The instruction page of the booklet was similar to those of the previous two experiments: a four point scale of judgment was required as before, from absolutely sure present to absolutely sure absent.

Procedure: The subjects were tested in groups of three. They viewed the sixteen slides (signal items) which were presented on a screen for three seconds each using a Kodak Carousal automatic projector. The subjects were instructed to try and remember the words viewed. After viewing the series the subjects read the instruction booklet and worked through the test sheet.

Results:

The individual results for the rare physics and chemistry words are shown in Appendix XXX1. From these the area (sensitivity) and bias measures were produced using Dr McNicols' area programme as before. The area and bias results are shown in Appendix XXX11. The means, variances and *t* test results are shown in Tables 23 (a) and 23 (b).

Discussion:

The chemistry terms were not harder to recognize than the physics terms (t = 1.71 n.s.). It is unlikely that the differences between the results of Experiments 2 and 7 were due to the difficulty of the chemistry item recognition among the subjects: of great interest is the bias result. The subjects were biased to say Yes (laxity) on the chemistry items compared

TABLE 23 (a)

MEANS, VARIANCES AND t-TEST VALUES
FOR THE RARE PHYSICS AND CHEMISTRY TERMS
(N = 18)

Chemistry Terms		Physics Terms	
SENSITIVITY SCORES			
$\bar{X}$	VAR	$\bar{X}$	VAR
0.8980	0.0097	0.8797	0.0124
TRANSFORMED (TA) SCORES			
$\bar{X}$	VAR	$\bar{X}$	VAR
0.6676	0.0182	0.7453	0.0168
t = 1.71 n.s.			
BIAS SCORES (B)			
$\bar{X}$	VAR	$\bar{X}$	VAR
1.4686	0.3858	2.2223	0.5457
$t = 3.22^{**}$ (2-tailed)			

TABLE 23 (b)

COMPARISON OF BIAS RESULTS WITH THE NULL
HYPOTHESIS OF NO EXPECTED BIAS (B=2.000)

Chemistry Terms

$\bar{X}$	VAR	
1.4686	0.3858	$t = 3.63^{**}$ (2-tailed)

Physics Terms

$\bar{X}$	VAR	
2.2223	0.5457	t = 1.28 n.s.

For 34 df. t = 2.73 (two-tailed 1% level).

** Significant at the 1% level.

with the physics terms ($\underline{t} = 3.22^{**}$) and compared with the null hypothesis of no expected bias ($\underline{t} = 3.63^{**}$); two-tailed tests. This supports the result for Experiment 7, for chemistry subjects: but not for the non-chemistry subjects.

A comparison of these results with Experiment 8 shows a similar phenomenon occurring on the rarer items. The bias is to say 'Yes' to the rarer words (see for example page 121 and Table 16 page 124). This was again shown in Experiment 3 where the arts subjects were biased towards saying 'Yes' to physics terms on the mainly physics word list.

As expected the physics terms were easier to recognize (0.7453 vs 0.6676, $\underline{t} = 1.71$ n.s.) but this result was not significant, and though it supports the diagram difference (Figures 12 and 3) it is not sufficient to explain the discrepancy: why are common elements perceived better than rare ones when all the other experimental evidence shows the contrary? It is possible that the multiple testing procedure has confounded the results, or rather has altered the <u>context</u> of the experiment and consequently no comparison can be made. The importance of context in recognition tests has been shown by Tulving and Thomson (1971) and this will be the subject of study of Part II of this thesis.

PART TWO

PART TWO - INTRODUCTION

One of the more significant developments in verbal learning has been an increasing realization that the subject in a verbal learning experiment is far more than an associative mechanism. The subject rather brings to bear complex organizational processes which serve to transform the stimulus materials presented to him.

In free recall Tulving (1964, 1968a), following Miller (1956), has shown that subjects can improve their organizational skills (even though they cannot increase their memory span) as they can increase the number of nominally independent information chunks in spite of the constancy of the functional information chunks. This is accomplished by coding or regrouping and reorganizing items; a relevant factor being the "E unit" of Tulving's (1964, 1968a). The E unit may be thought of as an "experimenter unit" as it is counted as a single unit by the experimenter (D'Amato 1970, page 581). However, several E units may be incorporated into a single subject (S) unit; the "information chunk" which is the functional element stored in the subject's memory. Thus recourse is made to a higher-order memory unit for storage.

This part of the thesis (Part II) will address itself to the effects of context upon recognition and the influence of repetitions on memory items. A consideration will be given to first, the effect of repetition upon memory, and secondly to the manipulation of context: in particular utilizing strong and weak cues in recognition memory. The molecular approach (word frequency, pronounciation, meaning etc) will be secondary to a molar view of the effect of context upon the to be remembered (TBR) words, and a consideration of the higher order memory units, utilizing chemistry students and the Periodic Table.

CHAPTER THIRTEEN

Recency Judgements and Repetition Experiments

Yntema and Trask (1963) have measured recency discrimination of words presented in a recognition task. In their experiment, a long succession of words was presented to the subject on cards, and at various points in the sequence he was tested by being shown two words at once. His task was to indicate which of the two words he had seen most recently. The longer the interval separating the original presentations of the two items, the more accurate was the discrimination behaviour. Further, the shorter the interval from the most recently presented item to the test, the better the discrimination behaviour. This seems reasonable on the assumption that the subject is discriminating time by some means. The greater the difference in times the easier should be the discrimination. Then, if whatever is being discriminated in relation to time changes in a negatively accelerated manner, the shorter the time since the last item, the easier should be the discrimination.

One experiment shows the effect of discriminatory behaviour in a striking fashion. Wickens, Born and Allen (1963) presented a subject with a sequence of tests on items made up of digits or letters. The activity minimizing rehearsal during the retention interval was colour naming. They found the customary decrease in retention after the first few tests. Then a test was given in which letters constituted the message for subjects who had previously been tested on digits. Recall of this item from a new class, letters as compared to digits, was found to be as good as recall on the first test of the session. Switching to a new class eliminated the interfering effect of the previous tests. It does not seem likely that the availability of the previous items decreased as a result of the new class being used. Rather, it seems that subjects can remember <u>class membership</u>, that letters were used in the most recent test, and they can edit their responses on the basis of that information.

There remains the question of how the subject can <u>discriminate recency in the case where the current item is of the same form class as previous messages</u>. In what sense do items bear "time tags", as Yntema and Trask (1963) have written? One possibility is that the memory trace varies in strength, and the subject discriminates the <u>amplitude</u> of this trace (Konorski, 1961, p.122). Another possibility is that an item becomes embedded in a <u>context</u> of other successive events, and can be <u>discriminated relative to this stream of events</u>. Peterson (1967) has run a recognition experiment which attempts to differentiate between these two explanations. A succession of words, one at a time, is presented to the subject. Occasionally a word has a question mark after it, and the subject has been instructed that when he sees this test item he is to estimate how many other items have been shown since he last saw the test word. Some of the words had been presented twice before being tested, others had been presented only once. A strength interpretation would seem to predict that items which had been presented twice should be judged more recent than items which had been presented only once. A single trace represents the stored item and the trace should be stronger with repetition. On the other hand, if the subject judges recency by the context in which the word appeared, two traces should be involved based on two presentations. Hence his judgment of how many items have intervened since the last of the two presentations should be at least as great as in the case of one presentation. To the extent that both traces may be present at the time of the test and he can keep the most recent presentation distinct from the earlier presentation of the same item, his judgment should be the same as in the case of a single presentation.

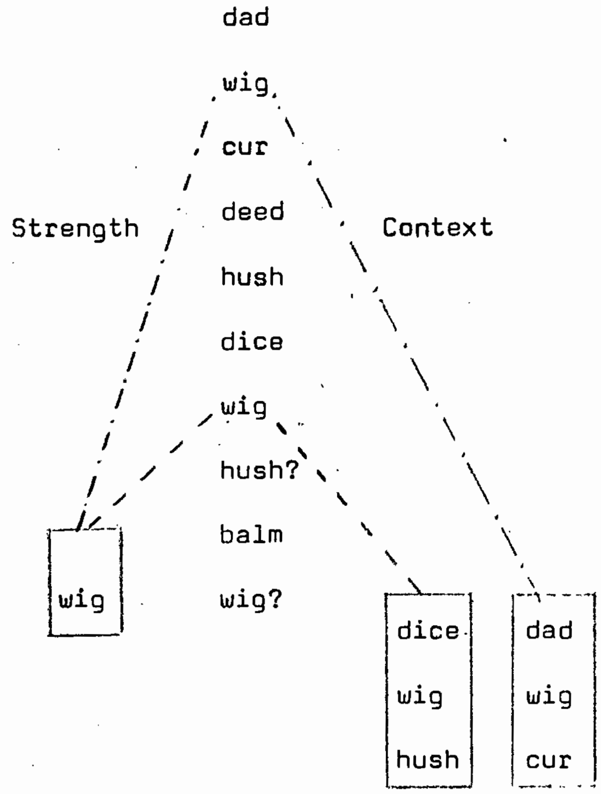


Figure 18:

Single and multiple trace conceptions of recognition memory. (Peterson 1967)

Figure 18 schematizes the two conceptions. The sequence of words is part of a block of words that was presented to the subjects. It can be seen that tests and presentations are interspersed in such a way that various conditions overlap. In the example shown, presentation of "HUSH", a single presentation condition with two intervening items, is completely contained within the sequence of events testing "WIG".

Figure 15 depicts the mean judgment of recency in two independent experiments. One was run with the memory drum set at a 2-second rate and the other at a 4-second rate. Within a given presentation rate each subject was tested 4 times in each of the 16 conditions of testing. Twenty-eight subjects were run at each rate. Tests were of the same duration as presentations. It was shown that subjects were on the average fairly accurate in their judgments of recency for items tested after up to 5 intervening items at the 2-second rate. At the 4-second rate subjects did a little better, being close to the ideal through 6 intervening items. In both cases subjects tended to overestimate small numbers of intervening items. The underestimates of the larger numbers of items probably reflect a guessing tendency for which there is a ceiling effect.

The point to be made is that there is no consistent difference between recency judgments after <u>one</u> as compared to <u>two</u> presentations. There is <u>no</u> support for a strength interpretation of the discrimination of recency, in spite of the fact that two presentations can be assumed to have produced a greater likelihood of being recognized as having occurred in the experimental session. It seems highly unlikely that the two presentations were too far apart for the earlier to affect the later. Four intervening items separated the two presentations in every case. By some means the subjects were able to distinguish the most recent occurrence of a word from earlier occurrences and judge the recency of that event. Of course, not only did the two occurrences have different words preceding and following them, but the subjects could undoubtedly recognize on the second occurrence that they had seen this word before. This recognition may have helped to make the second occurrence distinctive from the first.

Returning once more to the testing of individual items, Petersen has run an experiment in which subjects were given extended time, up to 20 seconds, in which to recall the current item. If an incorrect response was given, the experimenter said, "Wrong," and the subject continued to try to produce the correct response. The subject could make as many responses as he liked in the 20 seconds. One is interested in whether competition from the previous tests would be reduced by telling the subjects that a response was wrong. To what extent did the subject make the correct response? (Ninety-six subjects were run for six tests on trigrams having no letters in common.) The trigram was presented in a memory drum for 2 seconds, and then a number from which to count backward was presented. A rest interval of 10 seconds was given after the 20-second recall interval was concluded. It was shown that subjects were able to some extent to recall correctly after an initial wrong response. The point to be noted is that they were by no means able to correct themselves in 100% of the cases. Many responses were simply not available. They may have become unavailable by action of the recall process, or they may have been altered or lost during the retention interval activity. Note that there was some slight forgetting on the initial test of the session. It should also be considered that the trigrams, low association value CCCs, were not well-integrated units. A part of the recall task was the ordering of the elements. To the extent that this ordering was inefficient there can be said to have been intra-item interference, although it should be noted that this type of interference seems to be effective only in interaction with previous test items.

The experiment points up a limitation on the decision-making ability of subjects. Even when they are able to discard some information with the help of the experimenter, they cannot necessarily produce the correct response. If the response is not _unitary_ in composition, it may be unavailable.

Repeated items and the context within which they are buried:

It is not immediately obvious in a general sense, whether sequences which include repeated items (e.g., 61647) are easier to memorize or not than sequences with all different items. When a few sequences are constructed by drawing items from a set strictly randomly, the repetition factor is poorly controlled. (Conrad, 1965).

Wickelgren (1965) set up digit sequences of length 6, 7, 8, 9 or 10 items and with a variety of repetition patterns.

The sequences were auditorally presented at 1 digit/sec. His study reports on 17 different repetition sequence types, and one "all different" type which had no digit repeated, and with which the other 17 were compared in terms of % wrong sequences. Recall on 8 of the 17 sequence types was no different from the "all different" type; 1 was significantly worse, and 8 were significantly better.

This would appear to show that in general, repetition of items improves recall, but a more detailed study of Wickelgren's sequence types. suggests a relationship between the nature of the repetition pattern and ease of learning. Specifically, the greatest advantages are for sequence types with highly structured repetition patterns, e.g. 66114827 or 61614827 or 66614827. The sequence types which were not significantly different from the "all different" type were those with less regular repetition pattern, e.g. 14961670 or 16493670, etc.

"The importance of patterning can easily be illustrated in a simple classroom demonstration. If the sequences 085358703 and 620268899 are each visually exposed for immediate recall for say, 4 sec. to University students, it will generally be found that the latter sequence is correctly recalled by more students than the former. Both sequences have 4 digits repeated but of course in different patterns. (Conrad, 1965)."

That the pattern of repetition is crucial is supported by an experiment by Conrad (1965) in which 32 8-digit sequences were visually presented in a single exposure of 3.5 sec. Four sequence types were used with 8 examples of each, viz.: all digits different, one digit repeated, two digits repeated, three digits repeated. The location in the sequences of the repeated digits was strictly random, and the different sequence types were presented in haphazard order in a single test to 20 subjects, Table shows the % correct sequences for the 4 sequence types.

TABLE 24

Repetition Pattern and Recall Performance

	Number of Repeated Digits			
	0	1	2	3
% Correct Sequence	49.4	41.9	38.8	36.3

Clearly these results are at variance with those of Wickelgren, since best performance occurs with sequences without repeats, and the more digits repeated, the worse is recall. The essential difference seems therefore to be in the degree of patterning, and it seems difficult at this stage to specify exactly the point at which repetition aids or hinders recall or recognition.

Thus care is needed to ensure that the context of items within which repeated items are buried, is exactly the same: thus obviating spurious results due to patterning unconsciously introduced by the experimenter: Conrad's point is well taken.

It is a common assumption that giving a subject several repetitions of a to-be-remembered (TBR) item has an effect on memory that is equivalent to that of one long exposure of that item. That is, the effects of frequency (or number of repetitions) and exposure duration are thought to be mediated by a single underlying dimension of the memory trace, namely its strength. Hintzman (1970) has considered the possibility that frequency and duration may have different effects. He has postulated that judgment of frequency is based on strength whilst judgment of duration is based on strength and on an independent dimension of the trace related to duration. The total time hypothesis, or law, did not hold when the duration was manipulated within lists (c.f. chapter 7). This would appear to support Underwood (1969). Underwood has made a case for viewing memory as the storage of attributes which together comprise an event. In addition to the aggregate of such attributes (this being redolent of Miller (1968) see page 110) which coexist in time and usually serve to define such an event; Underwood has listed frequency and time of occurrence as important dimensions of memory. The evidence, while not quite conclusive, suggests that neither reduces to a simple process such as for example, strength of association. Vitz and Hazan (1969) have furnished evidence that a temporal tagging process occurs. It would indeed be surprising (as Miller (1968) has pointed out) if higher organisms could not use a spatial attribute in memory for events.

It is therefore fruitful to examine once more (but in greater detail) the effect of repetitions (c.f. Experiment 5) and to concentrate also upon the effect of context upon the remembering of repeated items. Certain contexts may encourage over-estimating of the number of items, others may cause underestimation. The following experiment will examine more closely contextual as well as repetition effects upon recognition memory.

Experiment 11

The purpose of this experiment was to investigate the perception of repeated words (physics and English words) embedded in a series of physics and English words as background contextual noise. Previous experiments have utilized stimuli of similar class and consequently the effect of varying context on repetition item perception was not directly observable.

Method:

Subjects: Sixty-four non-science students from the Education Faculty of U.C.T. were used as subjects; they were paid for their participation. They were divided, on a random basis, into four equal groups of sixteen.

Apparatus and Stimuli: The stimuli were physics and English words each list being comprised as follows :-

LIST A: 32 Physics words (PWs)

LIST B: 32 English words (CWs)

LIST C: 18 English words and 14 physics words.

LIST D: 18 Physics words and 14 English words.

Each list contained eighteen critical words, repeated items as follows :-

LISTS B & C:

Three appearances of: SECOND, TONIGHT, and COLUMN

Two appearances of: CAPTAIN, DINNER, and MIRROR

One appearance of: CREATURE, VILLAGE, and INSTANCE.

LISTS A & D:

Three appearances of: SECANT, TETRODE, and COULOMB.

Two appearances of: CATHODE, DIPOLE, and MICRON.

One appearance of: CALORIMETER, VERNIER, and ELASTANCE.

Thus, each list contained eighteen critical words (CWs or PWs); three repetitions of second, tonight and column on lists B and C, three of secant, tetrode and coulomb on lists A and D, etc. The breakdown of each list being as follows :-

LIST A: 14 PWs, 18 critical PWs: all physics list.

LIST B: 14 CWs, 18 critical CWs: all English list.

LIST C: 14 PWs, 18 critical CWs:) mixed lists.

LIST D: 14 CWs, 18 critical PWs:)

The complete lists are given in Appendix XLV. Five filler items were present at the beginning and end of each list, making an inspection list of forty-two slides. The filler items were ten PWs on lists A and C, and ten CWs on lists B and D: the forty-two words comprised the inspection list. The test list was a list of the critical words, (CWs or PWs - depending on the list viewed), see Appendix XXXIII. The twelve words (creature, captain, village, second, dinner, granular, mirror, menace, tonight, parable, column and instance, or the physics equivalent) were typed on sheets with two columns for (a) the number of repetitions, (b) the degree of surety from absolutely sure to guessing on a three point scale.

Procedure: The subjects were tested in groups of eight. Two groups of eight for each of the four conditions. The subjects were instructed to view the inspection (slide) series shown on a screen, projected by a Kodak Carousel 550R projector: each slide being exhibited for three seconds.

TABLE 25 (a)

LIST A:			LIST B:		
1 - 5	Filler Items		1 - 5	Filler Items	
6	COULOMB	(1)	6	COLUMN	(1)
7	TETRODE	(1)	7	TONIGHT	(1)
8	DIELECTRIC		8	PROTECTION	
9	MEGATRON		9	HEALTH	
10	CALCITE		10	EXAMPLE	
11	MICRON	(1)	11	MIRROR	(1)
12	DIPOLE	(1)	12	DINNER	(1)
13	VERNIER	(0)	13.	VILLAGE	(0)
14	SECANT	(1)	14	SECOND	(1)
15	DYNATRON		15	DIFFERENCE	
16	COULOMB	(2)	16	COLUMN	(2)
17	SOLENOID		17	REASON	
18	TETRODE	(2)	18	TONIGHT	(2)
19	RHEOSTAT		19	OPINION	
20	CALORIMETER	(0)	20	CREATURE	(0)
21	SECANT	(2)	21	SECOND	(2)
22	RESONANCE		22	CIRCUMSTANCE	
23	CATHODE	(1)	23	CAPTAIN	(1)
24	ADIACTINIC		24	GOVERNMENT	
25	MAGNETRON		25	POSSIBILITY	

TABLE 25 (a) (Contd)

LIST A:			LIST B:		
26	CATHODE	(2)	26	CAPTAIN	(2)
27	AUTOCLAVE		27	INSTITUTION	
28	MICRON	(2)	28	MIRROR	(2)
29	COULOMB	(3)	29	COLUMN	(3)
30	SECANT	(3)	30	SECOND	(3)
31	ELASTANCE	(0)	31	INSTANCE	(0)
32	TETRODE		32	TONIGHT	(3)
33	BEVATRON		33	NONE	
34	DIAMAGNETISM		34	THOUSAND	
35	DIPOLE	(2)	35	DINNER	(2)
36	VISCOSITY		36	INDUSTRY	
37	TENSOR		37	OBSERVATION	
38 - 42 Filler Items			38 - 42 Filler Items		

0: the critical word appears once only.

(1), (2), (3): the first, second and third appearance of the critical word preceding the numeral. The total number of appearances for the critical words (and their positions) appear in Table 25(b)

TABLE 25 (b)

THE CRITICAL WORDS : EXPERIMENT 11

COMMON WORD	PHYSICS WORD	LIST POSITION	NUMBER OF APPEARANCES
COLUMN	COULOMB	6, 16, 29	3
TONIGHT	TETRODE	7, 18, 32	3
MIRROR	MICRON	11, 28	2
DINNER	DIPOLE	12, 35	2
SECOND	SECANT	14, 21, 30	3
CAPTAIN	CATHODE	23, 26	2
VILLAGE	VERNIER	13	1
INSTANCE	ELASTANCE	31	1
CREATURE	CALORIMETER	20	1
GRANULAR	GALVANOMETER	Absent	0
PARABLE	PARACHOR	Absent	0
MENACE	MENISCUS	Absent	0

After viewing the slide series the subjects read the instruction page of the test sheets (Appendix XXXlll). They were requested to decide how many times they had viewed the particular critical word in question, and to ring the number under repetitions column: and also to give the degree of surety of their response. A three point scale from absolutely sure (1), to guessing (3), was used: examples were given to clarify the procedure.

Results:

A. The Over or Under-Estimation of the Critical Words:

I Within Lists:

Table 26 contains the means for this analysis. A negative sign meaning that the subjects under-estimated for that particular condition, (e.g. three repetitions $\bar{x}$ = -0.875 for list A). The analysis of variance (ANOVAR) for each list produced the following significant differences :-

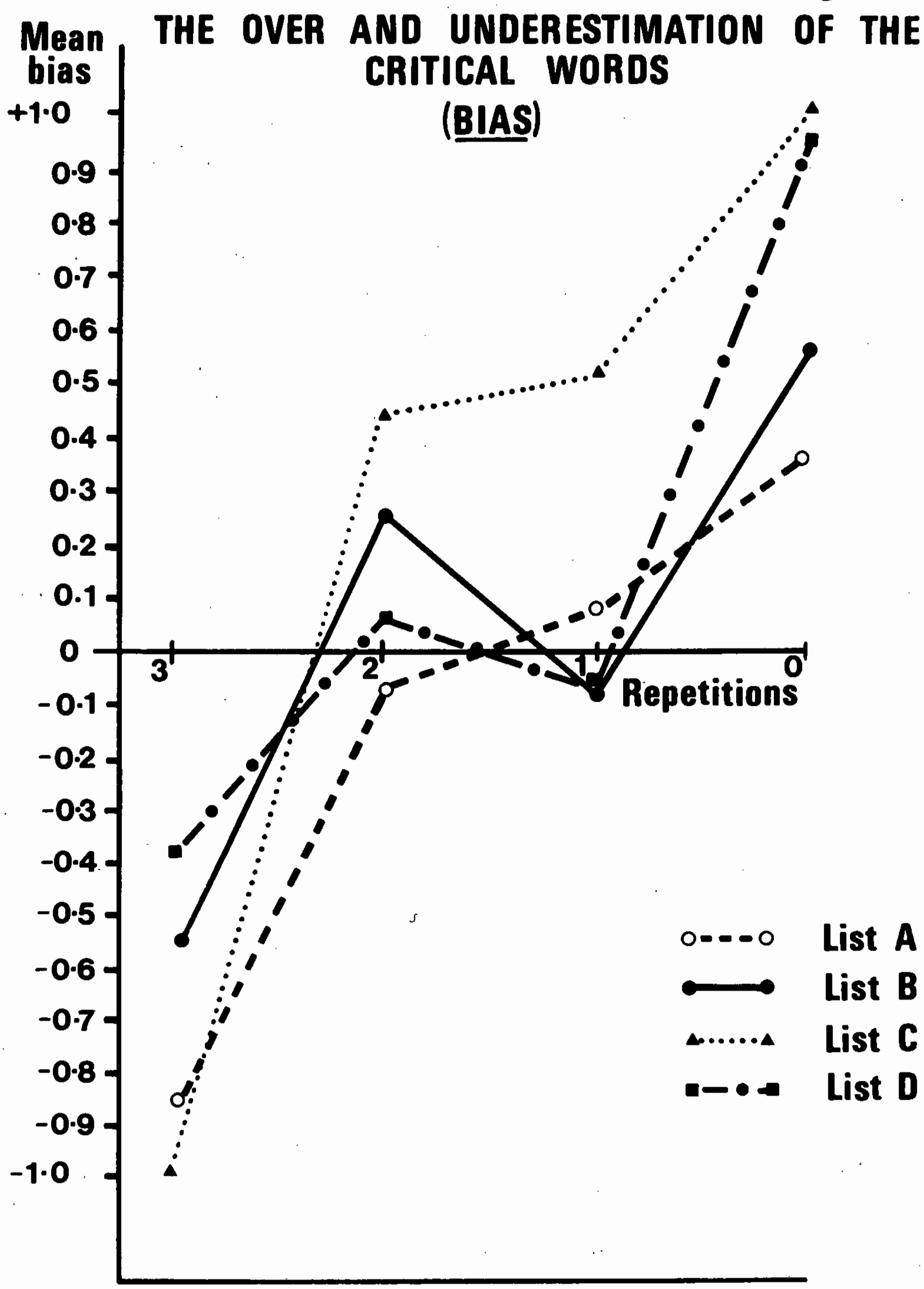
(a) List A: Between treatments (3, 2, 1 and 0 exposures), $F(3, 45) = 5.86^{**}$. This being mainly due to :-

(i) a significant under-estimation for three appearances compared with one appearance ($\bar{x}$'s of -0.875 c.f. +0.063; $F(3,45) = 3.024^{*}$).

and (ii) three compared with no appearances ($\bar{x}$'s, -0.875 c.f. +0.375) $F(3,45) = 5.376^{**}$). The other F values did not reach significance. (see Appendix XLlll).

(b) List B: Between treatments (3,2,1 and zero exposures), $F(3,45) = 5.397^{**}$. Again due to an underestimation of the occurrence of the 'three exposure' words. Due principally to:-

figure 19


THE OVER AND UNDERESTIMATION OF THE CRITICAL WORDS
(BIAS)
Mean bias
+1·0
0·9
0·8
0·7
0·6
0·5
0·4
0·3
0·2
0·1
0
-0·1
-0·2
-0·3
-0·4
-0·5
-0·6
-0·7
-0·8
-0·9
-1·0
3
2
1
0
Repetitions
List A
List B
List C
List D

(i) Three exposures being underestimated significantly more than zero words, $\underline{F}(3,45) = 4.947^{**}$ ($\bar{x}$'s of -0.563 and +0.563).

(c) List C: Between treatments; $\underline{F}(3,45) = 5.879^{**}$. Due again to an underestimation of the 'three repetition' words, principally :-

(i) between three and one ($\bar{x}$'s, -1.00 c.f. +0.50) $\underline{F}(3,45) = 2.977^{*}$.

(ii) between three and zero appearances ($\bar{x}$'s -1.00 and +1.00) $\underline{F}(3.45) = 5.292^{**}$.

(d) List D: A similar pattern; the 'three appearance' words being underestimated overall $\underline{F}(3,45)$, between treatments, $= 3.136^{*}$. Contributed mainly by a significant difference between three c.f. zero appearances ($\bar{x}$'s, of -0.375 c.f. +0.938) $\underline{F}(3,45) = 2.85^{*}$. The other $\underline{F}$ values did not reach significance (see again, Appendix XLIII)

II A comparison of the over and under estimations between lists.

Analyses of variance between similar treatments on the four lists (e.g. all 3's on lists A.B,C and D being the four treatments, $\underline{F}(3,60) = 0.708$ n.s.) showed that there were no significant differences between similar numbers of exposure on each of the lists (see Appendix XLIV for ANOVAR details). No list differed from another in spite of varying contexts; thus, the performance on all 3's, all 2's etc. did not vary significantly between lists.

figure 20

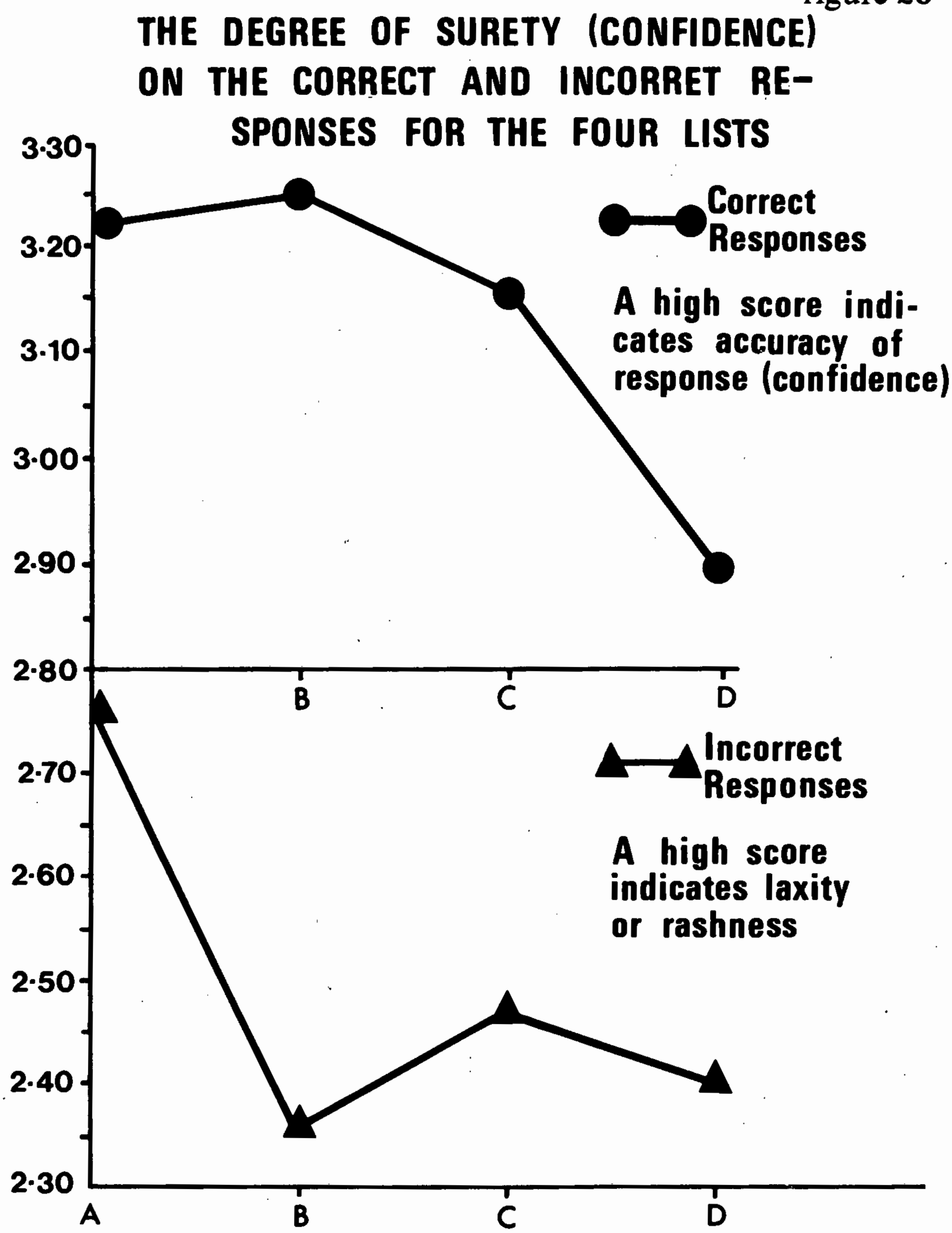

THE DEGREE OF SURETY (CONFIDENCE) ON THE CORRECT AND INCORRET RE-SPONSES FOR THE FOUR LISTS
3·30
3·20
3·10
3·00
2·90
2·80
2·70
2·60
2·50
2·40
2·30
A
B
C
D
Correct Responses
A high score indicates accuracy of response (confidence)
Incorrect Responses
A high score indicates laxity or rashness

TABLE 26

THE OVER AND UNDER ESTIMATIONS
OF THE CRITICAL WORDS FOR EACH LIST
(MEANS BASED ON 16 SUBJECTS)

		NUMBER OF APPEARANCES			
LIST		3	2	1	0
A	$\bar{x}$	-0.875	-0.063	+0.063	+0.375
	S.D.	1.36	1.12	0.44	0.62
B	$\bar{x}$	-0.563	+0.25	-0.063	+0.563
	S.D.	0.96	1.18	0.68	0.73
C	$\bar{x}$	-1.00	+0.438	+0.50	+1.00
	S.D.	1.46	1.59	1.37	1.51
D	$\bar{x}$	-0.375	+0.063	-0.063	0.938
	S.D.	1.36	1.95	1.18	0.85

TABLE 27

(a) The Degree of Surety on Correct Responses

LIST:		Appearances: 3	2	1	0
A	$\bar{x}$	7.25	5.125	9.375	6.125
	S.D.	3.493	3.500	2.895	2.778
B	$\bar{x}$	9.00	6.125	6.875	7.875
	S.D.	3.098	3.686	3.423	3.222
C	$\bar{x}$	4.500	5.125	4.875	7.750
	S.D.	3.464	3.008	3.649	3.256
D	$\bar{x}$	4.75	2.625	6.625	6.250
	S.D.	2.910	2.156	3.481	4.123

See Appendix XXXV for details

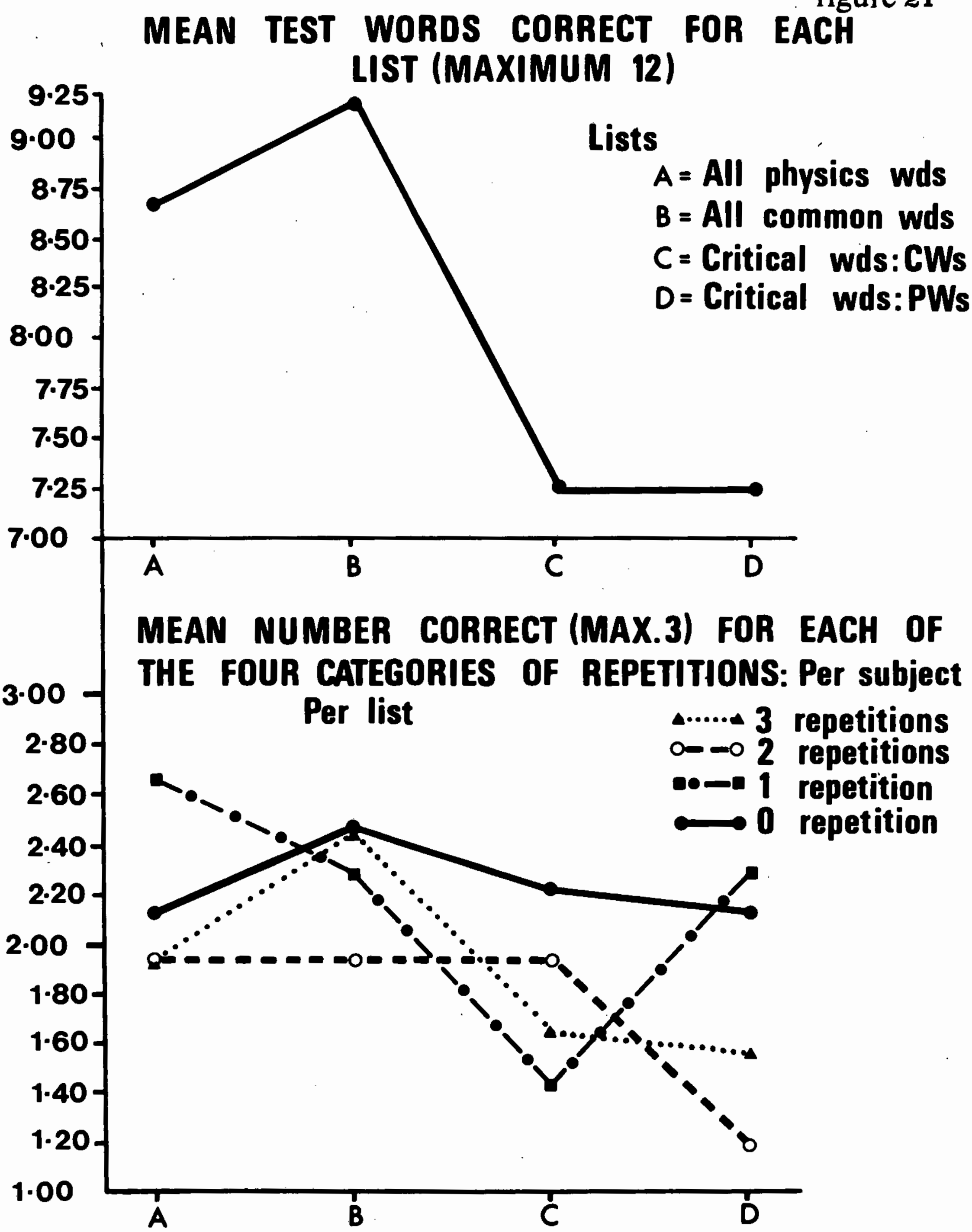
(b) The Degree of Surety on Incorrect Responses

LIST:		Appearances: 3	2	1	0
A	$\bar{x}$	3.00	3.50	0.75	1.875
	S.D.	2.921	2.875	1.77	1.857
B	$\bar{x}$	1.625	2.500	1.625	0.875
	S.D.	2.754	2.683	2.553	1.455
C	$\bar{x}$	4.00	2.875	3.125	1.750
	S.D.	3.425	2.730	2.187	2.408
D	$\bar{x}$	3.875	4.375	1.625	1.500
	S.D.	2.872	1.668	3.117	1.862

See Appendix XXXV1 for details

A Spearman rank correlation between surety on correct and incorrect responses for each list and condition yielded $r(15) = -0.828^{**}$

figure 21


MEAN TEST WORDS CORRECT FOR EACH LIST (MAXIMUM 12)
9·25
9·00
8·75
8·50
8·25
8·00
7·75
7·50
7·25
7·00
Lists
A = All physics wds
B = All common wds
C = Critical wds: CWs
D = Critical wds: PWs
A
B
C
D
MEAN NUMBER CORRECT (MAX.3) FOR EACH OF THE FOUR CATEGORIES OF REPETITIONS: Per subject Per list
3·00
2·80
2·60
2·40
2·20
2·00
1·80
1·60
1·40
1·20
1·00
3 repetitions
2 repetitions
1 repetition
0 repetition
A
B
C
D

B. <u>The Degree of Surety on the Correct Responses:</u>

I <u>Within Lists:</u>

The mean surety values are given in Table 26(a) as a function of treatments for each list. The values were obtained by giving a value of 4 for absolutely sure, 2 for probably sure, and zero for guessing, on correct responses. (see Appendix XXXIV for complete details and individual data).

(a) <u>List A</u>: Between treatments (3,2,1,0 exposures ($F(3,45) = 5.55^{**}$ (with means of 7.25, 5.125, 9.375 and 6.125 for 3,2,1 and 0 repetitions respectively). The subjects on List A (N = 16) did vary significantly in their performance on the four sub-tasks: list A being comprised of physics words. More confidence being shown on critical words viewed once, compared with those viewed twice. $F(3,45) = 0.025,^{**}$ ($\bar{x}$'s 9.375 c.f. 5.125) also compared with words not present on the inspection list, $F(3,45) = 2.94^{*}$ ($\bar{x}$'s 9.375 c.f. 6.125). More confidence being shown on physics words viewed <u>once</u> on the all physics word list (a).

(b) <u>List B</u>: (all English (CW) word list).

The confidence on this list was generally higher; there being, however, no significant differences between treatments, $F(3,45) = 2.455$ n.s.

(c) <u>List C</u>: (critical common words embedded in physics words).

The degree of confidence was generally low ($\bar{x}$'s 4.5, 5,125, 4.875, and 7.75), compare with list B where the critical words were also CWs. ($\bar{x}$'s, 9.00, 6.125, 6.875 and 7.875 : List B). Between treatments there was no significant difference on List C: $F(3,45) = 2.70$ n.s. There is however, no question that the confidence of surety on correct responses was depressed compared with the comparable critical word list, list B.

(d) List D: (critical physics words embedded in common words). Confidence is again low, especially when compared with list A, where the critical words are also physics terms (see Table 27). Between treatments $F(3,45) = 5.119^{**}$, the main difference being a lowered confidence for two repetitions compared with one viewing and zero repetition terms.

$F(3,45) = 4.14^{*}$ (between 2 and 1 appearances).

$F(3,45) = 3.40^{*}$ (between 2 and 0 appearances).

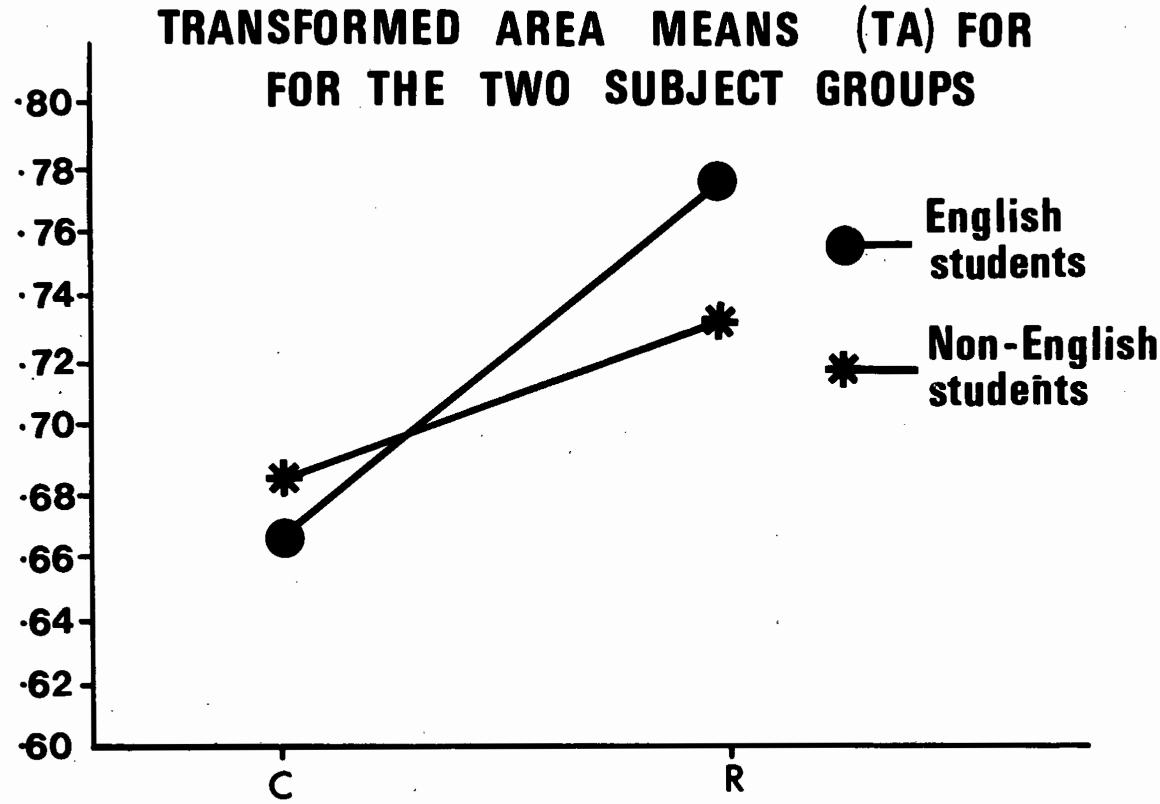
II The degree of surety between lists for correct responses:

(a) Three appearances: An overall F value was obtained of $F(3,60) = 7.347^{**}$. One contribution coming from the difference between lists B and C ($\bar{x}$s, 9.00 and 4.500). $F(3,60 = 5.070^{**}$. The surety for three appearances being lower on list C (common critical words within physics terms) compared with list B (critical CWs embedded in CWs).

The other contribution came from a consideration of lists B and D. The performance on list D was significantly lower ($\bar{x}$'s of 4.75 c.f. 9.00); $t\ (30) = 3.86.^{**}$ (A t test was performed as for some reason the $\bar{x}$'s of 4.75 c.f. 9.00 consideration was omitted from the ANOVAR calculations).

(b) Two appearances: The overall F value between lists was $F(3,60)\ 3.61^{*}$, significant at the five percent level. The main contribution being due to lack of surety on list D compared with list B ($\bar{x}$'s 6.125 c.f. 2.625), $F(3,60 = 3.31^{*}$.

figure 22


TRANSFORMED AREA MEANS (TA) FOR
FOR THE TWO SUBJECT GROUPS
·80
·78
·76
·74
·72
·70
·68
·66
·64
·62
·60
C
R
English students
Non-English students

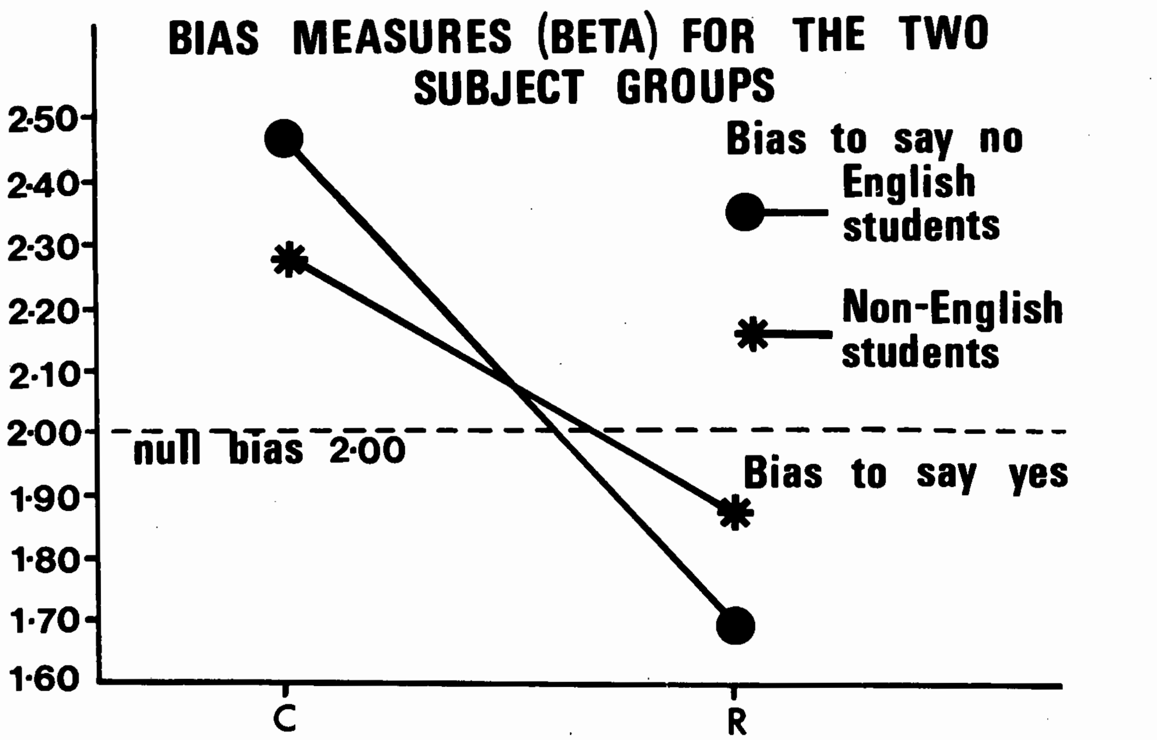

BIAS MEASURES (BETA) FOR THE TWO
SUBJECT GROUPS
2·50
2·40
2·30
2·20
2·10
2·00
1·90
1·80
1·70
1·60
Bias to say no
English students
Non-English students
null bias 2·00
Bias to say yes
C
R

TABLE 28

MEAN SURETY VALUES : LISTS A, B, C, D.

CORRECT AND INCORRECT

(Maximum possible being 4.00)

CORRECT

	A	B	C	D
$\bar{x}$	3.230	3.246	3.021	2.876
S.D.	0.434	0.515	0.569	0.656

$F(3,60) = 1.68$ n.s.

INCORRECT

	A′	B′	C′	D′
$\bar{x}$	2.47	2.037	2.441	2.381
S.D.	1.231	1.125	0.652	0.650

$F(3,60) = 0.724$ n.s.

CORRELATED t tests.

	A	B	C	D
A′	2.34*			
B′		4.31**		
C′			3.12**	
D′				2.37*

$t(15) = 2.131$ 5%* Significance

$t(15) = 2.947$ 1%** Significance

2-tailed tests

See Appendix XXXV11 for individual means

(c) <u>One appearance</u>: An overall $\underline{F}$ value of $F(3,60) = 4.77^{**}$ was obtained. This was principally due to a lack of confidence on list C compared with list A ($\bar{x}$'s of 4.875 c.f. 9.375), $\underline{F}(3,60) = 4.74^{*}$ (A c.f. C).

(d) <u>Zero appearance</u>: There was no significant difference on words absent from the inspection series ($\underline{F}(3,60) = 1.24$). A high degree of confidence was shown for <u>all</u> lists ($\bar{x}$'s, 6.125, 7.875, 7.750 and 6.250 respectively for lists A, B, C and D).

C. <u>The degree of surety on the incorrect responses</u>:

I <u>Within lists</u>:

The mean values are given in Table 27(b) as a function of treatment for each list. Again 4 was given for an absolutely sure response, 2 for probably sure and zero for guessing. Here (unlike the correct response performance) a <u>high</u> score was indicative of brashness, false confidence, or lack of caution, i.e. the adoption of a <u>lax criterion</u> with errors.

(a) <u>List A</u>: (Between treatments; three, two, one and zero appearances). An overall $\underline{F}(3,45) = 4.573^{**}$ (Appendix <u>XXX1X</u>). The contribution being from a (false) over-confidence on two appearances compared with one appearance ($\bar{x}$'s, 3.5 c.f. 0.75) $\underline{F}(3,45) = 3.83^{*}$. Thus, more accuracy was displayed for one appearance compared with two appearances. Though the mean for three appearances (3.00) was high it did not differ significantly from the other treatments. A true reflection of surety was evidently present only for zero and one appearance ($\bar{x}$'s 1.88 and 0.75) and not for the multiple appearances: list A being the all physics word list.

(b) List B: The overall $F(3,45) = 1.41$ was not significant (see Appendix XXXIX). The means were generally low (1.625, 2.500, 1.625 and 0.875) for all conditions. Thus laxity was not shown on this, the all common word list.

(c) List C: The overall F between the four treatments was $F(3,45) = 1.64$ not significant. However laxity was exhibited overall compared with list B ($\bar{x}$'s 4.0, 2.875, 3.125 and 1.75) except again for zero appearances.

(d) List D: (critical physics terms embedded in common words). The F value between treatments was significant at the 1% level: $F(3.45) = 5.47.^{**}$ The F values (Scheffé comparisons: see Appendix XXXIX) showed that the principal contribution came from a comparison of two appearances with zero, and two with one appearance. The F's being respectively 3.376^{*} and 3.089^{*} for (3,45) degrees of freedom. Again multiple appearances exhibited high scores for surety on incorrect responses ($\bar{x}$'s 3.875 (three), 4.375 (two): c.f. 1.625 (one) and 1.5 for zero showings).

II Between Lists:

(a) Three appearances of the critical word: There were no significant differences for the four lists on 'three appearance' words. Even though the surety on incorrect responses for list B (1.625) was low, it did not differ from A (3.00) nor from C (4.00), nor D (3.875): the standard deviations being high for all lists (overall F being 2.124 for (3,60) degrees of freedom) (Appendix XLII)

(b) Two appearances: The overall F was again not significant ($F(3,60) = 1.67$).

(c) One appearance: The F ratio was not significant being F(3,60) = 2,578, just short of five percent (see Appendix XLII).

(d) Zero appearance: Again no significant differences, F(3,60) = 0.854, n.s.

D. The mean surety values for the four lists and for Correct and Incorrect Responses:

Appendix XL gives the complete surety values (means) for each subject on each list. The overall means are given in Table 28. The overall F values were not significant.

(i) Correct: F(3,60) = 1.68 n.s.

(ii) Incorrect: F(3,60) = 0.72 n.s.

Thus, there were no subject differences on surety ratings for correct and incorrect responses.

E. Order of Accuracy of the Critical Words:

There was only one significant difference for the order of accuracy of the critical words, namely between A and D (see Table 29): i.e. critical words with high recognition scores on list A possessed high scores on list D (see Appendix XLVI), the critical word pure recognition score (maximum 16) was the number of times the word was correctly perceived (correct number of repetitions) for each subject (N = 16) on each list. Creature and Calorimeter, meson-merit (paired words) being equated; and so on for each list.[1]

[1] In brief, vernier and elastance with 14 correct out of 16 on list D were best perceived on list D, next being meniscus (13) and parachor (13) etc. A product moment correlation was performed (Table 29) for each critical word and its 'score' on each test. Elastance (lists A and D) being equated with Instance (lists B and C) its common word equivalent. Only lists A and D having any similarity of performance. (see Appendix XLVI for a complete list of the order of correctness for each list). The critical common words being mainly affected by the varying context (lists B and C).

TABLE 29

PRODUCT MOMENT CORRELATION FOR EACH CRITICAL WORD AND ITS SCORE ON EACH TEST
(See footnote page 177)

(a) MEANS AND STANDARD DEVIATIONS:

	$\bar{x}$	S.D.
A	11.25	3.81683
B	12.1667	1.89897
C	9.33333	2.96444
D	9.66667	3.33939

(b) CORELATION COEFFICIENTS:

	A	B	C
A			
B	-0.1944		
C	-0.3857	-0.1884	
D	-0.5920*	0.0382	0.003

Where $r(10) = 0.576$*

TABLE 30 (a)

THE NUMBER OF REPETITIONS FOR EACH LIST
CORRECTLY PREDICTED
(MAXIMUM POSSIBLE 12 : FOR ALL CRITICAL WORDS)

LIST A	LIST B	LIST C	LIST D
8.688	9.188	7.250	7.250

TABLE 30 (b)

THE NUMBER OF REPETITIONS FOR EACH LIST
FOR EACH CONDITION
(NUMBER OF REPETITIONS 3, 2, 1 OR 0)
PER SUBJECT CORRECTLY PREDICTED.
(MAXIMUM POSSIBLE: THREE)

	LIST A	LIST B	LIST C	LIST D
3	1.9375	2.4375	1.6250	1.5625
2	1.9375	1.9375	1.9375	1.1875
1	2.6875	2.3125	1.4375	2.3125
0	2.1250	2.4375	2.2500	2.1250

SEE FIGURE 21 FOR GRAPHICAL DETAILS

Discussion:

In all cases the 'three appearance' words, second, tonight and column on lists B and C, and secant, tetrode and coulomb on lists A and D were underestimated. In particular this was significantly different from one and zero appearance critical words. In particular the zero appearance words were over estimated on the mixed lists (C and D), compared with the 'pure' lists (A and B).

ZERO APPEARANCE WORDS OVER-ESTIMATION

A	B	C	D
(all PWs List)	(all CWs List)	(Mixed List)	(Mixed List)
+0.375	+0.563	+1.00	+0.938

None of these were significant. However, it is interesting to note the high accuracy (0.375) on list A. The rare words being accurately perceived as absent. A *t* test between 0.375 and 0.938, the physics lists yielded a *t* (30) = 2.00, just short of significance. In all cases (0.375 c.f. 0.938 and 0.563 c.f. 1.00) the pure lists yielded higher accuracy for zero appearance words. The highest accuracy was present for single word presentations. The occurrence of a single critical word did not appear to present any difficulties on any of the lists.

However, apart from the consistent underestimation of the 'three appearance' critical words, this analysis did not produce any inter-list differences of startling interest.

Of main concern was the nature of the degree of accuracy of judgement of the subjects on correct and incorrect response. How accurate are they at perceiving repetitions and do they exhibit laxity on certain lists due to contextual effects?

On list A, more confidence was shown on one appearance words $\underline{F}(3,45) = 5.55^{**}$, overall for treatments, the single critical words having a higher degree of surety, when correct, than those viewed twice ($\underline{F}(3,45) = 5.025^{**}$; $\bar{x}$'s 9.375 c.f. 5.125), also compared with words not present in the inspection list ($\underline{F}(3,45) = 2.94^{*}$; $\bar{x}$'s 9.375 c.f. 6.125). This is interesting as there was very little under or over estimation for single appearance words on this list, this was also true of the double appearance words ($\bar{x}$'s +0.063 c.f. -0.063; Table 26). Though accuracy was exhibited in <u>both</u> cases, the subjects were only willing to admit correct surety on <u>single</u> appearance critical words. This list (A) was a 'pure' list, how far does this phenomena extend? On list B, a pure (CW) list confidence was higher but not significantly different for the four treatments (three, two, one and zero appearances). Confidence was higher for the three appearances and much the same for the other three conditions. For list C there were no treatment differences yet confidence was reduced, especially compared with list B, where the critical words were also common words.

<u>MEANS</u> (SURETY ON CORRECT)

	3	2	1	0
<u>LIST B:</u>	9.00	6.125	6.875	7.875
<u>LIST C:</u>	4.5	5.125	4.875	7.75

Note the depression of confidence on list C: this was significant, $\underline{F}(3,60) = 5.07^{**}$. A consideration of Table 26 will show that the three appearance condition was very much <u>under estimated</u>, yet on correct responses for this condition the subjects displayed great caution. One would think that the all CW list (B) would be more difficult, does this extend to the physics lists?

The surety mean values for correct responses for lists A and D on three appearances were 7.25 and 4.75 respectively. Once more the mixed list induced extreme caution for correct responses; yet one would expect this list to be easier. If a von Restorff effect was evident the physics items would stand out or be more salient for a mixed list than for a pure physics list, especially as the subjects were arts students. This finding is certainly consistent and of great interest. In Experiment 3 a similar phenomena was present (see Figure 5, page 66). Table 27 illustrates the consistent lack of surety on mixed lists compared with pure lists. ($\bar{x}$'s 7.25, 9.00 c.f. 4.50 and 4.75, three appearances lists A and B c.f. lists C and D. Also 5.125, 6.125 c.f. 5.125 and 2.625, two appearances; and 9.375, 6.875 c.f. 4.875 and 6.625 for one appearance).

A consideration of surety of words absent on all lists showed no significant differences. Surety was high ($\bar{x}$'s 6.125, 7.875, 7.75 and 6.25 respectively for lists A, B, C and D).

How far can this trend be traced? Is there a concommitant laxity of surety on incorrect responses compared with a good performance on correct responses. That is, can one say that high surety was 'bought' on pure lists at the expense of adopting a lax criterion overall for degree of surety? Were this so then high scores must be evident on incorrect responses also (remembering that a high score on incorrect responses displayed the subject's false confidence in his decision).

Considering Table 27, it can be seen that the greater laxity on incorrect responses was displayed generally for lists C and D; the mixed lists. For three appearances, the surety values for lists C and D were :- 4.00 and 3.875, whereas for lists A and B they were respectively 3.00 and 1.625. So accuracy on correct produced a parallel inaccuracy on incorrect responses. A similar position exists for two appearances, the higher the surety on correct responses the lower the surety on incorrect responses (Table 27(a) and 27(b)). In fact a Spearman Rank Correlation yielded $V(15) = -0.83^{**}$. The reverse was true; high surety on incorrect responses yielded low surety on correct responses.

For list A more accuracy was shown for one as opposed to two appearances ($\underline{F}(3,45) = 3.83^{*}$), there being a false over confidence for two appearances. A true reflection of surety was present for zero and one appearances ($\bar{x}$'s 1.88 and 0.75) only; and not for multiple appearances on this, the all physics list.

More caution was shown for list B (all CWs), the means were low (1.625, 2.500, 1.625, 0.875) for all conditions; no laxity was apparent on this, a familiar list. The reverse was true for list C, more laxity was shown by the subjects ($\bar{x}$'s 4.0, 2.875, 3.125 and 1.75) except again for zero appearances. List C possessed critical common words and it is clear that the physics context has induced laxity here, compared with the other critical common word list (B).

List D, critical physics words embedded in common words, produced high scores for multiple appearances on incorrect responses. ($\bar{x}$'s for 3 and 2 appearances were 3.875 and 4.375

c.f. 1.625 and 1.50 for one and zero appearances). In fact the Scheffé comparisons showed that the two word performance was considerably greater than the zero $\underline{F}(3,45) = 3.376^{*}$ and $\underline{F}(3,45) = 3.09^{*}$ for the two compared with one appearance. This was also true for list A, the other physics list. The physics lists induced <u>over confidence</u> on <u>multiple</u> presentations; this was not so for the critical common word lists. No significant differences were found between lists between the four repetition conditions.

When the degree of accuracy was investigated for the critical words it was found that only lists A and D were similar, i.e. the critical physics words lists. The context did not alter the order of correct perception of the critical physics words. Thus (see Appendix XLVI) vernier, elastance, meniscus, parachor and calorimeter possessed high values (maximum 16) on list D with similar high scores on list A: similarly micron, tetrode and galvanometer possessed low scores on both lists. There was no relationship between the critical word performance on lists B and C, the CW critical lists. The context evidently upset the order of accuracy. It will be remembered that large discrepancies were also evident on lists B and C for surety values, both correct and incorrect.

It is evident that the context within which the critical common words were buried was important for ultimate surety ratings and accuracy for these critical words. For the unusual (uncommon) physics terms subjects approached the rating task with both <u>surety on correct</u> responses and <u>caution on incorrect</u> responses only for list A (all physics list). There was a depression of surety on correct and an increase in laxity on incorrect responses for the multiple presentations for list D; the reverse was true for single or zero presentations. This trend was evident on all lists (with the possible exception of list C).

It would appear that context affected mixed lists with the mixed (critical physics words) list D behaving in a similar manner to list A (all physics words) on surety of correct, surety on incorrect, and the bias to over or under estimate (see Figure and Table 26).

CHAPTER FOURTEEN

The remembrance of an event depends both upon the appropriate storage and subsequent (successful) retrieval of information about the various aspects of the form of the event to be remembered. Tulving and Thomson (1971) have stated the situation thus :-

"We report an experiment whose results suggest that recognition - identification of an event as identical with one that has occurred before - depends, among other things, upon the accessibility of stored information. This empirical lesson seems worth reporting for the simple reason that many students of memory assume the opposite. While few theorists might want to dispute the usefulness of the distinction between availability and accessibility of mnemonic information (e.g. Tulving & Pearlstone, 1966) in recall situations, the prevalent view with respect to recognition-memory tasks appears to be that problems of access to the stored information do not exist because such access is somehow "automatic" (e.g. Kintsch, 1970, p.335). If this view is misleading, as we believe it is, it should be corrected. The main purpose of this paper is to provide evidence for the necessity of such a correction.

Who holds the view that a part of the retrieval process in recall is absent in recognition? Kintsch (1970) is the foremost advocate of the dual-process theory:

> 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 (p. 337).

Bernbach (1967) also seemed to deny the access problem in recognition memory when he wrote that "the storage and retention of stimulus tags is the basis for performance in recognition-memory task (p. 514)" and that "when an item is presented for recognition test it is compared with the tags that are stored in memory (p. 514)." Murdock (1968) is another theorist who believes that "it is generally accepted that retrieval involves a search through memory (p. 79)," and that "recognition eliminates the search or retrieval problem (p. 79)." And Bower, together with a group of his young associates, (Bower, Clark, Lesgold, & Winzenz, 1969) puts the matter equally bluntly: "Recognition tests, which directly provide the test word, clearly bypass the search and retrieval processes by which S generates his recall (p. 329)." Others could be cited, but this sample of opinions illustrates the "automatic access" assumption we would like to question.

How can we throw doubt on the assumption that recognition tests "bypass search and retrieval processes"? Two steps are necessary, and we take them both in this paper. The first is the empirical demonstration that Ss' recognition performance varies for items for which (a) the appropriate information in the store is held constant and (b) test conditions differ. Such a demonstration removes any possibility for claiming that differences in recognition performance reflect differences in the "strength" (Norman & Waugh, 1968), "familiarity" (Kintsch, 1968), or "information attached to the test-word in memory" (Bower et al., 1969 p.329), on the basis of which, it is claimed, S makes the decision to call the test item "old" or "new". The logic here is the same as that underlying the experimental distinction between availability and accessibility of information in a recall task (Tulving & Pearlstone, 1966). By holding constant input and storage conditions and manipulating test conditions, we can demonstrate differences in accessibility to - independently of differences in availability of - the stored information. In the present experiment, variations in test conditions were effected through variations in verbal context of the test words.

The second step consists in the argument that differences in recognition memory under conditions where availability of stored information is held constant are more appropriately accounted for in terms of differential accessibility of stored information than in terms of differential decision criteria or whatever other factors might be postulated. (Tulving and Thomson, 1971)". Their experiment utilized a variety of input conditions and tested them subsequently under a variety of test conditions. "The input and test conditions of to-be-remembered (TBR) words varied in terms of the presence or absence of "context" words (Tulving and Thomson (1971) op cit, page 117)."

The design used single words and doublets. See Table 31, each word in a doublet served a dual function: either it was a "target" word to be remembered for the subsequent test or also the "context" for the other word in the doublet.

TABLE 31

DESIGN OF THE EXPERIMENT

(Tulving & Thomson (1971)

Input categories and sample words	Test categories and sample words		
	Si	DwD	DsD
Si DANCE BABY WATER	Cond. 1. O DANCE N SING FLAG UP MONEY TOOTH	Cond. 2. NwO GRASP BABY NwN JUSTICE WITNESS	Cond. 3. NsO LAKE WATER NsN GERM DISEASE
DwD ADULT WORK ART GIRL STEM SHORT	Cond. 4. O_1 ADULT O_2 WORK	Cond. 5. OwO ART GIRL	Cond. 6. NsO LONG SHORT OrN STEM COIN
DsD WHITE BLACK FAST SLOW HATE LOVE	Cond. 7. O_1 WHITE O_2 BLACK	Cond. 8. NwO MEMORY SLOW OrN FAST LAW	Cond. 9. OsO HATE LOVE

Where: O = old item, N = new item,

S = strong, W = weak: associations

In brief, weak and strongly associated doublets and single words were used; taken from free association norms (see page 118 of Tulving and Thomson (1971) for details); examples are given in Table 31, where w = weak and s = strong associations.

The results of the Tulving and Thomson (1971) experiment showed that the recognition of a single word was impaired when a strongly associated common word accompanied it at the testing time. The recognition of a word which was presented initially as a doublet, was impaired when the other member of the pair was removed or changed in the test sequence. This effect of context was viewed as being evidence for the dependence of retrieval or utilization of stored mnemonic information, in a recognition memory test, upon both availability and accessibility of information. Ostensibly identical input and test items may sometimes, argue Tulving and Thomson (1971), be encoded differently because of their different cognitive environments, with the consequence that the "old" test item as a retrieval one fails to provide access to the stored information about the earlier occurrence of its copy. The results of the experiment and their interpretation disagree with the widely held view that 'there is no retrieval problem in recognition memory', (Tulving and Thomson (1971) page 116)."

In view of the importance of the above results Experiment 12 will direct itself to a consideration of retrieval and accessibility problems in recognition memory.

Experiment 12

Introduction:

This experiment will investigate the effect of test and inspection list context on the subsequent recognition memory of single and paired Chemistry Elements of the Periodic Table stimuli. The Periodic Table was chosen as it is a good source of strong stimuli. For example, Calcium and Strontium; Lithium and Sodium; Bromine and Chlorine. Given the properties of one element of the pair, the properties of the other is known as they are next to each other in the Periodic Table. Consequently, chemistry students (from an early age) learn to ultilize the Periodic Table. As a source of cues to aid memory it is an excellent source of stimuli provided the subjects are chemistry students with some training at Chemistry.

Method:

Subjects: The subjects were twenty third year honours chemistry students from the Organic and Inorganic chemistry laboratories at the University of Cape Town. They were paid for their participation.

Materials:

The inspection series was a list of elements, single and double (see Appendix XLVll). The doublets, e.g. Strontium-Calcium were presented for four seconds; the single elements were shown for two seconds in the inspection (slide) series. A complete list is shown in Appendix XLVll. Twenty-four common elements or common element pairs were chosen from the norms for the Periodic Table (for chemistry students);

Appendix XI. Slides were made of these single and doublet items. Eight conditions for the stimuli were used. These are shown in Tables 32a and 32b. For example, a weak pair e.g. cobalt - silicon could be tested as weak singlets, cobalt (S) and caesium (N). A strong doublet could be tested as a strong doublet with strong doublet noise or as a strong single: e.g. (i) Sodium - Lithium tested as Sodium - Lithium (S) Potassium - Sodium (N), doublet[2]: and (ii) Arsenic - Antimony, tested as Arsenic (S) Bismuth (N).

Test Booklet: The booklet consisted of two pages of instructions (see Appendix XLVIII). The instructions requested that the students consider each single element, or the left hand side element of each doublet, and by using a four point scale give their degree of surety of presence (or absence) of the item being considered. For example, the target word to be considered was the first of a doublet; or the element itself, of a single item -

SODIUM - LITHIUM	X			

the cross is the first box indicating that the subject was absolutely sure that the element sodium appeared as a target (signal) item either as sodium alone, or as the L.H.S. element of a pair, sodium - element X. Examples, and detailed

1. Acknowledgments are due to Mr P. Maxwell for organizing the honours students. All students had studied inorganic chemistry for two years at the University of Cape Town.

2. The repetition of sodium here was unavoidable (lack of strong stimuli in group II of the Periodic Table): this degree of repetition was avoided for the most part.

TABLE 32(a)

THE EIGHT CONDITIONS FOR EXPERIMENT 12

I	Single elements tested with strong single noise.
II	Single elements tested with weak single noise.
III	Single elements tested in strong doublets.
IV	Weak doublets tested as weak single (L.H.S. Member only).
V	Single elements tested in weak doublets.
VI	Strong doublets tested with strong doublet noise.
VII	Weak doublets tested in weak doublet noise.
VIII	Strong doublets tested as strong single elements (L.H.S. Member) with strong single distractors.

TABLE 32 (b)

EXAMPLES OF THE EIGHT CONDITIONS

I	A single element tested with strong noise.		
	TIN (S)	TIN (S) LEAD (N)	
II	Single tested with weak single noise.		
	OXYGEN (S)	OXYGEN (S) SELENIUM (N)	
III	Single element tested in a strong doublet.		
	BARIUM (S)	BARIUM-STRONTIUM (S)	
IV	A weak double tested as a weak single.		
	COBALT-SILICON	COBALT (S) CAESIUM (N)	
V	Single tested in a weak double.		
	IODINE (S)	IODINE-PHOSPHORUS (N)	
VI	Strong double with strong double noise.		
	SODIUM-LITHIUM	SODIUM-LITHIUM (S) POTASSIUM-SODIUM (N)	
VII	Weak double with weak double noise.		
	IRIDIUM-THALLIUM (S)	IRIDIUM-THALLIUM (S) THALLIUM-ALUMINIUM (N)	
VIII	Strong double tested as strong single with strong single noise.		
	ARSENIC-ANTIMONY (S)	ANTIMONY (S) BISMUTH (N)	

instructions were given to clarify the task for the chemistry students. The booklet contained all the inspection items (S) and their distractors (N), an equal number of signal and noise items being present: all randomly assigned. The eight conditions were spread out in the four quarters of the booklet in order to avoid biasing any one condition.

Procedure: The subjects were tested in two groups of ten each. They were instructed to view a series of single and paired chemistry elements. The paired elements would appear for twice as long as the single ones. All words were to be committed to memory as far as possible. The right hand side (R.H.S.) of the doublet was present as a cue to aid recognition of the L.H.S. element, however, the instructions did not say that they, the subjects, could "get by" without using the cues. The instructions emphasized the use of cues and the importance of the R.H.S. element: thus, the subjects did not know that the R.H.S. items would not be tested in most cases. The inspection series was then shown with five filler items at the beginning of the test and five at the end. These items were very rare elements with no similarity to the common ones, they were taken from the Periodic Table norms. They were all from the Lanthanide and Actinide series, see Figure 23.

The subjects viewed the slides and then read the instruction pages for two and a half minutes. The test booklet was then administered, the subjects working through it at their own speed.

Results:

(a) Corrected Scores: Following Tulving and Thomson (1971) and Garton and Allen (1968) a corrected score was obtained as follows from the individual signal and noise distributions. A score of 3 was given for an absolutely sure judgment, 2 for probably sure, 1 for probably absent and 0 for absolutely sure absent; for both signal and noise distributions. The corrected score (C) was the result of the signal (S) values minus noise (N) values, (see Appendix for the individual data). Thus the following profiles (X and Y) would produce the C values given :-

	S				N				S	N	C
X	2	1	0	0	0	1	0	2	8	2	6
									(2x3)+2	(1x2)	
Score	3	2	1	0	3	2	1	0	S	N	C
Y	0	1	2	0	1	1	0	1	4	5	-1
									(1x2)+(2x1)	3+2	

Consequently, a maximum of +9 could be obtained (9 - 0), and a minimum of -9, (0 - 9).

A one way analysis of variance analysis of the corrected score data produced an overall F of $F(7,133) = 4.425^{**}$ (significant at the 1% level). The individual (Scheffé) analyses, comparison of means, showed that only conditions $\overline{\text{I}}$ vs $\overline{\text{V11}}$ (11.15 c.f. 7.85) and $\overline{\text{I}}$ vs $\overline{\text{V1}}$ (11.15, 8.0) were significant at the 5% level (see Appendix $\overline{\text{LI}}$). The subjects found the perception of strong single (condition $\overline{\text{I}}$) easier than the perception of strong doublets ($\overline{\text{V1}}$) and weak doublets ($\overline{\text{V11}}$).

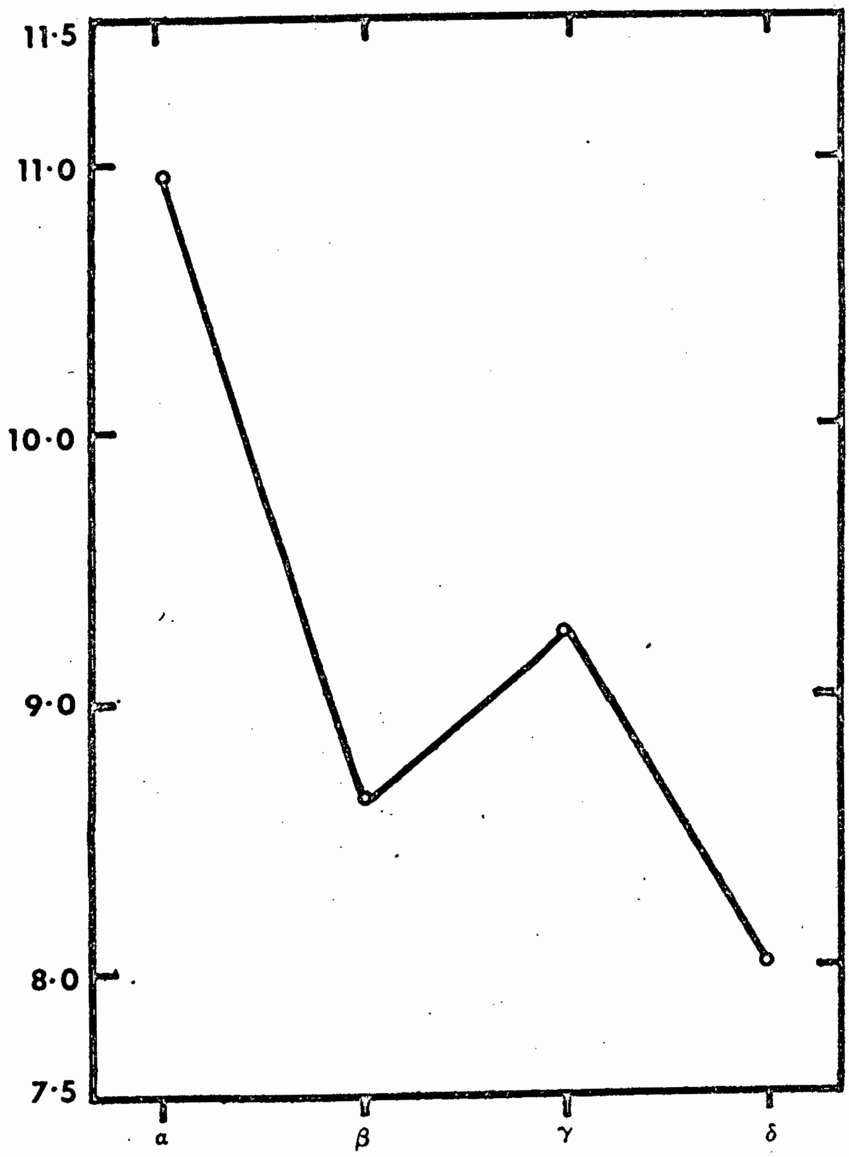
TABLE 33

EXPERIMENT 12: AREA, TRANSFORMED AREA AND BIAS RESULTS (MEANS AND VARIANCE) FOR THE 8 CONDITIONS

Condition	A		TA		BIAS		BIAS DIRECTION
	$\bar{x}$	VAR	$\bar{x}$	VAR	$\bar{x}$	VAR	
I	0.8278	0.0256	0.6041	0.0104	2.120	0.7656	NULL
II	0.8278	0.0399	0.5705	0.0112	2.1117	0.9182	NULL
III	0.7000	0.0489	0.5873	0.0196	2.1283	0.6509	NULL
IV	0.7708	0.0456	0.6246	0.0215	2.4867	0.4628	NO
V	0.6653	0.0759	0.5676	0.0297	2.3313	0.4646	NO
VI	0.6500	0.0481	0.5676	0.0164	1.7392	0.7001	YES
VII	0.6361	0.0226	0.5937	0.0115	1.7208	0.6040	YES
VIII	0.7083	0.0298	0.6085	0.0113	2.4200	0.6172	NO

Figure 24

EXPERIMENT 12: STRONG ASSOCIATIONS AMONG THE ELEMENTS.



Legend:

$\alpha : \underline{S}_S \longrightarrow \frac{\underline{S}_s(S)}{S_s(N)}$

$\beta : \underline{D}_S D \longrightarrow \frac{\underline{S}_s(S)}{S_s(N)}$

$\gamma : \underline{S}_S \longrightarrow \frac{\underline{D}_s D(S)}{D_s D(N)}$

$\delta : \underline{D}_S D \longrightarrow \frac{\underline{D}_s D(S)}{D_s D(N)}$

$\alpha - \beta : \underline{t} = 3{\cdot}24$ ☆☆

TABLE 34

EXPERIMENT 12: $\underline{t}$ TEST VALUES FOR THE STRONG AND WEAK ASSOCIATIONS AREA AND TRANSFORMED AREA VALUES

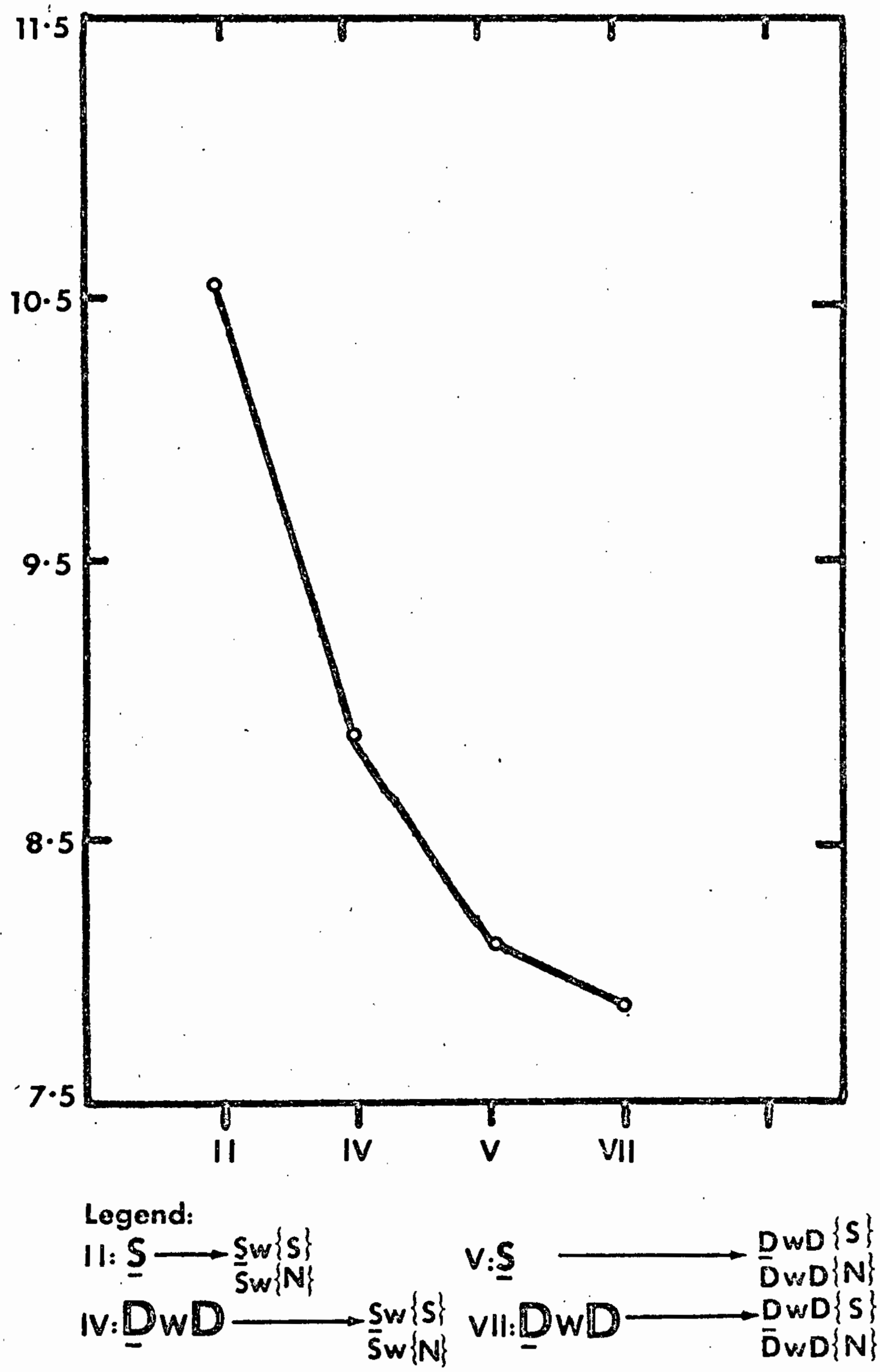
(a) Strong Associations

	AREA (A) SENSITIVITY					TRANSFORMED AREA (TA)			
	$\overline{I}$	$\overline{III}$	$\overline{VI}$	$\overline{VIII}$		$\overline{I}$	$\overline{III}$	$\overline{VI}$	$\overline{VIII}$
$\overline{I}$	-	2.04^{*}	2.86^{**}	0.70	$\overline{I}$	-	0.42	0.98	0.12
$\overline{III}$	2.04^{*}	-	0.70	0.13	$\overline{III}$	0.42	-	0.46	0.53
$\overline{VI}$	2.86^{**}	0.70	-	0.29	$\overline{VI}$	0.98	0.46	-	1.07
$\overline{VIII}$	0.70	0.13	0.29	-	$\overline{VIII}$	0.12	0.53	1.07	-

(b) Weak Associations

	AREA (A) SENSITIVITY					TRANSFORMED AREA (TA)			
	$\overline{II}$	$\overline{IV}$	$\overline{V}$	$\overline{VII}$		$\overline{II}$	$\overline{IV}$	$\overline{V}$	$\overline{VII}$
$\overline{II}$	-	0.93	0.66	3.34^{**}	$\overline{II}$	-	1.31	0.06	0.67
$\overline{IV}$	0.93	-	1.32	2.25	$\overline{IV}$	1.31	-	0.70	0.74
$\overline{V}$	0.66	1.32	-	0.42	$\overline{V}$	0.06	0.70	-	0.36
$\overline{VII}$	3.34^{**}	2.25	0.42	-	$\overline{VII}$	0.67	0.74	0.56	-

EXPERIMENT 12: WEAK ASSOCIATIONS AMONG THE ELEMENTS.



(b) Sensitivity values (area under the ROC curve). The means and standard deviations are given in Table 33, and the complete individual analyses in Appendix LII. Table 34 separates the strong and weak associations in order to enable a comparison to be made directly with Tulving and Thomson's (1971) results (t-test results). The results are shown graphically in Figures 24 and 25.

Discussion:

It can be seen from Table 34 (a) that single elements with single strong noise distractors were significantly easier to recognize than single elements tested in strong doublets. (conditions I vs III *t* = 2.04^{*}, for the direct area measurement. Howver, though the same trend was apparent for the transformed areas (I, (TA) = 0.6041, III, (TA) = 0.5873), the *t* value was not significant. The other significant result (I vs VI, simply showed that the single elements with strong distractors were easier to pick out than the strong doublet elements. This supports Tulving and Thomson's principal result (see Table 35). The weak association data (Table 34 (b)), showed a similar trend for doublets giving an inferior recognition memory result than single elements (II vs VII *t* = 3.34^{**}, for areas, but not for transformed areas *t* = 0.67).

Tulving and Thomson's (1971) propositions are also supported elsewhere. Should Kintsch et al be correct then condition II should produce the same result as condition V. A single element tested singly, should produce the same result as single elements tested in weak doublets.

	$\overline{\text{II}}$	$\overline{\text{V}}$
Corrected Scores:	10.55	8.10
Area (A)	0.8278	0.6653
Transformed Area (TA)	0.5705	0.5676

It can be seen that in all cases the pairing of the element at the test stage impairs performance; albeit the difference is not significant. Similarly, if Kintsch et al are correct $\overline{\text{IV}}$ should equal $\overline{\text{II}}$ (corrected scores $\bar{x}$, 2.90 c.f. $\bar{x}$, 4.55: Areas, 0.7708 c.f. 0.8278): also, $\bar{\text{I}}$ = $\overline{\text{VIII}}$ (corrected scores 5.15 c.f. 2.65, area 0.8278 c.f. 0.7083, TA, 0.6085 c.f. 0.6041 respectively).

In fact Tulving and Thomson (1971) appear to be correct (though the results here are generally not significant) in all instances; the alteration of the test context has impaired the subsequent recognition memory performance.

The important bias changes will be discussed with the results of Experiment 13, in the next chapter.

CHAPTER FIFTEEN

In view of the interesting results of Experiment Twelve it is apropos to; first, engage upon a replication to see if the trends evidently in favour of Tulving and Thompson's (1971) position are repeated, and secondly to investigate the interesting bias tendencies for doublets. The latter was not discussed in the last chapter but is evidently an important consideration for a discussion of contextual effects. It is perhaps a better index of the subject's approach to the recognition (testing) aspect of the task. Does he view doublets with caution as appears evident (B being more than 2.000; a propensity towards caution, an unwillingness to say Yes, present, to stimuli)[1]?

Experiment 13

This experiment will attempt to replicate some of the conditions considered in Experiment Twelve, as well as an additional condition a strong doublet (<u>D</u>sD) tested as a single element with weak noise [(Sw(S), Sw(N)]. This will allow a direct comparison with the condition <u>D</u>wD, tested as Sw(S), Sw(N); and the usual comparison with strong doublets tested as strong doublets with strong doublet noise [(<u>D</u>$_1$sD, as <u>D</u>$_1$sD(S), <u>D</u>$_2$D(N)]. In particular the bias measures will be replicated to see if any consistency in the chemists performance is manifest across the doublet conditions, or rather across the conditions where the test situation is a doublet

[1] It is clear that a tendency to say No, does not of necessity imply a poor performance, as the bias (B) measure is a function of the <u>signal as well as noise</u> categories. Analogous to the SDT's beta measure which is a function of two parameters: hit rates and false-alarms. It can be seen from Tables 36 and 37 that the <u>caution</u> exhibited does not lead to a poor performance. The BIAS (B) measure is indeed independent of Sensitivity or Area measures.

and the inspection series (input) is single and vice-versa. That is, does the alteration of the context cause the caution and hence alter the subject's behaviour with a concomitant alteration in overt performance?

METHOD:

Subjects: The subjects were twenty, third year honours chemistry students from the University of Cape Town chemistry department: they were different subjects from those employed in Experiment 12 and they were paid for their participation[2]. The importance of using naive subjects cannot be over emphasised as the 'short cut' to alleviate any memory load - just learning the left hand members of a doublet - is a tempting one for non-naive chemists: it is best avoided.

Materials: A new set of stimuli were used for the eight conditions and for the slide series. The slide order and items are shown in Appendix XLVll. The materials, namely number of slides, test instructions, test booklet and the eight conditions (a - h) were as for Experiment Twelve. The eight conditions are shown in Table 35(a). The test sheet is shown in Appendix Llll.

Procedure: As before twenty subjects were tested in two groups of ten. They were instructed to view the slides and to use the second member of a doublet as a cue to remembering the first member. They could not assume from the instructions that, for the most part, the right hand member of a doublet would not be tested except as noise.

[2] The low number of subjects was unavoidable; there was a ceiling on the number possible from honours students, Also the added constraint of using naive subjects (non-employment of those engaged in Experiment 12) made the recruiting of subjects a difficult one.

<u>Scoring</u>: The same scoring procedure employed in Experiment Twelve was used for Experiment Thirteen. Thus corrected scores, area values (A), transformed area values (TA) and bias (B) measures were obtained.

<u>RESULTS:</u>

All the individual results are shown in appendices. The mean values and variances for the area, transformed area and bias results are shown in Table 36. Whilst the *t* test results for the weak and strong associations are shown in Tables 39 and 38. In addition the bias measures for both Experiments Twelve and Thirteen are shown in Table 37. Figure 26 illustrates the replicated conditions (corrected scores) for Experiments Twelve and Thirteen, where :-

- A = a single element tested with strong single distractors.
- B = a single element tested with weak single distractors.
- C = a strong doublet with strong doublet distractors.
- D = a single element tested in a weak doublet with weak doublet noise.
- E = strong doublets tested with strong doublet distractors.
- F = weak doublets tested with weak doublet distractors.

The largest discrepancy is evident for D, E and F.

An analysis of variance for the eight conditions yielded an *F* value of $F(7,133) = 3.868^{**}$, but no individual (significant) Scheffé differences between the conditions: these analyses being performed on the corrected scores.$^{\Phi}$

Φ See Appendix LIV for details (ANOVAR).

EXPERIMENTS 12 & 13: REPLICATED CONDITIONS.

[See text for a description of the conditions]

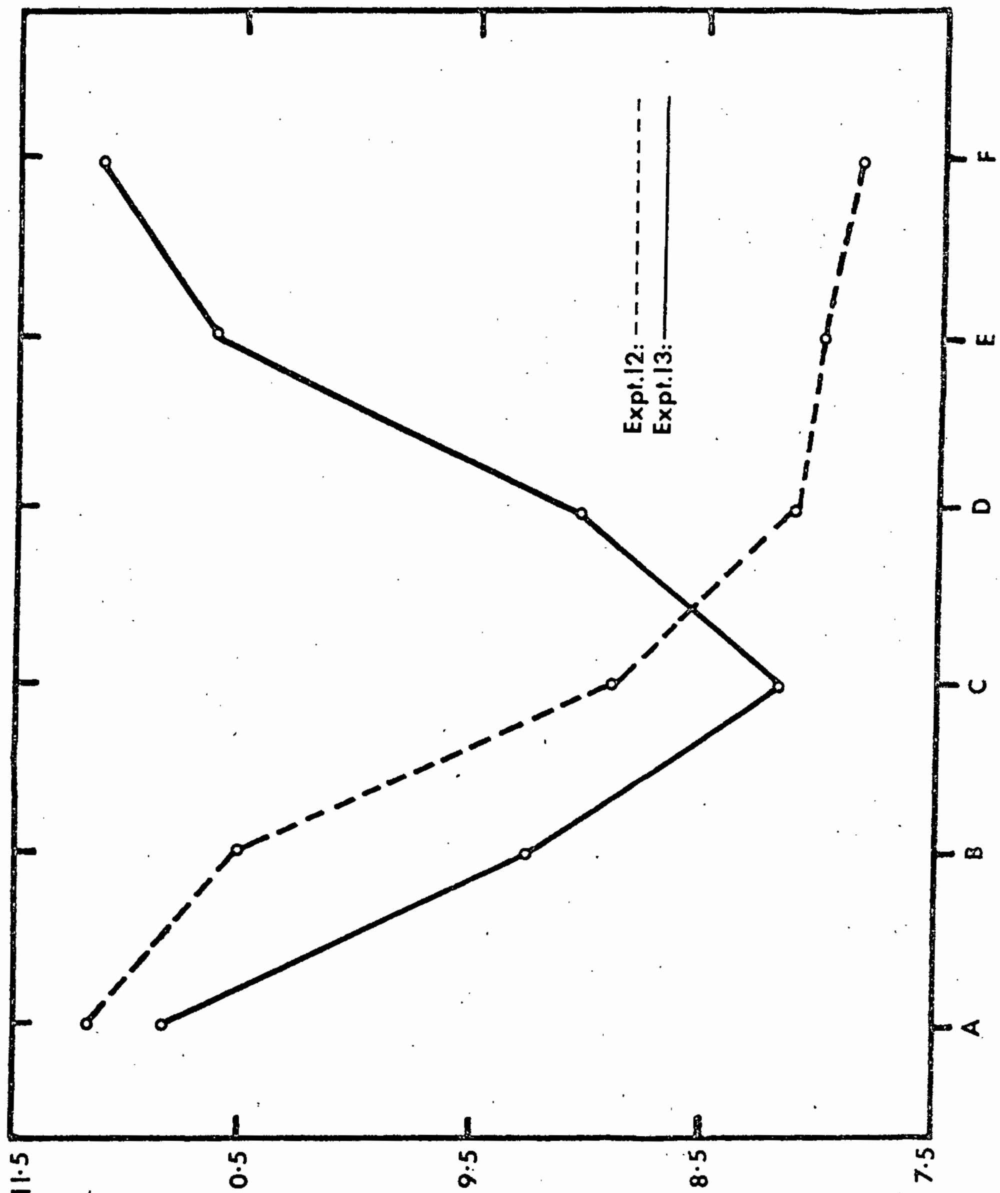


TABLE 35(a)

EXPERIMENT 13

EXAMPLES OF THE EIGHT CONDITIONS

(a) A single element tested with strong single noise.

CADMIUM	MERCURY (N) CADMIUM (S)

(b) A single element tested with weak noise.

CARBON	CARBON (S) GOLD (N)

(c) A single element tested in a weak doublet.

IODINE	IODINE - PHOSPHORUS

(d) A single element tested in a strong doublet.

BARIUM (S)	BARIUM - STRONTIUM (S) MERCURY - CADMIUM

(e) A strong doublet with strong doublet noise.

SODIUM - LITHIUM (S)	POTASSIUM - SODIUM (N)

(f) A weak doublet with a weak doublet noise.

BORON - NITROGEN	NITROGEN - COPPER (N)

(g) A weak doublet tested as a weak single.

RUBIDIUM - PALLADIUM	RUBIDIUM - PHOSPHORUS (N)

(h) A strong doublet tested as a strong single.

FLUORINE - CHLORINE	FLUORINE (S) BROMINE (N)

TABLE 35(b)

TULVING & THOMSON'S (1971) PRINCIPAL RESULTS.

(1)..Recognition of a singly presented (TBR) to be remembered word was impaired when it was presented for testing in the context of another, associatively related word.

(2)..Words shown as members of weak doublets (or pairs (DwD)) in the inspection list were recognized best when they occurred as members of the same doublets in the test list. There was considerable impairment in recognition memory when a new, strongly related, context word replaced the other member of the pair in the test sequence.

(3)..Members of strong input doubles (DsD) yielded best recognition scores when tested as members of old intact doubles. i.e. DsD_1, tested in DsD_1 (S); DsD_2 (N) produced better results than any alteration of the stimulus pairing.

(After Tulving, E., & Thomson, D.M. (1971) page 121)

TABLE 36

EXPERIMENT 13

MEAN VALUES AND VARIANCES
FOR AREA, TRANSFORMED AREA AND
BIAS RESULTS

		A	(TA)	BIAS	
(a)	$\bar{x}$	0.8402	0.6490	1.9158	Single in
	VAR	0.0137	0.0107	0.8539	Strong Single
(b)	$\bar{x}$	0.7472	0.5826	2.0716	Single in
	VAR	0.0391	0.0101	0.7496	Weak Single
(c)	$\bar{x}$	0.7111	0.5588	2.2821	A Single Element
	VAR	0.0612	0.0158	0.5422	in a Weak Doublet
(d)	$\bar{x}$	0.6416	0.5992	2.5366	A Weak Doublet tested as a Weak Single
	VAR	0.0365	0.0182	0.3825	Bias to No.
(e)	$\bar{x}$	0.7861	0.6293	1.6178	Strong Doublets
	VAR	0.0423	0.0206	0.8324	in Strong Doublets
(f)	$\bar{x}$	0.8416	0.5813	1.9249	A Weak Doublet tested
	VAR	0.0507	0.0210	0.6585	in Weak Doublet Noise
(g)	$\bar{x}$	0.7694	0.6020	2.1542	A Strong Doublet tested as a Single with
	VAR	0.0410	0.0154	0.8591	distractors
(h)	$\bar{x}$	0.6472	0.5946	2.4167	A Strong Doublet tested as a Single with Strong
		0.0472	0.0320	0.5702	Single Noise. Bias to No.

TABLE 37

BIAS MEASURES : MEANS, VARIANCES

AND t VALUES : EXPERIMENTS 12 AND 13

CONDITION	EXPERIMENT 12		EXPERIMENT 13	BIAS (TO YES or NO)
Weak Doublet Tested as a Single (Weak Noise)	2.4867 0.4628 3.12**	B VAR t	2.5366 0.3825 3.78**	NO
A Single Element Tested in a Weak Doublet	2.3313 0.4646 2.12*	B VAR t	2.2821 0.5422 1.67 n.s.	NO
A Strong Doublet Tested as a Single Strong Element	2.4200 0.6172 2.33*	B VAR t	2.4167 0.5702 2.41*	NO
A Strong Doublet Tested with a Strong Doublet Noise	1.7392 0.7001 1.36 n.s.	B VAR t	1.6178 0.8324 1.83 n.s.	YES, NOT SIGNIFICANT
A Weak Doublet Tested in Weak Doublet Noise	1.7208 0.6040 1.57 n.s.	B VAR t	1.9249 0.6585 0.40 n.s.	YES, NOT SIGNIFICANT

All t values are given for a consideration of the bias measure differing from B = 2.000, the null position (no bias). Thus a bias value (B) greater than 2.00 is a bias to NO, and conversely one of less than 2.00 is towards YES (laxity). Caution is exhibited in all cases where the testing condition varies from the inspection condition.

TABLE 38

EXPERIMENT 13

STRONG ASSOCIATION CONDITIONS

(a) Area (ROC area measure) t test values.

CONDITION

	(a)	(e)	(g)	(h)
(a)	-	1.00	1.32	3.41**
(e)	1.00	-	2.52*	2.02
(g)	1.32	2.52*	-	1.79
(h)	3.41**	2.02	1.79	-

(b) Transformed area (TA) t test values.

CONDITION

	(a)	(e)	(g)	(h)
(a)	-	0.49	1.27	1.15
(e)	0.49	-	0.63	0.66
(g)	1.27	0.63	-	0.15
(h)	1.15	0.66	0.15	-

TABLE 39

EXPERIMENT 13

WEAK ASSOCIATION CONDITIONS

(a) Area (ROC area measure) *t* test values

	(*b*)	(*c*)	(*d*)	(*f*)
(b)	-	0.50	1.67	1.37
(c)	0.50	-	0.97	1.70
(d)	1.67	0.97	-	0.79
(f)	1.37	1.70	0.79	-

(b) Transformed area (TA) *t* test values

	(*b*)	(*c*)	(*d*)	(*f*)
(b)	-	0.20	-0.43	-0.03
(c)	0.20	-	-0.96	0.51
(d)	-0.43	-0.96	-	0.39
(f)	-0.03	0.51	0.39	-

A _t_ test performed between conditions (g) and (h) produced a _t_ = 1.79 n.s. for area differences and _t_ = 0.96 for bias differences. Though the strong single distractors impaired performance this was not significant.

DISCUSSION:

Again there are sufficient significant differences and trends to warrant support for Tulving and Thomson's (1971) position. Though the transformed area results produced no significant differences here, one is justified in considering both A and TA values as the TA value gains weight only when the variances are very small and the areas are very large[3].

From Table 38, (the strong association conditions) one sees positive support for Tulving and Thomson (1971). The mode of testing greatly affects the ultimate recognition performance. Retrieval of strong elements (_a_ c.f. _h_) is impaired grossly (_a_ (A) = 0.8402, (TA) = 0.6490 : _h_ (A) = 0.6472, (TA) = 0.5946) when a different test condition (one differing from the inspection condition) was imposed upon the subject. The subjects found (_a_) _S_s - Ss(S), Ss(N) easier than (h) _D_sD - Ss(S), Ss(N). (_t_ (A) = 3.41**, _t_ (TA) = 1.15 n.s.)

Caution is needed in interpretation here, as the transformed area should take preference (see footnote 3) however, the differences rank among the largest in Table 36, and cannot be ignored. It is possible that too few subjects were used and not enough stimuli. Nevertheless, in spite of a conservative

[3] The purpose of the transformation is to spread variances when the A values are close to 1.0: this is only evident for condition (a) and (f) where A's are respectively 0.8402 and 0.8416 and variances are very small (0.0137 and 0.0507 respectively): with this proviso in mind area values may be considered elsewhere.

interpretation, there is support for Tulving and Thomson's (1971) results. Once more, comparing the area results for conditions e and g the intact condition strong doublets tested as strong doublets (e) produced a superior result than the altered condition (g); a strong doublet tested as a single with weak element distractors. The lack of the cue element impaired performance as Tulving and Thomson have also showed. This is perhaps the strongest evidence for their position as one can use area results here as the variances are comparable (e (VAR) = 0.0423, g (VAR) = 0.0410: and the means are 0.7861 (e), 0.7694 (g): not near 0.84 (c.f. (a) and (f) where TA values must be considered). Consider also e and h (t = 2.02) where similar (strong) elements are used for all conditions; again impairment.

The bias results from Experiments 12 and 13 are interesting. Both experiments produced the same trends for caution and laxity in the same conditions (Table 37). There was no reversal. The doublets tested as doublets produced a tendency towards laxity, which was not significant (last two conditions of the Table). The three replicated conditions, where a change was made in the test, produced strong bias tendencies towards caution. All but one of the six t tests being highly significant. It is clear that the change of condition of testing was difficult for the subject, or he viewed it as difficult and treated the task with caution. The bias measure in independent of sensitivity (see footnote one, page 203) so the resultant decrement in the ROC area values cannot be blamed upon an unwillingness to say Yes, as this unwillingness would improve the noise (distractor) distribution and hence improve the area measure. Or in terms of corrected scores a decrease in N must increase C, as C = S-N.

These bias results were strongly exhibited, and well replicated, and must be considered one of the principal results of these two experiments (12 and 13).

Evidence was shown for impairment of recognition memory when the initial coding of the test stimuli was interferred with by testing elements "out of inspection context": support for Tulving and Thomson (1971). The lack of replication of the doublet situation (Experiments 12 vs 13) will be considered in the next chapter.

CHAPTER SIXTEEN

The results of the previous experiments (twelve and thirteen) displayed interesting bias tendencies for doublets: do these tendencies exist for doublets alone (doublets tested as doublets) or are they a function of the changed test contexts? That is,

(i) DsD tested in Single elements (weak or strong).

(ii) DwD tested in Single elements (weak or strong)

(iii) S tested in strong doublets (DsD)

(iv) S tested in weak doublets (DwD).

This experiment will consider doublets tested in doublets in order to clarify the situation and to compare bias tendencies with the single - doublet; test and input conditions.

Experiment 14

When doublets alone are considered and they can vary along two dimensions (weak or strong) and can be present as weak or strong at the input (inspection) stage or similarly at the test stage there exist four conditions namely :-

(a) DsD - DwD

(b) DsD - DsD

(c) DwD - DwD

(d) DwD - DsD

These conditions will be considered in this experiment. There will be a reduction of conditions from eight to four enabling more and better stimuli to be used (see Table 40).

TABLE 40

*EXPERIMENT 14

STIMULUS MATERIALS

CONDITION 1 : Strong Pairs (S) : Weak Pairs (N)

Signal	Noise
BERYLLIUM - MAGNESIUM	BERYLLIUM - HYDROGEN
CADMIUM - MERCURY	CADMIUM - RADON
FLUORINE - CHLORINE	FLUORINE - TUNGSTEN
TIN - LEAD	TIN - NICKEL

CONDITION 11 : Weak Pairs (S) : Strong Pairs (N)

RADIUM - CHROMIUM	RADIUM - BARIUM
BORON - NITROGEN	BORON - ALUMIUM
THALLIUM - ALUMINIUM	THALLIUM - INDIUM
NITROGEN - COPPER	NITROGEN - PHOSPHORUS

CONDITION 111: Strong Pairs (S) : Strong Pairs (N)

STRONTIUM - CALCIUM	MAGNESIUM - BARIUM
BROMINE - CHLORINE	FLUORINE - IODINE
SODIUM - LITHIUM	POTASSIUM - RUBIDIUM
ARSENIC - ANTIMONY	BISMUTH - PHOSPHORUS

CONDITION 1V : Weak Pairs (S) : Weak Pairs (N)

BORON - NITROGEN	HYDROGEN - ZINC
ZINC - URANIUM	KRYPTON - SILVER
COBALT - SILICON	MANGANESE - MOLYBDENUM
IRON - SILVER	CAESIUM - SILICON

* The subjects were instructed to <u>learn</u> <u>both</u> <u>pairs</u> when viewing the inspection slide series.

Table 41

The Four Conditions for Experiment 14

			Example	
**** I(a)	Strong-pair (Inspection)	(a)	Cadmium-mercury .	S
(b)	Weak-pair (Test)...........	(b)	Cadmium-radon .	N
* II(a)	Weak-pair (Inspection)	(a)	Boron-nitrogen.	S
(b)	Strong-pair (Test)	(b)	Boron-aluminium.	N
*** III	Strong-pair (Inspection)....	(a)	Bromine-Chlorine.	S
	Strong-pair (Test)	(b)	Fluorine-Iodine.	N
** IV	Weak-pair (Inspection)	(a)	Iron-Silver.	S
	Weak-pair (Test)	(b)	Caesium-Silicon.	N

See Figure 28 for graphical details. (See page 225).

The Means for Corrected Results (C):

I $\bar{X}$ = 6·35 (****)

III $\bar{X}$ = 5·90 (***)

IV $\bar{X}$ = 5·35 (**)

II $\bar{X}$ = 3·10 (*)

THE PERIODIC TABLE

I	II											III	IV	V	VI	VII	Group '0' Noble Gases
								1 H HYDROGEN 1.008									2 He HELIUM 4.003
3 Li LITHIUM 6.939	4 Be BERYLLIUM 9.012											5 B BORON 10.811	6 C CARBON 12.011	7 N NITROGEN 14.007	8 O OXYGEN 15.999	9 F FLUORINE 18.998	10 Ne NEON 20.183
11 Na SODIUM 22.989	12 Mg MAGNESIUM 24.312	Transition Elements										13 Al ALUMINIUM 26.982	14 Si SILICON 28.086	15 P PHOSPHORUS 30.974	16 S SULPHUR 32.064	17 Cl CHLORINE 35.453	18 Ar ARGON 39.948
19 K POTASSIUM 39.102	20 Ca CALCIUM 40.08	21 Sc SCANDIUM 44.956	22 Ti TITANIUM 47.90	23 V VANADIUM 50.942	24 Cr CHROMIUM 51.996	25 Mn MANGANESE 54.938	26 Fe IRON 55.847	27 Co COBALT 58.933	28 Ni NICKEL 58.71	29 Cu COPPER 63.54	30 Zn ZINC 65.37	31 Ga GALLIUM 69.72	32 Ge GERMANIUM 72.59	33 As ARSENIC 74.922	34 Se SELENIUM 78.96	35 Br BROMINE 79.909	36 Kr KRYPTON 83.80
37 Rb RUBIDIUM 85.47	38 Sr STRONTIUM 87.62	39 Y YTTRIUM 88.905	40 Zr ZIRCONIUM 91.22	41 Nb NIOBIUM 92.906	42 Mo MOLYBDENUM 95.94	43 Tc TECHNETIUM *99.00*	44 Ru RUTHENIUM 101.07	45 Rh RHODIUM 102.905	46 Pd PALLADIUM 106.4	47 Ag SILVER 107.870	48 Cd CADMIUM 112.40	49 In INDIUM 114.82	50 Sn TIN 118.69	51 Sb ANTIMONY 121.75	52 Te TELLURIUM 127.60	53 I IODINE 126.904	54 Xe XENON 131.30
55 Cs CAESIUM 132.905	56 Ba BARIUM 137.34	57 La LANTHANUM 138.91	72 Hf HAFNIUM 178.49	73 Ta TANTALUM 180.948	74 W TUNGSTEN 183.85	75 Re RHENIUM 186.2	76 Os OSMIUM 190.2	77 Ir IRIDIUM 192.2	78 Pt PLATINUM 195.09	79 Au GOLD 196.967	80 Hg MERCURY 200.59	81 Tl THALLIUM 204.37	82 Pb LEAD 207.19	83 Bi BISMUTH 208.980	84 Po POLONIUM *209*	85 At ASTATINE *210*	86 Rn RADON *222*
87 Fr FRANCIUM *223*	88 Ra RADIUM *226*	89 Ac ACTINIUM *227*															

LANTHANIDE SERIES

58 Ce CERIUM 140.12	59 Pr PRASEODYMIUM 140.907	60 Nd NEODYMIUM 144.24	61 Pm PROMETHIUM *147*	62 Sm SAMARIUM 150.35	63 Eu EUROPIUM 151.96	64 Gd GADOLINIUM 157.25	65 Tb TERBIUM 158.924	66 Dy DYSPROSIUM 162.50	67 Ho HOLMIUM 164.93	68 Er ERBIUM 167.26	69 Tm THULIUM [illegible]	70 Yb YTTERBIUM 173.04	71 Lu LUTETIUM 174.97

ACTINIDE SERIES

90 Th THORIUM 232.038	91 Pa PROTACTINIUM *231*	92 U URANIUM 238.03	93 Np NEPTUNIUM *237*	94 Pu PLUTONIUM *244*	95 Am AMERICIUM *243*	96 Cm CURIUM *247*	97 Bk BERKELIUM *247*	98 Cf CALIFORNIUM *251*	99 Es EINSTEINIUM *254*	100 Fm FERMIUM *257*	[illegible] Md MENDELEVIUM [illegible]	102 No NOBELIUM [illegible]	103 Lr LAWRENCIUM *257*

FIGURE 23

METHOD:

Subjects: The subjects were twenty, third year honours students studying organic and inorganic chemistry: all students had studied inorganic chemistry for at least two years in an honours course at the University of Cape Town (U.C.T.). Six of the students had been subjects before but as only doublets were being considered the naivety of the subjects is not of paramount importance in this experiment. There was after all a finite limit to the number of honours chemistry students at U.C.T. All subject were paid for their participation.

Materials and Procedure: The slide series (inspection list) was composed of sixteen doublets, four for each of the four conditions. Table 40 shows the stimulus and noise doublets used in this experiment. The subjects viewed the sixteen doublets (with 4 single filler items at the beginning and end composed of very rare elements) for four seconds each. Thus the slide series consisted of twenty four slides all viewed for four seconds. The initial instructions clearly stated that all elements had to be learned, the doubles were to be learned *in toto* there was no request to use the right hand member of a doublet as a cue, all doublets were to be learned, as far as possible, as they were shown. After the inspection session the students read a short instruction booklet requesting them to consider all doublets and by applying the given four point scale (as for Experiments 12 and 13) to give their degree of surety concerning their initial impression of the doublets presence, or absence, from the inspection (slide) series. The subjects worked through the test booklet of thirty-two doublets (16 signal, 16 noise (distractor) pairs).

RESULTS AND DISCUSSION:

The test sheet is given in Appendix LVll and the individual (corrected score) data is present in Appendix

The individual area, transformed area and bias measures are shown in Appendix LXll. Table 41 gives the means for the corrected scores and order of facility (see Figure 28 for graphical details, page 216).

The area, transformed area and bias means and variances are shown in Table 42 , Figure 27, page 214 illustrates the means for the area (A) and transformed area (TA) results.

For easy comparison with Tulving and Thomson's (1971) results, the latter conclusions are indicated in Table 43.

An analysis of variance of the corrected scores (C) produced an overall $F(3,57) = 7.025^{**}$. Scheffé comparisons of means resulted in the following significant differences:-

(i) Conditions I (6.35), II (3.1), $F(3,57) = 5.94^{**}$.

(ii) Conditions I (6.35), III (5.9), $F(3,57) = 0.114$ n.s.

(iii) Conditions II (3.1), III (5.9), $F = 4.412^{**}$.

(iv) Conditions II (3.1), IV (5.35), $F = 2.85^{*}$

where the real corrected score ($\bar{x}$) is given in brackets after each condition number.

The subjects found condition I (DsD - DwD) easier than (DwD - DsD), condition II, significant at beyond the one per-cent level. This was true in Tulving and Thomson's (1971) data, corrected scores of 66 c.f. 58 (Table 43).

TABLE 42

EXPERIMENT 14

MEANS, AND VARIANCES FOR THE AREA (A), TRANSFORMED AREA (TA) AND BIAS MEASURES

	I	II	III	IV
A	0.8203	0.6484	0.7973	0.7989
	0.0277	0.0283	0.0169	0.0264
TA	0.6007	0.6018	0.6534	0.6591
	0.0113	0.0134	0.0094	0.0152
BIAS	2.0108	2.0774	2.0916	2.3358
	0.5788	0.7405	0.6246	0.5970
	NO BIAS	NO BIAS	NO BIAS	BIAS TO NO t = 1.95 n.s.

No bias measures differ (significantly) from each other the closest being t = 1.31 n.s. between I and IV. t = 1.95 n.s. between condition IV and a null bias of 2.000.

TABLE 43

PERCENTAGE OF HITS, FALSE ALARMS, CORRECTED RECOGNITION SCORES, AND STANDARD DEVIATIONS OF CORRECTED RECOGNITION SCORES FOR THE TULVING & THOMSON (1971) RETRIEVAL IN RECOGNITION MEMORY EXPERIMENT

	TEST CATEGORY											
Input Category	Si				DwD				DsD			
	H	FA	C	SD	H	FA	C	SD	H	FA	C	SD
Si	70	24	46	22	49	16	33	29	59	21	38	23
DwD	77	24	53	23	<u>85</u>	23	<u>62</u>	24	<u>58</u>	21	<u>37</u>	31
DsD	70	24	46	25	<u>66</u>	16	<u>50</u>	27	<u>88</u>	29	<u>59</u>	21

NOTE: Hits = H, FA = False Alarms, corrected recognition scores (S-N) = C.

The underlined figures are relevant to Experiment 14 (Tulving E., & Thomson D.M. (1971), Table 3, page 121).

TABLE 44

EXPERIMENT 14

THE t TEST VALUES FOR THE AREA AND TRANSFORMED AREA RESULTS

AREA (A) MEASURE

	I	II	III	IV
I	-	3.17**	0.48	4.01**
II	3.17**	-	3.06**	2.81*2
III	0.48	3.06**	-	0.03
IV	4.01**	2.81*2	0.03	-

TRANSFORMED AREA (TA) MEASURE

	I	II	III	IV
I	-	-0.031	-1.60	1.56
II	-0.031	-	1.45	1.48
III	-1.60	1.45	-	0.16
IV	1.56	1.48	0.16	-

Legend

** 1% level: (2-tailed)

*2 2% level: (2-tailed)

Condition lll was easier for the students than condition ll (iii, above: $F = 4.412^{**}$). That is, they preferred strong pairs tested with strong doublet noise as opposed to a weak doublet tested as a strong doublet. (Tulving and Thomson's result, 88 c.f. 58).

Also condition lV was easier than condition ll. Weak doublets tested as weak doublets were easier to recognize than weak doublets tested with strong doublet noise ($F\,(3,57) = 2.85^{*}$: again support for Tulving and Thomson (1971): corrected scores of 85 c.f. 58).

A consideration of A and TA results (*t* tests: Table 44) shows the expected problem with condition l (A = 0.8203, TA = 0.607). Apart from the area value of condition l, the other area values may be considered with impunity. There are no reversals when area measures are transferred to arc sine transformations[1]. Table 44 gives all the *t* values for the six pairs (2 from 4) possible: for both area and transformed area. All the reversals from A to TA considerations are a result of the three *t* tests involving condition l. These will be avoided in the discussion. In spite of this there are significant differences between conditions ll and lll ($t = 3.06^{**}$) and ll and lV ($t = 2.81^{*2}$, two percent level: two-tailed test). This was echoed in the Scheffé (corrected scores) analysis and must be considered conclusive evidence for strong differences here; hence -

[1] The area value for condition l 0.8203, with small variance 0.0277 resulted in a TA value of 0.6007, the lowest of the four conditions: the danger of this result is averted by adopting a conservative consideration, or even ignoring the *t* values involving condition l (Table 44): as for Experiments 12 and 13 when this reversal occurred.

Figure 28(a)

Mean Corrected Scores (C) for Experiment 14

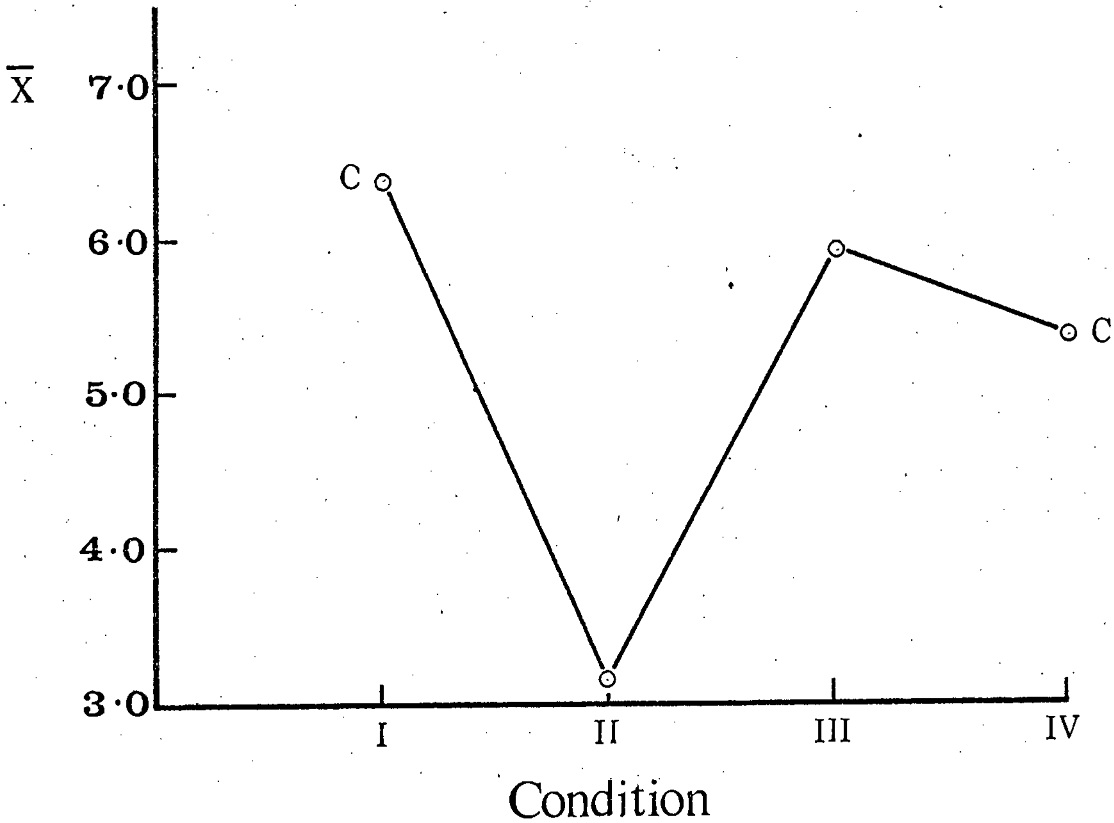
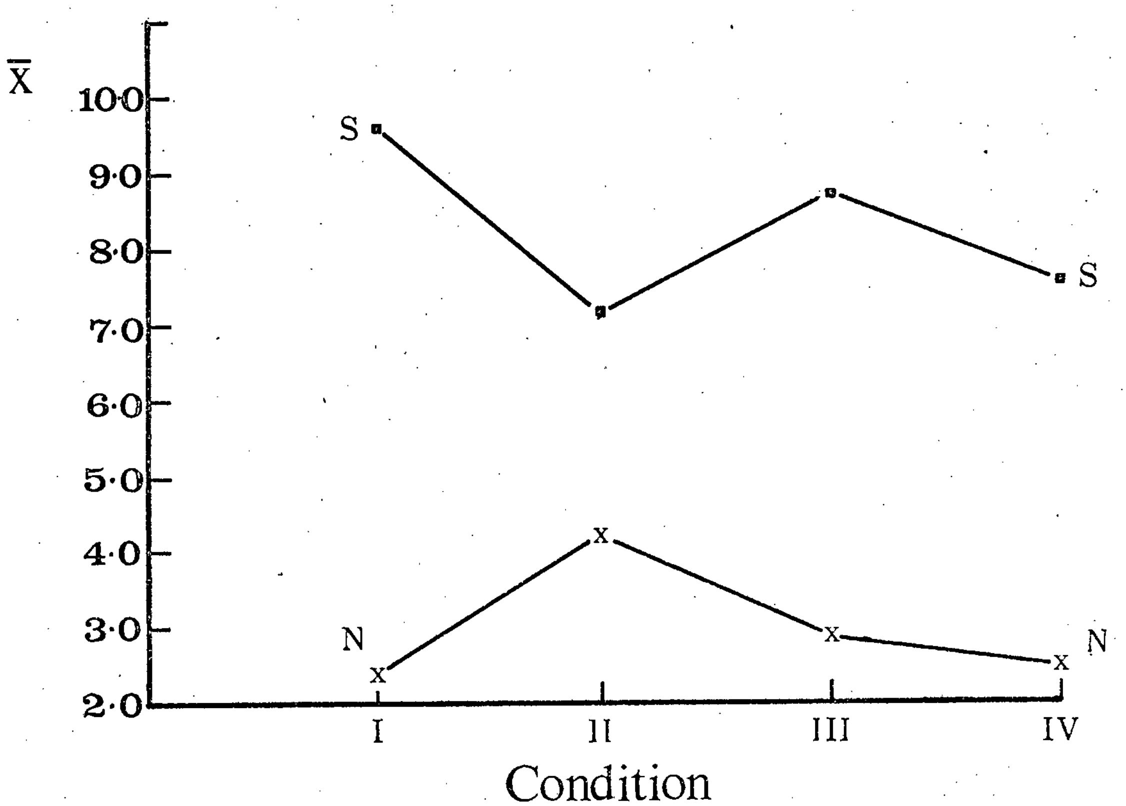
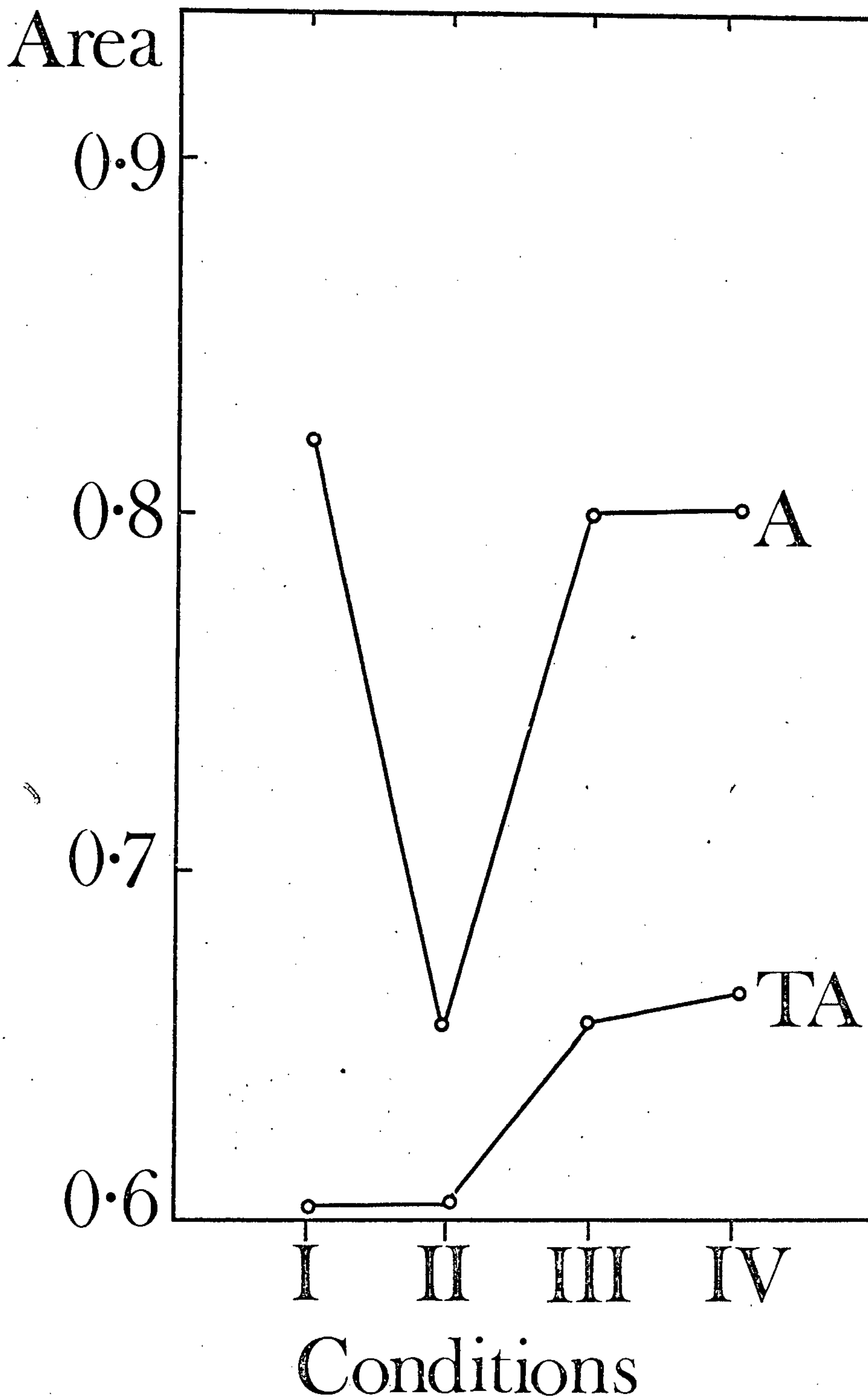


Figure 28(b)

Signal(S) and Noise (N) Values for Experiment 14



Area (A) and Transferred Area (TA) Results Experiment 14.



III was better than II and

IV was better than II

Note the III and IV conditions are 'pure', unaltered strong doublets tested as strong doublets and weak doublets tested as weak doublets. Condition II is a 'mixed' condition: weak doublets tested in strong doublet noise. The alteration of <u>testing</u> context has impaired performance; the principal lesson learned from Tulving and Thomson (1971) there is <u>no</u> evidence for easy access (no retrieval problem) in recognition memory.

The close and accurate performance under conditions III and IV in this experiment (III (A) = 0.7973, (TA) = 0.6534: IV (A) = 0.7989, (TA) = 0.6591) was reflected by Tulving and Thomson (1971): who found corrected scores of 88 for condition III and 85 for condition IV.

These results are irrefutable. Tulving and Thomson used association norms, this present experiment used the strong and weak associations possible from a consideration of the Periodic Table with (specialist) chemistry students. The replication of Tulving's exciting results leads to serious (and sceptical) doubts about any 'automatic' access theory in recognition processes. In addition, there are no bias differences between the four conditions. There was a slight bias to No on condition IV, but this was not significant.

CHAPTER SEVENTEEN

OVERVIEW

This thesis began with a consideration of molecular (parametric) aspects of verbal learning in general and recognition memory in particular; thence it progresses, by virtue of employing varying context (inspection and testing) lists, to a molar view of strategies and bias tendencies in subsequent recognition memory performances.

Investigations of word-frequency effects are _prima facie_ inclined to be circular in their arguments. Certain criticisms of the new look 'taboo word' studies have a tendency to beg questions and draw (somewhat) invalid conclusions as Erikson (1954) has adumbrated. The use of the Lorge-Thorndike word list (1944) as a source of _rare_ words is, for a University population of subjects at least, somewhat fatuous. Extremely rare words do not appear in the word count and words with frequencies as low as 1 to 10 occurrences per million words are hardly rare or unknown to educated people. This is not to decry the use of the norms but it is a limitation to be borne in mind. In this thesis the norms have been used for collecting common words, a purpose for which they are emminently suitable. Experiment One examined the perception, or rather the subsequent recognition memory of rare words only,divided into two categories: one where the meaning was known; two, where the meaning was unknown: yet both categories would of course have a very low word-count in the general literature. Two criterion groups

(Physicists and arts students) were used and the rare words were technical terms culled from dictionaries of science and advanced physics texts. The results showed that physics students found the identification of physics words an easier task than the arts students; perhaps self evident but the interesting facet of this experiment was that the arts students also found the physics terms easier to recognize. The performance for both groups on common (English) words was comparable (ds 1.43, 1.32). What is most interesting is that a knowledge of the meaning of low-frequency words, rather than unfamiliarity with their meaning, facilitated recognition.

Experiment Two, on first consideration may appear to contradict the results of Experiment One. However, it must be remembered that the physics terms were re-categorized into extremely rare terms, terms with few associations for arts students, one could even term them nonsense words. In spite of this, Figure 3 shows once more that the common word performance is almost identical for physics and arts students [(delta m (physics) 2.32, slope 0.58: delta m (arts) 2.52, slope 0.54)]. The low slope (far removed from 1.0) is a source of embarrassment as signal detection considerations are suspect when such deviations occur. However, the delta m values are large and therefore the results are meaningful.

The Garton and Allen (1968b) paper on familiarity and word recognition (Chapter Five introduction) is the first indication in this thesis of the strong effects of test <u>context</u> on recognition memory. The Physics students recognition of stimulus items (physics words) was not superior to that of the arts students. Yet, they, the physicists, excelled in their 'perception' of the distractor terms: consequently their performance was superior overall. Experiment Three pursued this line of interest. Instead of three different inspection lists (Allen and Garton (1968b)) three different test lists were used with a constant inspection seried of twenty physics terms and twenty common words. The test series contained respectively 60 PWs + 60 CWs, 100 PWs + 20 CWs and 20 PWs + 100 CWs, plus the forty signal items. The ratios of PWs to CWs being respectively 1:1, 3:1, and 1:3[1].

The highest degree of sensitivity (SDT measure of accurate performance) was for the 1:1 ratio list (List A, 80 PWs and 80 CWs), see Figure 5, page 66. The arts and physics students performed equally well on physics terms for this list. (The L.H.S. rectangle of Figure 4, page 63, circle symbols). The surprising result for list A was the very high false alarm rate for arts students on common words, which of necessity depressed the bias (beta) measure to a low 0.85. In fact the beta value is low for arts students (on CWs) for all lists, even list B (where only 40 CWs were present and twenty of these were signal items: even the physics subjects fared little better on CWs for list B).

The physics subjects performed well (on list A) on physics words simply because they kept their false alarm rate low. Again the inability of arts students to perform well on a

[1] Where PWs = physics words, CWs = common words, TWs = total for each list (160 words irrespective of dichotomy).

20 out of 40 list (list C physics words) is surprising. If a <u>von Restorff</u> effect were at work, why did they do so badly? An inspection of Figure 4, R.H.S. diagram, shows this to be due once more to a high false alarm rate (0.4), compared with the physicists 0.2. The inability to pick out distractors (the cause of a high False Alarm Rate) is once more shown to be true for subjects unfamilar with the stimuli or rather subjects tested in a list of familiar and unfamiliar stimuli. The only differences between lists A, B and C is the recognition booklet. Were recognition not a function of retrieval, or were it to by-pass retrieval mechanisms, these gross differences would not arise; a point elaborated upon by Tulving and Thomson (1971) in a different context. A consideration of stimulus parameters has again led to the intriguing and ubiquitous <u>contextual</u> effects entailed in recognition memory.

Experiments Four and Five investigated the effects of two processes in recognition memory: the subjects' actual viewing time of verbal material and the experimenter's fee-back of results. Recognition memory was improved when the experimenter gave feedback to the subject even though re-hearsal times were a constant and the subject could use his own "induced feedback". The actual viewing time was <u>not</u> an important factor.

Experiment Six pursued, to a limited extent, the problems raised in the previous two experiments. What are the effects of pacing (at the testing stage) of rare (PWs) and common (CWs) verbal items. In short, by forcing a subject to respond quickly can one depress the false alarm rate or will it increase? This is not as trivial as it would appear on first acquaintance as several studies on multiple-choice examination questions have shown that alteration of the subjects' first responses during the revision periods may lead to the alteration of correct responses: thus speeding here could improve performance. It was found that additional time for processing information reduced the number of false positive identifications for low-frequency words but not for common words. However, the difference was small and the slope of the speeded condition (physics words: 0.42) for the rare words was far too low for a valid interpretation.

A consideration of bias measures (beta: SDT) among rare and common words was continued anew in Experiment Seven. The stimulus items were the elements of the Periodic Table. These were rated by the chemists and non-chemists for their degree of familiarity. The table was desirable as it is a complete set of stimuli and one familiar to all chemists. Is it possible that knowing the complete set aids the recognition performance for chemists but not for arts students? Dale (1967) has shown strong biases existing for common English counties as opposed to rare ones yet, this bias breaks down in a subsequent recognition test when all the counties were named. Formal recognition tests do not aid when the complete category of stimuli are known, they only ameliorate the results for imperfectly known categories. One can hardly call the English counties rare items, so can one generalise this result of Dale's to very rare materials: such as for example the Lanthanide and Actinide series of the Periodic Table (see Figure 23 between pages 218 and 219)?

The results of the experiment were unexpected in that both chemists and non-chemists recognized common elements better than rare ones. This however could be a result (a lesson learnt from Experiment Three) of the recognition list. Because of the shortage of good distractor-signal pairs it was only possible to use a few stimuli, necessitating a repetition (undesirable of course) of the testing sequence. The chemists recognized the common elements much better than the rare ones {(TA) 0.7818 c.f. (TA) 0.6930, $t = 3.01^{**}$ 38 d.f.)}. The same situation existed for the arts subjects (0.7111 c.f. 0.6097, $t = 3.56^{**}$). However of more concern were the bias tendencies. Both groups were extremely cautious (Bias to NO: not present responses) on common elements. The arts subjects were biased to NO for rare elements too, the chemists displayed laxity only on rare elements. For arts subjects this is a reversal of bias as exemplified in Experiment Three where laxity was exhibited with a propensity for high false alarm rates on physics words on all lists, irrespective of the ratio of rare to common words. However, the least laxity was shown for the 1:1 list (equal number of PWs and CWs). Thus, as Experiment Seven was also a 1:1 list (or rather 7:8) it may be that the proportions of rare and common items is of tantamount importance in the test sequence. In fact this was clearly shown in Experiment Three.

Perhaps the principal lesson learnt from this experiment is the desirability to probe verbal learning experiments with instruments of a more delicate nature.

The bias for rare and common words is still in need of unravelling. It is important to settle the issue of strategies (laxity or caution) with a much better experiment. Consequently Experiment Eight dealt with biases in a more thorough fashion.

Once more two criterion groups of subjects (students of the English language (N=21) and science students (N=21)) were used in this experiment. It may be questionable to expect differences when both groups of subjects speak English, nevertheless one may presuppose that students of English are more fluent in their native tongue (this is not to say that scientists are not as erudite as arts students). The results of this experiment, using very rare and common words, were unequivocal only when the two groups were amalgamated (N=42): Table 16, page 128. The rare words were recognized much more easily than common words (0.7506 c.f. 0.6742, area measures, $\underline{t} = 3.80^{**}$; or area measures (A) 0.8397 c.f. 0.7508, $\underline{t} = 3.67^{**}$). There was a very strong bias to say Yes present to rare items and No absent to common words. This supported earlier experiments and in view of the careful controls and distractor items must now be accepted empirically {(Bias (B) 1.7733 for rare, 2.3718 for common, $\underline{t} = 4.61^{**}$)}.

The English students (N=21) displayed a superior performance on rare words compared with science students (not significant however). The science subjects performed better than English students on common words, again not statistically significant. To obviate any criticism concerning the English students performance on rare words being a result of their deterioration on common words, an overall test was performed. That is, the task was just treated as a recognition memory experiment using English words. Table 17 (page 129) gives the results. There were no significant differences between the two groups on area, transformed area or bias measures. In fact, the results were so similar that one can with a certain degree of confidence, assume that the breakdown into rare and common words as a viable, feasible, and justifiable operation.

Experiment Nine returned to a molecular study of an important parameter of verbal items; namely the degree of pronounceability. This experiment utilized very rare words from the English word norms culled for Experiment Eight. It was clearly shown that in an all rare word category (low word frequency and low familiarity) that pronounceability does not aid recognition. One suspects, however, that it is difficult for subjects to rate words on pronounceability alone; a certain degree of contamination creeps in with familiarity with the words in question. However, it is interesting to note that there are conditions where pronounceability is no aid to recognition.

Experiment Ten endeavoured to compare very rare physics and chemistry terms; as it was possible that rare elements e.g. Dysprosium, Ytterbium, Gadolinium, and Praseodymium were harder to learn (or even pronounce) than the rare physics terms. No significant evidence was shown for the inferior learning of the chemistry terms. However, there was a pronounced bias towards Yes responses for the difficult (chemistry) elements. There was also a corresponding bias towards NO for the physics terms. This is an echo from Experiment Eight (Table 15, page 126): where a bias to say Yes to rare words, and NO, absent, to common words was evident.

Part Two (Experiments Eleven, Twelve, Thirteen and Fourteen) was directed towards the molar aspects of verbal learning, the study of context effects and changes in recognition performance when the input stimuli were tested 'out of context', or as Tulving and Thomson (1971) aptly called it a change in the cognitive environment which can upset recognition and hence defy those theorists who deny the importance of accessibility and retrieval in recognition, as opposed to recall. Experiment Eleven used critical common and physics terms embedded in common or physics terms, leading to four test lists (2 x 2 conditions). Sufficient evidence was shown for impairment in performance for identical words in the same serial positions when they have different background stimuli.

Experiments Twelve, Thirteen and Fourteen following Tulving and Thomson (1971) used strong and weak cues (elements of the Periodic Table) and produced results fully in favour of Tulving and Thomson's position regarding recognition and retrieval. The effect of context on recognition performance being difficult to reconcile with the supposition that an old test item provides an automatic access to its stored trace.

LIST OF APPENDICES

APPENDIX I

PHYSICS AND COMMON WORDS USED IN EXPERIMENT ONE

LIST A (Common Words)	LIST B (Physics Words)
VILLAGE	VISCOSITY
REGISTER	RESONANCE
MOVEMENT	MENISCUS
MANNER	MATRIX
LEATHER	LAMBERT
NONE	NODE
DIFFERENCE	DIELECTRIC
COLUMN	COULOMB
CORNER	COSINE
DEVELOPMENT	DIAMAGNETISM
ISLAND	ISOMER
POSSIBILITY	POTENTIOMETER
CREATURE	CATALYST
TONIGHT	TETRODE
FEATHER	FELSPAR
PENCIL	PENTODE
HEALTH	HELIX
PASSENGER	PYROMETER
PROTECTION	PHOTOMETER
THOUSAND	THERMOCOUPLE

LIST A (Continued	LIST B (Continued)
CARRIAGE	CATHODE
DOLLAR	DIPOLE
CIRCUMSTANCE	CAPACITANCE
EXAMPLE	ENTROPY
HISTORY	HYSTERESIS
CASTLE	CALCITE
SOLDIER	SOLENOID
IMPORTANCE	IMPEDANCE
CENTURY	CATENARY
OBSERVATION	OSCILLOSCOPE
TEMPLE	TENSOR
SECOND	SECANT
OPINION	OERSTED
OCCASION	OSMOSIS
CONSIDERATION	CALORIMETER
MIRROR	MICRON
AMBITION	ANGSTROM
DOOR	DYNE
DIAMOND	DYNATRON

LIST A (Continued)	LIST B (Continued)
INSTANCE	ISOTOPE
VALUE	VERNIER
GOVERNMENT	GALVANOMETER
INSTITUTION	INTERFEROMETER
DIVISION	DECIBEL
REVOLUTION	RECTIFIER
MERIT	MESON
DINNER	DIODE
REASON	REACTANCE
CAPTAIN	CATION
INDUSTRY	INDUCTANCE
RELIGION	RHEOSTAT
SUGGESTION	SPECTROSCOPE

APPENDIX 11

GROUP RESULTS AND Z SCALE VALUES FOR EXPERIMENT ONE

PHYSICS SUBJECTS (N = 25) Confidence ratings (5 categories)

	(1)	(2)	(3)	(4)	(5)
Physics Words					
Present (Signal)	619	41	13	45	32
Absent (Noise)	31	40	20	101	658
Common Words					
Present (Signal)	450	70	31	74	125
Absent (Noise)	34	63	58	147	448

ARTS SUBJECTS (N = 25)

	(1)	(2)	(3)	(4)	(5)
Physics Words					
Present (Signal)	564	64	11	36	75
Absent (Noise)	59	76	22	102	491
Common Words					
Present (Signal)	445	71	28	59	147
Absent (Noise)	51	63	51	107	478

The inspection list contained 30 Physics and 30 Common words.

The recognition booklet contained 60 Physics and 60 Common words, including the inspection items.

With twenty five subjects and thirty old words and thirty new words each horizontal line must add up to 750, (30 x 25).

APPENDIX II (Contd)

Probabilities and Z Values

Physics Subjects (N = 25)

	Common Words: Hit Rate p	Common Words: Hit Rate Z	Common Words: False Alarm Rate p	Common Words: False Alarm Rate Z	Physics Words: Hit Rate p	Physics Words: Hit Rate Z	Physics Words: False Alarm Rate p	Physics Words: False Alarm Rate Z
1.	0.600	-0.25	0.045	+1.70	0.825	-0.94	0.041	1.74
2.	0.693	-0.50	0.129	+1.13	0.880	-1.17	0.095	1.31
3.	0.735	-0.63	0.207	+0.82	0.897	-1.27	0.121	1.17
4.	0.833	-0.97	0.403	+0.25	0.957	-1.72	0.256	0.65
5.	1.000	-	1.000	-	1.000	-	1.00	-

Arts Subjects (N = 25)

	Common Words: HR		Common Words: FAR		Physics Words: HR		Physics Words: FAR	
1.	0.593	-0.24	0.068	+1.49	0.752	-0.68	0.079	1.41
2.	0.688	-0.49	0.152	+1.03	0.837	-0.98	0.180	0.92
3.	0.725	-0.60	0.220	+0.77	0.852	-1.05	0.209	0.81
4.	0.804	-0.86	0.363	+0.35	0.900	-1.28	0.345	0.40
5.	1.000	-	1.000	-	1.000	-	1.00	-

Confidence Ratings

1. Absolutely sure that the word was present
2. Almost sure that the word was present.
3. Not sure.
4. Almost sure that the word was absent.
5. Absolutely sure that the word was absent.

APPENDIX 111

INSTRUCTION SHEET FOR THE FAMILIARITY RATING TASK : EXPERIMENT TWO

PLEASE COMPLETE THESE QUESTIONS:

Name:________________________(Surname)__________________(Initials)

Sex: M/F

Faculty: ______________________________

Physics Training: Highest level of physics attended or currently entered for :-

Intermediate Gen. Sci.	_____	1st Year Univ.	_____
Leaving Phys.	_____	2nd Year Univ.	_____
Matric. Physics	_____	3rd Year Univ.	_____
		4th or Higher	_____

INSTRUCTIONS

On the following page is a list of scientific terms. Some of these will be quite familiar, even to people who have had little or no formal scientific training. Other terms will be familiar only to advanced level students; that is to students studying for a B.Sc. degree. Your task is to rate each word according to your degree of familiarity with the meaning of the term. Utilize the following 6-point scale using the numbers 1, 2, 3, 4, 5, 6, to indicate in the brackets after each word how familiar it is to you.

Here is the scale:

(1) A highly familiar word - you could accurately define the term.

(2) A familiar word - although you might not be able to give its precise definition.

(3) A vaguely familiar word - you know the word but have only a very general idea of its meaning.

(4) A moderately unfamiliar word - you can guess something about its meaning but you would not take a large bet that you were correct.

(5) An unfamiliar word - although extremely unfamiliar, you can remember coming across the term before.

(6) A totally unfamiliar word - you have never seen or heard the word before.

For example, one student rated the following five terms thus:-

SOLENOID	(2)
VERNIER	(1)
LAMBERT	(3)
TROCHOTRON	(6)
VISCOMETER	(5)

This is just one example of a student's ratings, there are of course no right or wrong ratings; just rate the words on a degree of familiarity scale from 1 to 6, please try to use all the six categories if at all possible. The above example showed that the student considered vernier and solenoid as being more familiar than lambert, whereas viscometer and trochotron were extremely unfamiliar terms. The rater considered that he had never seen or heard of trochotron.

APPENDIX IV

MEANS AND STANDARD DEVIATIONS FOR THE FAMILIARITY RATING TASK : EXPERIMENT TWO

		Physics Postgraduates (N=30)		Arts Postgraduates (N=30)	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.
1.	ADIABATIC	1.300	0.458	5.400	1.254
2.	ADIACTINIC	5.667	0.943	6.000	0.000
3.	ANEMOMETER	2.367	1.853	4.633	1.560
4.	ANGSTROM	1.033	0.180	4.633	1.278
5.	ANION	1.333	1.011	4.600	1.873
6.	ANTINODE	1.567	1.334	5.033	1.200
7.	ASYMPTOTE	1.200	0.909	3.033	2.090
8.	AUTOCLAVE	4.133	1.708	4.600	1.583
9.	AZIMUTH	1.633	0.912	5.000	1.506
10.	BAROGRAPH	2.400	1.625	3.967	1.560
11.	BARYON	2.533	1.727	5.767	0.616
12.	BEVATRON	3.433	1.838	5.867	0.427
13.	CALORIMETER	1.067	0.250	2.600	1.645
14.	CAPACITOR	1.000	0.000	3.567	1.667
15.	CATENARY	2.100	1.700	5.700	0.781
16.	CATHODE	1.000	0.000	2.267	1.181
17.	CATION	1.267	0.964	4.600	1.855
18.	COLLOID	1.667	0.978	4.167	1.753
19.	COSECANT	1.267	0.929	3.633	2.041
20.	COSINE	1.033	0.180	1.900	1.300
21.	COTANGENT	1.067	0.250	2.300	1.370
22.	COULOMB	1.000	0.000	4.633	1.871
23.	CURSOR	1.700	1.370	5.167	1.157
24.	DIAMAGNETISM	1.967	1.048	4.800	1.137
25.	DIELECTRIC	1.200	0.400	4.933	1.237

APPENDIX IV (Contd)

		Physics Postgraduates (N=30)		Arts Postgraduates (N=30)	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.
26.	DIFFRACTION	1.000	0.000	3.000	1.528
27.	DIODE	1.033	0.180	3.800	1.759
28.	DIPLET	4.600	1.604	5.833	0.453
29.	DIPOLE	1.067	0.249	5.200	1.249
30.	DYNE	1.100	0.396	4.500	1.857
31.	ELASTANCE	3.900	1.491	4.933	0.964
32.	ELECTRET	4.333	1.758	5.800	0.476
33.	ENTROPY	1.667	0.978	3.933	1.340
34.	EUTECTIC	3.933	1.999	6.000	0.000
35.	FARAD	1.033	0.180	5.200	1.352
36.	FELSPAR	2.300	1.552	3.633	2.025
37.	FERMION	1.900	1.513	5.800	0.600
38.	FLUX	1.067	0.249	1.967	1.197
39.	GALVANOMETER	1.000	0.000	1.900	0.978
40.	HELIX	1.333	0.596	4.033	1.722
41.	HYDROLYSIS	1.267	0.512	2.733	1.389
42.	HYSTERISIS	1.100	0.300	5.167	1.098
43.	IMPEDANCE	1.033	0.180	3.800	1.641
44.	INTERFEROMETER	1.267	0.442	4.867	1.648
45.	IONIZATION	1.000	0.000	2.700	1.370
46.	ISOMER	1.633	1.224	4.833	1.416
47.	ISOTRON	4.967	1.643	4.733	1.237
48.	JOULE	1.033	0.180	4.433	1.961
49.	LAMBERT	3.800	1.514	5.067	1.263
50.	MAGNETRON	2.933	1.570	4.867	0.957

APPENDIX IV (Contd)

		Physics Postgraduates (N=30)		Arts Postgraduates (N=30)	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.
51.	MASER	1.767	1.146	5.333	1.300
52.	MEGATRON	3.800	1.815	4.667	1.164
53.	MEGOHM	1.000	0.000	4.400	1.685
54.	MESON	1.567	1.023	5.100	1.248
55.	MICROMETER	1.000	0.000	1.933	1.340
56.	MICRON	1.100	0.300	3.433	1.585
57.	MODULUS	1.067	0.359	3.800	1.661
58.	NEUTRON	1.033	0.180	1.967	1.080
59.	OERSTED	1.633	0.752	5.667	0.943
60.	OSCILLOSCOPE	1.000	0.000	2.867	1.628
61.	OSMOSIS	1.533	0.957	2.167	1.714
62.	PARACHOR	5.733	0.680	5.900	0.539
63.	PARSEC	2.233	1.499	5.500	1.232
64.	PENTODE	1.000	0.000	5.267	1.063
65.	PERMEABILITY	1.400	0.490	1.667	0.943
66.	PERMITIVITY	1.400	0.490	4.867	1.628
67.	PHOTOMETER	1.500	0.992	3.500	1.478
68.	PHOTON	1.033	0.180	3.333	1.556
69.	POTENTIOMETER	1.067	0.249	4.233	1.726
70.	POUNDAL	1.567	1.257	4.667	1.758
71	PYROMETER	2.367	1.560	4.767	1.146
72.	QUANTUM	1.200	0.476	3.633	1.303
73.	RECTIFICATION	1.067	0.359	3.567	1.542
74.	RECTIFIER	1.000	0.000	3.233	1.283
75.	REFRACTIVITY	1.733	1.263	2.900	1.136

APPENDIX IV (Contd)

		Physics Postgraduates (N=30)		Arts Postgraduates (N=30)	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.
76.	REMANANCE	2.633	1.581	5.633	0.706
77.	RHEOSTAT	1.000	0.000	4.333	1.700
78.	RESONANCE	1.000	0.000	2.100	1.012
79.	RESONATOR	1.167	0.453	3.133	1.284
80.	SPECTROSCOPE	1.100	0.300	2.467	1.176
81.	SOLENOID	1.000	0.000	4.067	1.631
82.	STRIATION	2.633	1.975	3.267	1.861
83.	TETRODE	1.033	0.180	5.033	1.169
84.	THERMION	2.733	1.652	5.333	1.135
85.	THERMOPILE	2.067	1.153	5.233	1.116
86.	TORQUE	1.033	0.180	3.700	1.792
87.	TRIODE	1.000	0.000	4.733	1.504
88.	TRITON	3.133	1.928	5.167	1.344
89.	TROCHOTRON	5.633	0.948	5.933	0.250
90.	VALENCY	1.200	0.476	2.333	1.445
91.	VERNIER	1.000	0.000	3.800	1.833
92.	VISCOMETER	2.167	1.267	3.633	1.402
93.	VISCOSITY	1.200	0.476	1.833	1.003

APPENDIX V

THE THREE LISTS USED IN EXPERIMENT TWO

Physics Terms Used In Experiment 2:

LIST A: Common terms for both populations.

	Signal (inspection words)	Noise (distractors)
1.	COSINE	ASYMPTOTE
2.	CATHODE	COTANGENT
3.	CALORIMETER	DIFFRACTION
4.	FLUX	HYDROLYSIS
5.	GALVANOMETER	NEUTRON
6.	IONIZATION	OSMOSIS
7.	MICROMETER	PERMEABILITY
8.	OSCILLOSCOPE	REFRACTIVITY
9.	RESONANCE	SPECTROSCOPE
10.	VISCOSITY	VALENCY

APPENDIX V (Contd)

LIST B: Rare terms for both populations.

	Signal	Noise
1.	AUTOCLAVE	ADIACTINIC
2.	BEVATRON	BARYON
3.	CATENARY	DIPLET
4.	ELECTRET	EUTECTIC
5.	ISOTRON	ELASTANCE
6.	THERMION	TRITON
7.	MEGATRON	MAGNETRON
8.	PARACHOR	PARSEC
9.	FERMION	TROCHOTRON
10.	LAMBERT	REMANENCE

APPENDIX V (Contd)

LIST C: Terms fairly common for Physics Students but almost rare for Arts Students.

	Signal	Noise
1.	MESON	MASER
2.	TRIODE	TETRODE
3.	ANTINODE	ADIABATIC
4.	CURSOR	COLLOID
5.	PENTODE	POUNDAL
6.	DIELECTRIC	DIPOLE
7.	INTERFEROMETER	POTENTIOMETER
8.	OERSTED	SOLENOID
9.	PERMITIVITY	THERMOPILE
10.	ISOMER	MEGOHM

An attempt was made to make the Signal and Noise pairs as similar to each other as possible.

APPENDIX VI

INDIVIDUAL DATA : EXPERIMENT TWO

LIST A, Experiment 2 (RAW DATA)

	S	ARTS SUBJECTS										N	S	PHYSICS SUBJECTS										N
1.	8	0	0	0	1	1	0	1	0	0	1	8	4	3	0	0	1	2	0	0	0	0	1	9
2.	6	1	0	0	0	3	2	0	0	0	0	8	9	0	0	0	1	0	0	0	1	0	4	5
3.	5	2	1	0	1	1	0	0	1	2	3	4	8	0	0	0	1	1	0	0	0	0	1	9
4.	7	0	0	0	1	2	0	0	0	0	4	6	9	1	0	0	0	0	1	2	0	1	2	4
5.	7	0	0	0	0	3	0	0	0	0	3	7	5	1	0	0	2	2	0	0	1	1	1	7
6.	5	1	0	0	0	4	1	0	0	0	4	5	6	1	0	0	1	2	1	0	0	0	1	8
7.	6	3	1	0	0	0	0	0	0	1	5	4	4	2	2	1	1	0	0	0	1	5	3	1
8.	5	2	2	1	0	0	2	0	1	0	3	4	3	0	0	0	4	3	0	1	0	0	5	4
9.	5	2	1	1	0	1	1	1	1	2	1	4	5	0	1	1	0	3	1	0	2	0	1	6
10.	8	0	0	0	1	1	0	0	0	0	2	8	8	0	0	0	1	1	0	0	1	0	1	8
11.	6	0	1	0	2	1	2	0	1	1	2	4	5	0	0	1	3	1	0	2	1	0	0	7
12.	7	0	0	0	2	1	0	0	0	3	1	6	5	1	0	0	0	4	0	0	1	0	0	9
13.	8	0	1	1	0	0	0	1	0	2	1	6	4	1	1	3	1	0	0	1	1	1	4	3
14.	5	2	1	1	0	1	0	1	1	2	2	4	9	0	0	0	0	1	0	0	0	1	1	8
15.	8	1	0	0	0	1	1	0	0	0	0	9	1	1	3	0	4	1	0	0	0	1	8	1
16.	8	2	0	0	0	0	2	0	0	0	1	7	6	0	4	0	0	0	0	2	0	2	2	4
17.	5	2	0	2	0	1	1	0	0	0	4	5	7	0	0	0	3	0	0	0	1	0	1	8
18.	5	1	1	2	0	1	0	0	1	1	1	7	8	0	0	1	0	1	0	0	0	0	2	8
19.	6	0	0	0	0	4	2	0	0	0	0	8	7	1	2	0	0	0	0	0	2	0	0	8
20.	6	2	1	0	1	0	0	0	0	1	3	6	3	0	1	3	3	0	0	0	1	1	7	1
21.	5	1	1	0	1	2	1	2	0	1	1	5	8	0	0	0	1	1	0	0	0	3	1	6
22.	8	1	0	1	0	0	0	0	0	0	1	9	5	1	0	0	1	3	0	1	0	1	1	7
23.	6	1	1	0	0	2	1	0	1	2	2	4	9	0	0	0	0	1	0	0	0	0	0	10
24.	6	1	0	0	0	3	1	0	0	0	5	4	6	0	2	1	1	0	0	1	1	0	1	7
25.	6	1	1	0	1	1	0	1	0	1	4	4	7	1	2	0	0	0	0	0	0	1	1	8
Totals	157	26	13	09	11	34	17	7	7	19	54	146	151	14	18	11	29	27	3	10	14	18	49	156
			S						N							S						N		

DATA FOR COMMON PHYSICS TERMS

APPENDIX VI (Contd)

LIST B, Experiment 2 (RAW DATA)

	ARTS SUBJECTS (N=25)												PHYSICS SUBJECTS (N=25)											
	S											N	S											N
1.	5	1	0	0	1	3	0	2	1	0	0	7	8	2	0	0	0	0	0	0	0	0	0	10
2.	7	1	0	0	0	2	3	2	0	0	0	5	8	0	0	0	0	2	0	0	0	0	1	9
3.	5	1	1	2	0	1	0	1	0	1	4	4	8	0	0	0	1	1	0	0	0	0	1	9
4.	8	0	0	0	0	2	1	0	0	0	4	5	5	2	0	0	3	0	0	1	0	0	6	3
5.	7	0	0	0	1	2	2	1	0	0	1	6	7	1	1	0	0	1	1	0	0	0	0	9
6.	7	0	0	0	0	3	1	0	0	1	3	5	10	0	0	0	0	0	2	0	1	0	1	6
7.	6	0	1	2	1	0	0	2	1	0	4	3	8	1	0	1	0	0	0	0	2	4	2	2
8.	7	1	0	0	2	0	3	1	1	0	0	5	7	0	0	0	2	1	1	0	0	0	1	8
9.	6	0	0	0	2	2	2	2	1	2	1	2	9	1	0	0	0	0	2	0	1	1	1	5
10.	8	0	0	1	1	0	1	0	0	1	4	4	9	0	1	0	0	0	0	0	1	2	5	2
11.	5	0	0	1	3	1	1	1	0	2	3	3	8	0	1	0	0	1	0	0	0	0	1	9
12.	6	1	0	0	0	3	2	1	0	0	0	7	7	0	0	0	0	3	1	0	0	1	0	8
13.	7	0	1	2	0	0	3	0	1	1	0	5	6	1	1	2	0	0	0	0	0	1	3	6
14.	6	1	1	1	0	1	1	0	1	2	2	4	6	1	1	0	1	1	0	0	0	1	0	9
15.	6	0	0	0	1	3	0	1	1	0	0	8	5	1	0	2	2	0	0	0	0	0	6	4
16.	6	2	0	0	0	2	1	2	1	0	0	6	8	0	1	0	0	1	1	0	1	0	6	2
17.	8	1	0	0	0	1	2	2	1	1	2	2	7	2	0	1	0	0	0	0	0	0	2	8
18.	6	1	0	2	1	0	0	2	2	1	1	4	9	0	0	1	0	0	0	0	0	0	2	8
19.	10	0	0	0	0	0	4	0	0	0	0	6	6	1	1	0	0	2	0	0	0	0	0	10
20.	7	0	1	1	1	0	1	0	0	2	4	3	8	0	0	1	1	0	1	1	3	0	4	1
21.	7	1	1	0	0	1	2	1	2	0	3	2	8	1	0	0	0	1	0	0	0	0	3	7
22.	9	0	0	1	0	0	0	1	0	2	1	6	10	0	0	0	0	0	1	0	0	1	3	5
23.	6	1	0	1	1	1	1	2	1	1	2	3	10	0	0	0	0	0	1	0	0	0	0	9
24.	5	1	1	0	1	2	3	2	0	0	1	4	8	1	0	1	0	0	0	0	1	1	1	7
25.	6	1	0	1	1	1	0	1	2	1	3	3	7	1	0	1	1	0	0	0	0	0	2	8
Totals	166	14	07	15	17	31	34	27	16	18	43	112	192	16	07	10	11	14	11	02	10	12	51	164
				S						N						S						N		

DATA FOR RARE PHYSICS TERMS

APPENDIX VI (Contd)

LIST C, Experiment 2 (RAW DATA)

	S						ARTS SUBJECTS (N=25)					N	S						PHYSICS SUBJECTS (N=25)					N
1.	6	1	0	0	1	2	2	0	0	0	1	7	6	1	1	0	0	2	0	1	0	0	2	7
2.	7	0	0	0	1	2	3	1	0	0	0	6	8	0	0	0	1	1	0	0	0	0	2	8
3.	3	2	2	1	2	0	0	1	0	1	4	4	8	0	0	0	0	2	2	1	0	0	0	7
4.	8	0	0	0	1	1	0	0	0	0	5	5	6	3	0	0	1	0	0	0	0	0	5	5
5.	8	1	0	0	0	1	1	0	0	0	4	5	7	1	1	0	1	0	1	0	1	1	1	6
6.	5	3	0	0	2	0	2	0	1	0	1	6	10	0	0	0	0	0	0	0	0	0	3	7
7.	5	3	1	0	1	0	0	2	0	0	3	5	8	0	0	2	0	0	0	0	0	2	3	5
8.	6	1	1	1	1	0	3	0	1	1	2	3	6	1	0	0	2	1	0	1	0	0	2	7
9.	10	0	0	0	0	0	1	0	2	0	2	5	9	1	0	0	0	0	3	0	0	0	1	6
10.	6	0	0	2	2	0	0	0	2	1	1	6	8	0	0	0	1	1	0	0	0	0	3	7
11.	4	1	0	1	3	1	1	0	0	0	5	4	7	0	0	1	1	1	0	0	0	0	2	8
12.	7	1	0	0	1	1	2	0	0	0	3	5	7	2	1	0	0	0	1	0	1	0	0	8
13.	8	0	2	0	0	0	2	0	2	2	0	4	5	3	1	0	1	0	0	2	0	0	5	3
14.	5	2	0	1	1	1	0	0	1	2	2	5	8	0	2	0	0	0	0	1	0	0	2	7
15.	7	1	1	0	1	0	0	0	0	0	0	10	1	0	1	2	5	1	0	0	0	0	7	3
16.	6	2	0	0	0	2	1	1	0	0	2	6	8	1	1	0	0	0	0	1	1	0	3	5
17.	8	0	0	1	1	0	2	0	2	1	1	4	8	1	0	0	1	0	0	1	0	0	0	9
18.	9	0	0	0	1	0	2	0	2	1	0	5	8	0	1	1	0	0	0	0	0	0	1	9
19.	8	0	0	0	0	2	3	0	0	0	0	7	7	0	2	0	0	1	0	0	1	0	0	9
20.	6	1	2	1	0	0	0	0	1	1	2	6	6	1	1	0	2	0	0	2	0	1	6	1
21.	8	1	0	0	0	1	2	1	1	0	2	3	8	1	0	1	0	0	1	1	0	1	1	6
22.	9	1	0	0	0	0	0	0	0	0	2	8	8	0	0	1	0	1	0	1	0	0	1	8
23.	7	1	1	0	1	0	2	1	0	2	1	4	10	0	0	0	0	0	0	0	0	0	1	9
24.	7	1	0	1	1	0	2	0	2	0	1	5	6	1	2	1	0	0	1	0	0	1	1	7
25.	6	1	1	0	1	1	1	1	0	1	3	5	7	2	1	0	0	0	0	0	1	1	2	6
Totals	169	24	11	09	22	15	32	08	17	13	47	133	180	19	15	09	16	11	09	12	105	08	53	163
	S						N						S						N					

APPENDIX VII

GROUP DATA : EXPERIMENT TWO

COMMON TERMS (LIST A)

Physics Students:

Category	$P(\frac{s}{s})$	$P(\frac{s}{n})$	Ht of Signal	Ht of Noise	Ys/Yn	Beta
1	0.60	0.01	0.39	0.03	13.00	*8.671
2	0.66	0.05	0.37	0.10	3.70	*2.648
3	0.73	0.11	0.33	0.19	1.737	*1.1586
4	0.78	0.18	0.30	0.26	1.154	0.77
5	0.89	0.38	0.19	0.38	0.500	0.3335

Arts Students:

Category						
1	0.63	0.07	0.38	0.13	2.923	*1.886
2	0.73	0.10	0.33	0.18	1.833	*1.183
3	0.78	0.12	0.30	0.20	1.500	0.9678
4	0.82	0.20	0.26	0.28	0.929	0.5994
5	0.86	0.42	0.22	0.39	0.564	0.3639

APPENDIX VII (Contd)

RARE TERMS (LIST B)

Physics Students:

Category	$P(\frac{S}{S})$	$P(\frac{S}{n})$	Ht of Signal	Ht of Noise	Ys/Yn	Beta
1	0.77	0.04	0.30	0.09	3.333	*2.223
2	0.83	0.05	0.25	0.10	2.500	*1.668
3	0.86	0.09	0.22	0.16	1.375	0.917
4	0.90	0.14	0.18	0.22	0.818	0.546
5	0.94	0.34	0.12	0.37	0.324	0.216

Arts Students:

Category						
1	0.66	0.14	0.37	0.22	1.682	0.966
2	0.72	0.24	0.34	0.31	1.097	0.631
3	0.75	0.31	0.32	0.35	0.9143	0.526
4	0.81	0.38	0.27	0.38	0.711	0.409
5	0.88	0.55	0.20	0.40	0.500	0.288

APPENDIX VII (Contd)

ALMOST RARE FOR ARTS STUDENTS,
FAIRLY COMMON FOR PHYSICS STUDENTS (LIST C)

Physics Students

Category	$P(\frac{S}{s})$	$P(\frac{S}{n})$	Ht of Signal	Ht of Noise	Ys/Yn	Beta
1	0.72	0.04	0.34	0.09	3.778	*3.148
2	0.80	0.08	0.28	0.15	1.8667	*1.556
3	0.86	0.10	0.22	0.18	1.222	*1.018
4	0.89	0.14	0.19	0.27	0.704	0.5867
5	0.96	0.35	0.09	0.37	0.2432	0.2027

Arts Students:

Category						
1	0.68	0.13	0.36	0.21	1.7143	*1.347
2	0.77	0.16	0.30	0.24	1.2500	0.982
3	0.82	0.23	0.26	0.30	0.8667	0.681
4	0.85	0.28	0.23	0.34	0.6765	0.532
5	0.94	0.47	0.12	0.40	0.3000	0.2357

* There is Bias to Noise when beta is greater than one.

APPENDIX V111

Z SCORES FOR THE DATA : EXPERIMENT TWO

COMMON TERMS (LIST A)

Category	Physics Students (N=25) $Z(\frac{s}{s})$	Physics Students (N=25) $Z(\frac{s}{n})$	Arts Students (N=25) $Z(\frac{s}{s})$	Arts Students (N=25) $Z(\frac{s}{n})$
1	-0.25	+2.33	-0.33	+1.48
2	-0.41	+1.65	-0.61	+1.28
3	-0.61	+1.23	-0.77	+1.18
4	-0.67	+0.92	-0.92	+0.84
5	-1.22	+0.31	-1.08	+0.21

Physics Students: Slope = 0.58 : Delta m = 2.32

$d'_s = 1.72$

Arts Students: Slope = 0.54 : Delta m = 2.52

$d'_s = 1.76$

APPENDIX VIII (Contd)

RARE TERMS (LIST B)

	Physics Students (N=25)		Arts Students (N=25)	
Category	$Z(\frac{s}{s})$	$Z(\frac{s}{n})$	$Z(\frac{s}{s})$	$Z(\frac{s}{n})$
1	-0.74	+1.75	-0.41	+1.08
2	-0.96	+1.65	-0.58	+0.71
3	-1.08	+1.34	-0.67	+0.50
4	-1.28	+1.08	-0.88	+0.31
5	-1.56	+0.41	-1.18	-0.13

Slope = 0.50 : Delta m = 3.60   Slope = 0.62 : Delta m = 1.68

$d'_s = 2.40$ $d'_s = 1.32$

APPENDIX VIII (Contd)

ALMOST RARE TERMS FOR ARTS STUDENTS,
FAIRLY COMMON FOR PHYSICS STUDENTS. (LIST C)

	Physics Students (N=25)		Arts Students (N=25)	
Category	$z(\frac{s}{s})$	$z(\frac{s}{n})$	$z(\frac{s}{s})$	$z(\frac{s}{n})$
1	-0.58	+1.75	-0.47	+1.12
2	-0.84	+1.40	-0.74	+0.99
3	-1.08	+1.28	-0.92	+0.74
4	-1.23	+1.08	-1.04	+0.58
5	-1.75	+0.39	-1.56	+0.08

Physics Students: Slope = 0.72 : Delta m = 2.62

$d'_s = 2.28$

Arts Students: Slope = 0.65 : Delta m = 2.16

$d'_s = 1.68$

Note: Delta m is the value of $z(\frac{s}{n})$ at $z(\frac{s}{s}) = 0$ (i.e. the intercept of the ROC curve on the X-axis of the curves in Figure).

APPENDIX IX

COMMON AND RARE WORDS USED IN THE GARTON AND ALLEN PAPER (1968)

LANGUAGE	RESONANCE
KNOWLEDGE	QUANTITY
OBJECT	SECOND
ATTENTION	REASON
HORSE	ANGSTROM
DOCTOR	REVOLUTION
VALUE	FLOOD
TONIGHT	DIPOLE
FEATHER	CORNER
CONSIDERATION	THOUSAND
DOLLAR	SOLENOID
OSMOSIS	CATHODE
INSTITUTION	SOLDIER
DYNE	CALCITE
DYNATRON	CARRIAGE
INSTANCE	TENSOR
DOOR	DIODE
REGISTER	OSCILLOSCOPE
DIFFERENCE	DIAMAGNETISM
EXAMPLE	OBSERVATION
RELIGION	COSINE
MICRON	ISOMER
ANGER	SUGGESTION
INDUCTANCE	VISITOR
HYSTERESIS	HEALTH
DIELECTRIC	

APPENDIX IX (Contd)

RHEOSTAT	PASSENGER
CATENARY	PARSEC
PROTECTION	RECTIFIER
CREATURE	IMPORTANCE
PERSON	PHOTOMETER
COULOMB	MANNER
LEATHER	COSECANT
MENISCUS	VERNIER
DIAMOND	CENTURY
PYROMETER	DIVISION
OPINION	DINNER
INTERFEROMETER	CIRCUMSTANCE
OERSTED	COLUMN
PENCIL	CALORIMETER
VISCOSITY	CASTLE
TETRODE	REACTANCE
HISTORY	OCCASION
CAPACITANCE	VILLAGE
NODE	LAMBERT
HELIX	MESON
FLUX	MOVEMENT
CAPTAIN	FELSPAR
ENTROPY	CATION
MATRIX	PENTODE
GOVERNMENT	GALVANOMETER
DIFFRACTION	POTENTIOMETER

APPENDIX X

GROUP DATA : MANIPULATION OF STUDY TRIALS : EXPERIMENTS 4 & 5

CONDITION A (one presentation of the stimulus for ½ sec.)

$d_s = 1.73$

Category:	1	2	3	4	5
Signal	177	26	8	15	54
Prob.	0.632	0.725	0.754	0.807	-
z	-0.34	-0.60	-0.69	-0.87	-
Category:	1	2	3	4	5
Noise	85	60	40	101	1109
Prob.	0.607	0.104	0.136	0.208	-
z	+1.55	+1.26	+1.10	+0.81	-

TOTAL TIME = 13.10 Secs.

CONDITION B (one presentation of the stimulus for 1.4 sec.)

$d_s = 1.92$

Category:	1	2	3	4	5
Signal	197	16	13	11	43
Prob.	0.704	0.761	0.807	0.846	-
z	-0.53	-0.71	-0.87	-1.02	-
Category:	1	2	3	4	5
Noise	85	46	61	92	1116
Prob.	0.061	0.094	0.137	0.203	-
z	1.55	1.32	1.09	0.83	-

TOTAL TIME = 22.1 secs

CONDITION C (two presentations for 0.25 sec.)

$d_s = 2.67$

Category:	1	2	3	4	5
Signal	232	12	7	7	22
Prob.	0.829	0.871	0.896	0.921	-
z	-0.95	-1.13	-1.26	-1.41	-
Category:	1	2	3	4	5
Noise	43	37	22	53	1245
Prob.	0.031	0.057	0.073	0.11	-
z	1.87	1.58	1.46	1.22	-

TOTAL TIME = 22.1 secs.

APPENDIX $\overline{X}$ (Contd)

DATA FOR THE REPEATED PRESENTATIONS WITH A CONSTANT REHEARSAL AND VIEWING TIME

One Presentation : $d_s = 1.54$

Category (1 to 5)

	1	2	3	4	5	
n	304	45	24	27	80	
P,	0.633	0.727	0.777	0.833	-	S
z	-0.34	-0.607	-0.762	-0.966	-	
n	46	45	13	27	349	
P,	0.096	0.190	0.217	0.273	-	N
z	+1.31	+0.88	+0.782	0.604	-	

Two Presentations : $d_s = 2.07$

n	330	47	38	19	46	
P,	0.688	0.785	0.865	0.904	-	S
n	17	26	35	48	354	
P,	0.035	0.090	0.163	0.263	-	N

Three Presentations : $d_s = 2.40$

n	354	37	24	13	52	
P,	0.738	0.815	0.865	0.892	-	S
n	14	12	19	26	409	
P,	0.029	0.054	0.094	0.148	-	N

Data for Experiment 5 : Figure 8.

Where S refers to words viewed : N to words used as distractor items.

APPENDIX XI

MEANS AND STANDARD DEVIATIONS FOR THE ELEMENTS OF THE PERIODIC TABLE RATING TASK

	Element	Chemistry Postgraduates $\bar{X}$	Chemistry Postgraduates S	Arts Postgraduates $\bar{X}$	Arts Postgraduates S
1.	ACTINIUM	2.433•	1.230	5.467•	1.231
2.	ALUMINIUM	1.033•	0.180	1.433•	0.559
3.	AMERICIUM	2.767•	1.174	5.367•	1.251
4.	ANTIMONY	1.567•	0.761	3.967•	1.958
5.	ARGON	1.167•	0.453	2.700	1.676
6.	ARSENIC	1.300	0.526	1.567•	0.559
7.	ASTATINE	2.200	1.447	5.600	1.143
8.	BARIUM	1.133	0.340	3.533•	1.190
9.	BERKELIUM	3.000	1.483	5.633•	1.197
10.	BERYLLIUM	1.633	0.948	4.633•	1.871
11.	BISMUTH	1.700	0.781	4.167•	1.899
12.	BORON	1.300	0.526	2.733•	1.389
13.	BROMINE	1.067•	0.249	2.333•	1.398
14.	CADMIUM	1.367•	0.547	3.967•	2.025
15.	CAESIUM	1.500	0.885	5.000	1.653
16.	CALCIUM	1.067•	0.249	1.467•	0.562
17.	CALIFORNIUM	2.800	1.327•	5.600	1.228
18.	CARBON	1.033•	0.180	1.267•	0.512
19.	CERIUM	1.900	0.831	5.500	1.231
20.	CHLORINE	1.000	0.000	1.567•	0.616
21.	CHROMIUM	1.167•	0.453	1.833	0.860
22.	COBALT	1.233•	0.599	2.067•	0.964
23.	COPPER	1.133•	0.340	1.367•	0.547
24.	CURIUM	2.900	1.274	5.233	1.283
25.	DYSPROSIUM	3.400	1.451	5.733	1.093

APPENDIX XI

	Element	Chemistry Postgraduates $\overline{X}$	S	Arts Postgraduates $\overline{X}$	S
26.	EINSTEINIUM	3.133*	1.431	5.600	1.200
27.	ERBIUM	3.400	1.497	5.733*	1.093
28.	EUROPIUM	3.233*	1.521	5.567*	1.230
29.	FERMIUM	3.233*	1.521	5.533*	1.360
30.	FLUORINE	1.133	0.427	2.333*	1.450
31.	FRANCIUM	3.167*	1.572	5.667*	1.106
32.	GADOLINIUM	3.100	1.325	5.733*	1.093
33.	GALLIUM	2.533*	1.310	5.533*	1.231
34.	GERMANIUM	2.067*	1.209	5.133*	1.455
35.	GOLD	1.333*	0.537	1.300	0.526
36.	HAFNIUM	2.500	1.455	5.733*	1.093
37.	HELIUM	1.166*	0.637	1.833*	0.778
38.	HOLMIUM	3.567*	1.564	5.667*	1.135
39.	HYDROGEN	1.067*	0.359	1.300	0.526
40.	INDIUM	2.733*	1.389	5.567*	1.116
41.	IODINE	1.200	0.600	1.667*	0.699
42.	IRIDIUM	2.167*	1.267	4.900	1.640
43.	IRON	1.033*	0.180	1.300	0.526
44.	KRYPTON	1.367*	0.795	3.333*	1.670
45.	LANTHANUM	2.033*	1.251	5.667*	1.135
46.	LAWRENCIUM	3.033*	1.538	5.667*	1.135
47.	LEAD	1.167*	0.373	1.400	0.554
48.	LITHIUM	1.067*	0.249	3.867*	1.839
49.	LUTETIUM	3.200	1.579	5.500	1.176
50.	MAGNESIUM	1.100	0.300	1.900	0.870
51.	MANGANESE	1.233*	0.423	2.000	1.125

APPENDIX XI

	Element	Chemistry Postgraduates $\overline{X}$	S	Arts Postgraduates $\overline{X}$	S
52.	MENDELEVIUM	3.300	1.531	5.533*	1.258
53.	MERCURY	1.233*	0.496	1.433*	0.559
54.	MOLYBDENUM	1.533*	0.763	4.100	2.055
55.	NEODYMIUM	3.267*	1.611	5.667*	1.135
56.	NEON	1.333*	0.699	2.200	1.222
57.	NEPTUNIUM	2.933*	1.413	4.833*	1.507
58.	NICKEL	1.167*	0.453	1.733*	0.814
59.	NIOBIUM	2.567*	1.430	5.467*	1.258
60.	NITROGEN	1.067*	0.359	1.433*	0.616
61.	NOBELIUM	3.100	1.469	5.667*	1.135
62.	OSMIUM	2.167*	1.067	5.333*	1.599
63.	OXYGEN	1.033*	0.180	1.167*	0.453
64.	PALLADIUM	1.833*	0.969	4.767*	1.745
65.	PHOSPHORUS	1.167*	0.373	1.867*	0.884
66.	PLATINUM	1.467*	0.670	2.067*	1.365
67.	PLUTONIUM	2.433*	1.257	3.933*	1.711
68.	POLONIUM	2.833*	1.507	5.400	1.254
69.	POTASSIUM	1.067*	0.249	2.000	0.856
70.	PRASEODYMIUM	3.433*	1.647	5.767*	1.086
71.	PROMETHIUM	3.600	1.451	5.567*	1.174
72.	PROTACTINIUM	3.467*	1.431	5.600	1.143
73.	RADIUM	2.000	1.065	2.100	1.136
74.	RADON	1.933*	1.365	4.333*	1.795
75.	RHENIUM	2.100	1.300	5.500	1.231
76.	RHODIUM	2.233*	1.174	5.167*	1.319
77.	RUBIDIUM	2.467*	1.522	5.533*	1.231

APPENDIX XI

	Element	Chemistry Postgraduates $\bar{X}$	Chemistry Postgraduates S	Arts Postgraduates $\bar{X}$	Arts Postgraduates S
78.	RUTHENIUM	2.633•	1.472	5.533•	1.231
79.	SAMARIUM	3.300	1.531	6.000	0.000
80.	SCANDIUM	3.200	1.376	5.800	0.541
81.	SELENIUM	1.500	0.619	5.167•	1.157
82.	SILICON	1.267•	0.442	2.400	1.143
83.	SILVER	1.133•	0.427	1.400	0.490
84.	SODIUM	1.033•	0.180	1.600	0.712
85.	STRONTIUM	1.600	0.800	3.667•	2.000
86.	SULPHUR	1.067•	0.249	1.700	0.640
87.	TANTALUM	2.567•	1.257	5.633•	0.795
88.	TECHNETIUM	2.800	1.514	5.967•	0.180
89.	TELLURIUM	2.267•	1.340	5.967•	0.907
90.	TERBIUM	3.333•	1.398	6.000	0.000
91.	THALLIUM	2.500	1.360	5.067•	1.263
92.	THORIUM	2.567•	1.174	5.700	0.586
93.	THULIUM	4.133•	1.543	5.967•	0.180
94.	TIN	1.133•	0.537	1.533•	0.500
95.	TITANIUM	1.467•	0.763	4.100	1.795
96.	TUNGSTEN	1.467•	0.718	2.233•	1.116
97.	URANIUM	1.400	0.712	1.800	0.833
98.	VANADIUM	1.333•	0.596	5.067•	1.289
99.	XENON	1.133•	0.340	5.033•	1.472
100.	YTTERBIUM	3.067•	1.436	5.833•	0.453
101.	YTTRIUM	2.767•	1.430	5.800	0.476
102.	ZINC	1.067•	0.249	1.667•	0.650
103.	ZIRCONIUM	1.967•	0.912	4.800	1.424

APPENDIX XII

INSTRUCTION PAGE FOR THE
RECOGNITION TASK IN EXPERIMENT SEVEN

NAME: ....

FACULTY:

ARTS/LAW	....	Highest level of Chemistry attended or currently entered for.	
SCIENCE	....		
ENGINEERING	....	INTERMEDIATE	....
OTHER	....	LEAVING	....
		MATRIC	....
		FIRST YEAR CHEMISTRY	....
		SECOND YEAR CHEMISTRY	....
		THIRD YEAR CHEMISTRY	....
		FOURTH YEAR OR HIGHER	....

INSTRUCTIONS

Before turning over, please read the following instructions.

On the following pages you will find a number of words. Some of these you will have seen on the slides, otherswill not have appeared.

Please mark in the appropriate box, with a cross, the degree of certainty of the word's presence or absence on the slides.

Beside each word there are four boxes.

If you are absolutely certain that the word (e.g. WATER) appeared on a slide, mark the first box with a cross.

i.e. WATER | X | | | |

APPENDIX XII (Contd)

If you are absolutely certain that the word did NOT appear on a slide, mark the last box with a cross.

i.e. WATER

			X

If you are not certain, but you are almost sure that the word appeared on a slide, mark the second box.

i.e. WATER

	X		

Similarly, if you are uncertain but you are almost sure that the word did NOT appear on a slide, then mark the third box.

i.e. WATER

		X	

The four boxes thus present a continuum from absolutely sure was present to absolutely sure was not present.

Try and work through the list of words at a fairly steady and rapid rate. Do not spend a long time over any one word. Your cross should indicate your initial impression rather than be a weighed decision.

APPENDIX XIII

INDIVIDUAL CATEGORY DATA: CHEMISTS AND NON-CHEMISTS EXPERIMENT SEVEN

Non-Chemists (N = 20)

		Common Words (Signal)				Common Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
1.	n	13	1	5	9	3	2	3	20
	p	.464	.500	.679	-	.107	.179	.286	-
2.	n	12	12	4	-	5	10	10	3
	p	.429	.857	1.0	-	.179	.536	.893	-
3.	n	15	-	-	13	-	1	2	25
	p	.536	.536	.536	-	0.00	.036	.107	-
4.	n	16	4	7	1	8	8	10	2
	p	.571	.714	.964	-	.286	.571	.929	-
5.	n	23	1	-	4	-	5	5	18
	p	.821	.857	.857	-	0.00	.179	.357	-
6.	n	17	1	4	6	-	-	4	24
	p	.607	.643	.786	-	0.00	0.00	.143	-
7.	n	12	1	-	15	4	2	2	20
	p	.429	.464	.464	-	.143	.214	.286	-
8.	n	20	1	6	1	2	2	7	17
	p	.714	.750	.964	-	.071	.143	.393	-
9.	n	23	2	3	-	8	2	11	7
	p	.821	.893	1.0	-	.286	.357	.750	-
10.	n	16	2	3	7	5	-	4	19
	p	.571	.643	.750	-	.179	.179	.321	-

THE TOTAL NUMBER OF RESPONSES FOR BOTH SIGNAL AND NOISE = 28

APPENDIX XIII (Contd)

Non-Chemists

		Common Words (Signal)				Common Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
	n	24	-	3	1	2	-	13	13
11.	p	.857	.857	.964	-	.071	.071	.536	-
	n	18	5	5	-	2	12	14	-
12.	p	.643	.821	1.0	-	.071	.500	1.0	-
	n	15	3	2	8	-	-	6	22
13.	p	.536	.643	.714	-	0.0	0.0	.214	-
	n	11	5	3	9	1	4	4	19
14.	p	.393	.571	.679	-	.036	.179	.321	-
	n	21	2	1	4	4	3	6	15
15.	p	.750	.821	.857	-	.143	.250	.464	-
	n	22	4	2	-	5	3	9	11
16.	p	.786	.929	1.0	-	.179	.286	.607	-
	n	17	9	2	-	1	6	11	10
17.	p	.607	.929	1.0	-	.036	.250	.643	-
	n	23	4	-	1	-	8	14	6
18.	p	.821	.964	.964	-	0.0	.286	.786	-
	n	17	3	3	5	3	3	6	16
19.	p	.607	.714	.821	-	.094	.188	.375	-
	n	15	1	-	12	-	-	-	28
20.	p	.536	.571	.571	-	0.0	0.0	0.0	-

APPENDIX XIII (Contd)

Non-Chemists (N = 20)

		Rare Words (Signal)				Rare Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
	n	27	-	1	4	15	-	2	15
1.	P	.844	.844	.875	-	.469	.469	.531	-
	n	9	8	12	3	3	8	14	7
2.	P	.281	.531	.906	-	.094	.344	.781	-
	n	17	1	-	14	6	-	1	25
3.	P	.531	.563	.563	-	.188	.188	.219	-
	n	18	4	6	4	3	-	10	19
4.	P	.563	.688	.875	-	.094	.094	.406	-
	n	8	3	6	15	10	5	2	15
5.	P	.250	.344	.531	-	.313	.469	.531	-
	n	9	2	4	17	8	1	7	16
6.	P	.281	.344	.469	-	.250	.281	.500	-
	n	20	3	-	9	5	-	1	26
7.		.625	.719	.719	-	.156	.156	.188	-
	n	16	-	3	13	1	1	7	23
8.	P	.500	.500	.594	-	.031	.063	.281	-
	n	19	2	6	5	13	1	8	10
9.	P	.594	.656	.844	-	.406	.438	.688	-
	n	9	7	14	2	5	7	5	15
10.	P	.281	.500	.938	-	.156	.375	.531	-

THE TOTAL NUMBER OF RESPONSES FOR BOTH SIGNAL AND NOISE = 32

APPENDIX XIII (Contd)

Non-Chemists

		Rare Words (Signal)				Rare Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
	n	20	-	9	3	10	1	16	5
11.	P	.625	.625	.906	-	.313	.344	.844	-
	n	27	3	2	-	5	4	19	4
12.	P	.844	.938	1.0	-	.156	.281	.875	-
	n	7	3	10	12	1	4	12	15
13.	P	.219	.313	.625	-	.031	.156	.531	-
	n	24	4	3	1	21	4	3	4
14.	P	.750	.875	.969	-	.656	.781	.875	-
	n	9	9	13	1	4	4	14	10
15.	P	.281	.563	.969	-	.125	.250	.688	-
	n	10	8	9	5	3	3	14	12
16.	P	.313	.563	.844	-	.094	.188	.625	-
	n	-	6	24	2	-	4	26	2
17.	P	0.00	.188	.938	-	0.0	.125	.938	-
	n	6	8	12	6	6	2	9	15
18.	P	.188	.438	.813	-	.188	.250	.531	-
	n	12	4	6	10	4	2	10	16
19.	P	.375	.500	.688	-	.125	.188	.500	-
	n	16	3	-	13	-	-	2	30
20.	P	.500	.594	.594	-	0.0	0.0	0.063	-

APPENDIX X111 (Contd)

Chemistry Postgraduates (N = 20)

		Rare Words (Signal)				Rare Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
	n	16	1	4	11	5	1	2	24
1.	P	.500	.531	.656	-	.156	.188	.250	-
	n	6	10	13	3	4	9	13	6
2.	P	.188	.500	.906	-	.125	.406	.813	-
	n	19	2	4	7	2	-	12	18
3.	P	.594	.656	.781	-	.063	.063	.438	-
	n	27	2	1	2	1	-	6	25
4.	P	.844	.906	.938	-	.031	.031	.219	-
	n	18	7	4	3	6	3	6	17
5.	P	.563	.781	.906	-	.188	.281	.469	-
	n	24.	-	-	8	22	-	-	10
6.	P	.750	.750	.750	-	.688	.688	.688	-
	n	13	11	6	2	6	5	16	5
7.	P	.406	.750	.938	-	.188	.344	.844	-
	n	18	5	6	3	5	8	8	11
8.	P	.563	.719	.906	-	.156	.406	.656	-
	n	23	2	5	2	8	2	7	15
9.	P	.719	.781	.938	-	.250	.313	.531	-
	n	19	5	6	2	5	6	11	10
10.	P	.594	.750	.938	-	.156	.344	.688	-

APPENDIX X111 (Contd)

Chemistry Postgraduates

		Rare Words (Signal)				Rare Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
	n	12	6	6	8	-	2	18	12
11.	P	.375	.563	.750	-	0.00	.063	.625	-
	n	11	12	9	-	2	10	15	5
12.	P	.344	.719	1.00	-	.063	.375	.844	-
	n	24	3	4	1	-	1	5	26
13.	P	.750	.844	.969	-	0.00	.031	.188	-
	n	20	1	6	5	13	1	-	18
14.	P	.625	.656	.844	-	.406	.438	.438	-
	n	19	3	3	7	4	2	11	15
15.	P	.594	.688	.781	-	.125	.188	.531	-
	n	14	9	4	5	2	7	5	18
16.	P	.438	.719	.844	-	.063	.281	.438	-
	n	22	1	9	-	1	1	17	13
17.	P	.688	.719	1.00	-	.031	.063	.594	-
	n	27	1	2	2	6	2	2	22
18.	P	.844	.875	.938	-	.188	.250	.313	-
	n	25	4	3	-	10	-	3	19
19.	P	.781	.906	1.00	-	.313	.313	.406	-
	n	26	2	3	1	1	-	5	26
20.	P	.813	.875	.969	-	.031	.031	.188	-

APPENDIX X111 (Contd)

Chemistry Postgraduates (N = 20)

		Common Words (Signal)				Common Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
	n	17	4	3	4	4	1	6	17
1.	p	.607	.750	.857	-	.143	.179	.393	-
	n	10	7	7	4	4	2	13	9
2.	p	.357	.607	.857	-	.143	.214	.679	-
	n	16	-	2	10	4	-	-	24
3.	p	.571	.571	.643	-	.143	.143	.143	-
	n	17	1	1	9	3	5	2	18
4.	p	.607	.643	.679	-	.107	.286	.357	-
	n	28	-	-	-	4	-	2	22
5.	p	1.00	1.00	1.00	-	.143	.143	.214	-
	n	24	2	-	2	-	-	-	28
6.	p	.857	.929	.929	-	0.0	0.0	0.0	-
	n	7	2	8	11	-	-	14	14
7.	p	.250	.321	.607	-	0.00	0.00	.500	-
	n	23	2	2	1	1	2	1	24
8.	p	.821	.893	.964	-	.036	.107	.143	-
	n	12	4	9	3	3	2	15	8
9.	p	.429	.571	.893	-	.107	.179	.714	-
	n	19	1	3	5	-	-	5	23
10.	p	.679	.714	.821	-	0.0	0.0	.179	-

APPENDIX XIII (Contd)

Chemistry Postgraduates

		Common Words (Signal)				Common Words (Noise)			
		Present		Absent		Present		Absent	
		1	2	3	4	1	2	3	4
	n	14	2	6	6	-	-	12	16
11.	p	.500	.511	.786	-	0.00	0.00	.429	-
	n	9	1	1	17	-	-	-	28
12.	p	.321	.357	.393	-	0.00	0.00	0.00	-
	n	27	1	-	-	-	-	-	28
13.	p	.964	1.00	1.00	-	0.00	0.00	0.00	-
	n	23	-	-	5	-	-	-	28
14.	p	.821	.821	.821	-	0.00	0.00	0.00	-
	n	28	-	-	-	-	-	-	28
15.	p	1.00	1.00	1.00	-	0.00	0.00	0.00	-
	n	24	-	-	4	-	1	3	24
16.	p	.857	.857	.857	-	o.00	.036	.143	-
	n	20	1	5	2	-	-	2	26
17.	p	.714	.750	.929	-	0.00	0.00	0.71	-
	n	26	1	-	1	1	-	-	27
18.	p	.929	.964	.964	-	.036	.036	.036	-
	n	25	1	-	2	-	1	1	26
19.	p	.893	.929	.929	-	0.00	.036	.071	-
	n	20	1	6	1	-	-	11	17
20.	p	.714	.750	.964	-	0.00	0.00	.393	-

APPENDIX XIV

GROUP DATA : EXPERIMENT 7

Chemistry Students : Common Elements

	Signal 1	Signal 2	Signal 3	Signal 4	Noise 1	Noise 2	Noise 3	Noise 4
n	389	31	53	87	24	14	87	435
P,	0.695	0.750	0.845	-	0.043	0.068	0.223	-
z	-0.50	-0.67	-1.01	-	+1.72	+1.49	+0.76	-

Chemistry Students : Rare Elements

	Signal 1	Signal 2	Signal 3	Signal 4	Noise 1	Noise 2	Noise 3	Noise 4
n	383	87	98	72	103	60	162	315
P,	0.598	0.734	0.888	-	0.161	0.255	0.508	-
z	-0.25	-0.62	-1.22	-	+0.99	+0.66	-0.02	-

Arts Students : Common Elements

	Signal 1	Signal 2	Signal 3	Signal 4	Noise 1	Noise 2	Noise 3	Noise 4
n	350	61	53	96	53	71	141	295
P,	0.625	0.734	0.829	-	0.095	0.221	0.473	-
z	-0.32	-0.62	-0.95	-	+1.31	+0.77	+0.07	-

Arts Students : Rare Elements

	Signal 1	Signal 2	Signal 3	Signal 4	Noise 1	Noise 2	Noise 3	Noise 4
n	283	78	140	139	123	51	182	284
P,	0.442	0.564	0.783	-	0.192	0.272	0.556	-
z	+0.15	-0.16	-0.78	-	+0.87	+0.61	-0.14	-

APPENDIX XV

AREA AND BIAS MEASURES FOR THE ELEMENTS OF THE PERIODIC TABLE DATA

(a) SENSITIVITY SCORES (AREA)

Common Elements

Chemistry Postgraduates (N = 20)		Arts Postgraduates (N = 20)	
1.	0.8036	1.	0.7219
2.	0.6983	2.	0.7066
3.	0.7449	3.	0.7430
4.	0.7309	4.	0.6352
5.	0.9286	5.	0.8999
6.	0.9643	6.	0.8673
7.	0.6339	7.	0.6186
8.	0.9509	8.	0.8884
9.	0.7213	9.	0.8004
10.	0.8852	10.	0.7443
11.	0.8010	11.	0.9094
12.	0.6964	12.	0.7921
13.	1.000	13.	0.8189
14.	0.9107	14.	0.7347
15.	1.000	15.	0.8151
16.	0.9184	16.	0.8648
17.	0.9554	17.	0.9114
18.	0.9636	18.	0.9477
19.	0.9611	19.	0.7883
20.	0.9330	20.	0.7857
MEAN (A)	0.8601	MEAN (A)	0.7997
VARIANCE	0.0139	VARIANCE	0.0084

APPENDIX XV (Contd)

SENSITIVITY SCORE (AREA)

Rare Elements

Chemistry Postgraduates		Arts Postgraduates	
1.	0.7134	1.	0.6909
2.	0.5728	2.	0.6377
3.	0.7891	3.	0.6777
4.	0.9429	4.	0.8271
5.	0.7803	5.	0.4717
6.	0.5313	6.	0.5010
7.	0.7017	7.	0.7695
8.	0.7349	8.	0.7158
9.	0.7788	9.	0.6157
10.	0.7651	10.	0.6738
11.	0.7266	11.	0.6489
12.	0.7358	12.	0.8774
13.	0.9663	13.	0.5933
14.	0.6655	14.	0.5571
15.	0.7471	15.	0.7129
16.	0.7808	16.	0.7090
17.	0.8955	17.	0.5293
18.	0.8555	18.	0.6377
19.	0.8052	19.	0.6582
20.	0.9565	20.	0.7842
MEAN (A)	0.7722	MEAN (A)	0.6645
VARIANCE	0.0130	VARIANCE	0.0109

APPENDIX XV (Contd)

(b) BIAS SCORES (B)

Chemistry Postgraduates		Arts Postgraduates	
Common Elements			
1.	2.2222	1.	3.0345
2.	2.2500	2.	1.5000
3.	3.1765	3.	3.2632
4.	2.6667	4.	1.3333
5.	0.8750	5.	1.8333
6.	3.0667	6.	3.0667
7.	2.8636	7.	3.200
8.	2.000	8.	2.2308
9.	2.2917	9.	0.9032
10.	3.000	10.	2.7143
11.	2.6667	11.	2.1250
12.	3.3778	12.	1.4706
13.	2.000	13.	3.0667
14.	3.1515	14.	3.000
15.	1.000	15.	1.600
16.	3.000	16.	1.1429
17.	3.000	17.	1.6667
18.	2.000	18.	1.4167
19.	3.000	19.	2.2222
20.	2.4118	20.	3.300
MEAN (B)	2.5010	MEAN (B)	2.2045
VARIANCE	0.4733	VARIANCE	0.6534

APPENDIX XV (Contd)

BIAS SCORES (B)

Chemistry Postgraduates		Arts Postgraduates	
Rare Elements			
1.	3.0857	1.	0.7619
2.	2.1154	2.	2.1538
3.	2.5625	3.	3.1795
4.	2.2857	4.	2.4375
5.	1.8000	5.	2.7500
6.	0.6957	6.	3.0303
7.	1.8125	7.	3.0857
8.	1.6923	8.	3.1111
9.	1.2500	9.	1.000
10.	1.7273	10.	2.2105
11.	2.5000	11.	2.0400
12.	1.8636	12.	1.000
13.	2.4444	13.	2.7727
14.	0.9697	14.	0.7111
15.	2.2857	15.	2.2222
16.	2.000	16.	2.3478
17.	2.2692	17.	2.4400
18.	0.9697	18.	2.4762
19.	0.9143	19.	2.6250
20.	2.3750	20.	3.2558
MEAN (B)	1.8809	MEAN (B)	2.2806
VARIANCE	0.4146	VARIANCE	0.6560

A bias score greater than 2 means a bias towards NO. A score less than 2 means a bias towards YES. The bias measures are based on the equiprobable point (p of 0.5 for Yes or No) on the FOUR POINT SCALE.

APPENDIX XV (Contd)

SENSITIVITY SCORES (AREAS)

Common Elements

Chemistry Postgraduates (N = 20)		Arts Postgraduates (N = 20)	
1.	.8036	1.	.7219
2.	.6983	2.	.7066
3.	.7449	3.	.7430
4.	.7309	4.	.6352
5.	.9286	5.	.8999
6.	.9643	6.	.8673
7.	.6339	7.	.6186
8.	.9509	8.	.8884
9.	.7213	9.	.8004
10.	.8852	10.	.7443
11.	.8010	11.	.9094
12.	.6964	12.	.7921
13.	1.0000	13.	.8189
14.	.9107	14.	.7347
15.	1.0000	15.	.8151
16.	.9184	16.	.8648
17.	.9554	17.	.9114
18.	.9636	18.	.9477
19.	.9611	19.	.7883
20.	.9330	20.	.7857
MEAN (A)	.8601	MEAN (A)	.7997
VARIANCE	.0139	VARIANCE	.0084

APPENDIX XV (Contd)

SENSITIVITY SCORES (AREAS)

Rare Elements

Chemistry Postgraduates		Arts Postgraduates	
1.	.7134	1.	.6909
2.	.5728	2.	.6377
3.	.7891	3.	.6777
4.	.9429	4.	.8271
5.	.7803	5.	.4717
6.	.5313	6.	.5010
7.	.7017	7.	.7695
8.	.7349	8.	.7158
9.	.7788	9.	.6157
10.	.7651	10.	.6738
11.	.7266	11.	.6489
12.	.7358	12.	.8774
13.	.9663	13.	.5933
14.	.6655	14.	.5571
15.	.7471	15.	.7129
16.	.7808	16.	.7090
17.	.8955	17.	.5293
18.	.8555	18.	.6377
19.	.8052	19.	.6582
20.	.9565	20.	.7842
MEAN (A)	.7722	MEAN (A)	.6645
VARIANCE	.0130	VARIANCE	.0109

APPENDIX XV (Contd)

BIAS SCORES
(Position of the 50:50 position within the four categories)

Chemistry Postgraduates (N = 20)		Arts Postgraduates (N = 20)	
Common Elements			
1.	2.2222	1.	3.0345
2.	2.2500	2.	1.5000
3.	3.1765	3.	3.2632
4.	2.6667	4.	1.3333
5.	.8750	5.	1.8333
6.	3.0667	6.	3.0667
7.	2.8636	7.	3.2000
8.	2.0000	8.	2.2308
9.	2.2917	9.	.9032
10.	3.0000	10.	2.7143
11.	2.6667	11.	2.1250
12.	3.3778	12.	1.4706
13.	2.0000	13.	3.0667
14.	3.1515	14.	3.0000
15.	1.0000	15.	1.6000
16.	3.0000	16.	1.1429
17.	3.0000	17.	1.6667
18.	2.0000	18.	1.4167
19.	3.0000	19.	2.2222
20.	2.4118	20.	3.3000
MEAN (B)	2.5010	MEAN (B)	2.2045
VARIANCE	.4733	VARIANCE	.6534

BIAS SCORES
(Position of the 50:50
position within the four categories)

Chemistry Postgraduates		Arts Postgraduates	
	Rare Elements		
1.	3.0857	1.	.7619
2.	2.1154	2.	2.1538
3.	2.5625	3.	3.1795
4.	2.2857	4.	2.4375
5.	1.8000	5.	2.7500
6.	.6957	6.	3.0303
7.	1.8125	7.	3.0857
8.	1.6923	8.	3.1111
9.	1.2500	9.	1.0000
10.	1.7273	10.	2.2105
11.	2.500	11.	2.0400
12.	1.8636	12.	1.0000
13.	2.4444	13.	2.7727
14.	.9697	14.	.7111
15.	2.2857	15.	2.2222
16.	2.0000	16.	2.3478
17.	2.2692	17.	2.4400
18.	.9697	18.	2.4762
19.	.9143	19.	2.6250
20.	2.3750	20.	3.2558
MEAN (B)	1.8809	MEAN (B)	2.2806
VARIANCE	.4146	VARIANCE	.6560

APPENDIX XV (Contd)

TRANSFORMED SENSITIVITY
SCORES - ARCSINE ROOT (AREA)

Chemistry Postgraduates (N = 20)		Arts Postgraduates (N = 20)	
		Common Elements	
1.	.7077	1.	.6464
2.	.6298	2.	.6356
3.	.6629	3.	.6615
4.	.6528	4.	.5872
5.	.8278	5.	.7950
6.	.8790	6.	.7627
7.	.5863	7.	.5762
8.	.8577	8.	.7832
9.	.6459	9.	.7051
10.	.7799	10.	.6625
11.	.7056	11.	.8054
12.	.6285	12.	.6986
13.	1.0000	13.	.7201
14.	.8068	14.	.6555
15.	1.0000	15.	.7170
16.	.8155	16.	.7603
17.	.8645	17.	.8075
18.	.8779	18.	.8531
19.	.8736	19.	.6956
20.	.8334	20.	.6936
MEAN (TA)	.7818	MEAN (TA)	.7111
VARIANCE	.0151	VARIANCE	.0057

APPENDIX XV (Contd)

TRANSFORMED SENSITIVITY SCORES - ARCSINE ROUT (AREA)

Rare Elements

Chemistry Postgraduates		Arts Postgraduates	
1.	.6403	1.	.6247
2.	.5465	2.	.5888
3.	.6962	3.	.6157
4.	.8464	4.	.7270
5.	.6894	5.	.4820
6.	.5199	6.	.5006
7.	.6321	7.	.6812
8.	.6566	8.	.6421
9.	.6883	9.	.5743
10.	.6779	10.	.6130
11.	.6497	11.	.5963
12.	.6564	12.	.7723
13.	.8825	13.	.5597
14.	.6074	14.	.5364
15.	.6645	15.	.6400
16.	.6898	16.	.6373
17.	.7904	17.	.5187
18.	.7517	18.	.5888
19.	.7090	19.	.6025
20.	.8663	20.	.6924
MEAN (TA)	.6930	MEAN (TA)	.6097
VARIANCE	.0091	VARIANCE	.0054

APPENDIX XVI

INSTRUCTION SHEET FOR THE RATING TASK
EXPERIMENT 8.

FACULTY: ARTS ....
LAW ....
SCIENCE ....
OTHER ....

YEAR OF STUDY:
(1st, 2nd, 3rd, etc)

....

Highest level of English language or literature attended or currently entered for:

Leaving ....
Matriculation ....
First or Second Year ....
Honours (Final Year) ....
Postgraduate ....

INSTRUCTIONS

Before turning over, please read the following instructions.

On the following pages you will find a number of words. Some of these will be familiar to you, others may not. Please mark in the bracket, following each word, a number from 1 to 6 denoting your degree of familiarity with the word in question according to the following scale :-

1. Place a 1 in the bracket if the word is completely familiar to you and if it can be defined unambiguously by you. That is, the word is well within your vocabulary, you are absolutely certain of its meaning.
2. Put a 2 in the bracket if the word is quite familiar, but its meaning may be difficult to define.
3. Put a 3 if the word is fairly familiar but on the other hand you cannot define it.
4. Place a 4 if you have seen the word several times before but you do not know its meaning.

5. Place a 5 in the bracket if you have only seen the word once or twice before.

6. Use a 6 if the word is completely foreign to you. That is, you have never seen it before.

Try and work through the list at a fairly steady and rapid rate. Do not spend long over any one word. Your rating should indicate your initial impression rather than be a weighed decision.

For example, one person rated the following words, thus :-

TRANSPARENT	(1)
EPIGRAM	(2)
OBDURATE	(5)
VITUPERATION	(6)

Transparent was completely familiar, epigram though familiar was not easy for the person to define adequately. Obdurate had been seen a couple of times before but was indefinable; on the other hand, vituperation had never been seen before by the person rating the list.

APPENDIX XVII

FAMILIARITY RATINGS : ENGLISH WORDS

200 Words (100 Word:Pairs)

		English Postgraduates and Honours English Students (N=54)		Non-English Postgraduates and Honours Science Students (N=44)	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
1.	ENDOW	1.055	0.229	1.045	0.208
2.	ENDUE	3.388	1.947	4.090	2.108
3.	EXOGENOUS	3.777	1.781	4.272	1.838
4.	ENDOGENOUS	3.666	1.914	4.363	1.871
5.	EXTRICATE	1.055	0.229	1.181	0.574
6.	EXTRADITE	1.111	0.314	1.409	0.937
7.	EXCORIATE	3.611	1.889	5.181	1.613
8.	EXCUPATE	5.055	1.470	5.772	0.516
9.	EXCURSUS	2.444	1.640	5.227	1.593
10.	EXECRATE	1.777	1.271	4.545	2.038
11.	EXPATRIATE	1.055	0.229	2.090	1.703
12.	EPICURE	1.111	0.314	2.727	1.420
13.	EPIGRAM	1.222	0.415	2.136	1.139
14.	EPITOME	1.166	0.372	2.227	1.443
15.	EMOLLIENT	2.833	1.922	4.545	1.558
16.	EMOLUMENT	2.333	1.763	3.727	1.813
17.	EXUVIATE	4.777	1.547	5.818	0.649
18.	EXTIRPATE	1.888	0.993	4.909	1.676
19.	EVINCE	1.333	0.471	3.363	1.797
20.	EVOKE	1.000	0.000	1.227	0.516
21.	RATIOMORPHIC	4.944	1.747	5.227	1.346
22.	RATIOCINATE	2.333	1.855	5.590	1.114
23.	RECONDITE	1.722	0.869	4.409	1.669
24.	REDOLENT	1.333	0.577	3.272	1.420
25.	RECREANT	2.333	1.732	4.454	1.993

The ratings are given to three decimal places.

APPENDIX XV11 (Contd)

		English Students		Non-English Students	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
26.	REFURBISH	1.888	1.286	2.636	1.871
27.	REFULGENT	2.000	1.527	5.272	1.320
28.	OBVIOUS	1.277	1.145	1.000	0.000
29.	OBVERSE	1.333	0.942	2.590	1.800
30.	OBVIATE	1.222	0.532	1.590	0.984
31.	EXPIATE	1.000	0.000	2.272	1.887
32.	EXPATIATE	1.777	1.082	4.636	1.693
33.	RAMPANT	1.055	0.229	1.954	1.580
34.	RAMPART	1.166	0.500	1.590	1.230
35.	MAGNILOQUENT	1.500	0.763	4.909	1.856
36.	GRANDILOQUENT	1.277	0.588	3.500	1.994
37.	OBSTREPEROUS	1.777	1.511	3.681	2.119
38.	OBSCURANTIST	1.833	1.536	4.381	2.119
39.	OBSEQUIOUS	1.222	0.711	3.227	1.704
40.	NEOTERIC	5.000	1.699	5.136	1.841
41.	NEOPHYTE	2.833	1.740	3.545	1.671
42.	NESCIENT	2.944	1.985	5.545	1.076
43.	NASCENT	1.722	1.325	3.636	2.012
44.	PROPENSITY	1.055	0.229	2.636	1.746
45.	PROPINQUITY	1.333	0.577	4.227	1.905
46.	OBDURATE	1.333	0.666	3.727	1.911
47.	OBJURGATE	3.388	1.799	5.318	1.220
48.	ORBICULAR	4.611	2.003	4.818	1.613
49.	ORACULAR	1.777	1.435	3.954	1.988
50.	PROTEAN	2.222	1.781	4.272	1.863

APPENDIX XVII (Contd)

		English Students		Non-English Students	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
51.	PROTASIS	4.666	1.414	5.136	1.486
52.	PERSPICUOUS	3.444	1.571	4.181	1.799
53.	PERSPICACIOUS	1.500	0.763	3.181	2.014
54.	PRORATE	5.222	1.271	5.000	1.678
55.	PROROGUE	3.722	1.909	5.545	1.117
56.	PORTENT	1.167	0.500	1.727	1.212
57.	PORTEND	1.444	0.895	2.681	1.962
58.	PURLOIN	1.333	0.667	2.545	1.924
59.	PURVIEW	2.889	1.760	4.181	1.722
60.	EMULOUS	2.778	1.930	4.909	1.703
61.	EMULATE	1.056	0.230	1.772	1.593
62.	FARDEL	3.389	2.111	5.590	1.302
63.	FERAL	2.667	1.972	4.136	1.983
64.	DOLOUR	1.667	1.333	4.454	1.947
65.	DOLOSE	5.222	1.356	5.363	1.149
66.	FRIABLE	2.611	1.768	3.591	1.946
67.	FRANGIBLE	2.778	1.873	4.318	1.892
68.	CORUSCATE	2.667	1.795	4.773	1.756
69.	CASTIGATE	1.111	0.314	1.955	1.224
70.	BELLICOSE	1.167	0.373	2.136	1.660
71.	COMATOSE	2.222	1.548	3.818	2.146
72.	BERGMEHL	6.000	0.000	5.864	0.625
73.	BERGSCHRUND	6.000	0.000	5.955	0.208
74.	BESPRENT	4.333	2.082	5.955	0.208
75.	BESLAVER	4.000	2.186	5.364	1.333

APPENDIX XVII (Contd)

		English Students		Non-English Students	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
76.	BICAMERAL	2.278	1.520	4.818	2.014
77.	BICEPHALOUS	3.778	1.873	4.364	1.524
78.	CABRIOLE	3.611	1.860	5.136	1.234
79.	CABRIOLET	3.278	1.820	4.318	1.986
80.	CALCARCOUS	5.056	1.870	5.227	1.312
81.	CALCIFEROUS	2.444	1.300	2.682	1.742
82.	CALUMNIOUS	2.333	1.856	3.682	2.140
83.	EXTIRPATION	1.611	0.891	4.636	1.639
84.	EXECRATION	1.611	0.890	4.318	1.986
85.	EXIGENT	2.055	1.268	4.500	1.588
86.	EXIGEANT	3.667	1.764	5.318	1.257
87.	INCULCATE	1.222	0.533	3.273	2.050
88.	INCULPATE	2.167	0.898	4.591	1.826
89.	TEMERITY	1.222	0.533	2.682	2.031
90.	TENACITY	1.000	0.000	1.182	0.490
91.	INURE	2.000	1.453	3.636	2.206
92.	INURN	3.833	1.893	5.409	1.302
93.	INDICT	1.167	0.500	2.091	1.411
94.	INDIGN	4.167	1.833	5.455	1.117
95.	TARDY	1.167	0.373	1.182	0.386
96.	TARRY	1.222	0.416	1.455	1.437
97.	IMPECUNIOUS	1.111	0.314	2.273	1.839
98.	IMPERIOUS	1.056	0.229	2.227	1.594
99.	INELECTABLE	4.222	1.901	4.182	2.167
100.	INERRABLE	3.833	2.034	4.091	2.254

APPENDIX XVII (Contd)

		English Students		Non-English Students	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
101.	INEXORABLE	1.278	0.448	2.682	1.843
102.	INEXPIABLE	1.333	0.471	3.636	1.896
103.	PALINODE	3.556	1.674	5.818	0.649
104.	PALLIATE	1.556	0.762	4.409	1.875
105.	EXUBERATE	2.667	1.826	2.909	1.832
106.	EXUVIATE	4.167	1.572	5.227	1.475
107.	EMPIRIC	1.556	0.685	1.864	1.391
108.	EMPRISE	4.056	1.929	4.909	1.593
109.	GLAUCOUS	2.944	1.957	5.318	1.103
110.	GLABROUS	4.778	1.750	6.000	0.000
111.	FECUND	1.278	0.650	3.136	1.740
112.	FECULENT	5.056	1.508	4.864	1.546
113.	IMMANENT	1.389	0.591	3.591	2.310
114.	IMMOLATE	1.222	0.416	3.864	1.914
115.	IMPITEOUS	3.556	2.006	4.091	1.881
116.	IMPIOUS	1.111	0.314	2.318	1.689
117.	TORPOR	1.222	0.712	2.636	1.943
118.	TORPID	1.389	1.161	3.273	1.960
119.	IMPUISSANT	3.056	2.147	4.955	1.610
120.	IMPECCANT	3.611	1.890	5.364	1.068
121.	UNION	1.000	0.000	1.000	0.000
122.	UNITE	1.000	0.000	1.000	0.000
123.	TRANSPARENT	1.000	0.000	1.000	0.000
124.	TRANSLUCENT	1.056	0.229	1.046	0.208
125.	TURGID	1.611	1.420	1.955	1.580

APPENDIX XVII (Contd)

		English Students		Non-English Students	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
126.	TURPID	3.278	1.850	3.318	1.892
127.	UNTANGLE	1.000	0.000	1.091	0.417
128.	UNTAUGHT	1.000	0.000	1.273	1.052
129.	VOLUBLE	1.111	0.458	1.909	1.621
130.	VOLATILE	1.000	0.000	1.000	0.000
131.	DETRACT	1.056	0.229	1.227	1.041
132.	DEGRADE	1.056	0.229	1.046	0.208
133.	SCONCE	2.889	1.487	4.455	1.751
134.	SCHISM	1.111	0.314	1.591	1.231
135.	SAPID	4.500	1.980	5.546	0.891
136.	SAPIENT	1.500	1.014	4.273	1.656
137.	SAGACIOUS	1.167	0.373	2.409	1.723
138.	SALUBRIOUS	1.333	0.471	2.818	1.641
139.	SHEER	1.056	0.229	1.227	0.419
140.	SHEEN	1.000	0.000	1.318	0.700
141.	SPOLIATE	2.389	1.458	5.182	1.496
142.	SPONSALIA	5.333	1.414	5.818	0.649
143.	DIELECTRIC	4.667	1.732	2.364	1.920
144.	DIALECTRIC	1.222	0.416	3.364	1.872
145.	SYBARITIC	2.944	2.172	5.000	1.446
146.	SYCOPHANT	1.667	1.054	3.773	1.807
147.	SYNEDOCHE	4.111	1.822	5.864	0.343
148.	SYNONYMICON	5.444	1.423	5.546	1.157
149.	DISPERSE	1.000	0.000	1.045	0.208
150.	DISPLACE	1.056	0.229	1.046	0.208

APPENDIX XVll (Contd)

		English Students		Non-English Students	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
151.	SENESCENCE	2.000	1.563	4.000	1.931
152.	SENESCHAL	3.889	1.792	5.409	1.267
153.	SEDULOUS	2.167	1.384	4.909	1.535
154.	SEDITIOUS	1.111	0.314	1.909	1.474
155.	DISCREET	1.056	0.229	2.500	2.105
156.	DISCRETE	1.777	1.617	1.682	1.489
157.	CONSUETUDE	3.167	1.803	5.727	0.862
158.	DESUETUDE	3.389	1.948	5.500	1.197
159.	COGNATE	1.778	0.854	3.864	1.816
160.	COGENT	1.000	0.000	3.455	1.900
161.	CONTUMACIOUS	2.889	1.912	5.455	1.339
162.	CONTUMELIOUS	3.722	2.103	5.727	1.052
163.	CONTERMINOUS	3.722	1.909	5.455	1.196
164.	CONTENTIOUS	1.222	0.533	2.228	1.881
165.	CONSOLE	1.000	0.000	1.091	0.417
166.	CONSORT	1.056	0.229	1.182	0.386
167.	CONTAGION	1.056	0.229	3.227	1.952
168.	CONTAGIUM	4.556	2.006	4.682	1.427
169.	IMPAIR	1.056	0.229	1.182	0.575
170.	IMPART	1.056	0.229	1.045	0.208
171.	INAPT	2.111	1.629	3.045	2.160
172.	INEPT	1.111	0.314	1.227	0.598
173.	INCULCATE	1.222	0.533	2.818	1.898
174.	INOCULATE	1.111	0.314	1.227	0.419
175.	INDURATED	3.556	1.892	4.727	1.483

APPENDIX XVll (Contd)

		English Students		Non-English Students	
		$\overline{X}$	S.D.	$\overline{X}$	S.D.
176.	INCULATED	1.833	1.607	3.000	2.045
177.	INEFFABLE	1.667	0.943	4.273	1.788
178.	INERRANT	2.944	1.957	4.227	1.905
179.	INEXORABLE	1.111	0.314	2.682	1.606
180.	INEXPUGNABLE	2.333	1.491	3.682	2.009
181.	IMPERVIOUS	1.111	0.314	1.136	0.343
182.	IMPERIOUS	1.111	0.458	1.909	1.474
183.	FACTIOUS	2.500	1.803	3.455	2.017
184.	FACTITIOUS	2.056	1.433	3.727	2.260
185.	FACETIOUS	1.111	0.314	2.636	2.035
186.	FALLACIOUS	1.111	0.314	1.864	1.575
187.	FELICITATE	1.111	0.314	2.455	1.751
188.	FELICITOUS	1.167	0.373	3.046	1.942
189.	FECUND	1.222	0.532	2.546	1.339
190.	FETID	1.778	1.315	2.955	1.796
191.	MERETRICIOUS	1.556	0.598	3.591	2.147
192.	MENDACIOUS	1.444	0.762	3.546	1.900
193.	JOCOSE	1.722	1.239	4.182	1.775
194.	JOCUND	1.722	1.145	4.682	1.742
195.	ASPERITY	1.500	0.601	3.591	1.875
196.	ACERBITY	1.778	0.853	4.727	1.981
197.	ABROGATE	1.722	1.557	3.591	2.015
198.	ABNEGATE	1.333	0.745	3.409	1.826
199.	APOCALYPSE	4.611	1.830	4.182	1.898
200.	APOCRYPHA	4.389	1.671	4.318	1.916

APPENDIX XV111

INSTRUCTION PAGE FOR EXPERIMENT 8

A RECOGNITION TEST

FACULTY:

Arts ________

Science ________

Engineering ________

Other ________

Highest level of English language or literature attended or currently entered for, at the University.

____

INSTRUCTIONS:

Before turning over please read the following instructions.

On the following pages you will find a number of words. Some of these you will have seen on the slides, others will not have appeared.

Please mark in the appropriate box, with a cross, the degree of certainty of the word's presence or absence on the slides.

Beside each word there are four boxes.

If you are absolutely certain that the word (e.g. WATER) appeared on a slide, mark the first box with a cross -

e.g. WATER

APPENDIX XV111 (Contd)

If you are absolutely certain that the word did NOT appear on a slide, mark the last box with a cross -

e.g. WATER

Similarly, if you are uncertain but think that the word probably appeared on a slide, mark the second box -

e.g. WATER

Should you think that the word probably did not appear mark the third box.

e.g. WATER

Try and word through the list of words at a fairly steady and rapid rate. Do not spend a long time over any one word. Your cross should indicate your initial impression rather than be a weighed decision. Remember if in doubt you should mark one of the middle boxes. Only use the extreme boxes if you are absolutely sure of your decision.

APPENDIX XIX

TEST ITEMS EXPERIMENT 8

Sheet 1	Sheet 2
SHEER	TENACITY
IMPERVIOUS	IMPUISSANT
VOLATILE	BESLAVER
IMPART	RAMPART
TARDY	CONSUETUDE
CABRIOLE	ENDOGENOUS
EPIGRAM	UNITE
EXTRADITE	VOLUBLE
IMPECCANT	INELECTABLE
DISPLACE	NEOPHYTE
DETRACT	CONSOLE
RAMPANT	EXTRICATE
TARRY	CONTERMINOUS
EXOGENOUS	TEMERITY
NEOTERIC	UNTANGLE
EXCORIATE	IMPAIR
CONTUMELIOUS	PROROGUE
BERGMEHL	FERAL
CONSORT	SYNONYMICON
BESPRENT	EPITOME
DEGRADE	SHEEN
SYNEDOCHE	BERGSCHRUND
UNION	UNTAUGHT
INERRABLE	IMPERVIOUS
FARDEL	EXCUPATE
PRORATE	GLAUCOUS
DESUETUDE	DISPERSE
GLABROUS	CABRIOLET

Four categories were used from Sure Present to Sure Absent for each word (See Text for details).

APPENDIX XX

INDIVIDUAL DATA EXPERIMENT 8

ENGLISH HONOURS STUDENTS

Common Words

Signal

Ss	1	2	3	4
1	7	3	4	0
2	3	1	5	5
3	10	3	1	0
4	5	4	2	3
5	4	1	3	6
6	8	1	1	4
7	4	5	1	4
8	5	1	1	7
9	5	3	5	1
10	7	0	5	2
11	7	1	2	4
12	3	1	7	3
13	10	1	2	1
14	10	1	2	1
15	8	3	0	3
16	7	2	3	2
17	9	2	3	0
18	6	0	1	7
19	12	0	1	1
20	6	1	6	1
21	5	1	7	1

Noise

Ss	1	2	3	4
1	1	2	9	2
2	0	3	3	8
3	1	2	7	4
4	1	1	1	11
5	1	1	6	6
6	1	4	1	8
7	0	1	2	11
8	4	0	1	9
9	7	2	0	4
10	0	1	6	7
11	2	0	5	7
12	1	0	5	8
13	3	0	3	8
14	0	2	7	5
15	0	2	1	11
16	4	0	5	5
17	1	2	6	4
18	2	1	0	11
19	1	0	0	13
20	0	3	7	4
21	1	2	7	4

APPENDIX XX (Contd)

ENGLISH HONOURS STUDENTS

Rare Words

Signal						Noise				
Ss	1	2	3	4		Ss	1	2	3	4
1	10	3	1	0		1	1	2	7	4
2	10	4	0	0		2	3	0	1	10
3	13	0	0	1		3	2	0	0	12
4	11	3	0	0		4	0	2	0	12
5	13	0	1	0		5	2	0	1	11
6	14	0	0	0		6	3	0	0	11
7	12	0	0	2		7	1	0	1	12
8	8	0	2	4		8	3	3	2	6
9	10	2	1	1		9	1	5	7	1
10	13	0	1	0		10	0	0	3	11
11	13	0	0	1		11	3	0	1	10
12	12	1	1	0		12	3	1	2	8
13	10	0	1	3		13	3	2	1	8
14	8	1	1	4		14	1	2	6	5
15	9	3	1	1		15	1	0	7	6
16	12	2	0	0		16	3	0	6	5
17	8	2	1	3		17	2	2	2	8
18	11	1	0	2		18	2	0	2	10
19	13	0	0	1		19	0	0	1	13
20	10	4	0	0		20	0	2	2	10
21	8	2	4	0		21	0	2	6	6

APPENDIX XX (Contd)

INDIVIDUAL DATA EXPERIMENT 8

NON-ENGLISH STUDENTS

Common Words

Signal					Noise				
Ss	1	2	3	4	Ss	1	2	3	4
1	6	0	4	4	1	1	1	4	8
2	6	4	2	2	2	3	3	7	1
3	5	3	4	2	3	2	1	6	5
4	4	3	4	3	4	3	0	7	4
5	9	2	3	0	5	0	1	7	6
6	9	2	2	1	6	3	6	2	3
7	3	3	5	3	7	0	3	7	4
8	9	0	3	2	8	1	1	5	7
9	9	0	1	4	9	3	1	1	9
10	10	1	0	3	10	4	0	0	10
11	11	2	0	1	11	1	0	0	13
12	8	2	0	4	12	0	0	1	13
13	4	3	1	6	13	2	0	2	10
14	6	2	0	6	14	0	2	2	10
15	4	6	4	0	15	0	6	8	0
16	8	4	2	0	16	4	2	2	6
17	8	2	4	0	17	2	1	2	9
18	9	0	5	0	18	0	2	3	9
19	11	0	2	1	19	2	0	0	12
20	7	2	3	2	20	1	3	5	5
21	10	1	2	1	21	1	1	2	10

APPENDIX XX (Contd)

NON-ENGLISH STUDENTS

Rare Words

Signal Ss	1	2	3	4	Noise Ss	1	2	3	4
1	11	2	1	0	1	1	1	6	6
2	9	1	3	1	2	3	6	2	3
3	8	3	2	1	3	1	4	6	3
4	8	4	1	1	4	4	2	5	3
5	8	4	2	0	5	2	2	5	5
6	4	2	6	2	6	0	1	6	7
7	6	4	4	0	7	2	6	4	2
8	11	1	2	0	8	2	0	3	9
9	10	2	2	0	9	2	2	1	9
10	8	1	2	3	10	3	1	1	9
11	9	3	0	2	11	0	0	2	12
12	9	3	2	0	12	0	2	1	11
13	11	0	0	3	13	1	0	3	10
14	14	0	0	0	14	1	0	0	13
15	4	5	5	0	15	0	5	8	1
16	5	3	3	3	16	1	1	6	3
17	7	1	4	2	17	5	1	4	4
18	9	2	2	1	18	1	3	4	6
19	14	0	0	0	19	1	0	1	12
20	8	3	3	0	20	2	2	4	6
21	11	1	1	1	21	0	2	3	9

APPENDIX XXI

SENSITIVITY SCORES (A)

ENGLISH STUDENTS

Common Words		Rare Words	
1	0.7984	1	0.9107
2	0.6224	2	0.8622
3	0.9107	3	0.8928
4	0.8010	4	0.9846
5	0.5688	5	0.9209
6	0.7321	6	0.8928
7	0.8035	7	0.8877
8	0.5663	8	0.6428
9	0.4642	9	0.8214
10	0.7908	10	0.9923
11	0.6938	11	0.8545
12	0.7091	12	0.8647
13	0.8112	13	0.7423
14	0.8801	14	0.7040
15	0.8545	15	0.8826
16	0.6709	16	0.8775
17	0.8543	17	0.7500
18	0.6505	18	0.8418
19	0.9260	19	0.9617
20	0.7321	20	0.9795
21	0.6836	21	0.8877
MEAN (A)	0.7392	MEAN (A)	0.8645
VAR. (A)	0.0148	VAR. (A)	0.0083

APPENDIX XXI (Contd)

SENSITIVITY SCORES (A)

NON-ENGLISH STUDENTS

Common Words		Rare Words	
1	0.6989	1	0.9311
2	0.6275	2	0.6836
3	0.6964	3	0.7882
4	0.6071	4	0.7091
5	0.9260	5	0.8316
6	0.7040	6	0.7653
7	0.6275	7	0.6632
8	0.8010	8	0.8979
9	0.7142	9	0.8724
10	0.7397	10	0.7295
11	0.9234	11	0.9183
12	0.8469	12	0.9591
13	0.6581	13	0.8341
14	0.7142	14	0.9642
15	0.7040	15	0.7066
16	0.7448	16	0.6720
17	0.8520	17	0.5969
18	0.9107	18	0.8341
19	0.8826	19	0.9642
20	0.7397	20	0.8214
21	0.8903	21	0.9285
MEAN (A)	0.7623	MEAN (A)	0.8129
VAR. (A)	0.0107	VAR. (A)	0.0127

APPENDIX XX1 (Contd)

TRANSFORMED SENSITIVITY SCORES - ARCSIN ROOT (A)

ENGLISH STUDENTS (N=21)

Common Words		Rare Words	
1	0.7036	1	0.8068
2	0.5787	2	0.7579
3	0.8068	3	0.7877
4	0.7056	4	0.9210
5	0.5439	5	0.8185
6	0.6536	6	0.7877
7	0.7076	7	0.7825
8	0.5423	8	0.5922
9	0.4772	9	0.7222
10	0.6975	10	0.9442
11	0.6267	11	0.7509
12	0.6373	12	0.7602
13	0.7138	13	0.6610
14	0.7749	14	0.6338
15	0.7509	15	0.7774
16	0.6110	16	0.7724
17	0.7507	17	0.6666
18	0.5973	18	0.7396
19	0.8246	19	0.8746
20	0.6536	20	0.9087
21	0.6197	21	0.7825
MEAN (TA)	0.6656	MEAN (TA)	0.7737
VAR. (TA)	0.0082	VAR. (TA)	0.0082

APPENDIX XXI (Contd)

TRANSFORMED SENSITIVITY SCORES - ARCSIN ROOT (A)

NON-ENGLISH STUDENTS (N=21)

Common Words		Rare Words	
1	0.6302	1	0.8309
2	0.5821	2	0.6197
3	0.6285	3	0.6955
4	0.5687	4	0.6373
5	0.8246	5	0.7308
6	0.6338	6	0.6780
7	0.5821	7	0.6058
8	0.7056	8	0.7930
9	0.6409	9	0.7675
10	0.6592	10	0.6518
11	0.8215	11	0.8155
12	0.7440	12	0.8704
13	0.6024	13	0.7330
14	0.6409	14	0.8789
15	0.6338	15	0.6356
16	0.6629	16	0.6118
17	0.7486	17	0.5621
18	0.8068	18	0.7330
19	0.7774	19	0.8789
20	0.6592	20	0.7222
21	0.7850	21	0.8277
MEAN (TA)	0.6828	MEAN (TA)	0.7276
VAR. (TA)	0.0069	VAR. (TA)	0.0096

APPENDIX XXI (Contd)

BIAS SCORES (B)

ENGLISH STUDENTS (N=21)

Common Words		Rare Words	
1	2.0769	1	1.6000
2	2.8750	2	1.2500
3	1.6000	3	0.9333
4	3.0000	4	1.6000
5	2.7777	5	0.9333
6	2.0000	6	0.8235
7	3.0666	7	3.0000
8	3.1250	8	2.0000
9	1.2835	9	1.4285
10	2.5454	10	2.2500
11	2.5714	11	0.8750
12	2.7500	12	0.9333
13	2.0000	13	1.5000
14	2.1111	14	2.2857
15	3.0000	15	2.1250
16	2.1250	16	0.9333
17	1.9444	17	2.0000
18	3.2222	18	2.0000
19	3.0000	19	3.0000
20	2.3076	20	1.6666
21	2.3571	21	2.2000
MEAN (B)	2.4637	MEAN (B)	1.6827
VAR. (B)	0.2934	VAR. (B)	0.4428

APPENDIX XXI (Contd)

BIAS SCORES (B)

NON-ENGLISH LITERATURE STUDENTS (N=21)

Common Words		Rare Words	
1	2.7500	1	1.6666
2	1.7142	2	1.2857
3	2.3000	3	1.7142
4	2.3636	4	1.3333
5	2.2000	5	1.6666
6	1.2500	6	2.5833
7	2.4166	7	1.6000
8	2.3750	8	2.0000
9	2.5000	9	1.5000
10	1.0000	10	2.3333
11	3.0000	11	3.0000
12	3.1764	12	2.0000
13	3.1250	13	2.6666
14	3.1250	14	0.9333
15	1.8333	15	2.0000
16	1.3333	16	2.3247
17	2.1666	17	2.0000
18	2.3750	18	1.8000
19	2.5000	19	0.9333
20	2.1250	20	1.8000
21	2.2500	21	2.0000
MEAN (B)	2.2799	MEAN (B)	1.8638
VAR. (B)	0.3635	VAR. (B)	0.2818

APPENDIX XXll

CUMULATIVE HIT AND FALSE ALARM PROBABILITIES

ENGLISH STUDENTS : COMMON WORDS

		1	2	3	4
1.	PSS	0.5000	0.7142	1.0000	1.0000
	PSN	0.0714	0.2142	0.8571	1.0000
2.	PSS	0.2142	0.2857	0.6428	1.0000
	PSN	0.0000	0.2142	0.4285	1.0000
3.	PSS	0.7142	0.9285	1.0000	1.0000
	PSN	0.0714	0.2142	0.7142	1.0000
4.	PSS	0.3571	0.6428	0.7857	1.0000
	PSN	0.0714	0.1428	0.2142	1.0000
5.	PSS	0.2857	0.3571	0.5714	1.0000
	PSN	0.0714	0.1428	0.5714	1.0000
6.	PSS	0.5714	0.6428	0.7142	1.0000
	PSN	0.0714	0.3571	0.4285	1.0000
7.	PSS	0.2857	0.6428	0.7142	1.0000
	PSN	0.0000	0.0714	0.2142	1.0000
8.	PSS	0.3571	0.4285	0.5000	1.0000
	PSN	0.2857	0.2857	0.3571	1.0000
9.	PSS	0.3571	0.5714	0.9285	1.0000
	PSN	0.5384	0.6923	0.6923	1.0000
10.	PSS	0.5000	0.5000	0.8571	1.0000
	PSN	0.0000	0.0714	0.5000	1.0000

APPENDIX XXII (Contd)

ENGLISH STUDENTS : COMMON WORDS

		1	2	3	4
11.	PSS	0.5000	0.5714	0.7142	1.0000
	PSN	0.1428	0.1428	0.5000	1.0000
12.	PSS	0.2142	0.2857	0.7857	1.0000
	PSN	0.0714	0.0714	0.4285	1.0000
13.	PSS	0.7142	0.7857	0.9285	1.0000
	PSN	0.2142	0.2142	0.4285	1.0000
14.	PSS	0.7142	0.7857	0.9285	1.0000
	PSN	0.0000	0.1428	0.6428	1.0000
15.	PSS	0.5714	0.7857	0.7857	1.0000
	PSN	0.0000	0.1428	0.2142	1.0000
16.	PSS	0.5000	0.6428	0.8571	1.0000
	PSN	0.2857	0.2857	0.6428	1.0000
17.	PSS	0.6428	0.7857	1.0000	1.0000
	PSN	0.0769	0.2307	0.6923	1.0000
18.	PSS	0.4285	0.4285	0.5000	1.0000
	PSN	0.1428	0.2142	0.2142	1.0000
19.	PSS	0.8571	0.8571	0.9285	1.0000
	PSN	0.0714	0.0714	0.0714	1.0000
20.	PSS	0.4285	0.5000	0.9285	1.0000
	PSN	0.0000	0.2142	0.7142	1.0000
21.	PSS	0.3571	0.4285	0.9285	1.0000
	PSN	0.0714	0.2142	0.7142	1.0000

APPENDIX XXII (Contd)

ENGLISH STUDENTS : RARE WORDS

		1	2	3	4
1.	PSS	0.7142	0.9285	1.0000	1.0000
	PSN	0.0714	0.2142	0.7142	1.0000
2.	PSS	0.7142	1.0000	1.0000	1.0000
	PSN	0.2142	0.2142	0.2857	1.0000
3.	PSS	0.9285	0.9285	0.9285	1.0000
	PSN	0.1428	0.1428	0.1428	1.0000
4.	PSS	0.7857	1.0000	1.0000	1.0000
	PSN	0.0000	0.1428	0.1428	1.0000
5.	PSS	0.9285	0.9285	1.0000	1.0000
	PSN	0.1428	0.1428	0.2142	1.0000
6.	PSS	1.0000	1.0000	1.0000	1.0000
	PSN	0.2142	0.2142	0.2142	1.0000
7.	PSS	0.8571	0.8571	0.8571	1.0000
	PSN	0.0714	0.0714	0.1428	1.0000
8.	PSS	0.5714	0.5714	0.7142	1.0000
	PSN	0.2142	0.4285	0.5714	1.0000
9.	PSS	P.7142	0.8571	0.9285	1.0000
	PSN	0.0714	0.4285	0.9285	1.0000
10.	PSS	0.9285	0.9285	1.0000	1.0000
	PSN	0.0000	0.0000	0.2142	1.0000

APPENDIX XXII (Contd)

ENGLISH STUDENTS : RARE WORDS

		1	2	3	4
11.	PSS	0.9285	0.9285	0.9285	1.0000
	PSN	0.2142	0.2142	0.2857	1.0000
12.	PSS	0.8571	0.9285	1.0000	1.0000
	PSN	0.2142	0.2857	0.4285	1.0000
13.	PSS	0.7142	0.7142	0.7857	1.0000
	PSN	0.2142	0.3571	0.4285	1.0000
14.	PSS	0.5714	0.6428	0.7142	1.0000
	PSN	0.0714	0.2142	0.6428	1.0000
15.	PSS	0.6428	0.8571	0.9285	1.0000
	PSN	0.0714	0.0714	0.5714	1.0000
16.	PSS	0.8571	1.0000	1.0000	1.0000
	PSN	0.2142	0.2142	0.6428	1.0000
17.	PSS	0.5714	0.7142	0.7857	1.0000
	PSN	0.1428	0.2857	0.4285	1.0000
18.	PSS	0.7857	0.8571	0.8571	1.0000
	PSN	0.1428	0.1428	0.2857	1.0000
19.	PSS	0.9285	0.9285	0.9285	1.0000
	PSN	0.0000	0.0000	0.0714	1.0000
20.	PSS	0.7142	1.0000	1.0000	1.0000
	PSN	0.0000	0.1428	0.2857	1.0000
21.	PSS	0.5714	0.7142	1.0000	1.0000
	PSN	0.0000	0.1428	0.5714	1.0000

APPENDIX XXII (Contd)

NON-ENGLISH STUDENTS : COMMON WORDS

		1	2	3	4
1.	PSS	0.4285	0.4285	0.7142	1.0000
	PSN	0.0714	0.1428	0.4285	1.0000
2.	PSS	0.4285	0.7142	0.8571	1.0000
	PSN	0.2142	0.4285	0.9285	1.0000
3.	PSS	0.3571	0.5714	0.8571	1.0000
	PSN	0.1428	0.2142	0.6428	1.0000
4.	PSS	0.2857	0.5000	0.7857	1.0000
	PSN	0.2142	0.2142	0.7142	1.0000
5.	PSS	0.6428	0.7857	1.0000	1.0000
	PSN	0.0000	0.0714	0.5714	1.0000
6.	PSS	0.6428	0.7857	0.9285	1.0000
	PSN	0.2142	0.6428	0.7857	1.0000
7.	PSS	0.2142	0.4285	0.7857	1.0000
	PSN	0.0000	0.2142	0.7142	1.0000
8.	PSS	0.6428	0.6428	0.8571	1.0000
	PSN	0.0714	0.1428	0.5000	1.0000
9.	PSS	0.6428	0.6428	0.7142	1.0000
	PSN	0.2142	0.2857	0.3571	1.0000
10.	PSS	0.7142	0.7857	0.7857	1.0000
	PSN	0.2857	0.2857	0.2857	1.0000

APPENDIX XXII (Contd)

NON-ENGLISH STUDENTS : COMMON WORDS

		1	2	3	4
11.	PSS	0.7857	0.9285	0.9285	1.0000
	PSN	0.0714	0.0714	0.0714	1.0000
12.	PSS	0.5714	0.7142	0.7142	1.0000
	PSN	0.0000	0.0000	0.0714	1.0000
13.	PSS	0.2857	0.5000	0.5714	1.0000
	PSN	0.1428	0.1428	0.2857	1.0000
14.	PSS	0.4285	0.5714	0.5714	1.0000
	PSN	0.0000	0.1428	0.2857	1.0000
15.	PSS	0.2857	0.7142	1.0000	1.0000
	PSN	0.0000	0.4285	1.0000	1.0000
16.	PSS	0.5714	0.8571	1.0000	1.0000
	PSN	0.2857	0.4285	0.5714	1.0000
17.	PSS	0.5714	0.7142	1.0000	1.0000
	PSN	0.1428	0.2142	0.3571	1.0000
18.	PSS	0.6428	0.6428	1.0000	1.0000
	PSN	0.0000	0.1428	0.3571	1.0000
19.	PSS	0.7857	0.7857	0.9285	1.0000
	PSN	0.1428	0.1428	0.1428	1.0000
20.	PSS	0.5000	0.6428	0.8571	1.0000
	PSN	0.0714	0.2857	0.6428	1.0000
21.	PSS	0.7142	0.7857	0.9285	1.0000
	PSN	0.0714	0.1428	0.2857	1.0000

APPENDIX XXII (Contd)

NON-ENGLISH STUDENTS : RARE WORDS

		1	2	3	4
1.	PSS	0.7857	0.9285	1.0000	1.0000
	PSN	0.0714	0.1428	0.5714	1.0000
2.	PSS	0.6428	0.7142	0.9285	1.0000
	PSN	0.2142	0.6428	0.7857	1.0000
3.	PSS	0.5714	0.7858	0.9285	1.0000
	PSN	0.0714	0.3571	0.7857	1.0000
4.	PSS	0.5714	0.8571	0.9285	1.0000
	PSN	0.2857	0.4285	0.7857	1.0000
5.	PSS	0.5714	0.8571	1.0000	1.0000
	PSN	0.1428	0.2857	0.6428	1.0000
6.	PSS	0.2857	0.4285	0.8571	1.0000
	PSN	0.0000	0.0714	0.5000	1.000
7.	PSS	0.4285	0.7142	1.0000	1.0000
	PSN	0.1428	0.5714	0.8571	1.0000
8.	PSS	0.7857	0.8571	1.0000	1.0000
	PSN	0.1428	0.1428	0.3571	1.0000
9.	PSS	0.7142	0.8571	1.0000	1.0000
	PSN	0.1428	0.2857	0.3571	1.0000
10.	PSS	0.5714	0.6428	0.7857	1.0000
	PSN	0.2142	0.2857	0.3571	1.0000

APPENDIX XXII (Contd)

NON- ENGLISH STUDENTS : RARE WORDS

		1	2	3	4
11.	PSS	0.6428	0.8571	0.8571	1.0000
	PSN	0.0000	0.0000	0.1428	1.0000
12.	PSS	0.6428	0.8571	1.0000	1.0000
	PSN	0.0000	0.1428	0.2142	1.0000
13.	PSS	0.7857	0.7857	0.7857	1.0000
	PSN	0.0714	0.0714	0.2857	1.0000
14.	PSS	1.0000	1.0000	1.0000	1.0000
	PSN	0.0714	0.0714	0.0714	1.0000
15.	PSS	0.2857	0.6428	1.0000	1.0000
	PSN	0.0000	0.3571	0.9285	1.0000
16.	PSS	0.3571	0.5714	0.7857	1.0000
	PSN	0.0909	0.1818	0.7272	1.0000
17.	PSS	0.5000	0.5714	0.8571	1.0000
	PSN	0.3571	0.4285	0.7142	1.0000
18.	PSS	0.6428	0.7857	0.9285	1.0000
	PSN	0.0714	0.2857	0.5714	1.0000
19.	PSS	1.0000	1.0000	1.0000	1.0000
	PSN	0.0714	0.0714	0.1428	1.0000
20.	PSS	0.5714	0.7857	1.0000	1.0000
	PSN	0.1428	0.2857	0.5714	1.0000
21.	PSS	0.7857	0.8571	0.9285	1.0000
	PSN	0.0000	0.1428	0.3571	1.0000

APPENDIX XXIII

BREAKDOWN OF THE TWO POPULATIONS

FOR THE RATING TASK OF EXPERIMENT 8.

English Students (N=54)		Non-English Students (N=44)	
Adelaide University			
English Honours Students	N = 20	Chemistry Students	N = 6
English Postgraduates	N = 10	Mathematics Students	N = 8
		Physics Postgraduates	N = 10
University of Cape Town			
English Literature and Language Students	N = 18	Honours Chemistry and Physics Students	N = 20
Postgraduates	N = 6		
TOTAL	N = 54		N = 44

APPENDIX XXIV

INSTRUCTIONS:

Before turning over, please read the following instructions. On the following pages you will find a number of words. Some of these will be easy to pronounce, others may not. Please mark in the bracket, following each word, a number from 1 to 4 denoting the ease of pronounceability of the word in question according to the following scale :-

1. Place a 1 in the bracket if the word is extremely easy to pronounce.
2. Place a 2 in the bracket if the word is fairly easy to pronounce.
3. Put a 3 in the bracket if the word is reasonably difficult to pronounce.
4. Place a 4 if the word is extremely difficult to pronounce.

Try and work through the list at a fairly steady and rapid rate. Do not spend long over any one word. Your weighting should indicate your initial impression rather than be a weighed decision.

For example one person rated the following words thus:-

DOLOSE	(1)
BERGMEHL	(2)
ONOMATOPOEIA	(3)
HOMONYM	(4)

DOLOSE was very easy to pronounce, ONOMATOPOEIA extremely difficult, and the other words lay in between in degree of pronounceability.

APPENDIX XXV

PRONOUNCEABILITY RATINGS : EXPERIMENT 9

		MEAN (N = 40)			MEAN (N = 40)
1.	EXOGENOUS	1.3	26.	BERGSCHRUND	3.0
2.	ENDOGENOUS	1.4	27.	BESPRENT	1.9
3.	EXCORIATE	2.0	28.	BESLAVER	1.5
4.	EXCUPATE	1.4	29.	BICAMERAL	1.9
5.	EXCURSUS	1.4	30.	BICEPHALOUS	1.9
6.	EXECRATE	1.6	31.	CABRIOLE	2.0
7.	EXUVIATE	1.7	32.	CABRIOLET	1.9
8.	EXTIRPATE	2.0	33.	EXTIRPATION	2.0
9.	RATIOMORPHIC	1.6	34.	EXECRATION	2.1
10.	RATIOCINATE	2.1	35.	EXIGEANT	2.4
11.	RECREANT	1.5	36.	EXIGENT	1.9
12.	REFULGENT	1.9	37.	INELECTABLE	1.7
13.	NEOTERIC	1.5	38.	INERRABLE	1.7
14.	NESCIENT	1.7	39.	PALINODE	1.5
15.	OBJURGATE	1.9	40.	PALLIATE	1.5
16.	ORBICULAR	1.4	41.	GLAUCOUS	1.8
17.	PROTEAN	1.1	42.	GLABROUS	2.0
18.	PROTASIS	1.2	43.	IMPUISSANT	2.5
19.	PRORATE	1.3	44.	IMPECCANT	1.9
20.	PROROGUE	1.3	45.	SAPID	1.4
21.	FARDEL	1.0	46.	SAPIENT	1.1
22.	FERAL	1.1	47.	SPOLIATE	1.3
23.	DOLOUR	1.7	48.	SPONSALIA	1.8
24.	DOLOSE	1.6	49.	SYNECDOCHE	2.7
25.	BERGMEHL	2.2	50.	SYNONYMICON	2.9

APPENDIX XXV (Contd)

		MEAN (N = 40)			MEAN (N = 40)
51.	SENESCENCE	2.4	76.	OBSCURANTIST	2.8
52.	SENESCHAL	2.2	77.	NEOTERIC	1.4
53.	CONSUETUDE	2.8	78.	NEOPHYTE	1.5
54.	DESUETUDE	2.6	79.	NESCIENT	1.7
55.	CONTUMACIOUS	2.6	80.	NASCENT	1.3
56.	CONTUMELIOUS	2.5	81.	OBDURATE	1.1
57.	INEFFABLE	1.5	82.	OBJURGATE	1.7
58.	INERRANT	1.4	83.	ORBICULAR	1.1
59.	FACTIOUS	1.9	84.	ORACULAR	1.5
60.	FACTITIOUS	2.1	85.	PERSPICUOUS	2.0
61.	MERETRICIOUS	2.5	86.	PERSPICACIOUS	2.2
62.	MENDACIOUS	1.6	87.	IMMANENT	1.4
63.	JOCOSE	1.7	88.	IMMOLATE	1.4
64.	JOCUND	1.3	89.	FECUND	1.6
65.	ASPERITY	1.2	90.	FECULENT	1.6
66.	ACERBITY	1.6	91.	INEXORABLE	1.7
67.	ABROGATE	1.4	92.	INEXPIABLE	2.0
68.	ABNEGATE	1.5	93.	DIELECTRIC	1.5
69.	APOCALYSE	1.7	94.	DIALECTIC	1.3
70.	APOCRYPHA	2.4	95.	SYBARITIC	2.2
71.	REDOLENT	1.6	96.	SYCOPHANT	1.9
72.	RECREANT	1.4	97.	COGENT	1.4
73.	MAGNILOQUENT	2.2	98.	COGNATE	1.3
74.	GRANDILOQUENT	1.6	99.	CONTAGION	1.7
75.	OBSTREPEROUS	1.4	100.	CONTAGIUM	1.5

APPENDIX XXV (Contd)

		MEAN (N = 40)			MEAN (N = 40)
101.	INDURATED	1.5	124.	ALLEGORICAL	1.3
102.	INCULCATED	1.7	125.	APOCALYPTIC	1.9
103.	FELICITATE	1.6	126.	ANTITHETICAL	2.7
104.	FELICITOUS	1.7	127.	APHORISM	1.5
105.	FECUND	1.5	128.	HOMONYM	1.1
106.	FETID	1.1	129.	METONYM	1.1
107.	OXYMORON	1.4	130.	EXEGESIS	2.1
108.	OBSCURANTIST	2.1	131.	ETYMOLOGY	1.6
109.	ONTOLOGICAL	2.0	132.	ELISION	1.6
110.	OBSOLESCENCE	1.5	133.	ELEGAIC	2.1
111.	OLIGOPOLY	2.2	134.	EXTANT	1.2
112.	ONOMATOPOEIA	1.8	135.	EPIGRAPH	1.1
113.	ORATORICAL	1.8	136.	MEROSIS	1.4
114.	PORTENTOUS	1.7	137.	MASQUE	1.0
115.	PETRARCHAN	3.0	138.	DACTYLIC	2.1
116.	PLATITUDE	1.3	139.	DIALECTIC	1.2
117.	PEDANTRY	1.5	140.	DIONYSIAN	1.7
118.	POLEMICS	1.3	141.	CHIMERA	1.8
119.	PERIPHRASIS	2.2	142.	CAESURA	2.0
120.	POETASTER	2.5	143.	CADENCE	1.3
121.	ASSONANCE	1.6	144.	CANTO	1.0
122.	ACCIDENCE	1.5	145.	INCHOATE	2.5
123.	ALLITERATE	1.2	146.	INSTRESS	1.5

APPENDIX XXVI

INDIVIDUAL DATA : EXPERIMENT 9

(N = 27)

Ss	Easy to Pronounce Words: Signal				Easy: Noise				Hard to Pronounce Words: Signal				Hard: Noise			
1.	7	0	1	5	2	1	1	10	9	0	0	5	1	0	1	12
2.	9	3	2	0	4	3	3	4	6	4	3	1	3	2	5	4
3.	8	2	4	0	1	1	8	4	10	4	0	0	0	4	8	2
4.	10	1	1	2	2	1	0	11	10	1	0	3	2	0	1	11
5.	11	0	0	2	4	0	0	10	11	0	0	3	3	0	0	11
6.	8	2	3	1	0	7	4	3	4	4	6	0	1	5	7	1
7.	9	2	0	3	6	2	1	5	10	4	0	0	3	3	4	4
8.	12	1	1	0	1	2	0	11	13	0	1	0	1	1	1	11
9.	10	1	0	3	2	1	1	10	14	0	0	0	5	1	0	8
10.	8	1	2	3	0	3	2	9	8	2	1	3	1	1	2	10
11.	9	0	2	3	0	2	4	8	7	2	3	2	3	2	2	7
12.	10	1	1	2	5	2	2	4	6	2	4	1	5	3	5	1
13.	13	0	0	1	0	1	1	12	9	3	0	2	4	2	0	8
14.	13	0	1	0	2	2	3	7	10	0	2	2	2	1	5	6
15.	6	4	4	0	1	4	6	3	5	7	1	1	1	3	7	3
16.	13	0	1	0	0	1	0	13	13	0	1	0	0	1	0	13
17.	9	0	0	5	2	2	1	9	13	0	0	1	2	2	0	10
18.	5	1	7	1	2	1	9	2	8	0	5	0	2	3	8	1
19.	12	0	0	2	2	0	1	11	11	0	0	3	2	0	0	12
20.	9	0	0	5	5	0	1	8	9	3	0	2	2	0	2	10
21.	5	5	4	0	1	0	4	9	8	2	3	1	1	1	5	7
22.	4	4	2	4	1	2	5	6	4	4	2	4	2	1	4	7
23.	14	0	0	0	0	1	0	13	14	0	0	0	0	0	0	14
24.	8	4	0	2	1	0	4	9	8	0	1	5	1	0	1	12
25.	6	4	3	1	2	2	5	5	11	2	1	0	1	1	1	11
26.	11	0	2	1	0	1	3	10	10	3	1	0	0	1	4	9
27.	10	2	2	0	0	1	10	3	9	2	2	1	1	3	6	4
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

Category: 1 Absolutely sure was present to 4 absolutely sure was absent.

APPENDIX XXVll

THE TWO PAGE BOOKLET

	Present 1	Present 2	Absent 3	Absent 4
ABROGATE				
CONSEUTUDE				
PETRARCHAN				
CABRIOLE				
ASPERITY				
PROTEAN				
APOCALYPTIC				
RECREANT				
SYNONYMICON				
ACERBITY				
DIALECTIC				
EXCURSUS				
METONYM				
ANTITHETICAL				
BERGSCHRUND				
BICEPHALOUS				
EXIGENT				
REDOLENT				
CONTUMELIOUS				
BICAMERAL				
EXIGEANT				
EXCUPATE				
SYNECDOCHE				
BERGMEHL				
PORTENTOUS				
PROTASIS				
DIELECTRIC				
CABRIOLET				
DESUETUDE				
HOMONYM				

APPENDIX XXVll (Contd)

	Present 1	Present 2	Absent 3	Absent 4
PERIPHRASIS				
ABNEGATE				
EXTIRPATION				
ASPERITY				
IMMOLATE				
SENESCHAL				
NEOPHYTE				
EXOGENOUS				
INEFFABLE				
NEOTERIC				
CONTUMACIOUS				
SYBARITIC				
ENDOGENOUS				
PERSPICACIOUS				
EXECRATION				
POETASTER				
SENESCENCE				
MEROSIS				
PERSPICUOUS				
IMMANENT				
SYCOPHANT				
ACERBITY				
INERRANT				
MASQUE				
PALLINODE				
PALLIATE				
PRORATE				

APPENDIX XXVII

INSTRUCTION PAGE FOR THE RATING TASK
EXPERIMENT 9

INSTRUCTIONS:

Before turning over, please read the following instructions. On the following pages you will find a number of words. Some of these will be easy to pronounce, others may not. Please mark in the bracket, following each word, a number from 1 to 4 denoting the ease of pronounceability of the word in question according to the following scale:-

1. Place a 1 in the bracket if the word is extremely easy to pronounce.
2. Place a 2 in the bracket if the word is fairly easy to pronounce.
3. Put a 3 in the bracket if the word is reasonably difficult to pronounce.
4. Place a 4 if the word is extremely difficult to pronounce.

Try and work through the list at a fairly steady and rapid rate. Do not spend long over any one word. Your weighting should indicate your initial impression rather than be a weighed decision.

APPENDIX XXVII (Contd)

For example one person rated the following words thus :-

DOLOSE	(1)
BERGMEHL	(2)
ONOMATOPOEIA	(4)
HOMONYM	(3)

DOLOSE was very easy to pronounce, ONOMATOPOEIA extremely difficult, and the other words lay in between in degree of pronounceability.

APPENDIX XXVIII

CUMULATIVE HIT AND FALSE ALARM PROBABILITIES

(FOUR CATEGORIES : STD. PARAMETERS)

(N = 27)

HARD TO PRONOUNCE WORDS

		1	2	3	4
1.	PSS	0.6428	0.6428	0.6428	1.000
	PSN	0.0714	0.0714	0.1428	1.000
2.	PSS	0.4285	0.7142	0.9285	1.000
	PSN	0.2142	0.3571	0.7142	1.000
3.	PSS	0.7142	1.000	1.000	1.000
	PSN	0.0000	0.2857	0.8571	1.000
4.	PSS	0.7142	0.7857	0.7857	1.000
	PSN	0.1428	0.1428	0.2142	1.000
5.	PSS	0.7857	0.7857	0.7857	1.000
	PSN	0.2142	0.2142	0.2142	1.000
6.	PSS	0.2857	0.5714	1.0000	1.0000
	PSN	0.0714	0.4285	0.9285	1.000
7.	PSS	0.7142	1.0000	1.0000	1.0000
	PSN	0.2142	0.4285	0.7142	1.0000
8.	PSS	0.9285	0.9285	1.0000	1.0000
	PSN	0.0714	0.1428	0.2142	1.0000
9.	PSS	1.0000	1.0000	1.0000	1.0000
	PSN	0.3571	0.4285	0.4285	1.0000
10.	PSS	0.5714	0.7142	0.7857	1.0000
	PSN	0.0714	0.1428	0.2857	1.0000
11.	PSS	0.5000	0.6428	0.8571	1.0000
	PSN	0.2142	0.3571	0.5000	1.0000
12.	PSS	0.4615	0.6153	0.9230	1.0000
	PSN	0.3571	0.5714	0.9285	1.0000
13.	PSS	0.6428	0.8571	0.8571	1.0000
	PSN	0.2857	0.4285	0.4285	1.0000
14.	PSS	0.7142	0.7142	0.8571	1.0000
	PSN	0.1428	0.2142	0.5714	1.0000

APPENDIX XXVIII (Contd)

HARD TO PRONOUNCE WORDS

		1	2	3	4
15.	PSS	0.3571	0.8571	0.9285	1.0000
	PSN	0.0714	0.2857	0.7857	1.0000
16.	PSS	0.9285	0.9285	1.0000	1.0000
	PSN	0.0000	0.0714	0.0714	1.0000
17.	PSS	0.9285	0.9285	0.9285	1.0000
	PSN	0.1428	0.2857	0.2857	1.0000
18.	PSS	0.6153	0.6153	1.0000	1.0000
	PSN	0.1428	0.3571	0.9285	1.0000
19.	PSS	0.7857	0.7857	0.7857	1.0000
	PSN	0.1428	0.1428	0.1428	1.0000
20.	PSS	0.6428	0.8571	0.8571	1.0000
	PSN	0.1428	0.1428	0.2857	1.0000
21.	PSS	0.5714	0.7142	0.9285	1.0000
	PSN	0.0714	0.1428	0.5000	1.0000
22.	PSS	0.2857	0.5714	0.7142	1.0000
	PSN	0.1428	0.2142	0.5000	1.0000
23.	PSS	1.0000	1.0000	1.0000	1.0000
	PSN	0.0000	o.0000	0.0000	1.0000
24.	PSS	0.5714	0.5714	0.6428	1.0000
	PSN	0.0714	0.0714	0.1428	1.0000
25.	PSS	0.7857	0.9285	1.0000	1.0000
	PSN	0.0714	0.1428	0.2142	1.0000
26.	PSS	0.7142	0.9285	1.0000	1.0000
	PSN	0.0000	0.0714	0.3571	1.0000
27.	PSS	0.6428	0.7857	0.9285	1.0000
	PSN	0.0714	0.2857	0.7142	1.0000

APPENDIX XXVIII (Contd)

EASY TO PRONOUNCE WORDS

(N = 27)

		1	2	3	4
1.	PSS	0.5384	0.5384	0.6153	1.0000
	PSN	0.1428	0.2142	0.2857	1.0000
2.	PSS	0.6428	0.8571	1.0000	1.0000
	PSN	0.2857	0.5000	0.7142	1.0000
3.	PSS	0.5714	0.7142	1.0000	1.0000
	PSN	0.0714	0.1428	0.7142	1.0000
4.	PSS	0.7142	0.7857	0.8571	1.0000
	PSN	0.1428	0.2142	0.2142	1.0000
5.	PSS	0.7857	0.7857	0.7857	1.0000
	PSN	0.2857	0.2857	0.2857	1.0000
6.	PSS	0.5714	0.7142	0.9285	1.0000
	PSN	0.0000	0.5000	0.7857	1.0000
7.	PSS	0.6428	0.7857	0.7857	1.0000
	PSN	0.4285	0.5714	0.6428	1.0000
8.	PSS	0.8571	0.9285	1.0000	1.0000
	PSN	0.0714	0.2142	0.2142	1.0000
9.	PSS	0.7142	0.7857	0.7857	1.0000
	PSN	0.1428	0.2142	0.2857	1.0000
10.	PSS	0.5714	0.6428	0.7857	1.0000
	PSN	0.0000	0.2142	0.3571	1.0000
11.	PSS	0.6428	0.6428	0.7857	1.0000
	PSN	0.0000	0.1428	0.4285	1.0000
12.	PSS	0.7142	0.7857	0.8571	1.0000
	PSN	0.3846	0.5384	0.6923	1.0000
13.	PSS	0.9285	0.9285	0.9285	1.0000
	PSN	0.0000	0.0714	0.1428	1.0000
14.	PSS	0.9285	0.9285	1.0000	1.0000
	PSN	0.1428	0.2857	0.50000	1.0000

APPENDIX XXVIII (Contd)

EASY TO PRONOUNCE WORDS

		1	2	3	4
15.	PSS	0.4285	0.7142	1.0000	1.0000
	PSN	0.0714	0.3571	0.7857	1.0000
16.	PSS	0.9285	0.9285	1.0000	1.0000
	PSN	0.0000	0.0714	0.0714	1.0000
17.	PSS	0.6428	0.6428	0.6428	1.0000
	PSN	0.1428	0.2857	0.3571	1.0000
18.	PSS	0.3571	0.4285	0.9285	1.0000
	PSN	0.1428	0.2142	0.8571	1.0000
19.	PSS	0.8571	0.8571	0.8571	1.0000
	PSN	0.1428	0.1428	0.2142	1.0000
20.	PSS	0.6428	0.6428	0.6428	1.0000
	PSN	0.3571	0.3571	0.4285	1.0000
21.	PSS	0.3571	0.7142	1.0000	1.0000
	PSN	0.0714	0.0714	0.3571	1.0000
22.	PSS	0.2857	0.5714	0.7142	1.0000
	PSN	0.0714	0.2142	0.5714	1.0000
23.	PSS	1.0000	1.0000	1.0000	1.0000
	PSN	0.0000	0.0714	0.0714	1.0000
24.	PSS	0.5714	0.8571	0.8571	1.0000
	PSN	0.0714	0.0714	0.3571	1.0000
25.	PSS	0.4285	0.7142	0.9285	1.0000
	PSN	0.1428	0.2857	0.6428	1.0000
26.	PSS	0.7857	0.7857	0.9285	1.0000
	PSN	0.0000	0.0714	0.2857	1.0000
27.	PSS	0.7142	0.8571	1.0000	1.0000
	PSN	0.0000	0.0714	0.7857	1.0000

APPENDIX XXIX

SENSITIVITY SCORES (A)

Hard to Pronounce Words (N = 27)		Easy to Pronounce Words (N = 27)	
1.	0.7729	1.	0.6950
2.	0.6964	2.	0.7372
3.	0.9591	3.	0.8418
4.	0.8086	4.	0.8341
5.	0.7857	5.	0.7500
6.	0.6275	6.	0.7627
7.	0.8316	7.	0.6147
8.	0.9540	8.	0.9438
9.	0.8214	9.	0.7984
10.	0.8112	10.	0.8061
11.	0.7066	11.	0.8061
12.	0.5412	12.	0.6648
13.	0.7295	13.	0.9591
14.	0.7806	14.	0.9056
15.	0.7959	15.	0.7602
16.	0.9948	16.	0.9948
17.	0.8877	17.	0.7117
18.	0.7087	18.	0.6275
19.	0.8214	19.	0.8520
20.	0.8316	20.	0.6301
21.	0.8418	21.	0.9005
22.	0.6632	22.	0.6683
23.	1.0000	23.	1.0000
24.	0.7678	24.	0.8622
25.	0.9438	25.	0.7499
26.	0.9770	26.	0.9285
27.	0.8188	27.	0.9336
MEAN (A)	0.8103	MEAN (A)	0.8051
VAR. (A)	0.0130	VAR. (A)	0.0133

APPENDIX XXIX (Contd)

TRANSFORMED SENSITIVITY SCORES - ARCSIN ROOT (A)

Hard to Pronounce Words (N = 27)		Easy to Pronounce Words (N = 27)	
1.	0.6838	1.	0.6275
2.	0.6285	2.	0.6573
3.	0.8704	3.	0.7396
4.	0.7117	4.	0.7330
5.	0.6936	5.	0.6666
6.	0.5821	6.	0.6761
7.	0.7308	7.	0.5737
8.	0.8625	8.	0.8477
9.	0.7222	9.	0.7036
10.	0.7138	10.	0.7097
11.	0.6356	11.	0.7097
12.	0.5262	12.	0.6069
13.	0.6518	13.	0.8704
14.	0.6896	14.	0.8011
15.	0.7015	15.	0.6742
16.	0.9544	16.	0.9544
17.	0.7825	17.	0.6391
18.	0.6371	18.	0.5821
19.	0.7222	19.	0.7486
20.	0.7308	20.	0.5837
21.	0.7396	21.	0.7957
22.	0.6058	22.	0.6093
23.	0.5000	23.	0.5000
24.	0.6799	24.	0.7579
25.	0.8477	25.	0.6666
26.	0.9031	26.	0.8277
27.	0.7201	27.	0.8341
MEAN (TA)	0.7121	MEAN (TA)	0.7073
VAR. (TA)	0.0115	VAR. (TA)	0.0111

APPENDIX XXIX (Contd)

BIAS SCORES (B)

Hard to Pronounce Words (N = 27)		Easy to Pronounce Words (N = 27)	
1.	3.1764	1.	3.0900
2.	1.8333	2.	1.1666
3.	1.5000	3.	2.1666
4.	3.0000	4.	2.0000
5.	3.0000	5.	0.9333
6.	2.0000	6.	1.6666
7.	1.1428	7.	0.9333
8.	1.0000	8.	1.3333
9.	0.7368	9.	2.0000
10.	2.6666	10.	2.5000
11.	2.0000	11.	2.5000
12.	1.4925	12.	0.9100
13.	1.2000	13.	2.0000
14.	2.1428	14.	0.9333
15.	1.8000	15.	1.8750
16.	2.0000	16.	2.0000
17.	0.9333	17.	3.0000
18.	2.0287	18.	2.3125
19.	3.0666	19.	2.0000
20.	2.0000	20.	2.0000
21.	2.2500	21.	2.3750
22.	2.5000	22.	2.4285
23.	1.0000	23.	1.0000
24.	3.1764	24.	2.2500
25.	1.6666	25.	2.0000
26.	2.0000	26.	2.4000
27.	1.8000	27.	2.0833
MEAN (B)	1.9671	MEAN (B)	1.9206
VAR. (B)	0.5188	VAR. (B)	0.3870

APPENDIX XXX

TEST SHEET EXPERIMENT 10

	Present 1	2	3	Absent 4
PROTACTINIUM				
ISOTRON				
YTTERBIUM				
PARSEC				
THERMION				
ERBIUM				
TRITON				
HOLMIUM				
NEPTUNIUM				
AUTOCLAVE				
THULIUM				
LUTETIUM				
BEVATRON				
FRANCIUM				
HAFNIUM				
MAGNETRON				
NEODYMIUM				
EUROPIUM				
MEGATRON				
CATENARY				
DIPLET				
PARACHOR				
BARYON				
YTTRIUM				
ELECTRET				
TECHNETIUM				
FERMIUM				
LAWRENCIUM				
ELASTANCE				
EUTECTIC				
ADIACTINIC				
PRAESEODYMIUM				

		1	2	3	4
C	S				
	N				
P	S				
	N				

APPENDIX XXXI

INDIVIDUAL DATA : EXPERIMENT 10 (N = 18)

	Rare Chemistry Elements								Rare Physics Terms							
	Signal				Noise				Signal				Noise			
Ss	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	6	0	0	2	1	1	1	5	5	1	1	1	0	0	3	5
2	6	1	1	0	0	0	7	1	5	2	1	0	0	1	5	2
3	8	0	0	0	0	0	1	7	7	0	0	1	0	0	0	8
4	8	0	0	0	0	1	0	7	7	1	0	0	0	0	0	8
5	8	0	0	0	2	0	0	6	7	0	0	1	0	0	0	8
6	8	0	0	0	0	0	0	8	5	1	0	2	0	0	0	8
7	8	0	0	0	0	0	0	8	7	1	0	0	0	0	0	8
8	5	1	1	1	0	2	1	5	4	1	2	1	1	1	3	3
9	5	0	1	2	1	0	2	5	4	0	3	1	1	0	0	7
10	6	2	0	0	0	0	8	0	6	0	2	0	1	0	6	1
11	8	0	0	0	1	0	0	7	7	0	0	1	1	0	0	7
12	6	0	1	1	0	0	4	4	8	0	0	0	1	0	0	7
13	7	1	0	0	1	2	1	4	3	1	2	2	1	2	4	1
14	7	1	0	0	1	1	2	4	7	0	1	0	0	1	0	7
15	5	2	0	1	1	1	1	5	7	0	0	1	0	1	6	1
16	8	0	0	0	0	0	1	7	7	0	1	0	0	0	1	7
17	6	0	0	2	3	0	0	5	6	0	0	2	2	0	0	6
18	6	0	0	2	1	1	1	5	6	0	0	2	0	0	0	8

APPENDIX XXXII

SENSITIVITY SCORES (A)

Chemistry Terms (N = 18)		Physics Terms (N = 18)	
1.	0.7812	1.	0.8906
2.	0.9453	2.	0.9296
3.	1.0000	3.	0.9375
4.	1.0000	4.	1.0000
5.	0.8750	5.	0.9375
6.	1.0000	6.	0.8750
7.	1.0000	7.	1.0000
8.	0.8593	8.	0.7343
9.	0.7578	9.	0.8515
10.	1.0000	10.	0.8281
11.	0.9375	11.	0.8750
12.	0.8750	12.	0.9375
13.	0.9140	13.	0.5546
14.	0.9218	14.	0.9843
15.	0.8281	15.	0.8828
16.	1.0000	16.	0.9921
17.	0.6875	17.	0.7500
18.	0.7812	18.	0.8750
MEAN (A)	0.8980	MEAN (A)	0.8797
VARIANCE	0.0097	VARIANCE	0.0124

APPENDIX XXXII (Contd)

TRANSFORMED SENSITIVITY
SCORES - ARCSIN ROOT (A)

Chemistry Terms		Physics Terms	
1.	0.6901	1.	0.7854
2.	0.8497	2.	0.8291
3.	0.5000	3.	0.8391
4.	0.5000	4.	0.5000
5.	0.7699	5.	0.8391
6.	0.5000	6.	0.7699
7.	0.5000	7.	0.5000
8.	0.7552	8.	0.6552
9.	0.6724	9.	0.7482
10.	0.5000	10.	0.7278
11.	0.8391	11.	0.7699
12.	0.7699	12.	0.8391
13.	0.8105	13.	0.5348
14.	0.8196	14.	0.9202
15.	0.7278	15.	0.7775
16.	0.5000	16.	0.9436
17.	0.6223	17.	0.6666
18.	0.6901	18.	0.7699
MEAN (TA)	0.6676	MEAN (TA)	0.7453
VARIANCE	0.0182	VARIANCE	0.0168

$\underline{t}$ = 1.71 n.s.

APPENDIX XXXII (Contd)

BIAS SCORES

Chemistry Terms		Physics Terms	
1.	2.0000	1.	2.5000
2.	2.1250	2.	2.0000
3.	1.0000	3.	3.1111
4.	1.0000	4.	2.0000
5.	0.8000	5.	3.1111
6.	1.0000	6.	3.2000
7.	1.0000	7.	2.0000
8.	2.0000	8.	2.2000
9.	2.6666	9.	3.0000
10.	2.0000	10.	2.1250
11.	0.8888	11.	1.0000
12.	2.4000	12.	0.8888
13.	1.0000	13.	2.1666
14.	1.0000	14.	2.0000
15.	1.6666	15.	2.0000
16.	1.0000	16.	2.5000
17.	0.8888	17.	1.0000
18.	2.0000	18.	3.2000
MEAN (B)	1.4686	MEAN (B)	2.2223
VARIANCE	0.3858	VARIANCE	0.5457

APPENDIX XXXIII

INSTRUCTIONS:

Below you will find a list of words beside each of which there is a series of numbers, ring the number that you think was the number of occasions that the word in question appeared in the inspection list viewed on the screen. Should you have thought that :

CREATURE

OR

CALORIMETER

appeared four times ring the number 4 below the number of repetition column. In addition give the degree of assurance that you have in your choice of repetitions. Thus if you are absolutely confident the word appeared four times you would score thus :-

WORD 0 1 2 3 (4) 5 6 (1) 2 3

If you are guessing mark 3 in the last column, use the 2 category for a probably correct response. Please consider all words, leave no blanks.

Now please turn over.

APPENDIX XXX111(Contd)

WORD	NUMBER OF REPETITIONS							DEGREE OF SURETY ABSOLUTELY SURE - GUESSING		
CREATURE	0	1	2	3	4	5	6	1	2	3
CAPTAIN	0	1	2	3	4	5	6	1	2	3
VILLAGE	0	1	2	3	4	5	6	1	2	3
SECOND	0	1	2	3	4	5	6	1	2	3
DINNER	0	1	2	3	4	5	6	1	2	3
GRANULAR	0	1	2	3	4	5	6	1	2	3
MIRROR	0	1	2	3	4	5	6	1	2	3
MENACE	0	1	2	3	4	5	6	1	2	3
TONIGHT	0	1	2	3	4	5	6	1	2	3
PARABLE	0	1	2	3	4	5	6	1	2	3
COLUMN	0	1	2	3	4	5	6	1	2	3
INSTANCE	0	1	2	3	4	5	6	1	2	3

Please ensure that you have marked all words.

APPENDIX XXX111 (Contd)

WORD	NUMBER OF REPETITIONS							DEGREE OF SURETY		
								ABSOLUTELY SURE - GUESSING		
CALORIMETER	0	1	2	3	4	5	6	1	2	3
CATHODE	0	1	2	3	4	5	6	1	2	3
VERNIER	0	1	2	3	4	5	6	1	2	3
SECANT	0	1	2	3	4	5	6	1	2	3
DIPOLE	0	1	2	3	4	5	6	1	2	3
GALVANOMETER	0	1	2	3	4	5	6	1	2	3
MICRON	0	1	2	3	4	5	6	1	2	3
MENISCUS	0	1	2	3	4	5	6	1	2	3
TETRODE	0	1	2	3	4	5	6	1	2	3
PARACHOR	0	1	2	3	4	5	6	1	2	3
COULOMB	0	1	2	3	4	5	6	1	2	3
ELASTANCE	0	1	2	3	4	5	6	1	2	3

Please ensure that you have marked all words.

APPENDIX XXXIV

LIST A: The Degree of Surety on the Correct Responses

WORD	Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Horizontal (Word) Total	No. W
SECANT	(3)	W	4	W	4	W	4	4	4	W	W	W	2	W	2	4	4	32	7
TETRODE	(3)	4	W	W	4	4	4	4	4	2	4	W	W	W	W	W	W	30	8
COULOMB	(3)	4	W	2	4	4	4	4	4	4	4	4	4	4	W	4	4	54	2
Sub-Total		8	4	2	12	8	12	12	12	6	8	4	6	4	2	8	8		
CATHODE	(2)	2	W	2	2	2	4	W	W	2	W	4	W	2	4	4	2	30	5
DIPOLE	(2)	W	2	2	4	4	4	2	2	4	0	W	W	W	4	W	4	32	5
MICRON	(2)	2	4	W	2	2	2	W	0	W	W	W	W	W	4	2	2	20	7
Sub-Total		4	6	4	8	8	10	2	2	6	0	4	0	2	12	6	8		
CALORIMETER	(1)	4	W	2	2	4	2	2	4	4	2	4	4	4	4	4	4	50	1
VERNIER	(1)	4	4	4	2	4	4	W	W	4	4	2	4	2	4	4	4	50	2
ELASTANCE	(1)	4	4	W	2	2	4	W	4	4	2	4	4	4	4	4	4	50	2
Sub-Total		12	8	6	6	10	10	2	8	12	8	10	12	10	12	12	12		
GALVANOMETER	(0)	W	W	W	2	W	2	2	4	W	W	4	W	W	W	W	2	16	10
MENISCUS	(0)	4	4	0	4	4	4	4	2	2	W	2	4	2	4	2	2	44	1
PARACHOR	(0)	4	W	2	2	2	W	4	2	4	W	4	4	2	2	2	4	38	3
Sub-Total		8	4	2	8	6	6	10	8	6	0	10	8	4	6	4	8		
GRAND TOTAL		32	22	14	34	32	38	26	30	30	18	28	26	20	32	30	36	448	
Number Correct		9	6	7	12	10	11	8	8	10	9	6	8	7	7	9	9		
Number Incorrect		3	6	5	0	2	1	4	4	2	3	6	4	5	5	3	3		
MEAN		3.56	3.67	2.00	2.83	3.2	3.64	3.25	3.0	3.33	3.00	3.50	3.71	2.86	3.56	3.33	3.27		

The mean for the correct responses = 448 ÷ 139 = 3.223

Where 4 = absolutely sure
2 = probably sure
0 = guessing
W = incorrect

APPENDIX XXXIV (Contd)

LIST A: The Degree of Surety on the Incorrect Responses

WORD	Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Horizontal (Word) Total	No. W
SECANT	(3)	4	C	4	C	2	C	C	C	4	0	4	C	2	C	C	C	20	7
TETRODE	(3)	C	2	4	C	C	C	C	C	C	C	4	2	2	4	2	2	22	8
COULOMB	(3)	C	2	C	C	C	C	C	C	C	C	C	C	C	4	C	C	6	2
Sub-Total		4	4	8	0	2	0	0	0	4	0	8	2	4	8	2	2	48	17
CATHODE	(2)	C	4	C	C	C	C	4	4	C	4	C	0	C	C	C	C	16	5
DIPOLE	(2)	4	C	C	C	C	C	C	C	C	C	4	2	4	C	4	C	18	5
MICRON	(2)	C	C	2	C	C	C	2	C	4	2	4	4	4	C	C	C	22	7
Sub-Total		4	4	2	0	0	0	6	4	4	6	8	6	8	0	4	0	56	17
CALORIMETER	(1)	C	4	C	C	C	C	C	C	C	C	C	C	C	C	C	C	4	1
VERNIER	(1)	C	C	C	C	C	C	4	0	C	C	C	C	C	C	C	C	4	2
ELASTANCE	(1)	C	C	2	C	C	C	2	C	C	C	C	C	C	C	C	C	4	2
Sub-Total		0	4	2	0	0	0	6	0	0	0	0	0	0	0	0	0	12	5
GALVANOMETER	(0)	4	2	4	C	4	C	C	C	4	2	C	2	2	2	0	C	26	10
MENISCUS	(0)	C	C	C	C	C	C	C	C	C	0	C	C	C	C	C	C	-	1
PARACHOR	(0)	C	2	C	C	C	0	C	C	C	2	C	C	C	C	C	C	4	3
Sub-Total		4	4	4	0	4	0	0	0	4	4	0	2	2	2	0	0	30	14
GRAND TOTAL		12	16	16	0	6	0	12	4	12	10	16	10	14	10	6	2	146	53
Number Correct		9	6	7	12	10	11	8	10	9	6	8	7	7	9	9	11		
Number Incorrect		3	6	5	0	2	1	4	2	3	6	4	5	5	3	3	1		
MEAN		4.0	2.67	3.20	0.0*	3.00	0.00	3.00	2.00	4.00	1.67	4.00	2.00	2.80	3.33	2.00	2.00		

GRAND MEAN = 146 ÷ 53 = 2.755

If Marked 1 give 4 points
" " 2 " 2 "
" " 3 " 0 "
C = Correct number repetitions
(surety not considered on C's)

A high score means rashness (boldness on incorrect - or a strong bias to say YES to incorrect responses) with the proviso that a high score is also a function of the number of incorrect responses: e.g. Subject 8 8 points on 4 incorrect words is less rash than subjects 4 and 5 (6 points on 2 responses and 12 points on 4 responses respectively: see text for details).

APPENDIX XXXIV (Contd)

LIST A: OVER AND UNDERESTIMATE NUMBER OF REPETITIONS

(Physics Word List)

Ss	SECANT	TETRODE	COULOMB	CATHODE	DIPOLE	MICRONS	CALORIMETER	VERNIER	ELASTANCE	GALVANOMETER	MENISCUS	PARACHOR	BIAS TOTAL
	*(3)	(3)	(3)	(2)	(2)	(2)	(1)	(1)	(1)	(0)	(0)	(0)	
1	-1	0	0	0	+1	0	0	0	0	+1	0	0	+1
2	0	+1	-1	+1	0	0	+1	0	0	+1	0	-1	+2
3	-1	-2	0	0	0	-1	0	0	-1	+1	0	-1	-5
4	0	0	0	0	0	0	0	0	0	0	0	0	0
5	-2	0	0	0	0	0	0	0	0	+1	0	0	-1
6	0	0	0	0	0	0	0	0	0	0	0	-1	-1
7	0	0	0	+1	0	+1	0	-1	-1	0	0	0	0
8	0	0	0	+1	0	0	0	+1	0	0	0	0	+2
9	-1	0	0	0	0	+1	0	0	0	+1	0	0	+1
10	-1	0	0	+1	0	-1	0	0	0	+1	0	-1	-1
11	-1	-1	0	0	-1	-1	0	0	0	0	0	0	-4
12	0	+1	0	+1	-1	-1	0	0	0	+1	0	0	+1
13	-2	-2	0	0	-1	-1	0	0	0	+1	0	0	-5
14	0	+1	-2	0	0	0	0	0	0	+1	0	0	0
15	0	-1	0	0	-1	0	0	0	0	+1	0	0	-1
16	0	+1	0	0	0	0	0	0	0	0	0	0	+1
													-10

* No. of appearances.

APPENDIX XXXIV (Contd)

LIST B: The Degree of Surety on the Correct Responses (Accuracy)

WORD	Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total for Word Accuracy	No. W
SECOND	(3)	W	W	4	4	2	4	4	2	4	W	4	4	4	4	W	4	44	4
TONIGHT	(3)	W	4	4	2	2	4	4	4	2	W	4	4	4	W	4	W	42	4
COLUMN	(3)	4	W	4	4	4	4	4	4	4	4	4	4	4	4	4	2	58	1
(a) Total		4	4	12	10	8	12	12	10	10	4	12	12	12	8	8	6	144	9
CAPTAIN	(2)	4	0	W	4	W	4	4	W	4	4	W	4	4	W	2	W	34	6
DINNER	(2)	W	2	W	4	2	4	4	2	W	W	2	4	4	W	2	W	30	6
MIRROR	(2)	W	4	2	4	2	4	W	W	2	2	W	4	2	2	2	4	34	4
(b) Total		4	6	2	12	4	12	8	2	6	6	2	12	10	2	6	4	98	16
CREATURE	(1)	W	2	4	4	2	W	4	4	4	4	4	2	4	0	0	4	42	2
VILLAGE	(1)	W	4	4	4	4	4	W	W	4	4	2	4	4	4	W	W	42	5
INSTANCE	(1)	W	4	2	2	2	4	W	2	W	W	2	2	4	0	0	2	26	4
(c) Total		0	10	10	10	8	8	4	6	8	8	8	8	12	4	0	6	110	11
GRANULAR	(0)	4	4	4	2	4	2	4	4	2	4	4	2	4	4	W	4	52	1
MENACE	(0)	4	W	2	2	W	2	W	4	4	4	W	W	4	2	W	4	32	6
PARABLE	(0)	2	4	2	0	4	4	4	2	4	4	2	W	4	W	2	4	42	2
(d) Total		10	8	8	4	8	8	8	10	10	12	6	2	12	6	2	12	126	9
GRAND TOTAL (a+b+c+d)	T	18	28	32	36	28	40	32	28	34	30	28	34	46	20	16	28	478	45
Number Correct	(c)	5	9	10	12	10	11	8	9	10	8	9	10	12	8	8	8	147	
Number Incorrect		7	3	2	0	2	1	4	3	2	4	3	2	0	4	4	4	45	
Average per 1 correct $= \frac{T}{(c)} =$		3.60	3.11	3.20	3.00	2.80	3.63	4.00	3.11	3.40	3.75	3.11	3.40	3.83	2.50	2.00	3.50		

147 Correct, 45 Incorrect Responses:

GRAND MEAN = 478 ÷ 147 = 3.252

Where 4 = absolutely sure
2 = probably sure
0 = guessing
W = an incorrect response

APPENDIX XXXIV (Contd)

LIST B: The Degree of Surety on the Incorrect Responses

WORD	Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Horizontal (Word) Total	No. W
SECANT	(3)	4	2	C	C	C	C	C	C	C	4	C	C	C	C	2	C	12	4
TONIGHT	(3)	4	C	C	C	C	C	C	C	C	4	C	C	C	2	C	2	12	4
COLUMN	(3)	C	2	C	C	C	C	C	C	C	C	C	C	C	C	C	C	2	1
Sub-Total		8	4	0	0	0	0	0	0	0	8	0	0	0	2	2	2	26	9
CAPTAIN	(2)	C	C	4	C	2	C	C	4	C	C	0	C	C	0	C	4	14	6
DINNER	(2)	4	C	2	C	C	C	C	C	4	2	C	C	C	C	C	0	12	5
MIRROR	(2)	2	C	C	C	C	C	4	4	C	C	4	C	C	C	C	C	14	4
Sub-Total		6	0	6	0	2	0	4	8	4	2	4	0	0	0	0	4	40	15
CREATURE	(1)	2	C	C	C	C	2	C	C	C	C	C	C	C	0	C	C	4	3
VILLAGE	(1)	4	C	C	C	C	C	2	2	C	C	C	C	C	C	2	2	12	5
INSTANCE	(1)	4	C	C	C	C	C	2	C	2	2	C	C	C	C	C	C	10	4
Sub-Total		10	0	0	0	0	2	4	2	2	2	0	0	0	0	2	2	26	12
GRANULAR	(0)	C	C	C	C	C	C	C	C	C	C	C	C	C	C	2	C	2	1
MENACE	(0)	C	2	C	C	4	C	2	C	C	C	0	2	C	C	0	C	10	6
PARABLE	(0)	C	C	C	C	C	C	C	C	C	C	C	2	C	0	C	C	2	2
Sub-Total		0	2	0	0	4	0	2	0	0	0	0	4	0	0	2	0	14	9
(a) GRAND TOTAL		24	6	6	0*	6	2	10	10	6	12	4	4	0*	2	6	8	106	
Number Correct		5	9	10	12	10	11	8	9	10	8	9	10	12	8	8	8		
(b) Number Incorrect		7	3	2	0	2	1	4	3	2	4	3	2	0*	4	4	4		
$\overline{X}$ = (a) ÷ (b)		3.43	2.00	3.00	0.0*	3.00	2.00	2.50	3.33	3.00	3.00	1.33	2.00	0.00	0.50	1.50	2.00		

147 Correct, 45 Incorrect Responses:

GRAND MEAN = 106 ÷ 45 = 2.356

Where 4 = absolutely sure correct
2 = probably correct
0 = guessing
C = a correct response.

* 0 ÷ 0 is taken as 0 ÷ 1 (i.e. one incorrect but guessing; the closest one can get to a value for subjects 4 and 13 as infinity would be meaningless).

APPENDIX XXXIV (Contd)

LIST B: OVER AND UNDERESTIMATE THE NUMBER OF REPETITIONS

(Common Word List)

Ss	SECOND	TONIGHT	COLUMN	CAPTAIN	DINNER	MIRROR	CREATURE	VILLAGE	INSTANCE	GRANULAR	MENACE	PARABLE	BIAS TOTAL
	*(3)	(3)	(3)	(2)	(2)	(2)	(1)	(1)	(1)	(0)	(0)	(0)	
1	-1	+1	0	0	+1	+1	+1	-1	+1	0	0	0	+3
2	-2	0	-1	0	0	0	0	0	0	0	+1	0	-2
3	0	0	0	-1	+1	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	+1	0	0	0	0	0	0	+1	0	+2
6	0	0	0	0	0	0	-1	0	0	0	0	0	-1
7	0	0	0	0	0	+1	0	-1	+1	0	+1	0	+2
8	0	0	0	-1	0	+1	0	-1	0	0	0	0	-1
9	0	0	0	0	+1	0	0	0	-1	0	0	0	0
10	-1	-1	0	0	+1	0	0	0	+1	0	0	0	0
11	0	0	0	+1	0	+1	0	0	0	0	+1	0	+3
12	0	0	0	0	0	0	0	0	0	0	+1	+1	+2
13	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	-1	0	-1	0	0	0	0	0	0	0	+1	-1
15	-1	0	0	0	0	0	0	+1	0	+1	+1	0	+2
16	0	-2	0	-1	-2	0	0	-1	0	0	0	0	-6

* No. of appearances.

APPENDIX XXXIV (Contd)

LIST B:

Ss	BIAS ON	3's	2's	1's	0's
1		0	+2	+1	0
2		-3	0	0	+1
3		0	0	0	0
4		0	0	0	0
5		0	+1	0	+1
6		0	0	-1	0
7		0	+1	0	+1
8		0	0	-1	0
9		0	+1	-1	0
10		-2	+1	+1	0
11		0	+2	0	+1
12		0	0	0	+2
13		0	0	0	0
14		-1	-1	0	+1
15		-1	0	+1	+2
16		-2	-3	-1	0

APPENDIX XXXIV (Contd)

LIST C: The Degree of Surety on the Correct Responses

WORD	Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Horizontal (Word) Total	No. W
SECOND	(3)	4	W	W	W	W	4	W	2	4	4	W	W	2	2	W	W	22	9
TONIGHT	(3)	W	2	2	2	W	4	2	2	4	4	4	W	2	W	W	2	30	5
COLUMN	(3)	W	4	W	W	W	2	W	2	4	W	0	2	2	4	W	W	20	8
Sub-Total		4	6	2	2	0	10	2	6	12	8	4	2	6	6	0	2	72	22
CAPTAIN	(2)	2	W	4	2	4	W	2	W	2	2	2	2	W	W	W	4	26	6
DINNER	(2)	W	2	2	4	W	W	4	4	2	4	0	W	2	2	4	2	32	4
MIRROR	(2)	2	W	4	4	4	W	2	W	2	W	0	W	W	4	2	W	24	7
Sub-Total		4	2	10	10	8	0	8	4	6	6	2	2	2	6	6	6	82	17
CREATURE	(1)	4	W	W	4	4	W	4	W	2	W	W	W	W	W	W	4	22	10
VILLAGE	(1)	4	W	4	W	4	W	4	W	2	W	W	W	4	W	4	4	30	8
INSTANCE	(1)	W	2	W	4	W	4	4	2	W	2	W	2	W	W	4	2	26	7
Sub-Total		8	2	4	8	8	4	12	2	4	2	0	2	4	0	8	10	78	25
GRANULAR	(0)	0	4	2	W	W	4	4	4	4	W	2	4	4	W	4	4	40	4
MENACE	(0)	4	4	4	W	4	0	4	2	W	W	W	4	4	4	4	W	38	5
PARABLE	(0)	4	4	2	4	4	4	W	4	2	W	4	2	4	W	4	4	46	3
Sub-Total		8	12	8	4	8	8	8	10	6	0	6	10	12	4	12	8	124	12
GRAND TOTAL		16	22	24	24	24	22	30	22	28	16	12	16	24	16	26	26	356	
Number Correct		8	7	8	7	6	7	9	8	10	5	7	6	8	5	7	8	116	
Number Incorrect		4	5	4	5	6	5	3	4	2	7	5	6	4	7	5	4	76	
Average per one correct		2.00	3.14	3.00	3.43	4.00	3.14	3.33	2.75	2.80	3.20	1.71	2.67	3.00	3.20	3.71	3.25		

The Mean for the correct responses:

GRAND AVERAGE = $^{356}/116$ = 3.16

Where 4 = absolutely sure
2 = probably sure
0 = guessing
W = an incorrect response.

APPENDIX XXXIV (Contd)

LIST C: The Degree of Surety on the Incorrect Responses

WORD	Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Horizontal (Word) Total	No. W
SECOND	(3)	C	2	4	4	0	C	4	C	C	C	4	4	C	C	4	2	28	8
TONIGHT	(3)	2	C	C	C	2	C	C	C	C	C	C	2	C	4	4	C	14	5
COLUMN	(3)	2	C	4	2	2	C	4	C	C	2	C	C	C	C	4	2	22	8
Sub-Total		4	2	8	6	4	0	8	0	0	2	4	6	0	4	12	4	64	22
CAPTAIN	(2)	C	2	C	C	C	2	C	2	C	C	C	C	2	4	2	C	14	6
DINNER	(2)	2	C	C	C	2	2	C	C	C	C	C	4	C	C	C	C	10	4
MIRROR	(2)	C	2	C	C	C	4	C	2	C	4	C	4	4	C	C	2	22	7
Sub-Total		2	4	0	0	2	8	0	4	0	4	0	8	6	4	2	2	46	17
CREATURE	(1)	C	2	2	C	C	4	C	0	C	2	2	0	2	2	2	C	18	10
VILLAGE	(1)	C	2	C	2	C	4	C	2	C	2	4	4	C	0	C	C	20	8
INSTANCE	(1)	4	C	2	C	0	C	C	C	2	C	0	C	2	2	C	C	12	7
Sub-Total		4	4	4	2	0	8	0	2	2	4	6	4	4	4	2	0	50	25
GRANULAR	(0)	C	C	C	4	4	C	C	C	C	2	C	C	C	2	C	C	12	4
MENACE	(0)	C	C	C	0	C	C	C	C	0	2	2	C	C	C	C	4	8	5
PARABLE	(0)	C	C	C	C	C	C	2	C	C	4	C	C	C	2	C	C	8	3
Sub-Total		0	0	0	4	4	0	2	0	0	8	2	0	0	4	0	4	28	12
(a) GRAND TOTAL		10	10	12	12	10	16	10	6	2	18	12	18	10	16	16	10	188	76
Number Correct		8	7	8	7	6	7	9	8	10	5	7	6	8	5	7	8	116	
(b) Number Incorrect		4	5	4	5	6	5	3	4	2	7	5	6	4	7	5	4	76	
$\bar{X}$ = (a) ÷ (b)		2.50	2.00	3.00	2.40	1.67	3.20	3.33	1.50	1.00	2.57	2.40	3.00	2.50	2.29	3.20	2.50		

Mean for the incorrect responses:

188 ÷ 76 = 2.474

Where 4 = absolutely sure
2 = probably sure
0 = guessing
C = correct response.

APPENDIX XXXlV (Contd)

THE OVER AND UNDER ESTIMATION OF THE WORDS ON LIST C

Ss	SECOND	TONIGHT	COLUMN	CAPTAIN	DINNER	MIRROR	CREATURE	VILLAGE	INSTANCE	GRANULAR	MENACE	PARABLE	BIAS TOTAL	
*	(3)	(3)	(3)	(2)	(2)	(2)	(1)	(1)	(1)	(0)	(0)	(0)		
1	0	-1	-1	0	+1	0	0	0	-1	0	0	0	-2	
2	-2	0	0	+1	0	-1	+1	+1	0	0	0	0	0	
3	-1	0	-1	0	0	0	+2	0	-1	0	0	0	-1	
4	+1	0	+1	0	0	0	0	+1	0	+1	+1	0	+5	
5	-1	+1	+1	0	+1	0	0	0	-1	+1	0	0	+2	
6	0	0	0	+1	+2	+2	-1	+1	0	0	0	0	+5	
7	-1	0	-1	0	0	0	0	0	0	0	0	+1	-1	
8	0	0	0	-1	0	+2	+1	-1	0	0	0	0	+1	
9	0	0	0	0	0	0	0	0	+1	0	+1	0	+2	
10	0	0	-1	0	0	+1	+1	+1	0	+2	+1	+1	+6	
11	-2	0	0	0	0	0	-1	-1	+1	0	+1	0	-2	
12	-1	-1	0	0	-1	-2	-1	-1	0	0	0	0	-7	
13	0	0	0	-1	0	+1	+1	0	+1	0	0	0	+2	
14	0	-3	0	-1	0	0	+1	+1	+1	+3	0	+2	+4	
15	-1	-1	-1	+1	0	0	+1	0	0	0	0	0	-1	
16	-1	0	+1	0	0	+1	0	0	0	0	+1	0	+2	
TOTALS	-9	-5	-2	0	+3	+4	+5	+2	+1	+7	+5	+4	-14	+29
	-16			+7			+8			+16			TOTAL	+15

Mean for three appearances = -0.333.
" " Two " = +0.146.
" " one " = +0.167.
" " no appearance = +0.333.

Mean = 0.078

* No. of appearances.

APPENDIX XXXIV (Contd)

LIST D: The Degree of Surety on Correct Responses : Accuracy

WORD		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Horizontal (Word) Total	No W.
SECANT	(3)	W	4	W	4	2	W	W	4	2	2	W	W	W	2	2	4	22	7
TETRODE	(3)	W	W	W	4	0	W	W	W	2	W	2	2	4	2	W	W	16	9
COULOMB	(3)	W	4	W	2	W	4	4	4	2	W	2	W	W	W	4	4	30	7
Sub-Total		0	8	0	10	2	4	4	8	6	2	4	2	4	4	6	8	68	
CATHODE	(2)	2	W	2	4	W	W	2	0	W	W	W	2	W	W	4	W	16	9
DIPOLE	(2)	2	W	2	W	W	2	W	W	W	W	2	2	4	2	4	2	22	7
MICRON	(2)	W	2	W	W	W	W	W	W	W	W	W	W	W	W	W	2	4	13
Sub-Total		4	2	4	4	0	2	2	0	0	0	2	4	4	2	8	4	42	
CALORIMETER	(1)	2	4	4	W	W	4	0	4	4	4	W	2	W	W	W	4	32	6
VERNIER	(1)	4	4	4	4	4	4	0	2	4	4	4	4	4	4	W	W	50	2
ELASTANCE	(1)	2	4	2	4	0	2	4	2	4	4	4	4	W	4	W	4	44	2
Sub-Total		8	12	10	8	4	10	4	8	12	12	8	10	4	8	0	8	126	
GALVANOMETER	(0)	4	W	4	4	4	W	W	W	0	0	W	W	4	W	4	W	24	8
MENISCUS	(0)	4	2	W	4	4	2	W	0	0	0	4	0	4	W	4	4	32	3
PARACHOR	(0)	2	4	4	4	W	0	W	2	4	4	4	W	4	4	4	4	44	3
Sub-Total		10	6	8	12	8	2	0	2	4	4	8	0	12	4	12	8	100	
GRAND TOTAL		22	28	22	34	14	16	10	18	22	18	22	16	24	18	26	28	336	
Number Correct		8	8	7	9	6	7	5	8	9	8	7	7	6	6	7	8	116	
Number Incorrect		4	4	5	3	6	5	7	4	3	4	5	5	6	6	5	4	76	
Mean degree of surety per subject ((a) ÷ (b))		2.75	3.50	3.13	3.78	2.33	2.26	2.00	2.25	2.44	2.25	3.13	2.26	4.00	3.00	3.71	3.50	$\bar{x}=\frac{336}{116}$	

GRAND MEAN ($\bar{x}$ = 2.897)

Responses: 116 Correct, 76 Incorrect.

Where 4 = absolutely sure
2 = probably sure
0 = guessing
W = an incorrect response.

APPENDIX XXXlV (Contd)

LIST D: The Degree of Surety on the Incorrect Responses

WORD	Ss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Horizontal (Word) Total	No. W
SECANT	(3)	2	C	2	C	C	2	4	C	C	C	2	2	4	C	C	C	18	7
TETRODE	(3)	2	4	2	C	C	4	4	2	C	4	C	C	C	C	2	0	24	9
COULOMB	(3)	4	C	4	C	4	C	C	C	C	2	C	2	2	2	C	C	20	7
Sub-Total		8	4	8	0	4	6	8	2	0	6	2	4	6	2	2	0	62	22
CATHODE	(2)	C	4	C	C	2	2	C	C	2	2	2	C	4	2	C	2	22	9
DIPOLE	(2)	C	2	C	2	2	C	4	4	2	2	C	C	C	C	C	C	18	7
MICRON	(2)	2	C	4	4	0	2	4	0	2	C	2	4	2	2	2	C	30	13
Sub-Total		2	6	4	6	4	4	8	4	6	4	4	4	6	4	2	2	70	30
CALORIMETER	(1)	C	C	C	4	2	C	C	C	C	C	0	C	0	2	4	C	12	6
VERNIER	(1)	C	C	C	C	C	C	C	C	C	C	C	C	C	C	4	2	6	2
ELASTANCE	(1)	C	C	C	C	C	C	C	C	C	C	C	C	4	C	4	C	8	2
Sub-Total		0	0	0	4	2	0	0	0	0	0	0	0	4	2	12	2	26	10
GALVANOMETER	(0)	C	0	C	C	C	2	4	2	C	C	0	4	C	2	C	0	14	8
MENISCUS	(0)	C	C	4	C	C	0	C	C	C	C	C	C	C	2	C	C	6	3
PARACHOR	(0)	C	C	C	C	4	C	0	C	C	C	C	0	C	C	C	C	4	3
Sub-Total		0	0	4	0	4	2	4	2	0	0	0	4	0	4	0	0	24	14
GRAND TOTAL		10	10	16	10	14	12	20	8	6	10	6	12	16	12	16	4	182	76
Number Correct		8	8	7	9	6	7	5	8	9	8	7	7	6	6	7	8	116	
Number Incorrect		4	4	5	3	6	5	7	4	3	4	5	5	6	6	5	4	76	
MEAN		2.50	2.50	3.20	3.33	2.33	2.40	2.86	2.00	2.00	2.50	1.20	2.40	2.67	2.00	3.20	1.00		

116 Correct, 76 Incorrect.

182 (Surety Points) on the Incorrect Responses.

GRAND MEAN $(\bar{x})$ = 182 ÷ 76 = 2.395

Where 4 = absolutely sure
2 = probably sure
0 = guessing
C = a correct response.

APPENDIX XXXIV (Contd)

THE OVER AND UNDER ESTIMATION OF THE WORDS ON LIST D

SS	SECANT	TETRODE	COULOMB	CATHODE	DIPOLE	MICRON	CALORIMETER	VERNIER	ELASTANCE	GALVANOMETER	MENISCUS	PARACHOR	BIAS TOTAL
*	(3)	(3)	(3)	(2)	(2)	(2)	(1)	(1)	(1)	(0)	(0)	(0)	
1	-1	+1	+1	0	0	+1	0	0	0	0	0	0	+2
2	0	-1	0	-1	-1	0	0	0	0	+1	0	0	-2
3	-2	-1	+1	0	0	-1	0	0	0	0	+1	0	-2
4	0	0	0	0	-1	-1	-1	0	0	0	0	0	-3
5	0	0	+1	+1	+1	+1	+1	0	+1	0	0	+1	+7
6	-1	-2	0	-1	0	-1	0	0	0	+1	0	0	-4
7	+1	+1	0	0	-1	-1	0	0	0	+1	+1	+1	+3
8	0	-1	0	0	+1	-1	0	0	0	+1	0	0	0
9	0	0	0	+1	+1	-1	0	0	0	0	0	0	+1
10	0	-2	+1	+1	+1	0	0	0	0	0	0	0	+1
11	-1	0	0	+1	0	+1	+1	0	0	+1	0	0	+3
12	-1	0	-1	0	0	-1	0	0	0	+1	0	+1	-1
13	-1	0	+1	-1	0	-2	-1	0	-1	0	0	0	-5
14	0	0	+1	+2	0	+1	+1	0	0	+1	+1	0	+7
15	0	+1	0	0	0	+1	-1	-1	-1	0	0	0	-1
16	0	-1	0	+1	0	0	0	+1	0	+1	0	0	+2
													+8

* No. of appearances.

APPENDIX XXXIV (Contd)

LIST D: BIAS ON

Ss	3's	2's	1's	0's
1	+1	+1	0	0
2	-1	-2	0	+1
3	-2	-1	0	+1
4	0	-2	-1	+1
5	+1	+3	+2	+1
6	-3	-2	0	+1
7	+2	-2	0	+3
8	-1	0	0	+1
9	0	+1	0	0
10	-1	+2	0	0
11	-1	+2	+1	+1
12	-2	-1	0	+2
13	0	-3	-2	0
14	+1	+3	+1	+2
15	+1	+1	-3	0
16	-1	+1	+1	+1
TOTALS	-6	+1	-1	+15

APPENDIX XXXV

LIST A: THE DEGREE OF SURETY ON THE CORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS.

(All Physics Words)

(N = 16)

Ss	3 (a)	2 (b)	1 (c)	0 (d)	$\bar{x}$	S.D.
1	8	4	12	8	8.0	3.266
2	4	6	8	4	5.5	1.915
3	2	4	6	2	3.5	1.915
4	12	8	6	8	8.5	2.517
5	8	8	10	6	8.0	1.633
6	12	10	10	6	9.5	2.571
7	12	2	2	10	6.5	5.260
8	12	2	8	8	7.5	4.123
9	6	6	12	6	7.5	3.00
10	8	0	8	0	4.0	4.619
11	4	4	10	10	7.0	3.464
12	6	0	12	8	6.5	5.0
13	4	2	10	4	5.0	3.464
14	2	12	12	6	8.0	4.899
15	8	6	12	4	7.5	3.416
16	8	8	12	8	9.0	2.0
TOTAL	116	82	150	98		
$\bar{x}$	7.25	5.125	9.375	6.125		
S.D.	3.493	3.50	2.895	2.778		

$F(3,45) = 5.55^{**}$ (a, b, c, d)

APPENDIX XXXV (Contd)

LIST B: THE DEGREE OF SURETY ON THE CORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS.
(All English Words)

	3	2	1	0	$\bar{x}$	S.D.
Ss	(a)	(b)	(c)	(d)		
1	4	4	0	10	4.5	4.123
2	4	6	10	8	7.0	2.582
3	12	2	10	8	8.0	4.321
4	10	12	10	4	9.0	3.464
5	8	4	8	8	7.0	2.00
6	12	12	8	8	10.0	2.309
7	12	8	4	8	8.0	3.266
8	10	2	6	10	7.0	3.830
9	10	6	8	10	8.5	1.915
10	4	6	8	12	7.5	3.416
11	12	2	8	6	7.0	4.163
12	12	12	8	2	8.5	4.726
13	12	10	12	12	11.5	1.00
14	8	2	4	6	5.0	2.582
15	8	6	0	2	4.0	3.652
16	6	4	6	12	7.0	3.464
TOTAL	144	98	110	126		
$\bar{x}$	9.0	6.125	6.875	7.875		
S.D.	3.0984	3.6856	3.430	3.222		

$F(3,45)$ ratio between a.b.c.d. = 2.455 n.s.

APPENDIX XXXV (Contd)

LIST C: THE DEGREE OF SURETY ON THE CORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS.

	3	2	1	0	$\bar{x}$	S.D.
Ss	(a)	(b)	(c)	(d)		
1	4	4	8	8	6.0	2.309
2	6	2	2	12	5.5	4.726
3	2	10	4	8	6.0	3.651
4	2	10	8	4	6.0	3.651
5	0	8	8	8	6.0	4.0
6	10	0	4	8	5.5	4.435
7	2	8	12	8	7.5	4.123
8	6	4	2	10	5.5	3.416
9	12	6	4	6	7.0	3.464
10	8	6	2	0	4.0	3.652
11	4	2	0	6	3.0	2.582
12	2	2	2	10	4.0	4.0
13	6	2	4	12	6.0	4.321
14	6	6	0	4	4.0	2.828
15	0	6	8	12	6.5	5.00
16	2	6	10	8	6.5	3.416
TOTAL	72	82	78	124		
$\bar{x}$	4.5	5.125	4.875	7.75		
S.D.	3.464	3.008	3.649	3.256		

$F(3,45) = 2.67$ n.s.

APPENDIX XXXV (Contd)

LIST D: THE DEGREE OF SURETY ON THE CORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS.

Ss	3 (a)	2 (b)	1 (c)	0 (d)	$\bar{x}$	S.D.
1	0	4	8	10	5.5	4.435
2	8	2	12	6	7.0	4.163
3	0	4	10	8	5.5	4.435
4	10	4	8	12	8.5	3.416
5	2	0	4	8	3.5	3.416
6	4	2	10	2	4.5	3.786
7	4	2	4	0	2.5	1.915
8	8	0	8	2	4.5	4.12311
9	6	0	2	4	3.0	2.582
10	2	0	12	4	4.5	4.0
11	4	2	8	8	5.5	3.0
12	2	4	10	0	4.0	4.321
13	4	4	4	12	6.0	4.0
14	4	2	8	4	4.5	2.517
15	6	8	0	12	6.5	5.0
16	8	4	8	8	7.0	2.0
TOTAL	72	42	116	100		
$\bar{x}$	4.75	2.625	6.626	6.25		
S.D.	2.9098	2.156	3.481	4.123		

$F(3,45) = 5.1186$ (a.b.c.d.)

(c) significantly higher than (a) and (b)

APPENDIX XXXVI

LIST A: THE DEGREE OF SURETY OF THE INCORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS

	3	2	1	0
Ss	(e)	(f)	(g)	(h)
1	4	4	0	4
2	4	4	4	4
3	8	2	2	4
4	0	0	0	0
5	2	0	0	4
6	0	0	0	0
7	0	6	6	0
8	0	4	0	0
9	4	4	0	4
10	0	6	0	4
11	8	8	0	0
12	2	6	0	2
13	4	8	0	2
14	8	0	0	2
15	2	4	0	0
16	2	0	0	0
TOTAL	48	56	12	30
$\bar{x}$	3.00	3.5	0.75	1.875
S.D.	2.922	2.875	1.770	1.857

APPENDIX XXXVI (Contd)

LIST B: THE DEGREE OF SURETY OF THE INCORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS

	3	2	1	0
Ss	(e)	(f)	(g)	(h)
1	8	6	10	0
2	4	0	0	2
3	0	6	0	0
4	0	0	0	0
5	0	2	0	4
6	0	0	2	0
7	0	4	4	2
8	0	8	2	0
9	0	4	2	0
10	8	2	2	0
11	0	4	0	0
12	0	0	0	4
13	0	0	0	0
14	2	0	0	0
15	2	0	2	2
16	2	4	2	0
TOTAL	26	40	25	14
$\bar{x}$	1.625	2.5	1.625	0.875
S.D.	2.754	2.683	2.553	1.455

APPENDIX XXXVI (Contd)

LIST C: THE DEGREE OF SURETY OF THE INCORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS

	3	2	1	0
Ss	(e)	(f)	(g)	(h)
1	4	2	4	0
2	2	4	4	0
3	8	0	4	0
4	6	0	2	4
5	4	2	0	4
6	0	8	8	0
7	8	0	0	2
8	0	4	2	0
9	0	0	2	0
10	2	4	4	8
11	4	0	6	2
12	6	8	4	0
13	0	6	4	0
14	4	4	4	4
15	12	2	2	0
16	4	2	0	4
TOTAL	64	44	50	28
$\bar{x}$	4.00	2.875	3.125	1.75
S.D.	3.425	2.730	2.187	2.408

APPENDIX XXXVI (Contd)

LIST D: THE DEGREE OF SURETY OF THE INCORRECT RESPONSES AS A FUNCTION OF THE NUMBER OF REPETITIONS

	3	2	1	0
Ss	(e)	(f)	(g)	(h)
1	8	2	0	0
2	4	6	0	0
3	8	4	0	4
4	0	6	4	0
5	4	4	2	4
6	6	4	0	2
7	8	8	0	4
8	2	4	0	2
9	0	6	0	0
10	6	4	0	0
11	2	4	0	0
12	4	4	0	4
13	6	6	4	0
14	2	4	2	4
15	2	2	12	0
16	0	2	2	0
TOTAL	62	70	26	24
$\bar{x}$	3.875	4.375	1.625	1.5
S.D.	2.873	1.668	3.117	1.862

APPENDIX XXXVII

THE OVER AND UNDER ESTIMATION OF THE WORDS ON LIST A

Ss	(i) 3's	(ii) 2's	(iii) 1's	(iv) 0's	
1	-1	+1	0	+1	
2	0	+1	+1	0	
3	-3	-1	-1	0	
4	0	0	0	0	
5	-2	0	0	+1	
6	0	0	0	-1	
7	0	+2	0	0	
8	0	+1	+1	0	
9	-1	+1	0	+1	
10	-1	0	0	0	
11	-2	-2	0	0	
12	+1	-1	0	+1	
13	-4	-2	0	+1	
14	-1	0	0	+1	
15	-1	-1	0	+1	
16	+1	0	0	0	
	-14	-1	+1	+9	TOTAL
	-0.875	-0.063	+0.063	+0.375	$\bar{x}$

$F(3,45) = 5.860$, Significant 1% level

(i) c.f. (iii) Significant 5%,

(i) c.f. (iv) Significant 1% level.

APPENDIX XXXVII (Contd)

THE OVER AND UNDER ESTIMATION
OF THE WORDS ON LIST B

	(v)	(vi)	(vii)	(viii)	
Ss	3's	2's	1's	0's	
1	0	+2	+1	0	
2	-3	0	0	+1	
3	0	0	0	0	
4	0	0	0	0	
5	0	+1	0	+1	
6	0	0	-1	0	
7	0	+1	0	+1	
8	0	0	-1	0	
9	0	+1	-1	0	
10	-2	+1	+1	0	
11	0	+2	0	+1	
12	0	0	0	+2	
13	0	0	0	0	
14	-1	-1	0	+1	
15	-1	0	+1	+2	
16	-2	-3	-1	0	
	-9	+4	-1	+9	TOTAL
	-0.563	+0.25	-0.063	+0.563	$\bar{x}$

$F(3,45) = 5.397$, Significant 1% level.

3 appearances under-estimated c.f. 0 :

($F(3,45) = 4.95$, 1% level.

APPENDIX XXXVII (Contd)

THE OVER AND UNDER ESTIMATION OF THE WORDS ON LIST C

	(ix)	(x)	(xi)	(xii)	
Ss	3's	2's	1's	0's	
1	-2	+1	-1	0	
2	-2	0	+2	0	
3	-2	0	+1	0	
4	+2	0	+1	+2	
5	+1	+1	-1	+1	
6	0	+5	0	0	
7	-2	0	0	+1	
8	0	+1	0	0	
9	0	0	+1	+1	
10	-1	+1	+2	+4	
11	-2	0	-1	+1	
12	-2	-3	-2	0	
13	0	0	+2	0	
14	-3	-1	+3	+5	
15	-3	+1	+1	0	
16	0	+1	0	+1	
	-16	+7	+8	+16	TOTAL
	-1.0	+0.438	+0.50	+1.0	$\bar{x}$

THE OVER AND UNDER ESTIMATION

OF THE WORDS ON LIST D

	(xiii)	(xiv)	(xv)	(xvi)	
Ss	3's	2's	1's	0's	
1	+1	2's	0	0	
2	-1	-2	0	+1	
3	-2	-1	0	+1	
4	0	-2	-1	+1	
5	+1	+3	+2	+1	
6	-3	-2	0	+1	
7	+2	-2	0	+3	
8	-1	0	0	+1	
9	0	+1	0	0	
10	-1	+2	0	0	
11	-1	+2	+1	+1	
12	-2	-1	0	+2	
13	0	-3	-2	0	
14	+1	+3	+1	+2	
15	+1	+1	-3	0	
16	-1	+1	+1	+1	
	-6	+1	-1	+15	TOTAL
	-0.375	+0.063	-0.063	+0.938	$\overline{x}$

APPENDIX XXXV111

ANALYSIS OF VARIANCE SUMMARY:
LIST A, DEGREE OF SURETY ON CORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Repetitions
7.25	5.125	9.375	6.125	

Treatment Sdevs

3.49285	3.5	2.8954	2.77789

Newman-Keuls Root N*MS(Residual) Statistic
12.3837

Sums of Squares: Between S 176.937 DF 15
Mean Sums of Sqrs: Between S 11.7958

Sums of Squares: Within S 591 DF 48
Mean Sums of Squrs: Within S 12.3125

Sums of Squares: Treatment 159.687 DF 3
Mean Sums of Squrs: Treatment 53.2292

Sums of Squares: Residual 431.312 DF 45
Mean Sums of Squrs: Residual 9.58472

F Ratio: 5.55354 DF 3 , 45 significant 1% level.

SCHEFFE COMPARISONS

Means for comparison
7.25, 5.125
Number for each mean
1. 16,16
F Ratio 1.25634 DF 3 , 45

Means for comparison
7.25, 9.375
Number for each mean
2. 16,16
F Ratio 1.25634 DF 3 , 45

Means for comparison
7.25, 6.125
Number for each mean
3. 16,16
F Ratio .352123 DF 3 , 45

APPENDIX XXXV111 (Contd)

SCHEFFE COMPARISONS

4. Means for comparison
5.125, 9.375
Number for each mean
16,16
F Ratio 5.02536 DF 3 , 45

5. Means for comparison
7.25, 9.375
Number for each mean
16,16
F Ratio 1.25634 DF 3 , 45

6. Means for comparison
7.25, 5,125
Number for each mean
16,16
F Ratio 1.25634 DF 3 , 45

7. Means for comparison
5.125, 6.125
Number for each mean
16,16
F Ratio .278221 DF 3 , 45

8. Means for comparison
6.125, 9.375
Number for each mean
16,16
F Ratio 2.9387 DF 3 , 45

Where $F(3,45) = 4.24$ 1% level (2-tailed)

$F(3,45) = 2.81$ 5% level (2-tailed)

APPENDIX XXXV111 (Contd)

ANALYSIS OF VARIANCE SUMMARY:

LIST B, DEGREE OF SURETY ON CORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Repetitions
9.0	6.125	6.875	7.875	

Treatment Sdevs

3.09839	3.68556	3,42296	3.22232

Newman-Keuls Root N*MS(Residual) Statistic

12.7375

Sums of Squares:	Between S	222.937	DF 15
Mean Sums of Sqrs:	Between S	14.8625	
Sums of Squares:	Within S	531	DF 48
Mean Sums of Sqrs:	Within S	11.0625	
Sums of Squares:	Treatment	74.6875	DF 3
Mean Sums of Sqrs:	Treatment	24.8958	
Sums of Squares:	Residual	456.312	DF 45
Mean Sums of Sqrs:	Residual	10.1403	

F Ratio: 2.45514 DF 3 , 45 not significant.

SCHEFFE COMPARISONS

1. Means for comparison
9, 6.125
Number for each mean
16,16
F Ratio 2.17367 DF 3 , 45

2. Means for comparison
9, 6.875
Number for each mean
16,16
F Ratio 1.18751 DF 3 , 45

3. Means for comparison
9, 7.875
Number for each mean
16,16
F Ratio .332831 DF 3 , 45

4. Means for comparison
6.125, 7.875
Number for each mean
16,16
F Ratio .805369 DF 3 , 45

APPENDIX XXXVIII (Contd)

ANALYSIS OF VARIANCE SUMMARY:

LIST C, DEGREE OF SURETY ON CORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Repetitions
4.5	5.125	4.875	7.75	

Treatment Sdevs

3.4641	3.00832	3.6492	3.25576

Newman-Keuls Root N*MS (Residual) Statistic

14.4191

Sums of Squares:	Between S	89.75	DF 15
Mean Sums of Sqrs:	Between S	5.98333	
Sums of Squares:	Within S	690	DF 48
Mean Sums of Sqrs:	Within S	14.375	
Sums of Squares:	Treatment	105.25	DF 3
Mean Sums of Sqrs:	Treatment	35.0833	
Sums of Squares:	Residual	584.75	DF 45
Mean Sums of Sqrs:	Residual	12.9944	

F Ratio: 2.69987 DF 3 , 45 n.s.

SCHEFFE COMPARISONS

1. Means for comparison
4.5, 7.75
Number for each mean
16,16
F Ratio 2.16759 DF 3 , 45

2. Means for comparison
4.875, 7.75
Number for each mean
16,16
F. Ratio 1.69624 DF 3 , 45

3. Means for comparison
5.125, 7.75
Number for each mean
16,16
F Ratio 1.41407 DF 3 , 45

4. Means for comparison
4,5, 5.125
Number for each mean
16,16
F Ratio 0.0801 DF 3 , 45

APPENDIX XXXVIII (Contd)

ANALYSIS OF VARIANCE SUMMARY:

LIST D, DEGREE OF SURETY ON CORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Repetitions
4.75	2.625	6.625	6.25	

Treatment Sdevs

2.90975	2.15639	3.4809	4,12311

Newman-Keuls Root N*MS(Residual) Statistic

12.8409

Sums of Squares:	Between S	169.75	DF 15
Mean Sums of Sqrs:	Between S	11.3167	
Sums of Squares:	Within S	622	DF 48
Mean Sums of Sqrs:	Within S	12.9583	
Sums of Squares:	Treatment	158.25	DF 3
Mean Sums of Sqrs:	Treatment	52.75	
Sums of Squares:	Residual	463.75	DF 45
Mean Sums of Sqrs:	Residual	10.3056	

F Ratio: 5.1186 DF 3 , 45 Significant 1% level.

SCHEFFE COMPARISONS

1. Means for comparison
4.75, 2.625
Number for each mean
16,16
F Ratio 1.16846 DF 3 , 45

2. Means for comparison
4.75, 6.625
Number for each mean
16,16
F Ratio .909703 DF 3 , 45

3. Means for comparison
2.625, 6.625
Number for each mean
16,16
F Ratio 4.14016 DF 3 , 45

4. Means for comparison
2.625, 6.25
Number for each mean
16,16
F Ratio 3.40027 DF 3 , 45

APPENDIX XXXIX

ANALYSIS OF VARIANCE SUMMARY:
LIST A, DEGREE OF SURETY ON
INCORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Appearances
3	3.5	.75	1.875	

Treatment Sdevs

2.92119 2.87518 1.77012 1.85742

Newman-Keuls Root N*MS(Residual) Statistic

9.17606

Sums of Squares:	Between S	113.937	DF	15
Mean Sums of Sqrs:	Between S	7.59583		
Sums of Squares:	Within S	309	DF	48
Mean Sums of Sqrs:	Within S	6.4375		
Sums of Squares:	Treatment	72.1875	DF	3
Mean Sums of Sqrs:	Treatment	24.0625		
Sums of Squares:	Residual	236.812	DF	45
Mean Sums of Sqrs:	Residual	5.2625		

F Ratio: 4.57245 DF 3 , 45
Significant, 1% level (2-tailed)

SCHEFFE COMPARISONS

1. Means for comparison
3, 3.5
Number for each mean
16,16
F. Ratio .126682 DF 3 , 45 n.s.

2. Means for comparison
3, .75
Number for each mean
16,16
F Ratio 2.56532 DF 3 , 45 n.s.

SCHEFFE COMPARISONS

3.	Means for comparison 3, 1.875 Number for each mean 16,16 F Ratio .64133	DF 3 , 45	n.s.
4.	Means for comparison 3.5, .75 Number for each mean 16,16 F Ratio 3.83215*	DF 3 , 45	
5.	Means for comparison 3.5, 1.875 Number for each mean 16, 16 F Ratio 1.33808	DF 3 , 45	n.s.
6.	Means for comparison .75, 1.875 Number for each mean 16,16 F Ratio .64133	DF 3 , 45	n.s.

APPENDIX XXXIX (Contd)

ANALYSIS OF VARIANCE SUMMARY:
LIST B, DEGREE OF SURETY ON
INCORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Appearances
1.625	2.5	1.625	.875	

Treatment Sdevs

2.75379	2.68328	2.55278	1.45488

Newman-Keuls Root N*MS(Residual) Statistic

8.96041

Sums of Squares:	Between S	125.437	DF 15
Mean Sums of Sqrs:	Between S	8.3625	
Sums of Squares:	Within S	247	DF 48
Mean Sums of Sqrs:	Within S	5.14583	
Sums of Squares:	Treatment	21.1875	DF 3
Mean Sums of Sqrs:	Treatment	7.0625	
Sums of Squares:	Residual	225.812	DF 45
Mean Sums of Sqrs:	Residual	5.01806	

F Ratio: 1.40742 DF 3 , 45 n.s.

SCHEFFE COMPARISONS

1. Means for comparison
   2.5, .875
   Number for each mean
   16,16
   F Ratio 1.40327 DF 3 , 45 n.s.

2. Means for comparison
   1.625, 2.5
   Number for each mean
   16,16
   F Ratio .406864 DF 3 , 45 n.s.

3. Means for comparison
   1.625, .875
   Number for each mean
   16,16
   F Ratio .298921 DF 3 , 45 n.s.

ANALYSIS OF VARIANCE SUMMARY: LIST C, DEGREE OF SURETY ON INCORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Appearances
4	2.875	3.125	1.75	

Treatment Sdevs

3.4254	2.72947	2.18708	2.40832

Newman-Keuls Root N*MS(Residual) Statistic

11.5739

Sums of Squares:	Between S 69.75	DF 15	
Mean Sums of Sqrs:	Between S 4.65		
Sums of Squares:	Within S 418	DF 48	
Mean Sums of Sqrs:	Within S 8.70833		
Sums of Squares:	Treatment 41.25	DF 3	
Mean Sums of Sqrs:	Treatment 13.75		
Sums of Squares:	Residual 376.75	DF 45	
Mean Sums of Sqrs:	Residual 8.37222		

F Ratio: 1.64234   DF 3 , 45 n.s.

SCHEFFE COMPARISONS

1. Means for comparison
   4, 1.75
   Number for each mean
   16,16
   F Ratio 1.61247   DF 3 , 45 n.s.

2. Means for comparison
   4, 3.125
   Number for each mean
   16,16
   F Ratio .243862   DF 3 , 45 n.s.

APPENDIX XXXIX (Contd)

SCHEFFE COMPARISONS

Means for comparison
4, 2.875
3. Number for each mean
16,16
F Ratio .403119 DF 3 , 45 n.s.

Means for comparison
3.125, 1.75
4. Number for each mean
16,16
F Ratio .60219 DF 3 , 45 n.s.

APPENDIX XXXIX (Contd)

ANALYSIS OF VARIANCE SUMMARY:
LIST D, DEGREE OF SURETY ON
INCORRECT RESPONSES

TREATMENT MEANS

3	2	1	0	Appearances
3.875	4.375	1.625	1.5	

Treatment Sdevs

2.87228	1.66833	3.11716	1.8619

Newman-Keuls Root N*MS(Residual) statistic
10.2209

Sums of Squares:	Between S	69.4375	DF 15
Mean Sums of Sqrs:	Between S	4.62917	
Sums of Squares:	Within S	401	DF 48
Mean Sums of Sqrs:	Within S	8.35417	
Sums of Squares:	Treatment	107.187	DF 3
Mean Sums of Sqrs:	Treatment	35.7292	
Sums of Squares:	Residual	293.812	DF 45
Mean Sums of Sqrs:	Residual	6.52917	

F Ratio: 5.47224** DF 3 , 45
Significant 1% level

SCHEFFE COMPARISONS

1. Means for comparison
3.875, 4.375
Number for each mean
16,16
F Ratio .102106 DF 3 , 45 n.s.

2. Means for comparison
3.875, 1.625
Number for each mean
16,16
F Ratio 2.06765 DF 3 , 45 n.s.

APPENDIX XXXIX (Contd)

SCHEFFE COMPARISONS

3. Means for comparison
3.875, 1.5
Number for each mean
16,16
F Ratio 2.30377 DF 3 , 45 n.s.

4. Means for comparison
4.375, 1.625
Number for each mean
4.375, 1.5
F Ratio .431269 DF 3 , 45 n.s.

5. Means for comparison
4.375, 1.5 (2 c.f. 0)
Number for each mean
16,16
F Ratio 3.37588 DF 3 , 45

6. Means for comparison
4.375, 1.625 (2 c.f. 1)
Number for each mean
16,16
F Ratio 3.08871 DF 3 , 45

APPENDIX XL

MEAN SURETY VALUES:
LISTS A, B, C AND D
CORRECT AND INCORRECT

	CORRECT					INCORRECT			
Ss	A	B	C	D		A′	B′	C′	D′
1	3.56	3.60	2.00	2.75	1	4.00	3.43	2.50	2.50
2	3.67	3.11	3.14	3.50	2	2.67	2.00	2.00	2.50
3	2.00	3.20	3.00	3.13	3	3.20	3.00	3.00	3.20
4	2.83	3.00	3.43	3.78	4	0.00	0.00	2.40	3.33
5	3.20	2.80	4.00	2.33	5	3.00	3.00	1.67	2.33
6	3.64	3.63	3.14	2.26	6	0.00	2.00	3.20	2.40
7	3.25	4.00	3.33	2.00	7	3.00	2.50	3.33	2.86
8	3.00	3.11	2.75	2.25	8	2.00	3.33	1.50	2.00
9	3.33	3.40	2.80	2.44	9	4.00	3.00	1.00	2.00
10	3.00	3.75	3.20	2.25	10	1.67	3.00	2.57	2.50
11	3.50	3.11	1.71	2.86	11	4.00	1.33	2.40	1.20
12	3.71	3.40	2.67	2.26	12	2.00	2.00	3.00	2.40
13	2.86	3.83	3.00	4.00	13	2.80	0.00	2.50	2.67
14	3.56	2.50	3.20	3.00	14	3.33	0.50	2.29	2.00
15	3.33	2.00	3.71	3.71	15	2.00	1.50	3.20	3.20
16	3.27	3.50	3.25	3.50	16	2.00	2.00	2.50	1.00
$\bar{x}$	3.23	3.246	3.021	2.876	$\bar{x}$	2.48	2.037	2.441	2.381
S.D.	0.434	0.515	0.569	0.656	S.D.	1.231	1.125	0.652	0.650
	ANOVAR $F(3,60) = 1.68$ n.s.					$F(3,60) = 0.724$ n.s.			

APPENDIX XL1

ANALYSIS OF VARIANCE:
DEGREE OF SURETY ON THREE APPEARANCES, CORRECT RESPONSES.

Sums of Squares:	Between 234.75	DF 3
Mean Sums of Sqrs:	Between 78.25	
Sums of Squares:	Within 639	DF 60
Mean Sums of Sqrs:	Within 10.65	

F Ratio 7.34742 DF 3 , 60
Significant at the 1% level.

SCHEFFE COMPARISONS

1. Two Means for comparison
   7.25, 9 (List A c.f. List B)
   Number for each mean
   16,16
   F Ratio .766823 DF 3 , 60 n.s.

2. Two means for comparison
   7.25, 4.5 (List A c.f. List C)
   Number for each mean
   16,16
   F. Ratio 1.89358 DF 3 , 60 n.s.

3. Two means for comparison
   9, 4.5 (List B c.f. List C)
   Number for each mean
   16,16
   F ratio 5.07042 DF 3 , 60

(List B c.f. List C) 1% level

Two Means for Comparison

9.00, 4.75

$t(30) = 3.86^{**}$ (1% level, 2-tailed)

APPENDIX XLI (Contd)

ANALYSIS OF VARIANCE:
DEGREE OF SURETY ON TWO APPEARANCES,
CORRECT RESPONSES.

Sums of Squares: Between 107 DF 3
Mean Sums of Sqrs: Between 35.6667

Sums of Squares: Within 593 DF 60
Mean Sums of Sqrs: Within 9.88333

F Ratio 3.60877 DF 3 , 60

Significant at the 5% level

SCHEFFE COMPARISONS

1. Two means for comparison
5.125, 6.125 (List A c.f. List B)
Number for each mean
16,16
F. Ratio .269814 DF 3 , 60 n.s.

2. Two means for comparison
5.125, 2.625 (List A c.f. List D)
Number for each mean
16,16
F Ratio 1.68634 DF 3 , 60 n.s.

3. Two means for comparison
6.125, 2.625 (List B c.f. List D)
Number for each mean
16,16
F Ratio 3.30523 DF 3 , 60
(List B c.f. List D)

Significant at the 5% level

APPENDIX XLI (Contd)

ANALYSIS OF VARIANCE:

DEGREE OF SURETY ON ONE APPEARANCE,

LISTS A, B, C, D.

CORRECT RESPONSES

Sums of Squares: Between 163.187 DF 3
Mean sums of sqrs: Between 54.3958

Sums of Squares: Within 684.25 DF 60
Mean Sums of Sqrs: Within 11.4042

F Ratio 4.76982 DF 3 , 60

Significant at the 1% level

SCHEFFE COMPARISONS

1. Two means for comparison
9.375,6.9-875
Number for each mean
16,16
F Ratio 1.46145 DF 3 , 60 n.s.

2. Two means for comparison
9.375, 4.875
Number for each mean
16,16
F Ratio 4.73511 DF 3 , 60
(List A c.f. List C)

3. Two means for comparison
9.375, 7.25 (List A c.f. List D)
Number for each mean
16,16
F Ratio 1.0559 DF 3 , 60 n.s.

4. Two means for comparison
6.875, 4.875 (List B c.f. List C)
Number for each mean
16,16
F Ratio .935331 DF 3 , 60 n.s.

5. Two means for comparison
4.875, 7.25 (List C c.f. List D)
Number for each mean
16,16
F Ratio 1.31896 DF 3 , 60 n.s.

APPENDIX XLI (Contd)

ANALYSIS OF VARIANCE:
LISTS A, B, C, D: DEGREE OF SURETY
ON '0' REPETITION CONDITION
CORRECT RESPONSES.

Sums of Squares: Between 42.5 DF 3
Mean sums of Sqrs: Between 14.1667

Sums of Squares: Within 685.5 DF 60
Mean Sums of Sqrs: Within 11.425

F Ratio 1.23997 DF 3 , 60 n.s.

SCHEFFE COMPARISONS

Two Means for comparison
6.125, 7.875 (List A c.f. List B)
Number for each mean
16,16
F Ratio .714807 DF 3 , 60 n.s.

APPENDIX XL11

ANALYSIS OF VARIANCE: DEGREE OF SURETY ON THE INCORRECT: THREE APPEARANCES OF THE CRITICAL WORDS.

Sums of Squares:	Between 57.5	DF 3
Mean Sums of Sqrs:	Between 19.1667	
Sums of Squares:	Within 541.5	DF 60
Mean Sums of Sqrs:	Within 9.025	

F Ratio 2.12373 DF 3 , 60 n.s.

SCHEFFE COMPARISONS

1. Two means for comparison
4, 1.625 (List C c.f. List B)
Number of each mean
16,16
F Ratio 1.66667 DF 3 , 60 n.s.

2. Two means for comparison
3.875, 1.625 (List D c.f. List B)
Number for each mean
16,16
F Ratio 1.49584 DF 3 , 60 n.s.

3. Two means for comparison
3, 1.625 (List A c.f. List B)
Number for each mean
16,16
F Ratio .558633 DF 3 , 60 n.s.

APPENDIX XLII (Contd)

ANALYSIS OF VARIANCE:
DEGREE OF SURETY ON THE INCORRECT:
TWO APPEARANCES OF THE CRITICAL WORDS.

Sums of Squares:	Between 32.25	DF	3
Mean sums of Sqrs:	Between 10.75		

Sums of Squares:	Within 385.5	DF	60
Mean sums of Sqrs:	Within 6.425		

F Ratio 1.67315 DF 3 , 60 n.s.

SCHEFFE COMPARISONS

Two means for comparison
2.5, 4.375 (List B c.f. List D)
1. Number for each mean
16,16
F Ratio 1.45914 DF 3 , 60 n.s.

Two means for comparison
2.875, 4.375
2. Number for each mean
16,16
F. Ratio .933852 DF 3 , 60 n.s.

APPENDIX XLII (Contd)

ANALYSIS OF VARIANCE:
DEGREE OF SURETY ON THE INCORRECT:
ONE APPEARANCE OF THE CRITICAL WORDS.

Sums of Squares:	Between 46.6875	DF 3
Mean sums of Sqrs:	Between 15.5625	
Sums of Squares:	Within 362.25	DF 60
Mean sums of Sqrs:	Within 6.0375	

F Ratio 2.57764 DF 3 , 60 n.s.

SCHEFFE COMPARISONS

1. Two means for comparison
.75, 3.125
Number for each mean
16,16
F Ratio 2.49137 DF 3 , 60 n.s.

2. Two means for comparison
1.625, 3.125
Number for each mean
16,16
F Ratio .993789 DF 3 , 60 n.s.

3. Two means for comparison
.75, 1.625
Number for each mean
16,16
F Ratio .338164 DF 3 , 60 n.s.

APPENDIX XLII (Contd)

ANALYSIS OF VARIANCE:

DEGREE OF SURETY ON THE INCORRECT:

ZERO APPEARANCE OF THE CRITICAL WORDS.

Sums of Squares: Between 9.5 DF 3
Mean sums of Sqrs: Between 3.16667

Sums of Squares: Within 222.5 DF 60
Mean sums of Sqrs: Within 3.70833

F Ratio .853932 DF 3 , 60 n.s.

APPENDIX XL111

ANALYSIS OF VARIANCE SUMMARY:
OVER AND UNDERESTIMATION OF
THE WORDS ON LIST A

TREATMENT MEANS

3	2	1	0	Appearances
-.875	-6.25000E-02	6.25000E-02	.375	

Treatment Sdevs

1.36015	1.2361	.442531	.61939

Newman-Keuls Root N*MS(Residual) Statistic

3.52136

Sums of Squares:	Between S	20.5	DF 15
Mean Sums of Sqrs:	Between S	1.36667	
Sums of Squares:	Within S	48.5	DF 48
Mean Sums of Sqrs:	Within S	1.01042	
Sums of Squares:	Treatment	13.625	DF 3
Mean Sums of Sqrs:	Treatment	4.54167	
Sums of Squares:	Residual	34.875	DF 45
Mean Sums of Sqrs:	Residual	.775	

F Ratio: 5.86022 DF 3 , 45

SCHEFFE COMPARISONS

1. Means for comparison
   -.875, -.0625
   Number for each mean
   16,16
   F Ratio 2.27151 DF 3 , 45 n.s.

2. Means for comparison
   -.875, .0625
   Number for each mean
   16,16
   F Ratio 3.02419 DF 3 , 45 Significant 5% level

APPENDIX XL111 (Contd)

SCHEFFE COMPARISONS

3.	Means for comparison -.875, .375 Number for each mean 16,16 F Ratio 5.37634	DF 3 , 45	Significant 1% level
4.	Means for comparison -.0625, .0625 Number for each mean 16,16 F Ratio 5.37634E-02	DF 3 , 45	n.s.
5.	Means for comparison -.0625, .375 Number for each mean 16,16 F Ratio .658602	DF 3 , 45	n.s.
6.	Means for comparison .0625, .375 Number for each mean 16,16 F Ratio .336022	DF 3 , 45	

APPENDIX XLIII (Contd)

ANALYSIS OF VARIANCE SUMMARY:
OVER AND UNDER ESTIMATION :
CRITICAL WORDS LIST B

TREATMENT MEANS

3	2	1	0	Appearances
-.5625	.25	-6.25000E-02	.5625	

Treatment Sdevs

3	2	1	0
.963933	1.18322	.680073	.727438

Newman-Keuls Root N*MS(Residual) Statistic

3.30404

Sums of Squares:	Between S	19.1094	DF 15
Mean Sums of Sqrs:	Between S	1.27396	
Sums of Squares:	Within S	41.75	DF 48
Mean Sums of Sqrs:	Within S	.869792	
Sums of Squares:	Treatment	11.0469	DF 3
Mean Sums of Sqrs:	Treatment	3.68229	
Sums of Squares:	Residual	30.7031	DF 45
Mean Sums of Sqrs:	Residual	.6822292	

F Ratio: 5.39695 DF 3 , 45

SCHEFFE COMPARISONS

1. Means for comparison
 -.5625, .25 (3 vs 2)
 Number for each mean
 16,16
 F Ratio 2.58015 DF 3 , 45 n.s.

2. Means for comparison
 -.5626, -.0625 (3 vs 1)
 Number for each mean
 16,16
 F Ratio .977099 DF 3 , 45 n.s.

APPENDIX XLIII (Contd)

SCHEFFE COMPARISONS

3. Means for comparison
-.5625, .5625 (3 vs 0)
Number for each mean
16,16
F Ratio 4.94656 DF 3 , 45
Significant 1% level

4. Means for comparison
.25, -.0625
Number for each mean
16,16
F Ratio .381679 DF 3 , 45 n.s.

5. Means for comparison
.25, .5625
Number for each mean
16,16
F Ratio .381679 DF 3 , 45 n.s.

6. Means for comparison
-.0625, .5625
Number for each mean
16,16
F Ratio 1.52672 DF 3 , 45 n.s.

APPENDIX XL111 (Contd)

ANALYSIS OF VARIANCE SUMMARY:
OVER AND UNDER ESTIMATION :
CRITICAL WORDS LIST C

TREATMENT MEANS

3	2	1	0	Appearances
-1	.4375	.5	1	

Treatment Sdevs

1.46059 1.59034 1.36626 1.50555

Newman-Keuls Root N*MS(Residual) Statistic

5.67891

Sums of Squares:	Between S	41.2344	DF 15
Mean Sums of Sqrs:	Between S	2.74896	
Sums of Squares:	Within S	126.25	DF 48
Mean Sums of Sqrs:	Within S	2.63021	
Sums of Squares:	Treatment	35.5469	DF 3
Mean Sums of Sqrs:	Treatment	11.849	
Sums of Squares:	Residual	90.7031	DF 45
Mean Sums of Sqrs:	Residual	2.01562	

F Ratio: 5.87855 DF 3 , 45

Significant at 1% level.

SCHEFFE COMPARISONS

Means for comparison
-1, .4375 (3 c.f. 2)
1. Number for each mean
16, 16
F Ratio 2.73385 DF 3 , 45 n.s.

Means for comparison
-1, .5 (3 c.f. 1)
2. Number for each mean
16, 16
F Ratio 2.97674 DF 3 , 45

Significant at 5% level

APPENDIX XLIII (Contd)

SCHEFFE COMPARISONS

3. Means for comparison
-1, 1 (3 c.f. 0)
Number for each mean
16, 16
F Ratio 5.29199 DF 3 , 45
Significant at 1% level

4. Means for comparison
.4375, .5 (2 c.f. 1)
Number for each mean
16, 16
F Ratio 0.005 DF 3 , 45 n.s.

5. Means for comparison
.4375, 1 (2 c.f. 0)
Number for each mean
16, 16
F Ratio .418605 DF 3 , 45

6. Means for comparison
5, 1 (1 c.f. 0)
Number for each mean
16, 16
F Ratio .330749 DF 3 , 45 n.s.

APPENDIX XL111 (Contd)

ANALYSIS OF VARIANCE SUMMARY :

OVER AND UNDER ESTIMATION :

CRITICAL WORDS LIST D

TREATMENT MEANS

3	2	1	0	Appearances
-.375	6.25000E-02	-6.250000E-02	.9375	

Treatment Sdevs

1.36015	1.94829	1.18145	.853913

Newman-Keuls Root N*MS(Residual) Statistic

5.07992

Sums of Squares:	Between S	43.9844	DF 15
Mean Sums of Sqrs:	Between S	2.93229	
Sums of Squares:	Within S	87.75	DF 48
Mean Sums of Sqrs:	Within S	1.82812	
Sums of Squares:	Treatment	15.1719	DF 3
Mean Sums of Sqrs:	Treatment	5.05729	
Sums of Squares:	Residual	72.5781	DF 45
Mean Sums of Sqrs:	Residual	1.61285	

F Ratio: 3.13563 DF 3 , 45

Significant at 5% level

SCHEFFE COMPARISONS

Means for comparison
-.375, .0625
1. Number for each mean
16, 16
F Ratio .316469 DF 3 , 45 n.s.

Means for comparison
-.375, -.0625
2. Number for each mean
16, 16
F Ratio .161464 DF 3 , 45 n.s.

APPENDIX XLIII (Contd)

SCHEFFE COMPARISONS

3. Means for comparison
.372, .9375
Number for each mean
16,16
F. Ratio .528738 DF 3 , 45 n.s.

4. Means for comparison
-.375, .9375 (3 c.f. 0)
Number for each mean
16, 16
F Ratio 2.84822 DF 3 , 45
Significant at 5% level

5. Means for comparison
.0625, -.0625
Number for each mean
16,16
F Ratio 0.0258 DF 3 , 45 n.s.

6. Means for comparison
.0625, .9375
Number for each mean
16, 16
F Ratio 1.26588 DF 3 , 45 n.s.

7. Means for comparison
-.0625, .9372
Number for each mean
16, 16
F Ratio 1.6524 DF 3 , 45 n.s.

APPENDIX XLIV

OVER AND UNDER-ESTIMATION (LISTS A, B, C AND D)

ANALYSIS OF VARIANCE:
FOR 3 APPEARANCES (CRITICAL WORDS)
LISTS A, B, C AND D.

Sums of Squares:	Between 3.42187	DF 3
Mean sums of Sqrs:	Between 1.14062	
Sums of Squares:	Within 96.6875	DF 60
Mean sums of Sqrs:	Within 1.61146	

F Ratio .707822 DF 3 , 60 n.s.

There is no significant difference = the performance on 3 appearances, all lists.

ANALYSIS OF VARIANCE:
FOR 2 APPEARANCES (CRITICAL WORDS)
LISTS A, B, C AND D.

Sums of Squares:	Between 2.29687	DF 3
Mean Sums of Sqrs:	Between .765625	
Sums of Squares:	Within 134.812	DF 60
Mean Sums of Sqrs:	Within 2.24687	

F Ratio .340751 DF 3 , 60 n.s.

ANALYSIS OF VARIANCE
FOR 1 APPEARANCE (CRITICAL WORDS)
LISTS A, B, C AND D

Sums of Squares:	Between 3.42187	DF 3
Mean Sums of Sqrs:	Between 1.14062	
Sums of Squares:	Within 58.8125	DF 60
Mean Sums of Sqrs:	Within .980208	

F Ratio 1.16366 DF 3 , 60 n.s.

ANALYSIS OF VARIANCE:
FOR ZERO APPEARANCE (CRITICAL WORDS)
LISTS A, B, C AND D

Sums of Squares:	Between 4.3125	DF 3
Mean Sums of Sqrs:	Between 1.4375	
Sums of Squares:	Within 58.625	DF 60
Mean Sums of Sqrs:	Within .977083	

F Ratio 1.47122 DF 3 , 60 n.s.

APPENDIX XLV

TABLE: The Four Lists for Experiment 11

LIST A:			LIST B:		
1 - 5	Filler Items		1 - 5	Filler Items	
6	COULOMB	(1)	6	COLUMN	(1)
7	TETRODE	(1)	7	TONIGHT	(1)
8	DIELECTRIC		8	PROTECTION	
9	MEGATRON		9	HEALTH	
10	CALCITE		10	EXAMPLE	
11	MICRON	(1)	11	MIRROR	(1)
12	DIPOLE	(1)	12	DINNER	(1)
13	VERNIER	(0)	13	VILLAGE	(0)
14	SECANT	(1)	14	SECOND	(1)
15	DYNATRON		15	DIFFERENCE	
16	COULOMB	(2)	16	COLUMN	(2)
17	SOLENOID		17	REASON	
18	TETRODE	(2)	18	TONIGHT	(2)
19	RHEOSTAT		19	OPINION	
20	CALORIMETER	(0)	20	CREATURE	(0)
21	SECANT	(2)	21	SECOND	(2)
22	RESONANCE		22	CIRCUMSTANCE	
23	CATHODE	(1)	23	CAPTAIN	(1)
24	ADIACTINIC		24	GOVERNMENT	
25	MAGNETRON		25	POSSIBILITY	
26	CATHODE	(2)	26	CAPTAIN	(2)

APPENDIX XLV (Contd)

TABLE: The Four Lists for Experiment 11.

LIST A:			LIST B:		
27	AUTOCLAVE		27	INSTITUTION	
28	MICRON	(2)	28	MIRROR	(2)
29	COULOMB	(3)	29	COLUMN	(3)
30	SECANT	(3)	30	SECOND	(3)
31	ELASTANCE	(0)	31	INSTANCE	(0)
32	TETRODE		32	TONIGHT	(3)
33	BEVATRON		33	NONE	
34	DIAMAGNETISM		34	THOUSAND	
35	DIPOLE	(2)	35	DINNER	(2)
36	VISCOSITY		36	INDUSTRY	
37	TENSOR		37	OBSERVATION	
38 - 42 Filler Items			38 - 42 Filler Items		

O: the critical word appears once only.

(1). (2). (3): the first, second and third appearance of the critical word preceding the numeral. The total number of appearances for the critical words (and their positions) appear in Table

APPENDIX XLVI

ORDER OF ACCURACY OF THE CRITICAL WORDS

(a) List A : Order of Accuracy

				No. of Appearances
1	1 =	CALORIMETER	(15)	(1)
2	1 =	MENISCUS	(15)	(0)
3	3 =	COULOMB	(14)	(3)
4	3 =	VERNIER	(14)	(1)
5	3 =	ELASTANCE	(14)	(1)
6	6 =	PARACHOR	(13)	(0)
7	7 =	CATHODE	(11)	(2)
8	7 =	DIPOLE	(11)	(2)
9	9 =	SECANT	(9)	(3)
10	9 =	MICRON	(9)	(2)
11	11 =	TETRODE	(8)	(3)
12	12	GALVANOMETER	(2)	(0)

APPENDIX XLV1 (Contd)

(b) List B : Order of Accuracy

				No. of Appearances
1	1 =	COLUMN	(15)	(3)
2	1 =	GRANULAR	(15)	(0)
3	3 =	PARABLE	(14)	(0)
4	3 =	CREATURE	(14)	(1)
5	5 =	SECOND	(12)	(3)
6	5 =	TONIGHT	(12)	(3)
7	5 =	INSTANCE	(12)	(1)
8	8 =	MIRROR	(11)	(2)
9	8 =	VILLAGE	(11)	(1)
10	10 =	CAPTAIN	(10)	(2)
11	10 =	DINNER	(10)	(2)
12	10 =	MENACE	(10)	(0)

APPENDIX XLVI (Contd)

(c) List C : Order of Accuracy

				No. of Appearances
1	1 =	PARABLE	(13)	(0)
2	2 =	GRANULAR	(12)	(0)
3	2 =	DINNER	(12)	(2)
4	4 =	TONIGHT	(11)	(3)
5	4 =	MENACE	(11)	(0)
6	6 =	CAPTAIN	(10)	(2)
7	7 =	MIRROR	(9)	(2)
8	7 =	INSTANCE	(9)	(1)
9	9 =	COLUMN	(8)	(3)
10	9 =	VILLAGE	(8)	(1)
11	11 =	SECOND	(7)	(3)
12	12	CREATURE	(2)	(1)

APPENDIX XLVI (Contd)

(d) List D : Order of Accuracy

				No. of Appearances
1	1 =	VERNIER	(14)	(1)
2	1 =	ELASTANCE	(14)	(1)
3	3 =	MENISCUS	(13)	(0)
4	3 =	PARACHOR	(13)	(0)
5	5 =	CALORIMETER	(10)	(1)
6	6 =	DIPOLE	(9)	(2)
7	6 =	COULOMB	(9)	(3)
8	6 =	SECANT	(9)	(3)
9	9 =	GALVANOMETER	(8)	(0)
10	10 =	TETRODE	(7)	(3)
11	10 =	CATHODE	(7)	(2)
12	12	MICRON	(3)	(2)

APPENDIX XLV11

INSPECTION (SLIDE) SERIES

Experiment 12

Order		
1.) – 5.)	Filler Items (Very rare elements)	
6.	BORON - NITROGEN	(DwD)
7.	STRONTIUM - CALCIUM	(DsD)
8.	CADMIUM	
9.	BERYLLIUM - MAGNESIUM	(DsD)
10.	BISMUTH	
11.	RUBIDIUM - PALLADIUM	(DwD)
12.	CARBON	
13.	IODINE	
14.	IRON - SILVER	(DwD)
15.	IRIDIUM - THALLIUM	(DwD)
16.	SODIUM - LITHIUM	(DsD)
17.	TIN	
18.	COBALT - SILICON	(DwD)
19.	ARSENIC - ANTINOMY	(DsD)
20.	XENON - RADON	(DsD)
21.	HYDROGEN	
22.	MANGANESE - RADIUM	(DwD)
23.	HELIUM	
24.	FLUORINE - CHLORINE	(DsD)
25.	TITANIUM	
26.	BARIUM	
27.	OXYGEN	
28.	MOLYBDENUM	
29.	BROMINE	
30.) – 34.)	Filler Items (very rare elements)	

Experiment 13

Order		
1.) – 5.)	Filler Items (Very rare elements)	
6.	NITROGEN - COPPER	(DwD)
7.	STRONTIUM - CALCIUM	(DsD)
8.	NEON	
9.	MAGNESIUM - CALCIUM	(DsD)
10.	ARSENIC	
11.	IRON - SILVER	(DwD)
12.	HELIUM	
13.	CARBON	
14.	KRYPTON - SILVER	(DwD)
15.	THALLIUM - ALUMINIUM	(DwD)
16.	SODIUM - POTASSIUM	(DsD)
17.	XENON	
18.	COBALT - SILICON	(DwD)
19.	BERYLLIUM - MAGNESIUM	(DsD)
20.	TIN - LEAD	(DsD)
21.	ZINC	
22.	CAESIUM - SILICON	(DwD)
23.	OXYGEN	
24.	FLUORINE - CHLORINE	(DsD)
25.	RUBIDIUM	
26.	CADMIUM	
27.	TITANIUM	
28.	NICKEL	
29.	NIOBIUM	
30.) – 34.)	Filler Items (very rare elements)	

EXPERIMENT 13 is essentially a replication of EXPERIMENT 12 except for two conditions: see the text for details.

All elements are common for chemistry 3rd year Honours students, (see the rating data produced for the earlier experiment on the Periodic Table).

APPENDIX XLVIII

INSTRUCTION SHEET FOR EXPERIMENTS 12 AND 13

If you are sure that the element underlined in the test series was present in the slide series mark the first box with a cross thus :-

	Present 1	2	3	4 Absent
LITHIUM - FERMIUM	X			
SODIUM - YTTERBIUM	X			

This means that you are absolutely sure that LITHIUM and SODIUM were present as the left hand element of a pair, or as an element on its own :-

e.g. (i) LITHIUM

(ii) SODIUM - PROCTACTINIUM ; LITHIUM and SODIUM are present as target (underlined) words.

If you are absolutely sure that the element was not a target (L.H.S. of an element paired or singly) mark the last box (No. 4)

e.g.

	1	2	3	4
THULIUM				X

This means that THULIUM never appeared as a target word (though it may have appeared as a cue word for a pair (R.H.S. of a pair).

Use the 3 and 4 boxes for probably sure was present and probably sure was absent responses respectively.

Thus, there is a continuum from 1 to 4; namely, absolutely sure was present (1) to absolutely sure was absent (4).

APPENDIX XLV111 (Contd)

RÉSUMÉ

You have just viewed a series of slides, single elements and doublets. The first element was always underlined, this element is the one to be considered in the test. Thus if THULIUM -PROTACTINIUM was shown in the slide series and you are considering :-

PROTACTINIUM - CALCIUM

THULIUM - STRONTIUM

then for a correct performance you would mark these pairs thus :-

	1	2	3	4
PROTACTINIUM - CALCIUM				X
THULIUM - STRONTIUM	X			

As THULIUM was the target word, PROTACTINIUM was just a cue (it was not underlined in the inspection series).

For single words just consider whether the element was present as a target (underlined) word in the inspection series.

Thus

	1	2	3	4
CALCIUM		X		
FERMIUM				X

means you are probably sure that CALCIUM was present (either as :-

CALCIUM - "ELEMENT X";

or CALCIUM ; (ALONE).

You are definitely sure that FERMIUM was not present as a target word (paired or single).

APPENDIX XL1X

EXPERIMENT 12

Consider the first element only, the second is present as a cue to aid recognition.	Absolutely Sure Present			Absolutely Sure Absent
	1	2	3	4
NITROGEN - COPPER				
HELIUM - SULPHUR				
SODIUM - LITHIUM				
TIN				
BARIUM - STRONTIUM				
MERCURY				
NIOBIUM - TANTALIUM				
TITANIUM - SCANDIUM				
IRIDIUM - THALLIUM				
HYDROGEN				
SELENIUM				
ARSENIC				
CARBON				
TUNGSTEN				
RUBIDIUM - PALLADIUM				
OXYGEN				
ANTIMONY - BISMUTH				
MANGANESE				
TUNGSTEN				
IRON - SILVER				
STRONTIUM				
LEAD				
RUBIDIUM				
BARIUM - STRONTIUM				
IODINE - PHOSPHORUS				

APPENDIX XLIX (Contd)

Consider the first (underlined) element, the second of a doublet is present as a cue to aid recognition.

	Present			Absent
	1	2	3	4
XENON - RADON				
BROMINE				
NITROGEN - COPPER				
MOLYBDENUM				
FLUORINE				
CAESIUM				
KRYPTON - SILVER				
BERYLLIUM - MAGNESIUM				
ZINC				
OXYGEN - SELENIUM				
BROMINE				
BORON - NITROGEN				
CHROMIUM				
MERCURY - CADMIUM				
SODIUM - POTASSIUM				
COBALT				
GOLD				
ANTIMONY				
CADMIUM				
CARBON - GOLD				
BROMINE - CHLORINE				
BISMUTH -ANTIMONY				
THALLIUM - ALUMINIUM				
BARIUM				
TIN - LEAD				
MAGNESIUM - CALCIUM				
PHOSPHORUS				

END

Please check in order to see that you have omitted no responses (crosses).

APPENDIX L

EXPERIMENT 12: RAW DATA

CONDITION 1

A Single Element Tested with
Strong Single Noise

Ss	S				S(T)	N(T)	CORR	N			
	3	2	1	0				3	2	1	0
1	1	2	0	0	7	2	5	0	0	2	1
2	2	0	1	0	7	5	2	1	0	2	0
3	0	2	1	0	5	5	0	0	2	1	0
4	2	1	0	0	7	0	7	0	0	0	3
5	0	0	2	1	2	2	0	0	0	2	1
6	2	0	0	1	6	0	6	0	0	0	3
7	2	0	0	1	6	1	5	0	0	1	2
8	2	0	0	1	6	0	6	0	0	0	3
9	1	1	1	0	6	3	3	0	1	1	1
10	3	0	0	0	9	2	7	0	0	2	1
11	1	1	1	0	6	3	3	0	1	1	1
12	2	0	1	0	7	0	7	0	0	0	3
13	3	0	0	0	9	3	6	1	0	0	2
14	2	1	0	0	8	0	8	0	0	0	3
15	1	0	0	2	3	0	3	0	0	0	3
16	3	0	0	0	9	0	9	0	0	0	3
17	2	0	1	0	7	3	4	1	0	0	2
18	1	1	0	1	5	0	5	0	0	0	3
19	3	0	0	0	9	0	9	0	0	0	3
20	2	0	0	1	6	1	5	0	0	1	2

$\bar{x}_c = 5.00$
(for corrected scores)

APPENDIX $\overline{\text{L}}$

CONDITION $\overline{11}$

A single element tested
with weak single noise

Ss	S				S(T)	N(T)	CORR	N			
	3	2	1	0				3	2	1	0
1	1	1	1	0	6	4	2	0	1	2	0
2	1	0	1	1	4	4	0	1	0	1	1
3	3	0	0	0	9	3	6	0	1	1	1
4	1	0	0	2	3	6	-3	2	0	0	1
5	0	0	2	1	2	2	0	0	1	0	2
6	1	0	0	2	3	0	3	0	0	0	3
7	2	0	1	0	7	0	7	0	0	0	3
8	3	0	0	0	9	2	7	0	0	2	1
9	3	0	0	0	9	2	7	0	0	2	1
10	2	0	1	0	7	2	5	0	0	2	1
11	2	1	0	0	8	0	8	0	0	0	3
12	2	0	0	1	6	0	6	0	0	0	3
13	2	1	0	0	8	5	3	1	1	0	1
14	3	0	0	0	9	0	9	0	0	0	3
15	3	0	0	0	9	0	9	0	0	0	3
16	1	0	1	1	4	0	4	0	0	0	3
17	2	0	1	0	7	4	3	0	2	0	1
18	1	0	1	1	4	1	3	0	0	1	2
19	3	0	0	0	9	1	8	0	0	1	2
20	2	0	0	1	6	2	4	0	1	0	2

$\bar{x}_c = 4.55$

APPENDIX L

CONDITION 111

A Single Element Tested in
a Strong Doublet

Ss	S 3	S 2	S 1	S 0	S(T)	N(T)	CORR	N 3	N 2	N 1	N 0
1	2	0	0	1	6	2	4	0	1	0	2
2	1	0	1	1	4	6	-2	1	1	1	0
3	1	1	1	0	6	6	0	2	0	0	1
4	1	0	1	1	4	4	0	1	0	1	1
5	0	2	0	1	4	5	-1	1	1	0	1
6	2	1	0	0	8	0	8	0	0	0	3
7	2	0	0	1	6	0	6	0	0	0	3
8	2	0	1	0	7	3	4	1	0	0	2
9	2	1	0	0	8	4	4	1	0	1	1
10	1	1	0	1	5	4	1	1	0	1	1
11	2	1	0	0	8	0	8	0	0	0	3
12	0	0	1	2	1	4	-3	1	0	1	1
13	2	1	0	0	8	3	5	1	0	0	2
14	1	0	1	1	4	0	4	0	0	0	3
15	2	0	0	1	6	3	3	1	0	0	2
16	2	1	0	0	7	2	5	0	1	0	2
17	1	1	1	0	6	3	3	1	0	0	2
18	2	1	0	0	8	5	3	1	1	0	1
19	2	1	0	0	8	1	7	0	0	1	2
20	1	1	0	0	5	2	3	0	1	0	2

$\overline{x}_c = 3.1$

APPENDIX L

CONDITION IV

A Weak Doublet tested as a
Weak Single Element (L.H.S. Element)

Ss	S				S(T)	N(T)	CORR	N			
	3	2	1	0				3	2	1	0
1	2	1	0	0	8	4	4	0	2	0	1
2	1	0	1	1	4	5	-1	1	1	0	1
3	0	1	2	0	4	4	0	0	1	2	0
4	0	0	1	2	1	3	-2	1	0	0	2
5	0	1	2	0	4	3	1	0	1	1	1
6	0	0	1	2	1	2	-1	0	0	2	1
7	1	0	0	2	3	0	3	0	0	0	3
8	1	0	1	1	4	0	4	0	0	0	3
9	0	2	1	0	5	1	4	0	0	1	2
10	1	1	1	0	6	2	4	0	1	0	2
11	1	0	1	1	4	0	4	0	0	0	3
12	3	0	0	0	9	0	9	0	0	0	3
13	2	1	0	0	8	1	7	0	0	1	2
14	0	2	1	0	5	0	5	0	0	0	3
15	1	0	0	2	3	0	3	0	0	0	3
16	2	0	0	1	6	4	2	0	1	2	0
17	1	1	1	0	6	1	5	0	0	1	2
18	0	1	2	0	4	1	3	0	0	1	2
19	2	1	0	0	8	0	8	0	0	0	3
20	1	1	0	1	5	2	3	0	1	0	2

$\bar{x}_c = 3.25$

APPENDIX L

CONDITION V

A Single Element Tested
in a Weak Doublet

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	0	2	0	1	4	3	1	1	0	0	2
2	1	1	0	1	5	5	0	1	1	0	1
3	1	2	0	0	7	1	6	0	0	1	2
4	0	0	1	2	1	5	-4	1	1	0	1
5	1	0	1	1	4	7	-3	2	0	1	0
6	0	0	0	3	0	6	-6	2	0	0	1
7	2	0	1	0	7	1	6	0	0	1	2
8	0	0	0	3	0	3	-3	1	0	0	2
9	0	1	2	0	4	2	2	0	0	2	1
10	2	1	0	0	8	2	6	0	0	2	1
11	2	0	0	1	6	3	3	0	1	1	1
12	2	0	1	0	7	4	3	0	2	0	1
13	2	0	1	0	7	1	6	0	0	1	2
14	1	1	1	0	6	1	5	0	0	1	2
15	0	2	1	0	5	2	3	0	1	0	2
16	1	1	0	1	5	5	0	1	2	0	0
17	1	0	1	1	4	2	2	0	1	0	2
18	0	1	2	0	4	2	2	0	1	0	2
19	3	0	0	0	9	0	9	0	0	0	3
20	1	0	1	0	4	2	2	0	1	0	2

$\bar{x}_c = 2.00$

APPENDIX L

CONDITION VI

A Strong Doublet Tested
with Strong Doublet Noise

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	3	0	0	0	9	6	3	0	3	0	0
2	1	0	2	0	5	1	4	0	0	1	2
3	1	2	0	0	7	7	0	2	0	1	0
4	2	0	1	0	7	3	4	1	0	0	2
5	2	0	0	0	6	1	5	0	0	1	2
6	2	0	0	1	6	6	0	2	0	0	1
7	2	0	0	1	6	3	3	1	0	0	2
8	3	0	0	0	9	6	3	2	0	0	1
9	1	1	1	0	6	4	2	0	1	2	0
10	1	1	1	0	6	5	1	0	2	1	0
11	0	0	3	0	3	5	-2	0	2	1	0
12	1	0	1	1	4	7	-3	2	0	1	0
13	3	0	0	0	9	6	3	2	0	0	1
14	2	0	1	0	7	4	3	1	0	1	1
15	1	0	1	1	4	0	4	0	0	0	3
16	2	1	0	0	8	5	3	1	1	0	1
17	1	0	1	1	4	4	0	0	2	0	1
18	2	0	0	1	6	2	4	0	1	0	2
19	1	1	0	1	5	6	-1	2	0	0	1
20	1	0	0	2	3	1	2	0	0	1	2

$\bar{x}_c = 1.9$

APPENDIX I

CONDITION VII

Weak Doublets tested with
Weak Doublet Noise

Ss	S 3	S 2	S 1	S 0	S(T)	N(T)	CORR	N 3	N 2	N 1	N 0
1	1	1	1	0	6	3	3	1	0	0	2
2	2	0	1	0	7	3	4	1	0	0	2
3	2	1	0	0	8	8	0	2	1	0	0
4	1	0	1	1	4	3	1	1	0	0	2
5	1	1	0	1	5	6	-1	2	0	0	1
6	1	0	1	1	4	6	-2	2	0	0	1
7	1	2	0	0	7	4	3	1	0	1	1
8	3	0	0	0	9	3	6	1	0	0	2
9	1	0	2	0	5	4	1	1	0	1	1
10	1	0	2	0	5	4	1	1	0	1	1
11	2	0	1	0	7	4	3	1	0	1	1
12	1	0	1	1	4	4	0	1	0	1	1
13	3	0	0	0	9	5	4	1	0	2	0
14	2	1	0	0	7	3	4	0	1	1	1
15	2	1	0	0	7	6	1	2	0	0	1
16	1	0	1	1	4	4	0	1	0	1	1
17	1	1	1	0	6	3	3	1	0	0	2
18	2	0	0	1	6	6	0	2	0	0	1
19	2	0	1	0	7	5	2	1	1	0	1
20	1	0	1	0	4	2	2	0	0	2	1

$\bar{x}_c = 1.75$

APPENDIX L

CONDITION VIII

A Strong Doublet Tested as a
Strong Single with Strong
Single Noise*

Ss	S 3	S 2	S 1	S 0	S(T)	N(T)	CORR	N 3	N 2	N 1	N 0
1	0	3	0	0	6	1	5	0	0	1	2
2	1	1	1	0	6	3	3	1	0	0	2
3	1	2	0	0	7	4	3	0	0	2	1
4	1	0	0	2	3	0	3	0	0	0	3
5	1	1	0	1	5	7	-2	1	2	0	0
6	1	0	0	2	3	5	-2	1	1	0	1
7	1	0	0	2	3	0	3	0	0	0	3
8	1	0	1	1	4	1	3	0	0	1	2
9	2	0	1	0	7	2	5	0	1	0	2
10	1	2	0	0	7	5	2	1	1	0	1
11	2	0	0	1	6	2	4	0	1	0	2
12	2	0	0	1	6	3	3	1	0	0	2
13	2	0	0	1	6	2	4	0	1	0	2
14	2	0	0	1	6	2	4	0	0	2	1
15	1	0	0	2	3	3	0	1	0	0	2
16	2	0	1	0	7	2	5	0	1	0	2
17	1	1	1	0	6	2	4	0	0	2	1
18	1	0	0	2	3	2	1	0	1	0	2
19	3	0	0	0	9	7	2	2	1	0	0
20	1	1	0	1	5	3	2	0	1	1	1

$\bar{x}_c = 2.79$

* i.e. DsD - $\frac{\text{Ds(S)}}{\text{Ds(N)}}$

APPENDIX LI

EXPERIMENT 12

ANALYSIS OF VARIANCE

8 TREATMENTS

CORRECTED (C) SCORES

CONDITIONS

I	Single elements tested with strong single noise.
II	Single elements tested with weak single noise.
III	Single elements tested in strong doublets.
IV	Weak doublets tested as weak single (L.H.S. Member only).
V	Single elements tested in weak doublets.
VI	Strong doublets tested with strong doublet noise.
VII	Weak doublets tested in weak doublet noise.
VIII	Strong doublets tested as strong single elements (L.H.S. Member) with strong single distractors.

APPENDIX LI

EXPERIMENT 12

ANOVAR: 8 TREATMENTS (I - VIII)
(N = 20)

CORRECTED (C) SCORES

Ss	I	II	III	IV	V	VI	VII	VIII	$\bar{x}$
1	11	8	10	10	7	9	9	11	9.375
2	8	6	6	5	6	10	10	9	7.5
3	6	12	5	6	12	6	6	11	8.0
4	14	3	6	4	4	10	7	9	7.125
5	6	6	7	7	3	11	5	4	6.125
6	12	9	14	5	0	6	4	4	6.75
7	11	13	12	9	12	9	9	9	10.5
8	12	13	10	9	3	9	12	9	9.625
9	9	13	10	8	8	8	7	11	9.25
10	13	11	7	10	12	9	7	8	9.625
11	11	14	14	10	9	4	9	10	10.125
12	13	12	3	15	9	3	6	9	8.75
13	12	9	11	13	12	9	10	10	10.75
14	14	15	10	6	11	9	11	10	10.75
15	9	16	9	9	9	10	8	6	9.375
16	15	10	12	9	6	9	6	11	9.75
17	10	9	9	11	8	6	9	10	9.0
18	11	9	9	9	8	10	6	7	8.625
19	15	14	13	14	15	5	8	7	11.375
20	11	10	9	9	8	8	8	8	8.875
$\bar{x}$	11.15	10.55	9.30	8.90	8.10	8.00	7.85	8.65	
S.D.	2.601	3.252	2.975	2.936	3.726	2.224	2.059	2.134	

Corrected Scores: raw scores have +6 added to remove negative quantities.

APPENDIX LI

ANALYSIS OF VARIANCE SUMMARY:
EXPERIMENT 12 (CORRECTED SCORES)

TREATMENT MEANS

11.15	10.55	9.3	8.9	8.1	8
7.85	8.6				

Treatment Sdevs

2.60111	3.25213	2.97534	2.93616	3.72615	2.22427
2.059	2.13431				

Newman-Keuls Root N*MS (Residual) Statistic

11.5607

Sums of Squares:	Between S	297.625	DF 19
Mean Sums of Sqrs:	Between S	15.6645	
Sums of Squares:	Within S	1095.75	DF 140
Mean Sums of Sqrs:	Within S	7.82679	
Sums of Squares	Treatment	206.975	DF 7
Mean Sums of Sqrs:	Treatment	29.5678	
Sums of Squares:	Residual	888.775	DF 133
Mean Sums of Sqrs:	Residual	6.68252	

F Ratio: 4.42465** DF (7 , 133)
Significant at the 1% level.

SCHEFFÉ COMPARISONS

Means for comparison
11.15, 7.85
Number for each mean
20, 20
F Ratio 2.32803 DF (7 , 133)
Significant at the 5% level

Means for comparison
11.15, 8.0
Number for each mean
20, 20
F Ratio 2.1212 DF (7 ,133)
Significant at the 5% level

APPENDIX L1

SCHEFFÉ COMPARISONS

Means for comparison
10.55, 7.85
Number for each mean
20, 20
F Ratio 1.55844 DF (7 , 133) n.s.

Means for comparison
11.15, 8.1
Number for each mean
20, 20
F Ratio 1.98866 DF (7 , 133) n.s.

Means for comparison
11.15, 8.65
Number for each mean
20, 20
F Ratio 1.33611 DF (7 , 133) n.s.

Means for comparison
10.55, 8.0
Number for each mean
20, 20
F Ratio 1.39009 DF (7 , 133) n.s.

Means for comparison
10.55, 8.65
Number for each mean
20, 20
F Ratio .771736 DF (7 , 133) n.s.

Means for comparison
11.15, 8.9
Number for each mean
20, 20
F Ratio 1.08225 DF (7 , 133) n.s.

Where: $F(7,125) = 2.08^{*}$, $2,79^{**}$ (1%)
$F(7,150) = 2.07^{*}$, 2.76^{**} (1%)

APPENDIX L11

EXPERIMENT 12

SENSITIVITY SCORES (A)

	CONDITIONS			
	1	11	111	1V
1	1.0000	.7222	.7778	.8889
2	.6667	.5000	.3333	.4444
3	.5000	1.0000	.4444	.5000
4	1.0000	.3333	.5000	.4444
5	.5000	.5556	.3889	.6111
6	.8333	.6667	1.0000	.3333
7	.7778	1.0000	.8333	.6667
8	.8333	1.0000	.7778	.8333
9	.7778	1.0000	.7778	.9444
10	1.0000	.8889	.5556	.8333
11	.7778	1.0000	1.0000	.8333
12	1.0000	.8333	.2778	1.0000
13	.8333	.7222	.7778	1.0000
14	1.0000	1.0000	.8333	1.0000
15	.6667	1.0000	.6667	.6667
16	1.0000	.8333	.9444	.6667
17	.7778	.7778	.7222	.9444
18	.8333	.7222	.7222	.8889
19	1.0000	1.0000	1.0000	1.0000
20	.7778	1.0000	.6667	.9167
MEAN (A)	.8278	.8278	.7000	.7708
VAR. (A)	.0256	.0399	.0489	.0456

APPENDIX L11

EXPERIMENT 12

SENSITIVITY SCORES (A)

	CONDITIONS			
	V	V1	V11	V111
1	.5556	1.0000	.7222	1.0000
2	.5000	.8889	.7778	.7222
3	1.0000	.4444	.5000	1.0000
4	.2222	.7778	.6111	.6667
5	.2778	1.0000	.3889	.3889
6	.1667	.5000	.3889	.3889
7	.9444	.6667	.7222	.6667
8	.3333	.6667	.8333	.7222
9	.7778	.7222	.6111	.8889
10	1.0000	.6111	.6111	.6111
11	.7222	.1667	.7222	.7778
12	.7778	.2778	.5000	.6667
13	.9444	.6667	.8333	.7778
14	.9444	.7222	.9444	.7222
15	.7778	.8333	.5556	.5000
16	.3889	.7222	.5000	.8889
17	.6667	.5000	.7222	.8889
18	.7222	.7778	.5000	.5556
19	1.0000	.3889	.6667	.6667
20	.5833	.6667	.6111	.6667
MEAN (A)	.6653	.6500	.6361	.7083
VAR. (A)	.0759	.0481	.0226	.0298

APPENDIX LII

EXPERIMENT 12

TRANSFORMED SENSITIVITY SCORES - ARCSIN ROOT (A)

	CONDITIONS			
	I	II	III	IV
1	.5000	.6466	.6875	.7837
2	.6082	.5000	.3918	.4646
3	.5000	.5000	.4646	.5000
4	.5000	.3918	.5000	.4646
5	.5000	.5354	.4287	.5713
6	.7323	.6082	.5000	.3918
7	.6875	.5000	.7323	.6082
8	.7323	.5000	.6875	.7323
9	.6875	.5000	.6875	.8485
10	.5000	.7837	.5354	.7323
11	.6875	.5000	.5000	.7323
12	.5000	.7323	.3534	.5000
13	.7323	.6466	.6875	.5000
14	.5000	.5000	.7323	.5000
15	.6082	.5000	.6082	.6082
16	.5000	.7323	.8485	.6082
17	.6875	.6875	.6466	.8485
18	.7323	.6466	.6466	.7837
19	.5000	.5000	.5000	.5000
20	.6875	.5000	.6082	.8136
MEAN (TA)	.6041	.5705	.5873	.6246
VAR. (TA)	.0104	.0112	.0171	.0215

APPENDIX L11

EXPERIMENT 12

TRANSFORMED SENSITIVITY SCORES - ARCSIN ROOT (A)

	CONDITIONS			
	V	V1	V11	V111
1	.5354	.5000	.6466	.5000
2	.5000	.7837	.6875	.6466
3	.5000	.4646	.5000	.5000
4	.3125	.6875	.5713	.6082
5	.3534	.5000	.4287	.4287
6	.2677	.5000	.4287	.4287
7	.8485	.6082	.6466	.6082
8	.3918	.6082	.7323	.6466
9	.6875	.6466	.5713	.7837
10	.5000	.5713	.5713	.5713
11	.6466	.2677	.6466	.6875
12	.6875	.3534	.5000	.6082
13	.8485	.6082	.7323	.6875
14	.8485	.6466	.8485	.6466
15	.6875	.7323	.5354	.5000
16	.4287	.6466	.5000	.7837
17	.6082	.5000	.6466	.7837
18	.6466	.6875	.5000	.5354
19	.5000	.4287	.6082	.6082
20	.5533	.6082	.5713	.6082
MEAN (TA)	.5676	.5675	.5937	.6085
VAR. (TA)	.0297	.0164	.0115	.0113

APPENDIX L11

EXPERIMENT 12

BIAS SCORES (B)

CONDITIONS

	I	11	111	1V
1	2.0000	2.0000	3.0000	1.3333
2	2.0000	2.5000	2.0000	2.0000
3	1.7500	1.0000	1.0000	2.2500
4	2.0000	3.0000	2.5000	3.2500
5	2.7500	3.0000	1.6667	2.3333
6	3.2500	3.4000	2.0000	3.0000
7	3.0000	3.0000	3.2500	3.4000
8	3,2500	1.0000	2.0000	3.2500
9	2.0000	1.0000	1.0000	2.5000
10	1.0000	2.3333	2.0000	2.0000
11	2.0000	2.0000	2.0000	3.2500
12	3.0000	3.2500	3.0000	1.0000
13	.7500	1.0000	1.0000	2.0000
14	2.0000	1.0000	3.2500	3.0000
15	3.4000	1.0000	3.0000	3.4000
16	1.0000	3.2500	1.5000	2.0000
17	2.0000	1.5000	2.0000	2.5000
18	3.2500	3.0000	1.0000	2.6667
19	1.0000	1.0000	2.0000	2.0000
20	1.0000	3.0000	3.4000	2.6000
MEAN (B)	2.1200	2.1117	2.1283	2.4867
VAR. (B)	.7656	.9182	.6509	.4628

APPENDIX LII

EXPERIMENT 12

BIAS SCORES (B)

CONDITIONS

	V	VI	VII	VIII
1	3.0000	1.0000	2.0000	2.0000
2	1.5000	2.6667	2.0000	2.0000
3	2.0000	1.0000	.7500	2.0000
4	3.0000	2.0000	3.0000	3.4000
5	2.0000	1.0000	1.0000	1.3333
6	3.2500	.7500	2.0000	3.0000
7	2.5000	3.0000	1.5000	3.4000
8	3.4000	.6000	.7500	3.0000
9	2.5000	2.0000	2.3333	2.0000
10	2.0000	1.6667	2.3333	1.3333
11	2.0000	2.2500	2.0000	3.0000
12	1.5000	2.0000	2.5000	3.0000
13	2.5000	.6000	.7500	3.0000
14	2.5000	2.0000	1.5000	2.5000
15	2.0000	3.2500	.7500	3.2500
16	1.3333	1.0000	2.5000	2.0000
17	3.0000	2.0000	2.0000	2.3333
18	2.5000	3.0000	.7500	3.2500
19	1.0000	1.0000	1.0000	.6000
20	3.1429	2.0000	3.0000	2.0000
MEAN (B)	2.3313	1.7392	1.7208	2.4200
VAR. (B)	.4646	.7001	.6040	.6172

APPENDIX LIII

EXPERIMENT 13 : TEST SHEET

Consider the first element (underlined): the other is present as a cue.

	Present			Absent
	1	2	3	4
BORON - NITROGEN				
OXYGEN - SELENIUM				
SODIUM - POTASSIUM				
XENON				
CADMIUM - MERCURY				
ARGON				
BROMINE - CHLORINE				
RUBIDIUM - PALLADIUM				
THALLIUM - ALUMINIUM				
ZINC				
SCANDIUM				
COBALT				
HELIUM				
TITANIUM - SCANDIUM				
BISMUTH - ANTIMONY				
TITANIUM				
CAESIUM				
PLATINUM				
KRYPTON - SILVER				
STRONTIUM				
RADON				
IRON				
CARBON - GOLD				
TIN - LEAD				
NIOBIUM				
NICKEL				
FLUORINE				

P.T.O.

APPENDIX LIII (Contd)

Consider the underlined elements only.

	Present 1	2	3	Absent 4
IRON - SILVER				
MAGNESIUM - CALCIUM				
URANIUM				
HELIUM - SULPHUR				
TUNGSTEN				
NITROGEN - COPPER				
RUBIDIUM				
BARIUM - STRONTIUM				
SODIUM - LITHIUM				
MOLYBDENUM				
COPPER				
SULPHUR				
SCANDIUM				
NEON				
IODINE - PHOSPHORUS				
NIOBIUM - TANTALIUM				
ARSENIC - BISMUTH				
IRIDIUM - THALLIUM				
BISMUTH				
XENON - RADON				
BERYLLIUM - MAGNESIUM				
LITHIUM - SODIUM				
RUTHENIUM				

END

Please check in order to see that you have omitted No responses (crosses).

APPENDIX LIV

EXPERIMENT 13

ANALYSIS OF VARIANCE
8 TREATMENTS

CONDITIONS

(a) Single elements tested with strong single noise.

(b) Single elements tested with weak single noise.

(c) Single elements tested in weak doublet.

(d) Weak doublets tested as weak single with weak single noise.

(e) Strong doublets tested with strong doublet noise.

(f) Weak doublets tested in weak doublet noise.

(g) Strong doublets tested as single weak and weak noise.

(h) Strong doublets tested as strong single elements with strong noise.

APPENDIX LIV

EXPERIMENT 13

ANALYSIS OF VARIANCE
8 TREATMENTS
(N = 20)

Ss	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	$\bar{x}$ (Row)
1	6	10	6	8	4	10	8	9	7.625
2	11	8	7	6	12	10	8	9	8.875
3	11	9	7	6	9	10	6	8	8.25
4	12	6	11	10	10	12	13	7	10.125
5	8	7	10	6	8	11	8	7	8.125
6	9	5	8	7	11	9	11	9	8.625
7	10	7	6	8	8	1	9	12	7.625
8	11	5	3	6	15	10	8	5	7.875
9	11	9	5	10	13	14	0	9	8.875
10	11	4	3	4	12	12	5	9	7.50
11	12	9	10	7	10	13	10	7	9.75
12	14	11	11	12	15	15	13	6	12.125
13	10	13	15	10	12	9	15	11	11.875
14	7	14	10	1	9	15	12	0	8.50
15	15	12	10	12	12	15	14	9	12.375
16	12	12	11	9	13	6	12	5	10.00
17	12	15	14	12	12	15	12	12	13.00
18	15	15	14	12	7	15	12	12	12.75
19	9	6	11	9	11	10	10	7	9.125
20	11	9	9	8	10	11	12	10	10.00
$\bar{x}$	10.85	9.30	9.05	8.15	10.65	11.15	9.9	8.15	
S.D.	2.346	3.389	3.410	2.91	2.681	3.50	3.538	2.871	

Corrected Scores: raw scores have +6 added to remove negative quantities.

APPENDIX LIV

EXPERIMENT 13

ANALYSIS OF VARIANCE SUMMARY: CORRECTED SCORES

TREATMENT MEANS

10.85	9.3	9.05	8.15	10.65	11.15
9.9	8.15				

Treatment Sdevs

2.34577	3.38884	3.41012	2.90689	2.68083	3.49849
3.53777	2.87045				

Newman-Keuls Root N*MS (Residual) Statistic

11.9918

Sums of Squares:	Between S	511.4	DF 19
Mean Sums of Sqrs:	Between S	26.9158	
Sums of Squares:	Within S	1151	DF 140
Mean Sums of Sqrs:	Within S	8.22143	
Sums of Squares:	Treatment	194.701	DF 7
Mean Sums of Sqrs:	Treatment	27.8145	
Sums of Squares:	Residual	956.299	DF 133
Mean Sums of Sqrs:	Residual	7.19022	

F Ratio : 3.86837** DF (7 , 133) 1% level.

SCHEFFÉ COMPARISONS

Means for comparison
11.15, 8.15
Number for each mean
20, 20
F Ratio 1.78814 DF (7 , 133) n.s.

Means for comparison
10.85, 8.15
Number for each mean
20, 20
F Ratio 1.4484 DF (7 , 133) n.s.

Means for comparison
10.65, 8.15
Number for each mean
20, 20
F Ratio 1.24177 DF (7 , 133) n.s.

Means for comparison
9.05, 11.15
Number for each mean
20,20
F Ratio .876191 DF (7 , 133) n.s.

Where: $F(7,125) = \frac{2.08^{*}}{2.79^{**}}$ $F(7,150) = \frac{2.07^{*}}{2.76^{**}}$

APPENDIX LV

EXPERIMENT 13

A Single Tested with
a Weak Doublet

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	0	1	2	0	4	4	0	0	1	2	0
2	0	1	2	0	4	3	1	1	0	0	2
3	1	0	0	2	3	2	1	0	0	2	1
4	2	1	0	0	8	3	5	0	0	3	0
5	2	0	1	0	7	3	4	1	0	0	2
6	1	1	0	1	5	3	2	0	1	1	1
7	2	0	0	1	6	6	0	2	0	0	1
8	0	0	1	2	1	4	-3	0	2	0	1
9	1	0	0	2	3	4	-1	1	0	1	1
10	0	1	0	2	2	5	-3	1	1	0	1
11	1	1	1	0	6	2	4	0	1	0	2
12	2	0	0	1	6	1	5	0	0	1	2
13	3	0	0	0	9	0	9	0	0	0	3
14	2	0	0	1	6	2	4	0	1	0	2
15	2	0	0	1	6	2	4	0	1	0	2
16	2	1	0	0	8	3	5	1	0	0	2
17	2	1	0	0	8	0	8	0	0	0	3
18	2	1	0	0	8	0	8	0	0	0	3
19	0	2	1	0	5	0	5	0	0	0	3
20	1	1	1	0	6	3	3	0	1	1	2

$\overline{x}_c = 3.05$

APPENDIX LV

EXPERIMENT 13

A Strong Doublet Tested With
A Single Weak

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	1	1	0	1	5	3	2	1	0	0	2
2	1	0	0	2	3	1	2	0	0	1	2
3	0	2	1	0	5	5	0	0	2	1	0
4	3	0	0	0	9	2	7	0	1	0	2
5	1	1	1	0	6	4	2	0	1	2	0
6	1	2	0	0	7	2	5	0	0	2	1
7	2	0	0	1	6	3	3	1	0	0	2
8	2	1	0	0	8	6	2	2	0	0	1
9	1	0	0	2	3	3	0	0	1	1	1
10	1	0	0	2	3	4	-1	1	0	1	1
11	2	1	0	0	8	4	4	1	0	1	1
12	2	1	0	0	8	1	7	0	0	1	2
13	3	0	0	0	9	0	9	0	0	0	3
14	3	0	0	0	9	3	6	1	0	0	2
15	2	1	0	0	8	0	8	0	0	0	3
16	2	0	0	1	6	0	6	0	0	0	3
17	2	0	0	1	6	0	6	0	0	0	3
18	2	0	0	1	6	0	6	0	0	0	3
19	1	1	1	0	6	2	4	0	0	2	1
20	2	1	0	0	8	2	6	0	1	0	2

$\bar{x}_c = 3.90$

APPENDIX LV

EXPERIMENT 13

A Strong Doublet Tested With
A Strong Doublet Noise

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	0	2	1	0	5	7	-2	2	1	0	0
2	3	0	0	0	9	3	6	1	0	0	2
3	1	0	2	0	5	2	3	0	0	2	1
4	2	1	0	0	8	4	4	1	0	1	1
5	1	1	1	0	6	4	2	0	1	2	0
6	1	2	0	0	7	2	5	0	1	0	2
7	1	0	0	2	3	1	2	0	0	1	2
8	3	0	0	0	9	0	9	0	0	0	3
9	2	0	1	0	7	0	7	0	0	0	3
10	2	0	0	1	6	0	6	0	0	0	3
11	2	0	1	0	7	3	4	0	1	1	1
12	3	0	0	0	9	0	9	0	0	0	3
13	2	1	0	0	8	2	6	0	1	0	2
14	2	0	0	1	6	3	3	1	0	0	2
15	3	0	0	0	9	3	6	1	0	0	2
16	3	0	0	0	9	2	7	0	1	0	2
17	3	0	0	0	9	3	6	1	0	0	2
18	2	0	0	1	6	5	1	1	1	0	1
19	3	0	0	0	9	4	5	1	0	1	1
20	2	1	0	0	8	4	4	1	0	1	0

$\bar{x}_c = 4.65$

APPENDIX LV

EXPERIMENT 13

A Weak Pair Tested With
a Weak Single in
Weak Single Noise

Ss	S				S(T)	N(T)	CORR	N			
	3	2	1	0				3	2	1	0
1	0	2	0	1	4	2	2	0	1	0	1
2	1	1	0	1	5	4	0	0	2	0	1
3	0	2	1	0	5	5	0	0	2	1	0
4	2	0	0	1	6	3	4	0	1	1	1
5	1	0	2	0	5	5	0	0	2	1	0
6	1	2	0	0	7	6	1	1	1	1	0
7	1	1	1	0	6	4	2	1	0	1	1
8	0	0	2	1	2	2	0	0	0	2	1
9	1	0	1	1	4	0	4	0	0	0	3
10	0	2	1	0	4	6	-2	2	0	0	1
11	1	0	1	1	4	3	1	1	0	0	2
12	2	0	1	1	7	1	6	0	0	1	2
13	2	0	0	1	6	2	4	0	1	0	2
14	0	0	1	2	1	6	-5	2	0	0	1
15	2	0	0	1	6	0	6	0	0	0	3
16	1	0	0	2	3	0	3	0	0	0	3
17	2	0	0	1	6	0	6	0	0	0	3
18	2	0	1	0	7	1	6	0	0	1	2
19	1	1	1	0	6	3	3	0	0	3	0
20	1	0	1	1	4	2	2	0	1	0	2

$\bar{x}_c = 2.15$

APPENDIX LV

EXPERIMENT 13

A Weak Doublet Tested With
A Strong Single With
Strong Noise

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	1	0	1	1	4	1	3	0	0	1	2
2	1	0	1	1	4	1	3	0	0	1	2
3	0	2	1	0	5	3	2	0	1	1	1
4	2	0	1	0	7	6	1	2	0	0	1
5	1	0	2	0	5	4	1	0	2	0	1
6	1	2	0	0	7	4	3	0	1	2	0
7	2	0	0	1	6	0	6	0	0	0	3
8	0	0	2	1	2	3	-1	0	1	1	1
9	1	0	1	1	4	1	3	0	0	1	2
10	1	0	1	1	4	1	3	0	0	1	2
11	1	0	1	1	4	3	1	0	1	1	1
12	2	0	0	1	6	6	0	2	0	0	1
13	2	0	0	1	6	1	5	0	0	1	2
14	0	0	1	2	1	7	-6	1	2	0	0
15	2	0	0	1	6	3	3	1	0	0	2
16	1	0	0	2	3	4	-1	1	0	1	1
17	2	0	0	1	6	0	6	0	0	0	3
18	2	0	1	0	7	1	6	0	0	1	2
19	1	1	1	0	6	5	1	1	0	2	0
20	1	1	1	0	6	2	4	0	1	0	2

$\bar{x}_c = 2.15$

APPENDIX LV

EXPERIMENT 13

A Single Tested with
a Strong Single

Ss	S				S(T)	N(T)	CORR	N			
	3	2	1	0				3	2	1	0
1	0	0	3	0	3	3	0	1	0	0	2
2	2	0	1	0	7	2	5	0	1	0	2
3	3	0	0	0	9	4	5	0	1	2	0
4	3	0	0	0	9	3	6	0	1	1	1
5	1	1	1	0	6	4	2	0	1	2	0
6	1	1	1	0	6	3	3	0	0	3	0
7	2	0	1	0	7	3	4	1	0	0	2
8	2	1	0	0	8	3	5	1	0	0	2
9	2	0	0	1	6	1	5	0	0	1	2
10	2	1	0	0	8	3	5	1	0	0	2
11	3	0	0	0	9	3	6	1	0	0	2
12	3	0	0	0	9	1	8	0	0	1	2
13	1	0	1	1	4	0	4	0	0	0	3
14	1	0	1	1	4	3	1	1	0	0	2
15	3	0	0	0	9	0	9	0	0	0	3
16	2	0	0	1	6	0	6	0	0	0	3
17	2	0	0	1	6	0	6	0	0	0	3
18	3	0	0	0	9	0	9	0	0	0	3
19	1	1	0	1	5	2	3	0	0	2	1
20	2	1	0	0	8	3	5	0	1	1	0

$\bar{x}_c = 4.85$

APPENDIX LV

EXPERIMENT 13

A Weak Doublet Tested
With a Weak Doublet Noise

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	2	0	0	1	6	2	4	0	0	2	1
2	1	1	0	1	5	1	4	0	0	1	2
3	2	0	1	0	7	3	4	0	1	1	1
4	2	0	0	1	6	0	6	0	0	0	3
5	1	2	0	0	7	2	5	0	0	2	1
6	2	0	1	0	7	4	3	0	1	2	0
7	0	1	0	2	2	7	-5	2	0	1	0
8	0	1	2	0	4	0	4	0	0	0	3
9	3	0	0	0	9	1	8	0	0	1	2
10	2	0	0	1	6	0	6	0	0	0	3
11	2	1	0	0	8	1	7	0	0	1	2
12	3	0	0	0	9	0	9	0	0	0	3
13	2	0	0	1	6	3	3	0	1	1	1
14	3	0	0	0	9	0	9	0	0	0	3
15	3	0	0	0	9	0	9	0	0	0	3
16	1	1	1	0	6	6	0	2	0	0	1
17	3	0	0	0	9	0	9	0	0	0	3
18	3	0	0	0	9	0	9	0	0	0	3
19	1	1	1	0	6	2	4	0	1	0	2
20	1	1	1	0	6	1	5	0	0	1	2

$\bar{x}_c = 5.15$

APPENDIX LV

EXPERIMENT 13

A Single Tested with
a Weak Single

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	1	1	1	0	6	2	4	0	1	0	2
2	1	0	1	1	4	2	2	0	1	0	2
3	1	1	1	0	6	3	3	0	1	1	1
4	1	0	2	0	5	5	0	0	0	0	3
5	0	0	3	0	3	2	1	0	0	2	1
6	0	1	1	1	3	4	-1	1	0	1	1
7	1	0	1	1	4	3	+1	1	0	0	2
8	1	0	1	1	4	5	-1	1	0	2	1
9	2	1	0	0	8	5	3	1	2	0	0
10	0	1	1	1	3	5	-2	1	1	0	1
11	1	0	1	1	4	1	3	0	0	1	2
12	2	0	0	1	6	1	5	0	0	1	2
13	3	0	0	0	9	2	7	0	1	0	2
14	3	0	0	0	9	1	8	0	0	1	2
15	3	0	0	0	9	3	6	1	0	0	2
16	2	0	0	1	6	0	6	0	0	0	3
17	3	0	0	0	9	0	9	0	0	0	3
18	3	0	0	0	9	0	9	0	0	0	3
19	0	1	2	0	4	4	0	1	0	1	1
20	2	0	0	1	6	3	3	0	2	0	1

$\bar{x}_c = 3.30$

APPENDIX LVI

EXPERIMENT 13

A STRONG DOUBLET TESTED AS A STRONG SINGLE

	Sensitivity Scores (A)		Transformed Sensitivity Scores Arcsin Root (A)		Bias Scores (B)
1	.7222		.6466		3.0000
2	.7222		.6466		3.0000
3	.7222		.6466		2.0000
4	.5556		.5354		.7500
5	.5556		.5354		2.0000
6	.8889		.7837		1.6667
7	.8333		.7323		3.2500
8	.3889		.4287		2.6667
9	.7222		.6466		3.0000
10	.7222		.6466		3.0000
11	.5556		.5354		2.5000
12	.5000		.5000		.7500
13	.7778		.6875		3.0000
14	.0000		.0000		2.0000
15	.6667		.6082		3.0000
16	.3889		.4287		3.0000
17	.8333		.7323		3.2500
18	.9444		.8485		2.5000
19	.6111		.5713		2.0000
20	.8333		.7323		2.0000
MEAN (A)	.6472	(TA)	.5946	(B)	2.4167
VAR. (A)	.0472	(TA)	.0320	(B)	.5702

APPENDIX LVI

EXPERIMENT 13

A STRONG DOUBLET TESTED AS A SINGLE WEAK

	Sensitivity Scores (A)		Transformed Sensitivity Scores Arcsin Root (A)		Bias Scores (B)
1	.6111		.5713		3.0000
2	.5556		.5354		3.2500
3	.5000		.5000		1.7500
4	1.0000		.5000		1.0000
5	.7222		.6466		2.0000
6	1.0000		.5000		2.0000
7	.6667		.6082		3.0000
8	.5556		.5354		.7500
9	.4444		.4646		3.0000
10	.3889		.4287		3.0000
11	.7778		.6875		1.0000
12	1.0000		.5000		2.0000
13	1.0000		.5000		1.0000
14	.8333		.7323		.7500
15	1.0000		.5000		2.0000
16	.8333		.7323		3.2500
17	.8333		.7323		3.2500
18	.8333		.7323		3.2500
19	.8889		.7837		2.3333
20	.9444		.8485		1.5000
MEAN (A)	.7694	(TA)	.6020	(B)	2.1542
VAR. (A)	.0410	(TA)	.0154	(B)	.8591

APPENDIX LVI

EXPERIMENT 13

A WEAK DOUBLET TESTED AS A SINGLE WEAK (L.H.S. ELEMENT)

	Sensitivity Scores (A)	Transformed Sensitivity Scores Arcsin Root (A)	Bias Scores (B)
1	0.4444	0.4645	2.0000
2	0.5000	0.5000	2.0000
3	0.5000	0.5000	1.7500
4	0.8333	0.7322	2.0000
5	0.4444	0.4645	2.0000
6	0.6111	0.5713	1.3333
7	0.6111	0.5713	2.0000
8	0.5000	0.5000	2.7500
9	0.8333	0.7322	3.2500
10	0.3888	0.4286	2.0000
11	0.6111	0.5713	3.0000
12	0.7777	0.6874	3.0000
13	0.7777	0.6874	3.0000
14	0.2222	0.3125	3.0000
15	0.8333	0.7322	3.2500
16	0.6666	0.6081	3.4000
17	0.8333	0.7322	3.2500
18	0.9444	0.8485	2.5000
19	0.8333	0.7322	2.2500
20	0.6666	0.6081	3.0000
MEAN (A)	0.6416	(TA) 0.5992	(B) 2.5366
VAR. (A)	0.0365	(TA) 0.0182	(B) 0.3825

APPENDIX LVI

EXPERIMENT 13

STRONG DOUBLETS TESTED
AS STRONG DOUBLETS

	Sensitivity Scores (A)	Transformed Sensitivity Scores Arcsin Root (A)	Bias Scores (B)
1	0.1111	0.2163	1.3333
2	0.8333	0.7322	0.7500
3	0.7777	0.6874	2.5000
4	0.7777	0.6874	1.0000
5	0.7222	0.6465	2.0000
6	0.8888	0.7836	1.6666
7	0.5555	0.5354	3.2500
8	1.0000	0.5000	1.0000
9	1.0000	0.5000	3.0000
10	0.8333	0.7322	3.2500
11	0.8333	0.7322	2.0000
12	1.0000	0.5000	1.0000
13	0.9444	0.8425	1.5000
14	0.6666	0.6081	3.0000
15	0.8333	0.7322	0.7500
16	1.0000	0.5000	1.0000
17	0.8333	0.7322	0.7500
18	0.6111	0.5713	1.0000
19	0.8333	0.7322	0.7500
20	0.6666	0.6081	0.8571
MEAN (A)	0.7861	(TA) 0.6293	(B) 1.6178
VAR. (A)	0.0423	(TA) 0.0206	(B) 0.8324

APPENDIX LVI

EXPERIMENT 13

A SINGLE ELEMENT TESTED
IN A STRONG SINGLE

	Sensitivity Scores (A)	Transformed Sensitivity Scores Arcsin Root (A)	Bias Scores (B)
1	0.6666	0.7222	2.6666
2	0.8888	0.5000	2.0000
3	1.0000	1.0000	1.0000
4	1.0000	0.3333	1.0000
5	0.7222	0.5555	2.0000
6	0.8333	0.6666	2.2500
7	0.7777	1.0000	2.0000
8	0.7777	0.6874	1.0000
9	0.7777	0.6874	3.0000
10	0.7777	0.6874	1.0000
11	0.8333	0.7322	0.7500
12	1.0000	0.5000	1.0000
13	0.8333	0.7322	3.2500
14	0.6111	0.5713	3.0000
15	1.0000	0.5000	1.0000
16	0.8333	0.7322	3.2500
17	0.8333	0.7322	3.2500
18	1.0000	0.5000	1.0000
19	0.7222	0.6465	2.5000
20	0.9166	0.8135	1.4000
MEAN (A)	0.8402	(TA) 0.6490	(B) 1.9158
VAR. (A)	0.0137	(TA) 0.0107	(B) 0.8539

APPENDIX LVI

EXPERIMENT 13

A SINGLE ELEMENT TESTED IN A WEAK DOUBLET

	Sensitivity Scores (A)		Transformed Sensitivity Scores Arcsin Root (A)		Bias Scores (B)
1	0.5000		0.5000		2.2500
2	0.6666		0.6081		2.5000
3	0.4444		0.4645		3.0000
4	1.0000		0.5000		2.0000
5	0.7777		0.6874		2.0000
6	0.6666		0.6081		2.0000
7	0.5000		0.5000		0.7500
8	0.2222		0.3125		3.0000
9	0.3888		0.4286		3.0000
10	0.2777		0.3534		3.0000
11	0.8333		0.7322		2.0000
12	0.7777		0.6874		3.0000
13	1.0000		0.5000		1.0000
14	0.7777		0.6874		3.0000
15	0.7777		0.6874		3.0000
16	0.7777		0.6874		1.0000
17	1.0000		0.5000		2.0000
18	1.0000		0.5000		2.0000
19	1.0000		0.5000		3.0000
20	0.8333		0.7322		2.1428
MEAN (A)	0.7111	(TA)	0.5588	(B)	2.2821
VAR. (A)	0.0612	(TA)	0.0158	(B)	0.5422

APPENDIX LVI

EXPERIMENT 13

A SINGLE ELEMENT TESTED
IN A WEAK SINGLE

	Sensitivity Scores (A)	Transformed Sensitivity Scores Arcsin Root (A)	Bias Scores (B)
1	0.8333	0.7322	2.0000
2	0.6666	0.6081	3.0000
3	0.7777	0.6874	2.0000
4	1.0000	0.5000	3.0000
5	0.6666	0.6081	2.6000
6	0.4444	0.4645	2.5000
7	0.6111	0.5713	3.0000
8	0.5000	0.5000	2.5000
9	0.6666	0.6081	1.0000
10	0.3333	0.3918	2.0000
11	0.7222	0.6465	3.0000
12	0.7777	0.6874	3.0000
13	1.0000	0.5000	1.0000
14	1.0000	0.5000	1.0000
15	0.8333	0.7322	0.7500
16	0.8333	0.7322	3.2500
17	1.0000	0.5000	1.0000
18	1.0000	0.5000	1.0000
19	0.5555	0.5354	2.3333
20	0.7222	0.6465	1.5000
MEAN (A)	0.7472	(TA) 0.5826	(B) 2.0716
VAR. (A)	0.0391	(TA) 0.0101	(B) 0.7496

APPENDIX LVI

EXPERIMENT 13

A WEAK DOUBLET TESTED IN WEAK DOUBLET NOISE

	Sensitivity Scores (A)	Transformed Sensitivity Scores Arcsin Root (A)	Bias Scores (B)
1	0.7222	0.6465	2.5000
2	0.7777	0.6874	3.0000
3	0.8333	0.7322	2.0000
4	0.8333	0.7322	3.2500
5	1.0000	0.5000	2.0000
6	0.7777	0.6874	2.0000
7	0.1111	0.2163	2.0000
8	1.0000	0.5000	3.0000
9	1.0000	0.5000	1.0000
10	0.8333	0.7322	3.2500
11	1.0000	0.5000	2.0000
12	1.0000	0.5000	1.0000
13	0.7222	0.6465	2.0000
14	1.0000	0.5000	1.0000
15	1.0000	0.5000	1.0000
16	0.4444	0.4645	1.0000
17	1.0000	0.5000	1.0000
18	1.0000	0.5000	1.0000
19	0.8333	0.7322	2.0000
20	0.9444	0.8485	2.5000
MEAN (A)	0.8416	(TA) 0.5813	(B) 1.9249
VAR. (A)	0.0507	(TA) 0.0210	(B) 0.6585

APPENDIX LV11

TEST SHEET : EXPERIMENT 14

	CATEGORY 1	2	3	4
BERYLLIUM - MAGNESIUM				
RADIUM - CHROMIUM				
FLUORINE - TUNGSTEN				
CADMIUM - MERCURY				
NITROGEN - PHOSPHORUS				
RADIUM - BARIUM				
BERYLLIUM - HYDROGEN				
STRONTIUM -CALCIUM				
HYDROGEN - ZINC				
THALLIUM - INDIUM				
BORON - NITROGEN				
CADMIUM - RADON				
KRYPTON - SILVER				
FLUORINE - CHLORINE				
BORON - NITROGEN				
MAGNESIUM - BARIUM				
ZINC - URANIUM				
TIN - LEAD				
FLUORINE - IODINE				
MANGANESE - MOLYBDENUM				
COBALT - SILICON				
NITROGEN - COPPER				
BROMINE - CHLORINE				
TIN - NICKEL				
IRON - SILVER				
POTASSIUM - RUBIDIUM				
BORON - ALUMINIUM				
CAESIUM - SILICON				
SODIUM - LITHIUM				
ARSENIC - ANTIMONY				
BISMUTH - PHOSPHORUS				
THALLIUM - ALUMINIUM				

APPENDIX LV11 (Contd)

CHEMISTRY ELEMENT : EXPERIMENT 14

CONDITION

	I			11			111			1V			
Ss	S	N	C	S	N	C	S	N	C	S	N	C	Ss
1	12	0	12	9	0	9	12	0	12	12	0	12	1
2	12	0	12	7	2	5	12	3	9	12	0	12	2
3	12	0	12	6	1	5	11	0	11	5	0	5	3
4	8	0	8	9	1	8	5	3	2	8	3	5	4
5	10	1	9	7	7	0	11	3	8	7	2	5	5
6	12	0	12	8	3	5	6	0	6	7	0	7	6
7	12	0	12	6	6	0	12	6	6	8	0	8	7
8	9	0	9	9	1	8	9	1	8	8	0	8	8
9	6	2	4	5	4	1	9	2	7	6	1	5	9
10	6	5	1	9	5	4	7	3	4	10	2	8	10
11	8	2	6	3	5	-2	6	3	3	8	5	3	11
12	6	3	3	9	8	1	12	4	8	6	5	1	12
13	7	4	3	4	3	1	7	4	3	3	5	-2	12
14	7	4	3	8	6	2	10	6	4	9	7	2	14
15	10	6	4	10	5	5	10	4	6	10	3	7	15
16	5	3	2	8	7	1	9	5	4	10	3	7	16
17	7	4	3	8	4	4	4	3	1	7	5	2	17
18	7	3	4	7	9	-2	7	3	4	4	0	4	18
19	9	7	2	7	3	4	8	2	6	6	3	3	19
20	9	3	6	6	3	3	9	3	6	7	2	5	20
$\bar{x}$	8.7	2.35	6.35	7.25	4.15	3.1	8.80	2.9	5.90	7.65	2.30	5.35	$\bar{x}$

APPENDIX LV111

EXPERIMENT 14

CONDITION I

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	4	0	0	0	12	0	12	0	0	0	4
2	4	0	0	0	12	0	12	0	0	0	4
3	4	0	0	0	12	0	12	0	0	0	4
4	1	2	1	0	8	0	8	0	0	0	4
5	2	2	0	0	10	1	9	0	0	1	3
6	4	0	0	0	12	0	12	0	0	0	4
7	4	0	0	0	12	0	12	0	0	0	4
8	3	0	0	1	9	0	9	0	0	0	4
9	2	0	0	2	6	2	4	0	0	2	2
10	1	1	1	1	6	5	1	0	2	1	1
11	1	2	1	0	8	2	6	0	0	2	2
12	2	0	0	2	6	3	3	0	1	1	2
13	1	1	2	0	7	4	3	1	0	1	2
14	1	1	2	0	7	4	3	0	1	2	1
15	3	0	1	0	10	6	4	0	2	2	0
16	1	0	2	1	5	3	2	0	0	3	1
17	2	0	1	1	7	4	3	0	1	2	1
18	1	2	0	1	7	3	4	0	0	3	1
19	2	1	1	0	9	7	2	1	2	0	1
20	2	1	1	0	9	3	6	0	1	1	2

$\bar{x} = 6.35$

APPENDIX LV111

EXPERIMENT 14

CONDITION 11

Ss	S				S(T)	N(T)	CORR	N			
	3	2	1	0				3	2	1	0
1	3	0	0	1	9	0	9	0	0	0	4
2	2	0	1	1	7	2	5	0	0	2	2
3	2	0	0	2	6	1	5	0	0	1	3
4	3	0	0	1	9	1	8	0	0	1	3
5	0	3	1	0	7	7	0	1	1	2	0
6	3	0	1	0	8	3	5	1	0	0	3
7	2	0	0	2	6	6	0	2	0	0	2
8	3	0	0	1	9	1	8	0	0	1	3
9	1	1	0	2	5	4	1	0	1	2	1
10	3	0	0	1	9	5	4	0	2	1	1
11	0	1	1	2	3	5	-2	0	1	3	0
12	3	0	0	1	9	8	1	1	2	1	0
13	1	0	1	2	4	3	1	0	1	1	2
14	1	2	1	0	8	6	2	1	3	0	0
15	2	2	0	0	10	5	5	1	1	0	2
16	2	0	2	0	8	7	1	2	0	1	1
17	1	2	1	0	8	4	4	0	1	2	1
18	2	0	1	1	7	9	-2	2	1	1	0
19	2	0	1	1	7	3	4	0	1	1	2
20	2	0	0	2	6	3	3	0	1	1	2

$\overline{X} = 3.10$

APPENDIX LV111

EXPERIMENT 14

CONDITION 111

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	4	0	0	0	12	0	12	0	0	0	4
2	4	0	0	0	12	3	9	1	0	0	3
3	3	1	0	0	11	0	11	0	0	0	4
4	1	1	0	2	5	3	2	0	1	1	2
5	3	1	0	0	11	3	8	0	0	3	1
6	2	0	0	2	6	0	6	0	0	0	4
7	4	0	0	0	12	6	6	2	0	0	2
8	3	0	0	1	9	1	8	0	0	1	3
9	3	0	0	1	9	2	7	0	0	2	2
10	2	0	1	1	7	3	4	0	1	1	2
11	1	1	1	1	6	3	3	0	0	3	1
12	4	0	0	0	12	4	8	1	0	1	2
13	3	0	1	1	7	4	3	0	1	2	1
14	2	2	0	0	10	6	4	0	2	2	0
15	3	0	1	0	10	4	6	0	0	4	0
16	2	1	1	0	9	5	4	0	1	3	0
17	1	0	1	2	4	3	1	0	1	1	2
18	1	1	2	0	7	3	4	0	0	3	1
19	2	1	0	1	8	2	6	0	0	2	2
20	1	1	1	1	6	3	3	0	1	1	2

$\bar{x} = 5.75$

APPENDIX LVIII

EXPERIMENT 14

CONDITION IV

	S				S(T)	N(T)	CORR	N			
Ss	3	2	1	0				3	2	1	0
1	4	0	0	0	12	0	12	0	0	0	4
2	4	0	0	0	12	0	12	0	0	0	4
3	1	1	0	2	5	0	5	0	0	0	4
4	2	1	0	1	8	3	5	0	1	1	2
5	1	1	2	0	7	2	5	0	0	2	2
6	2	0	1	1	7	0	7	0	0	0	4
7	2	1	0	1	8	0	8	0	0	0	4
8	2	1	0	1	8	0	8	0	0	0	4
9	1	1	1	1	6	1	5	0	0	1	3
10	3	0	1	0	10	2	8	0	0	2	2
11	0	4	0	0	8	5	3	0	2	1	1
12	2	0	0	2	6	5	1	1	2	0	1
13	1	0	0	3	3	5	-2	1	1	0	2
14	2	1	1	0	9	7	2	1	1	2	0
15	3	1	0	0	10	3	7	0	0	3	1
16	3	0	1	0	10	3	7	0	1	1	2
17	1	1	2	0	7	5	2	0	2	1	1
18	1	0	1	2	4	0	4	0	0	0	4
19	1	1	1	1	6	3	3	0	1	1	2
20	2	0	1	1	7	2	5	0	1	0	3

$\bar{x} = 5.35$

APPENDIX LXI

EXPERIMENT 14

ANOVAR (VARIANCES I - IV)

Ss	I	II	III	IV	Row (Ss) $\bar{x}$	Row (Ss) S.D.
1	12	9	12	12	11.25	1.5
2	12	5	9	12	9.5	3.32
3	12	5	11	5	8.25	3.78
4	8	8	2	5	5.75	2.87
5	9	0	8	5	5.50	4.04
6	12	5	6	7	7.50	3.11
7	12	0	6	8	6.50	5.0
8	9	8	8	8	8.25	0.5
9	4	1	7	5	4.25	2.5
10	1	4	4	8	4.25	2.87
11	6	-2	3	3	2.50	3.32
12	3	1	8	1	3.25	3.30
13	3	1	3	-2	1.25	2.36
14	3	2	4	2	2.75	0.96
15	4	5	6	7	5.5	1.29
16	2	1	4	7	3.5	2.65
17	3	4	1	2	2.5	1.29
18	4	-2	4	4	2.5	3.0
19	2	4	6	3	3.75	1.71
20	6	3	6	5	5.0	1.41
$\bar{x}$	6.35	3.10	5.90	5.35		
S.D.	4.004	3.16	2.88	3.45		

APPENDIX LXI (Contd)

EXPERIMENT 14

ANALYSIS OF VARIANCE SUMMARY

TREATMENT MEANS

I	II	III	IV
6.35	3.1	5.9	5.35

Treatment Sdevs

4.00362	3.16061	2.88189	3.45307

Newman-Keuls Root N*MS (Residual) Statistic

10.8846

Sums of Squares:	Between S 541.05		DF 19
Mean Sums of Sqrs:	Between S	28.4763	
Sums of Squares:	Within S 462.5		DF 60
Mean Sums of Sqrs:	Within S	7.70833	
Sums of Squares:	Treatment 124.85		DF 3
Mean Sums of Sqrs:	Treatment	41.6165	
Sums of Squares:	Residual 337.65		DF 57
Mean Sums of Sqrs:	Residual	5.92369	

F Ratio: 7.02544 DF (3 , 57)

SCHEFFE COMPARISONS

Means for comparison
6.35, 3.1
Number for each mean
20, 20
F Ratio 5.94365 DF (3 , 57)

Means for comparison
6.35, 5.9
Number for each mean
20, 20
F Ratio: .11395 DF (3 , 57)

Means for comparison
3.1, 5.9
Number for each mean
20, 20
F Ratio: 4.41166 DF (3 , 57)

Means for comparison
3.1, 5.35
Number for each mean
20, 20
F Ratio: 2.84873 DF (3 , 57)

APPENDIX LX11

EXPERIMENT 14

SENSITIVITY SCORES (A)

	CONDITIONS			
	1	11	111	1V
1	1.0000	0.8750	1.0000	1.0000
2	1.0000	0.7500	0.8750	1.0000
3	1.0000	0.6875	1.0000	0.7500
4	1.0000	0.8437	0.5937	0.7812
5	1.0000	0.5312	1.0000	0.8750
6	1.0000	0.8437	0.7500	0.8750
7	1.0000	0.5000	0.7500	0.8750
8	0.8750	0.8437	0.8437	0.8750
9	0.6250	0.5312	0.8125	0.8125
10	0.5625	0.7812	0.7187	0.9375
11	0.9375	0.3125	0.6875	0.7500
12	0.6250	0.6562	0.8750	0.5000
13	0.7187	0.5312	0.6562	0.4062
14	0.7187	0.4062	0.8750	0.6562
15	0.8125	0.7500	0.8750	1.0000
16	0.5937	0.5625	0.8125	0.9062
17	0.6562	0.8125	0.5312	0.6250
18	0.7812	0.4062	0.8125	0.7500
19	0.6250	0.7187	0.8125	0.6875
20	0.8750	0.6250	0.6666	0.9166
MEAN (A)	0.8203	0.6484	0.7973	0.7989
VAR. (A)	0.0277	0.0283	0.0169	0.0264

APPENDIX LXII

EXPERIMENT 14

TRANSFORMED SENSITIVITY SCORES -
ARCSIN ROOT (A)

	CONDITIONS			
	I	II	III	IV
1	0.5000	0.7699	0.5000	0.5000
2	0.5000	0.6666	0.7699	0.5000
3	0.5000	0.6223	0.5000	0.6666
4	0.5000	0.7412	0.5600	0.6901
5	0.5000	0.5199	0.5000	0.7699
6	0.5000	0.7412	0.6666	0.7699
7	0.5000	0.5000	0.6666	0.7699
8	0.7699	0.7412	0.7412	0.7699
9	0.5804	0.5199	0.7149	0.7149
10	0.5398	0.6901	0.6441	0.8391
11	0.8391	0.3776	0.6223	0.6666
12	0.5804	0.6011	0.7699	0.5000
13	0.6441	0.5199	0.6011	0.4399
14	0.6441	0.4399	0.7699	0.6011
15	0.7149	0.6666	0.7699	0.5000
16	0.5600	0.5398	0.7149	0.8018
17	0.6011	0.7149	0.5199	0.5804
18	0.6901	0.4399	0.7149	0.6666
19	0.5804	0.6441	0.7149	0.6223
20	0.7699	0.5804	0.6081	0.8135
MEAN (TA)	0.6007	0.6018	0.6534	0.6591
VAR. (TA)	0.0113	0.0134	0.0094	0.0152

APPENDIX LXII

EXPERIMENT 14

BIAS SCORES (B)

	CONDITIONS			
	I	II	III	IV
1	1.0000	3.2000	1.0000	1.0000
2	1.0000	2.6666	0.8000	1.0000
3	1.0000	3.2000	2.0000	3.3333
4	3.0000	3.0000	3.0000	2.0000
5	2.0000	1.7500	2.0000	2.5000
6	1.0000	1.0000	3.3333	3.2000
7	1.0000	1.0000	0.6666	3.2000
8	3.2000	3.0000	3.0000	3.2000
9	3.0000	2.5000	2.5000	3.0000
10	2.0000	1.5000	2.5000	2.3333
11	2.3333	2.5000	2.5000	1.6666
12	3.0000	1.0000	0.8000	1.5000
13	2.3333	3.0000	2.3333	3.2000
14	2.2500	1.4000	1.5000	1.5000
15	1.5000	1.3333	2.2000	2.0000
16	2.6000	1.0000	2.0000	2.0000
17	2.3333	2.0000	3.0000	2.0000
18	2.3333	1.0000	2.4000	3.3333
19	1.3333	2.5000	2.5000	2.5000
20	2.0000	3.0000	1.8000	2.2500
MEAN (B)	2.0108	2.0774	2.0916	2.3358
VAR. (B)	0.5788	0.7405	0.6246	0.5970

APPENDIX LXIII

EXPERIMENT 14

PRODUCT MOMENT CORRELATIONS

The Intercorrelations of Signal, Noise and Correlated Scores

	S	N	C		S	N	C		S	N	C
1	12	0	12	28	9	1	8	55	10	3	7
2	12	0	12	29	5	4	1	56	7	5	2
3	12	0	12	30	9	5	4	57	4	0	4
4	8	0	8	31	3	5	-2	58	6	3	3
5	10	1	9	32	9	8	1	59	7	2	5
6	12	0	12	33	4	3	1	60	8	0	8
7	12	0	12	34	8	6	2	61	11	0	11
8	9	0	9	35	10	5	5	62	12	0	12
9	6	2	4	36	8	7	1	63	12	3	9
10	6	5	1	37	8	4	4	64	5	3	2
11	8	2	6	38	7	9	-2	65	11	3	8
12	6	3	3	39	7	3	4	66	6	0	6
13	7	4	3	40	6	3	3	67	12	6	6
14	7	4	3	41	12	0	12	68	9	1	8
15	10	6	4	42	12	0	12	69	9	2	7
16	5	3	2	43	5	0	5	70	7	3	4
17	7	4	3	44	8	3	5	71	6	3	3
18	7	3	4	45	7	2	5	72	12	4	8
19	9	7	2	46	7	0	7	73	7	4	3
20	9	3	6	47	8	0	8	74	10	6	4
21	9	0	9	48	6	1	5	75	10	4	6
22	7	2	5	49	10	2	8	76	9	5	4
23	6	1	5	50	8	5	3	77	4	3	1
24	9	1	8	51	6	5	1	78	7	3	4
25	7	7	0	52	3	5	-2	79	8	2	6
26	8	3	5	53	9	7	2	80	9	3	6
27	6	6	0	54	10	3	7				

APPENDIX LXIII (Contd)

EXPERIMENT 14

80 Pairs
78 df

	S	N	C
S	-	-0.197	0.781**
N	-0.197	-	-0.766**
C	0.781*	-0.766**	-

So Noise is independent of Signal values.

r (78) = r = 0.287 1% level

r = 0.229 5% level

	$\bar{x}$	S.D.
S	8.10	2.34
N	2.93	2.27
C	5.18	3.56

	5%	1%
r(80)	0.217	0.283
r(70)	0.232	0.302
r(78)	0.229	0.287

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