A COGNITIVE ANALYSIS OF DISCOURSE PROCESSING IN NATIVE AND NON-NATIVE SPEAKERS OF ENGLISH

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ABSTRACT

This study establishes a quantitative and qualitative difference in the pattern of text processing of native and non native speakers of English. The psychological nature of this difference is explored in five studies. They reveal the following influences.

1 - Non-native speakers are disadvantaged when text processing relies on mental operations which are based on schema representations of the language e.g. assumption, evaluation and interpretation. They are not disadvantaged when processing is based on mental operations more related to ability like deducing and inferring. A test of these five mental processes was constructed especially for this investigation.

2 - The study also reveals that native speakers benefit almost twice as much from repeated presentations of the same text. The improvement, however, is limited to certain types of test items.

3 - The processing difference between native and non-native speakers of English was elucidated when analysed in terms of the current expert/novice paradigm. Factors and strategies which differentiate expert learners from novices were also seen to differentiate between native and non-native speakers of English.

4 - The contribution of ability to text processing is studied under a condition of varying relationship between past experience and learning content. The results show that learners' performance is quantitatively and qualitatively different when faced with schema related as against schema unrelated texts. A reciprocal function is observed when the non-schema relevant group compensates for lack of past experience by making use of deductive reasoning. On the other hand, learners in the schema relevant condition make minimum call upon this ability.

5 - The generality of the influence of cognitive group membership (e.g. identical native language, similarity of past experience) was tested by comparing the processing patterns of 'A' level students doing the same science subject (physics) with students doing an arts subject (history). The results support the hypothesis of differential approaches to learning associated with subject discipline. The findings are discussed in the context of positive attempts to improve the processing performance of students operating in a non-native language.

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CHAPTER I

INTRODUCTION

A chance finding of a consistent difference between native and non-native speakers of English when meaningfully subdividing a text, gave rise to some interesting educational and theoretical questions.

INTRODUCTION

It would be possible to present this thesis in a neat and clinical fashion showing questions asked, the theoretical considerations that prompted these questions, the design and operationalization of the study and how the results illuminated both questions and the theory. Instead the approach will be to trace the path of the enquiry as it happened; starts and stops, fruitful alleys and blind ones, failures and successes.

The study started with the general interest in schema theory as applied to comprehension. It was inspired by a serendipitous finding which is referred to in a Ph.D thesis done at the Institute of Education, London (Matambo, 1982).

In 1982, two experiments were carried out using Johnson's (1970) procedure (Matambo, 1982; Fourali, 1982). This procedure was set up in order to segment written information into 'pausal units' P.Us. Thus, subjects were requested to indicate where pausing might occur, to 'catch a breath, to give emphasis to the story, or to enhance meaning' (Johnson, 1970, p.13). Johnson (ibid), subsequently, obtained a qualitative differentiation of these units, by having them rated according to their importance to the text's theme. Both Matambo (1982) and Fourali (1982) noted that Native-Speakers (NS) of the English language tended to differ from Non-Native-Speakers (NNS) of that language in the way they arrange their pauses whilst subdividing a text.

A first systematic analysis of these observations carried out by Matambo (1982) showed consistently, that throughout 3 texts dealing with such topics as war, psychology and plants, NS tended, not only to make more pauses than NNS, but also to insert them at particular points within the text. There was a high degree of within group concordance with large between group differences. The contingency coefficient testing the between group differences gave χ^2 = 17.29,df=1, P<.001, for the psychology text; χ^2 =4.97, df=1,P<.05 for the war text; and χ^2 =26.99,df=1,P<.001 for the plant passage. In other words, the NS identified more pauses. The tendency was for both groups to agree on a number of pause locations with the NS going on to specify other pauses not accepted by the NNS. The NNS rejected 13 stops out of 21 (i.e. 61%) accepted by at least 50 per cent of NS. (To maintain homogeneity, within groups pauses were scored only when at least 50 per cent of the group accepted the positioning. Even, according to a more stringent criterion, 70% agreement, the tendency remains the same). The NNS also rejected 20 out of 36 (55%) and 6 out of 19 (31%) in the other 2 passages.

However, it was necessary to replicate the findings if they were to be considered valid since there were only 10 subjects in each sample group.

The same pattern of results was shown in a repeat study by Thatha (1983). In this study, the number of subjects was increased to 15 in each group. The results were quite consistent

with the previous ones. The differences between the 2 groups were still maintained, although not as clearly as before. The contingency coefficients found were:

χ^2=12.31, df=1, P<.001 (psychology text); χ^2=4.18, df=1, P<.05 (war text); χ^2=7.29, df=1, P<.01 (Plant text).

If these findings do reflect a reliable and consistent trend in behaviour patterns, then they are of theoretical and educational value. From a research point of view, the challenge would be to isolate the determinants of the observed differences. A number of possible theoretical models could be invoked to explain the mechanisms behind the differences. These would include a model based on the information processing of the learner , the learner's experience with the content of the subject matter, the learner's cognitive ability and also the learner's experience with the language.

The focus of research would be to examine the explanatory power of each of these to identify the relative contributions of each. On the education side, the practical advantage of assisting non-native speakers of a language to process written information using similar mechanisms as native speakers is obviously attractive. The possibility of identifying a simple method of operationalizing the difference in processing technique, i.e. P.U. , is itself a worthwhile educational target.

CHAPTER II

In order to verify the reported findings of Matambo and Thatha, a study was designed as a new replication using an increased sample of 40 subjects: 20 NS and 20 NNS.

Experiment I

Preparing the learning material

A number of conditions were observed when preparing the English text to be used (see A. Matambo, 1982).

1 - The text had to be self-contained.

2 - The text had to be equally familiar to all subjects regardless of their level and ability in different disciplines.

3 - The text had to have an argument supported by evidence.

4 - Although equally familiar to all the subjects, the text should require a minimum prior knowledge about the topic so that at the end of the process of reading most of the information would be newly acquired.

5 - Finally, the text should have a reasonable length in order to control the effect of fatigue.

These conditions led to choosing the following texts:

i) Snellgrove (1968) - 'The modern world since 1070' - Hiroshima (698 words).

ii) McKeachie and Doyle - 'Psychology'- The Influence of Heredity and Maturation on Behaviour (713 words).

iii) McKean (1962) - Introduction to Biology - The Stem of a flowering Plant (738 words) (See appendices I-a-b-c)

Subjects

The findings were replicated on the three passages. The first language of the 20 NNS included Danish, Malaysian, Spanish, Chinese, Arabic, Iranian and French. The age range of the group was 18 to 34. Their academic level ranged from secondary to University level.

Procedure

The instructions given were similar to those used in Matambo's research. They were also followed by comments and examples to make sure the subjects understood them (Appendix II). Each subject was told in English:

'Commas and other punctuation marks usually indicate where it would be convenient to pause. They do not indicate all the possible places where a reader could naturally pause. Your task is to put a line through all the places where it occurs to you that there is a pause. I imagine that some pauses will occur after just a few words while others will occur after many more words. This does not matter, neither is it important if the different pauses occur for different reasons. For example, it is likely that one pause may occur simply to enable the reader to catch his/her breath. Another may serve to enhance the meaning and so on: the only restriction on where you place the pause is that it should seem natural to you.'

Each subject was first given the instruction, followed by the text. The subjects were required to mark pauses while reading it. This procedure was repeated for three passages. The order of presentation of the 3 passages was counterbalanced before presenting them to the subject.

Treatment of results

An initial analysis was carried out on the raw data. Before considering the results offered by the contingency tables and to cross check the present results with those of the previously stated findings, a first overall comparison in the total number of allocated P.Us, before the 15 and 50 per cent criteria are introduced, was deemed necessary. That is a preliminary question was aimed at establishing whether there is a difference between NS and NNS in the overall P.Us allocated for each text. A comparison of this category would represent a gross view of the phenomenon which will be further closely looked at.

A t.test was performed to compare the number of P.Us allocated by NS and NNS for each text separately. The P.Us considered for this purpose included those that coincided with punctuation except for full stops. Table (II-1) below shows the result of the t. test for both Thatha's data (1983) and those of the present experiment. The difference in the overall number of P.Us as allocated by both groups of subjects, reached statistical significance, (all at least $p<.05$) throughout the 3 passages for both experiments.

			Passages		
			Hiroshima	Heredity	Stem
M. Thatha (a) (N=30)	NS	$\bar{x}$	43	36.6	40.13
		S.D	12.01	5.89	9.61
	NNS	$\bar{x}$	30.54	27.07	29.40
		S.D	10.43	7.62	8.24
		t(df28)	3.03	3.89	3.32
		P	<.01	P<.001	P<.01

			Passages		
			Hiroshima	Heredity	Stem
C.F(N=40) (b)	NS	$\bar{x}$	43	54	45.80
		S.D	26.15	25	26.14
	NNS	$\bar{x}$	24.85	35.10	26.75
		S.D	13.02	15	23.01
	t (df 38)		2.78	2.02	2.45
	P		<.01	<.05	<.01

Table (II-1): shows the result of the t. test for both Thatha's (a) and the present experiment (b). All NS/NNS differences in number of P.U allocations reached significance level.

Thus the observed difference in P.Us allocation, between NS and NNS, noted by Matembo (Ibid.) and Thatha (Ibid.) appears to be already present in the data even before any refinement of the raw scores is introduced.

The next question considered the data from a closer perspective, after a) the omission from the analysis of all pauses that coincided with punctuation marks; b) the introduction of the 15 and 50 percent criteria. These criteria were defined as follows:

A P.U was considered to be above chance level, if at least 15% of the sample indicated it. For group acceptance however, it had to be marked by 50 per cent or more of each sample. All P.Usswhich coincided with marked punctuation marks such as full stops, commas, semi colons, colons etc were omitted from the analysis. Only those which the subject imposed unaided were retained in the analysis. The criterion for accepting a P.U was therefore:

Each P.U marked by 50 per cent or more of the NS was judged accepted by that group. Similarly, those agreed by 50 per cent or more of the NNS were considered accepted by the group. P.Usmarked by less than 50 per cent were judged unaccepted by this group.

In practice, there was a clear difference in responses between P.Us which were accepted and those which were rejected. The range of accepted and non accepted P.Us are given in Appendices (III a,b,c).

Results

Tables (III-a,b,c) in the Appendix show all the P.Us and the rating given by the NS and the NNS for each article. A contingency table was drawn up summarizing the level of agreement and disagreement between the two groups. The contingency table used the P.U as its unit of analysis. Each unit received a Yes or No judgement from each independent group of students. There is no overlapping category in the contingency table, since each unit is placed in a discrete category by the judges (e.g. table II-2a,b,c).

It is worth noticing that the 20 NS and 20 NNS judges serve simply as an independent criterion for classifying the P.U into the accepted or non-accepted category. Therefore, the contingency table is divided into acceptable and non-acceptable P.Us. This satisfies the independence of responses required for a contingency table. Each contingency table drawn up for each article in this experiment was followed by contingency tables from Matembo's and Thatha's studies on the same article.

The analysis carried out was aimed at establishing the degree of discrepancy or similarity in the contingency tables. Thus a contingency coefficient analysis was adopted to look at the differences between the ratings of first and second language users. This was repeated for the three articles (see Appendices Iv-a(1)b(1),C(1).

Table (II-2): Relation between acceptable and non-acceptable units for the Hiroshima passage.

a) experiment 1 (Matembo, 1982)

P.Us allocated by NNS	P.Us allocation by NS: 50+ (Yes)	15-50 (No)	
50+ (Yes)	16	6	22
15-50 (No)	20	29	49
	36	35	71

$\chi^2 = 4.97$

b) experiment 2 (Thatha, 1983)

P.Us allocated by NNS	P.Us allocation by NS: 50+ (Yes)	15-50 (No)	
50+ (Yes)	5	4	9
13-50 (No)	14	50	64
	19	54	73

$\chi^2 = 4.18$

c) experiment 3 (Fourali, present one)

		P.Us allocated by NS		
		50+ (Yes)	15-50 (No)	
P.Us allocated by NNS	50+(Yes)	7 1.9	4 9.1	11
	15-50(No)	6 11.1	58 52.9	64
		13	62	75

$\chi^2 = 17.72$

Table (II-2), showing degree of agreement on pausal units as given by Native and Non Native Speakers of English for 'Hiroshima' passage. The 3 experiments are compared (c.f calculations are reported in Appendix IV).

The χ^2 applied to the Hiroshima passage for the present experiment showed a difference of $\chi^2 = 17.72$, df=1 (see Appendix Iv, for calculations). This was highly significant (P<.001), even more significant than the results obtained for the two previous studies. A further depth analysis of the contribution of each cell to the χ^2 results was carried out as recommended by Guilford (1965 p.232). Thus taking only the cells 'a_2' and 'b_1', that is those showing the disagreement between the 2 groups, the obtained $\chi^2 = 6.26$ df=1, was significant (p<.05). In fact, the main difference seems to be concentrated in cell 'b_1', that

is on the number of pauses accepted by NS and yet rejected by NNS. Hence, the present study does reaffirm the previous findings. Conversely, the number of P.Us rejected by NS out of those accepted by NNS is comparatively insignificant. As pointed by Matembo (Ibid.) in his research the data pose a different slant from what would logically be expected. The NNS, as second language users, would normally be expected to use more, rather than less mental pauses for the proper comprehension of a text. Here, the opposite seems to be the case.

One wonders if the results do reflect a genuine difference between the two groups. In fact it could be possible that the subjects are just putting the pauses hap-hazardly. The obtained coefficients of concordance for 2 by 2 contingency table as outlined by Croxton and Cowden (1962) r=o.30, r=0.25 r=.50) do suggest that it is not the case since the obtained correlations show that there is a basic level of agreement between NS and NNS. (Appendices IV-a (2), b(2)c(2) for calculations) This agreement can be more closely verified by looking at the contingency tables where the majority of the pauses rejected by one group are also rejected by the other.

Table II-3): Relation between acceptable and non-acceptable units for the 'Heredity' passage.

a) experiment 1 (Matembo, 1982)

		P.Us allocated by NS: 50+ (Yes)	P.Us allocated by NS: 15-50 (No)	
P.Us allocated by NNS	50+ (Yes)	8	2	10
	15-50 (No)	13	49	62
		21	51	72

$\chi^2 = 17.29$

b) experiment 2 (Thatha, 1983)

		P.Us allocated by NS: 50+ (Yes)	P.Us allocated by NS: 15-50 (No)	
P.Us allocated by NNS	50+ (Yes)	8	3	11
	15-50 (No)	7	39	46
		15	42	57

$\chi^2 = 12.31$

c) experiment 3 (present one)

		P.Us allocated by NS: 50+ (Yes)	P.Us allocated by NS: 15-50 (No)	
P.Us allocated by NNS	50+ (Yes)	8 (1.3)	2 (8.7)	10
	15-50 (No)	7 (13.7)	95 (102)	102
		15	97	112

$\chi^2 = 38.45$

Table (II-3) showing degree of agreement on P.Us as given by NS and NNS of English for the 'Heredity' passage. The 3 experiments are compared. (details of calculations of both χ^2 and 'rs' is in Appendix IV).

Looking at the article on 'Heredity', (Table II-3) again we find the same level of significance in the newly obtained results (χ^2=38.45) and the previous ones (χ^2=17.29 - A.M and χ^2=12.31-MT). All of them significant at .001 level. The χ^2 based on the disagreement cells (a_2,b_1) was also significant (χ^2=9.67, df=1, p<.01). The Croxton and Cowden coefficients showed again a basic level of agreement (M; r=.48;T;r=.51; F;r=.61). The resulting trend is confirmed since NNS repeatedly:

a - indicate less pauses than the NS.

b - reject a large number of the units approved by the NS.

Before going further, one important point has to be made. It is that in both experiments, all the used articles were punctuated. Thus the P.Us that coincided with the punctuation were not taken into account. This, it is believed, has cut down the differences between NS and NNS groups.

Table (II-4): Relation between acceptable and non-acceptable units for the 'stem' passage.

a) experiment 1 (Matembo, 1982)

		P.Us allocated by NS		
		50+ (Yes)	15-50 (No)	
P.Us allocated by NNS	50+ (Yes)	13	0	13
	15-50 (No)	6	29	35
		19	29	48

$\chi^2 = 26.99$

b) experiment 2 (Thatha, 1983)

		P.Us allocated by NS		
		50+ (Yes)	15-50 (No)	
P.Us allocated by NNS	50+ (Yes)	8	4	12
	15-50 (No)	13	45	58
		21	49	70

$\chi^2 = 7.29$

c) experiment 3 (present one).

		P.Us allocated by NS		
		50+ (Yes)	15-50 (No)	
P.Us allocated by NNS	50+ (Yes)	7	2	9
	15-50 (No)	11	73	84
		18	75	93

$\chi^2 = 19.94$

Table (II-4), showing the degree of agreement on P.Us as given by NS and NNS for the 'Stem' passage. The 3 experiments are compared. (calculations are in Appendix IV).

The analysis for the 'stem' article (Table II-4) showed the same trend observed for the two previous articles. That is there a general level of agreement concerning Pausal recognition, with NS consistently accepting a higher number of pauses. Once more all the obtained χ^2 showed a high degree of significance with M. (26.99,P<.001); T. (7.29,P<.01) and F. (19.94,P<.001).

The χ^2 yielded by cells a_2 and b_1, was also significant ($\chi^2 = 6.61$, df=1,P<.05).

It seems that the overall results shown for the more recent experiment conform to those of the former ones. There is a tendency in the NNS to omit mental pauses which are

deemed necessary for proper comprehension by the NS of the language. This outcome must be of some educational relevance as already indicated.

Thus, it was seen that the previous results (Matembo, 1982; Thatha, 1983) are repeatable both in terms of number of P.Us and their positions.

The next stage of the enquiry is to try to identify which among the possible explanations account best for the obtained difference.

Before embarking on this investigation, a qualitative analysis and description of the phenomenon seems appropriate. The question is, how is this difference between NS and NNS reflected in other than quantitative terms.

CHAPTER III

QUALITATIVE ANALYSIS

In order to investigate the phenomenon qualitatively, an experiment was set up where both NS and NNS were repeatedly presented with the same text for a total of 5 trials over 4 days - twice on the first day.

Thirty four subjects were given the Hiroshima article and asked to place P.Us. The data suggest areas of structural blind spots; where NS placed pauses and the NNS did not.

Qualitative Analysis

The qualitative analysis proceeded by first identifying the P.Us on which both groups disagree. Then, it sought to detect existing patterns in the text where these disagreements occured. For this purpose the pauses made by 50% and over at every word were considered.

Two tables were drawn up for the NNS and NS. See Appendices VI, a,b. The tables show the number of each group pausing after any given word of the text. Only words where 50% or over paused on at least one trial are included in the Tables. For clarity, an example from the NNS table is given below. The complete tables are on Appendices VI,a,b.

Words of Text	% pausing after each word Trials 1 2 3 4 5	Comment
For	/ / / / /	% responses exceeds 50% on no trial. Hence omit from table.
Some	/ / / / /	" " " " " " " " " "
Years	27 36 45 45 54	% response exceeds 50% on fifth trial.
Scientists		
had		
known		
that		
if		
an		
atom	50 59 73 63 63	
	/ / / / /	
	/ / / / /	
Explosive	77 77 86 86 86	
in	/ / / / /	
1939	41 45 45 50 59	

Table III-1: explaining the 50% criterion for selection of accepted Pauses.

The Hiroshima Text used in this experiment, had all its punctuation marks removed; except capital letters in names of people and places, were retained, as well as the paragraphs. Hence it was possible to include in this analysis also the pauses that in the previous text coincided with the punctuation marks (Appendix V).

The raw data were convered for qualitative comparison. A Table of disagreement was then constructed using a gap of 30% or more as the criterion for inclusion in the analysis. Table III-2 gives the words marking the positions where the groups diverged in their judgement. The percentage gap is also indicated.

	Trial 1	%	Trial 2	%	Trial 3	%	Trial 4	%	Trial 5	%
1	physicist	31	years	39	Fermi	37	physicist	30	physicist	41
2	1945	34	physicist	39	reaction	46	Einstein	37	Einstein	37
3	away	37	Fermi	49	sound	38	Fermi	53	Fermi	53
4	light	32	reaction	31	oven	32	reaction	45	war	35
5	fire	32	proportion	42	it	33	Gay	40	reaction	40
6	faces	30	mornings	32	bodies	51	sound	30	sound	30
7	bodies	34	opened	37	breakfast	41	faces	32	oven	46
8	trees	34	sound	34	blaze	49	exclaimed	38	slowly	46
9	escape	37	it	32	flames	37	since	35	faces	41
10	bomb	41	faces	46	disease	41	bomb	39	bodies	45
11	flames	37	bodies	42	day	46	day	46	breakfast	50
12	exclaimed	34	ground	37	innocent	37	Hiroshima	41	disease	41
13	died	32	bomb	41					bomb	30
14	disease	31	flame	37					day	53
15	day	46	exclaimed	46						
16	innocent	32	died	32						
17			disease	53						
18			bomb	30						
19			day	46						
20			innocent	33						
$\bar{X}$		34.6		38.9		40.6		38.8		42

Table III-2. Pausal disagreement of 30% or more between NS and NNS percentage scores are calculated by subtracting percentage of NNS allocating the pause at the same place. With successive trials, there is two observed tendencies. The first is a reduction in disagreement as measured by the number of P.U allocations indicated. The second is an increase in disagreement as measured by the gap between the number of NS and NNS disagreeing on the location.

As would be expected, percentage scores were positive. This followed our previous quantitative result that native speakers tended to draw more P.Us than the rest. In fact all the percentages were positive.
Also in the first two trials there seem to be more observed differences, an average of 18 words compared to 12.6 words for the three remaining trials. This could mean that although NS seem to be quicker in recognizing some pauses on the first trial, NNS tend to recognize them when given a second chance at the task. However, the average of the difference scores for each trial tend to increase with practice.

In the early stages, the NS identify many more P.U locations. By the 3rd Trial, however, the NNS start to identify some of the previously omitted pauses. The observed tendency for the gap between the groups i.e. the degree of disagreement, to widen over trials could be explained by the fact that only part of the NNS group were recovering from the blind spot effect and recognising the previously omitted locations for pauses.

However, there were some pauses that NS consistently recognised and which NNS did not. Hence it was judged of importance to focus on these consistent differences (i.e. the pauses that NS took as regular and the NNS did not).

Thus any pause whose obtained difference is 30% or above and which was repeated over 4 or 5 trials was selected for further analysis. There were eight such locations (Appendix VII (a)). Subsequently the textual locations obtained in this manner were regarded as indicating structural blind spots that the NNS seemed to ignore.(1)

In an attempt to reach some explanations about this observed difference, 3 experts in English, all native graduate teachers of English were invited to offer any suggestions e.g. try to discern any pattern or underlying structure characteristic of these observed P.U locations in the text (Appendix VII). On the whole, apart from the tendency of the NS to dissect more the parts of a sentence (e.g. dependent clause and main one such as pausing after 'proportion' in line 11; or change in subject after the verb 'opened' in line 22); it seems that NS identify better not only the various parts of different ideas but also when and where each one starts and finishes (e.g. it was suggested that some differences in pausing may have been a consequence of a failure by NNS to recognize the function of a word; thus taking a name for a verb such as 'light' in line 27. Or line 29 where the idea finishes at the word 'been' but the NNS stopped only two words later, including them to the previous idea. Another reason of disagreement could be the pausing by NS for dramatic effect e.g. after 'sound' in line 26.

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(1) the issue of whether this 'attitude' is conscious or unconscious is still open to question.

Considering these different suggestions, a number of reasons can be put forward to account for the observed differences. The following ones are those that were thought the most important:

1 - to separate ideas
2 - dramatic effect
3 - unconscious cues (triggering effect)
4 - unfamiliarity
5 - to complete idea units (self contained idea unit, i.e. setting up a unit)
6 - end of lengthy predicate (or subject)
7 - enumerating

Looking back at the group of locations where the differences between N.S and NNS was consistent (4 and 5 times) it was felt that this later group did not seem to be sensitive to the following textual situations:

1. separation of noun from action
2. separation of descriptive phrases (ideas) from events
3. separation of repeated phrases or ideas

Thus all these eight significant pauses could be put under either of the three above mentioned categories.
In fact the second category seems to include most of the observed disagreements as shown below.

Category I	Category II	Category III
physicists		
Fermi		
	- reaction	
	- sound	
	- faces	
	- books	
	- diseases	
		day

Table III-3. Three categories of failures to account for NNS structural blind spots and their corresponding pauses in the Hiroshima text.

The NS identify more easily not only the general ideas of the text but also their components - or subcomponents. Thus it appears that even if a non native speaker reaches 'mastery' of the English language, there may still be some deficiency regarding certain structural or cognitive components that prevent him/her from attending to all the constituent parts of the information. This level of mastery would have been acquired by NS at some earlier stages. A more thorough investigation of these blind spots would represent a significant contribution to the knowledge of NS/NNS differences.

Finally, another aspect of the qualitative analysis attempted to check whether there was any story grammar effect. (Thorndyke, 1977).

Researchers such as Rummelhart (1975) and Thorndyke (1977) have tried to extend the case grammar issue and its set of rules for finding the relationships between a predicate and its argument (Fillmore, 1968) in a sentence, to the field of story writing. The result of this endeavour led to the suggestion of some parsing rules that specify the relations among simple sentences within a story. (Thorndyke, 1977). These can be summarized as follows (Mayer, 1981).

Rule 1 : STory = Setting + Theme + PLot + Resolution.

These four categories are said to include each of the simple sentences that make up a story.

Each of the four categories was further subdivided into its constituent parts. This description into the subcomponents led to the formulation of the following rules:

Rule 2: Setting = Characters + Location + Time

Thus a setting generally includes the characters that took part in a story, as well as the specific location and time.

Rule 3: Theme = Event(s) + Goal

A story revolves around a theme which generally consists of a number of events that lead to the need of achieving some goal.

Rule 4: Plot = Episode(s)

In order to reach a goal, usually a number of sub goals or episodes have to be realised. Thus:

Rule 4a Episode = Subgoal + Attempt(s) + Outcome

It is also usual that an episode could consist of a number of attempts. Finally:

Rule 5: Resolution = Event or State

Resolution consists of the final outcome of a story. This can either consist of a state or an event.

The aim of this section of the qualitative analysis is to try to ascertain whether the blind spots tend to occur at certain parts of the text (e.g. Setting or Theme) rather than others (e.g. plot or resolution). .

Three native graduate teachers of English were requested to delineate the various parts of the text that represent its story grammar. They were first introduced to this concept and a description was given to them as to what each part of components or subcomponents represent. Once they were satisfied with the description they were provided with a copy of the Hiroshima passage and a pencil to carry out the task.

The 3 obtained constituent parts of the passage are shown on Appendix VII(b). Initially the aim of the three judges was to identify all four parts of the story grammar; but it has been pointed out by all of them that in the Hiroshima text, both setting and Theme are intermingled.(*1) Thus, and for ease of analysis these two ingredients were considered as one whole part.

(*1) There has even been the suggestion that there is more than one theme. One directly expressed at the start of paragraph 2, which is to win and end the war; the other implicit in the author's message and which aims to show how bad are wars and the use of nuclear weapons.

The results were as follows:

Table III-4: showing the occurence of the blindspots at the 3 story grammar levels.

	Setting/Theme	Plot	Resolution
Number of blindspots	3	5	0
Percentage in number of words	1	1	0

These results were not seen as indicative of any tendency. Thus although, one could state that most of the blind spots are gathered around the Plot area as against Setting, Theme and Resolutions parts, the relative proportions corresponding to each of these levels are too disparate to venture any serious interpretation.

A more appropriate situation for this kind of analysis would be a text where the four levels of the story grammar are represented by 4 distinct equivalent paragraphs.

SUMMARY

Further investigation of Matembo's finding reveals the following:

1. The findings are consistent and repeatable.
2. The difference between the NS and the NNS shows a recognisable pattern with both groups identifying the same P.U locations.
3. The NS went further than the NNS and identified more P.Us.
4. The difference between the NS and NNS, having been validated quantitatively was explored qualitatively.
5. The qualitative analysis revealed consistent textual response patterns separating the groups.
6. NNS tended to omit certain categories of pausal locations. These were described as:
   - a - pauses separating noun from action.
   - b - " " descriptive phrases from events.
   - c - " " repetitions of phrases or ideas.
7. The difference between the group P.U allocations was not noticeably affected by story grammar.

The next stage of the research is directed to the identification of underlying differences in methods of processing the textual information.

The approach used was to develop ways of monitoring different types of cognitive processes involved with text comprehension. Then to explore the difference in performance between NS and NNS on each of these processes. Next, to see whether responses on P.U tasks could be explained by differences in performance on these processes.

CHAPTER IV

Overview

This stage of the investigation was devoted to identifying the mental operations which contribute to performance on the P.U test. From these relevant processes, the next step would be to isolate those which discriminated between the NS and NNS. For this purpose a test battery was constructed on the basis of the Watson and Glaser critical thinking test (Appendix VIII) Five essential mental operations were monitored by this battery. These were Inference, Assumption, Interpretation, Evaluation and Deduction. The battery was administered to the groups of NS and NNS students. An intercorrelation matrix suggests that these 5 tests could be grouped into 3 identifiable sets which were labelled 'schema-related', 'ability-related' and a 'unique factor'. The results also showed that the groups differed significantly in terms of the 3 schema-related processes. They did not differ on the ability factor or on the 'unique factor'. In order to account for P.U differences in terms of these underlying mental processes, performances on the test battery were correlated with P.U scores. The correlations were significant for the schema related processes and the unique factor but not for the ability related processes. The results are interpreted to mean that differences in P.U allocation are more related to schematic and unique activities than ability related ones.

CHAPTER IV

UNDERLYING DIFFERENTIATING PROCESSES

Procedure

In order to arrive at an appropriate procedure, the recently developed Expert/Novice paradigm was used as a theoretical frame of reference (Glaser, 1984). Glaser's recent formulations of this paradigm start with the notion that performance results from 3 components: ability, schema and strategy.

The difference between the Novice and Expert in performance is in the way in which each weighs and combines these 3 components. A clearer picture of the way an individual processes information can be obtained by requiring the individual to perform tasks which make different demands on each of the three component processes. If, for example, a task makes heavy demands on a learner's schematic representations and is observed to be better performed by NS, it would be reasonable to suspect that NS are better able to make use of schema than NNS. Similar deductions can be made about the two other components of this paradigm. In general the proponents of this paradigm are saying that Experts may not be more able than Novices but are better at applying schema related strategies. It was necessary therefore to identify a number of different tasks which made different demands on the processer. This implies that tasks can be devised to make different demands on the learner.

Some , for example, would make greater demand on the learner's knowledge. Some make their greatest demand on ability, others require greater use of strategy.

The Watson and Glaser test although subject to criticism (e.g. Levy and Goldstein, 1984) does provide a measure of five complex high level processes. These are: Inference, Assumption, Interpretation, Evaluation and Deduction (Appendix VIII). The name given by the authors to each separate process seems less important than the exact mental process that is being exercised by the testee. Hence it is necessary for our purposes to carry out an analysis of what the subject is expected to do in order to successfully complete the tasks. From this, it may emerge that the processing for each task should be renamed.

Analysis of the Watson and Glaser processes.

Inference

The 'inference' process as defined by Watson and Glaser requires a subject to draw a conclusion from certain observed or supposed facts. Thus, according to Watson and Glaser 'from the electric light visible behind the window shades and from the sound of piano music in a house, a person might infer that someone is at home. But this inference may or may not be correct. Each exercise begins with a statement of facts to be accepted as given. After each statement, the subject is offered several possible inferences and required to make a decision as to its degree of truth and falsity.

Five categories of responses are permitted. An inference may be definitely true, that is, follows beyond any reasonable doubt; or it may be probably true, that is better than an even chance to be true; or there may be insufficient data which means that the information available is not enough to support the inference; or it may be probably false which is better than an even chance to be false; or it may be definitely false, that it contradicts the given facts. Watson and Glaser go on to acknowledge that on deciding whether an inference is probably true or false, subjects may have to use commonly accepted knowledge of information. It is worth noticing that our expert judges found it difficult to differentiate between this process and that of 'deduction' which will be considered later. The inference test measures the facility to use schema. This is particularly true for items that are probably true or probably false. In order to arrive at a decision, the subject is expected to assess from past experience the strength of the association between the events described in the given statement of fact and the conclusion reached. If from previous experience these events are inseparable, the answer would clearly be true. If they frequently occur together the answer would be that it is 'probably true'. If they only occur together when some unmentioned event is present, then the answer is 'insufficient data'. If from experience, they occur together only rarely, the answer is 'probably false'. If finally, they never occur together,th

answer is 'false'. The subject must rely on his previous experience schematically organised. From Watson and Glaser's own description 'common knowledge' is a vital ingredient of success in this task.

The difference between these inference tasks and the deduction tasks which will be described later is in the degree of reliance on past experience. Deduction, by its nature is experience free and depends on logical arguments from a given premise. It is unexpected therefore that the three professional judges found difficulty in distinguishing the 'Inference' items from the 'deduction' items. The reason could rest in the failure of Watson and Glaser to adhere rigidly to their own basic principles in constructing the items. A detailed analysis of the items under 'Inference' show that a number of them rested heavily on experience free logical arguments.

Assumption

An 'assumption' is something pre-supposed or taken for granted. When someone states for example, 'I'll graduate in January', he takes for granted or assumes that he will be alive in January, that the school will judge him to be eligible for graduation in January and so on.

The subject is presented with a statement followed by several proposed assumptions. S/He will have to decide which of these are being made (i.e. taken for granted justifiably or not) when making that statement. Two possibilities of answering are offered. An 'assumption' is either 'made' if the subject

thinks it is taken for granted in the statement or 'not made' if s/he thinks it is not necessarily taken for granted. Once more, a heavy reliance on past experience is necessary in order to recognize an assumption. This is clearly shown from the examples given in the Appendix. The assumption is an intermediary process (event) which links the beginning statement and the final conclusion. The question is whether the linking statement is based on logic or past experience. Most of the examples given by Watson and Glaser include both logic and past experience. Hence, in this case, schema availability is quite decisive in carrying out this task.

Interpretation

In the 'interpretation' performance, a short paragraph is read. Subjects are required to assume that all that is read is true. They will have to judge whether or not a proposed conclusion logically 'follows', i.e. beyond a reasonable doubt, although it may not follow absolutely and necessarily. A second possibility is that the conclusion does not follow beyond a reasonable doubt from the facts given. From the example given by Watson and Glaser, it can be noticed that a heavy reliance on intellectual ability is necessary to decide between the two alternatives (test in Appendix VIII) . Let's analyse the mental operations involved.

An 'interpretation' is a reformulation of a previous statement without any elaborations or addition of unstated facts. Whether or not one is dealing with the process of Interpretation, can

be tested by linking the original statement and the concluding statement by the phrase 'From that it appears....'. This process involves a mental comparison between the first statement and the concluding statement to assess whether they are the same. Therefore, here, apart from linguistic mastery, past experience does not seem to be a vital ingredient.

Deduction

For 'deduction', the subject is presented with 2 statements or premises, which have to be taken as true. These are followed by several suggested conclusions, classified into 2 categories: the conclusion either necessarily follows from the given statements; or does not follow whenever it is thought to be unnecessary, although it might be believed to be true from general knowledge. Unlike the case for 'inference' general knowledge can be a hindrance rather than a help. Thus a minimum reliance on schema is encouraged in this exercise. What seems to be mostly stressed in the examples given in the appendix is more 'a logic in the abstract' than background knowledge.

Evaluation

In order to 'evaluate' arguments, the subject is required to differentiate between a 'strong' and a 'weak' argument. A strong argument is the one that is both important and directly related to the question. It is weak if it is not directly related to the question even though it may be of great general importance; or if it is of minor importance; or if it is

related only to trivial aspects of the question.
A series of questions are followed by several arguments, each one regarded as true. The task is to judge an argument to be a strong or a weak one.
As can be seen from the examples given in the test, the ability to judge seems rather important in this task. This includes both culture bound components and ability. Therefore it would seem difficult to account for the relative use of either schema or ability.

The evaluation of this test by Levy and Goldstein (1984) expressed some concern relating to its content and construct validity. These authors do formulate some doubts as regard its reflection of some real life situations where such activities as judgements, inferences and gambles in decision making are involved. Another shortcoming is the lack of a clear evidence about predictive validity. This test is quite unusual in its conception when compared to more conventional intelligence and achievement tests, and offers an insignificant relationship with them. However, as pointed by Levy and Goldstein (1984), it is still not clear from the evidence what it has to offer.

MODIFIED WATSON AND GLASER TEST

In the view of the uncertainty about the precise nature of the process measured by the Watson and Glaser, a modified version was constructed for this study.(Appendix IX). However some basic changes were introduced.
The first change concerns the mode of responding employed. Whereas the Watson and Glaser described the mental operations being used and asks the subject to confirm the examples as true or false (a recognition mode); the modified test required the subject to perform the mental operations and it was then assessed for accuracy (a problem solving mode).

A second change relates to the meaningfulness of the exercise. The Watson and Glaser test presented short unconnected statements (Asking for the)subject's reactions to them. The modified test presented a meaningful connected discourse requesting the subject to say what he or she understood from it.
A third change reflects the ecological or naturalness dimension. The Watson and Glaser artificially presents a series of 'inference' items, then a series of 'assumption' items and so on. The modified test requires the subject to carry out a normal reading and acquisition task during which a series of different processes are mixed.
A fourth change involves the method of quantifying the performances The Watson and Glaser scores correct identification of the processes:

The modified test presents questions some of which require accurate 'inferences', some require accurate 'assumptions' and so on. Scoring is done by counting the number of 'inference' questions accurately answered, the number of assumption questions accurately answered and so on.

Once again of the three texts previously used, the Hiroshima one was chosen to construct this test. However as in the qualitative study the text was not punctuated. Only the beginning of each of the 4 paragraphs started with a capital letter (see Appendix V-b).

As can be seen below, some changes were also made to account for the modifications to the text (Appendix V-a).

Instruction (given to the subjects)

'Punctuation marks do not indicate all possible places where a reader could naturally pause. Some pauses will occur after one or two words while others occur after many more words. This could be due to reasons such as to catch your breath, to enhance meaning and so on.

The article you have been given is not punctuated. Please read it through at your normal reading speed. The task consists of putting a vertical line whenever you feel you would naturally pause. This should be done while you are going through the article. It does not matter if you think you have made a mistake; just carry on until you finish the whole text.

Then you will have another chance to do the same task again.'

The changes were made, to emphasize the lack of punctuation as a new situation, and also as a result of the general comments made by the subjects in the previous experiment regarding the clarity of the instructions. The degree of understanding of the information was measured using the modified test. It consisted of 5 sub-tests measuring subjects' capacity of inferring, recognising assumptions, interpreting information, evaluating various arguments and deducing new information.

Question Selection

Questions were formulated based on the text.

Each question was intended to engage the subject in one of the 5 mental operations. For example in question 1, (see Appendix IX-b) used to test the interpretation process, the subject was required to identify a reason from the three suggested answers, for the selection of the school near Los Alamos to carry on the final testing. In order to answer this, s/he has to compare systematically a previous statement that appeared in the passage with each of the proposed concluding statements offered in the test for this question. Of these statements, the one(s) that the subject judges beyond a reasonable doubt as being an appropriate reason for selecting the school near Los Alamos and as being consistent with all the given facts will be chosen. In this case answer 'a' is consistent with the statement in the text that a disused school

in a lonely spot was selected.

The initial pilot contained 40 items approximately 8 for each operation. These were submitted to 5 judges who were asked to identify which of the 5 processes related to each question.

A Table of agreement was drawn up and only items on which all 5 agreed were eventually used. The final test contained 15 questions: 3 for each process (see Appendix IX-b)

Procedure.

Each item started with a statement followed by a multiple choice test. Twelve of these items contained only one correct answer each. As in the original Watson and Glaser (Ibid.) test, there were unequal number of maximum scores for each process. There were 3 correct answers for question 5, and 2 for questions 14 and 15. This allowed a maximum of 19 correct scores. The unequal scoring did not affect the analysis since in treating the data cross comparisons between processing are not made. Only within process and between group comparisons are made. Questions relating to each process and maximum possible scores were as follows.

Processes	Questions	Maximum Score
1. Inference	6,7,8	3
2. Assumption	5,12,14	6
3. Interpretation	1,11,15	4
4. Evaluation	2,9,10	3
5. Deduction	3,4,13	3
Total	15	19

Table IV-1: showing the questions in the C. Critical Thinking test relating to each process and their corresponding maximum score.

The Comprehension Test was started by instructions describing how to use it. Thus, subjects were told that each exercise began with a statement followed by several possible answers. Also that the answers were derived from the text through either a process of Deduction, Assumption, Interpretation, Evaluation of arguments or Inference. They were informed that there might be more than one right answer for each question: Lastly they were asked to put down their responses just by ticking what they believed to be the correct ones.

One hundred and seventy pairs of scores were collected for each process from subjects in a pretest (Each subject completed questions for five mental processes).

Results

An intercorrelation matrix was constructed giving the correlation coefficients between each subtest and also the correlation of each subtest against the total. The results are provided in Table IV-2.

Table IV-2 = gives the coefficient of correlations between each of the 5 processes of C. Critical Thinking Test and the rest.

	Infer.	Assum	Interp	Eval.	Deduc.
Infer.	-				
Int.	.20	.45	Schema		
Eva.	.29	.36	.41		
Ded.	.14	.15	.11	.05	
Total	.56	.77	.71	.66	.42

Inter correlation matrix showing structure of the test of the C. Critical Thinking. Data is based on a sample of 170 pairs of scores.

For significance at $P<.05$, $r<.19$; at $P<.01$, $r<.25$; at $P<.001$, $r=.32$.

Based on the theoretical prediction and construction procedures, one expects a structure in which 'assumption' and 'interpretation' would form a distinct subgroup being both based on schematic background. The other 3 subtests would constitute a separate grouping. Therefore, at least 2 clusters of subtests would be anticipated. The groupings should of course, have greater within correlations than between correlations.

The results show a main grouping in which 'assumption', 'interpretation' and 'evaluation' are highly intercorrelated. Each of these 3 correlations is at least at the level of $P<.001$. The other 2 items do not seem to constitute a separate grouping but to maintain independent identities.

Deduction, for example is not significantly correlated with any other sub test. It maintains a position in the battery on the basis of a very significant correlation with the total test score. Similarly inference has some claim to independence as an item being highly correlated with the total test score and not correlated with deduction. Inference is more closely associated with the main grouping than is deduction, but the overlap is sufficiently low to leave a large percentage of unexplained variance. We assume that some of that unexplained variance is attributable to the unique contribution of inference to this battery of tests. The data supports the detailed qualitative analysis of the test items. And although it is speculative to go beyond

these correlations, it is not unreasonable to surmise that the main grouping of assumption, interpretation and evaluation is measuring schema influences; the deduction subtest is measuring ability, while inference reflects some schema with an unspecifiable component.

The data supports the construct validity of the modified test. Each subtest contributes meaningfully to the total score. It also throws some light on the inter relationship between the different sub tests.

These analyses taken together support the view that a schema related subgroup of test can be identified and compared with the ability related test (Deduction) and a mixed effect test (Inference).

It should be possible therefore to identify which of these subgroups of test discriminates between the NS and NNS.

It should also be possible to see which correlates most with the P.U processing measure. The prediction would be that the process which discriminates most between the groups would also correlate highest with the P.U scores. This would lead to a finer identification of the nature of the mental operations accounting for the difference in P.U scores between NS and NNS.

The results are presented in the table below. The performance of the subjects differ significantly according to the subtest and group membership.

Table IV-3: giving the obtained averages for each process of each group and the calculated t . test.

		Inf.	Ass.	Interp.	Evalu.	Deduc.	Comprehension
NS	$\bar{X}$	2.5	3.75	2.80	2.02	2.42	13.48
	S.D	.75	.97	.68	.76	.59	2.40
NNS	$\bar{X}$	2.5	3.34	2.25	1.83	2.28	12.2
	S.D	.73	1.27	.96	.83	.84	2.96
t(df 168)			2.20	3.89	1.45	1.11	2.88
P		N S	P<.01	<.001	NS	NS	P<.01

1.65 <.05
2.33 <.01

The differences between the groups were evaluated on the one tailed t .test. The one tailed version was used because of the directionality involved in the hypothesis. They differed significantly on assumption, interpretation and on evaluation. The other differences did not reach the level of significance. These results support the deductions made on the basis of the Expert/Novice paradigm; since the analysis of each task in terms of its demand on the components of performance showed that 'interpretation', 'evaluation' and 'assumption' placed heavy load on the subjects' facility in using past experience. By calculating the degree of association between group membership

and scores on the different tasks a W^2 of .076 was obtained for the interpretation task and .022 for the assumption task. This means that being an NS gave a 7.6% advantage in doing the interpretation and a 2.2% advantage when performing the assumption task (Hays, page 327, 1970)*1. The NS so far seem to outperform the NNS on processing tasks which rely on past experience. It is notable that 'deduction' as operationalized by the modified test relies more on ability, and 'inference' relies on a mixed factor. As a result, the groups do not differ on these items . The first hypothesis received strong support from these data.

*1 The evaluation process was calculated for degree of association with group membership. The result was insignificant (W^2=.006) i.e. less than 1% advantage.

The exercise carried out earlier suggests a grouping of the five tests in schema related (assumption, interpretation and evaluation), ability related (deduction) and mixed (inference). By collapsing the appropriate cells and calculating the group differences a more direct test of the mental operations accounting for the group difference in performance could be carried out. The results are shown in Table (IV.4) below.

	Schema Related	Ability Related	Other
NS	8.57	2.42	2.5
NNS	7.42	2.28	2.5
t(df 168)	3.23	1.11	00
P	<.001	NS	NS

Table (Iv-4): showing the t. test results for the 3 groupings: schema, ability and mixed.

Our results are in conformity with the hypothesis that NS perform better in schema related tasks. This would be predicted from the Expert/Novice comparison.

In conclusion, the results imply that the differences between the two groups on the modified C.C.T.Test are based mainly on the process that rely on schema.
The ability process of Deduction failed to show a significant difference. The Inference test deserves special comment because although it relates from its correlation with schema grouping it contains a unique dimension. Nevertheless, there is no difference between the groups on this dimension or combination of dimensions involved in this process.

We can summarize the position at this point. There is a reliable difference in performance between NS and NNS of English when asked to externalize the natural places of pausing during discourse processing.
This difference is seen in the number of P.Us and in the location of these units identified by the 2 groups.
In an attempt to isolate the mental operations responsible for this difference a more detailed test of mental operations used during discourse processing was constructed. The research data suggest that the NS differ from the NNS on those processes which are associated to schema activities and not to non schema or other activities. There is a strong probability therefore that the difference in P.U performance is related to the schema functions only and this would advance our understanding of the nature of mental processing variations between the two groups.

To explore this possibility statistically, correlations coefficients were calculated between total P.Us scores and scores for each of the five processes.

	Infer.	Assump.	Interpre.	Evalu.	Deduc.
Total P.Us (NS + NNS)	.92	.98	.86	.86	.64
P	<.01	<.01	<.02	<.02	NS

Table (IV-5) Processes, P.Us correlations.
Correlations were calculated using Total scores for each mental operation with number of P.U allocations for the particular test. There were five replications. N = 5

The correlations were significant for the three processes classified as schema related. The coefficients were .98, .86 and .86 for Assumption, Interpretation and Evaluation respectively. There was no correlations (i.e. insignificant coefficients) between P.Us and the ability related process of Deduction. The inference process which was classified as a mixture of some unique operations and some schema related activity was also significantly correlated with P.U. allocations (r = .92). These results were checked on Spearman rank order correlational techniques which, supported the Pearson's finding.
The data reinforce the point that the differences between NS and NNS in PUs scores are due less to ability related mental operations than to schema related and some other unique mental activity. We can further conclude that the differences on both the C.C.T. Test and the P.U Test are accounted for more by

schema related activities than in terms of ability. The overall correlation between P.U test and C.C.T.Test was $r = .2746$ ($N = 170$). $P<.01$.

CHAPTER V

Overview

Hypotheses derived from contemporary studies comparing cognitive approaches and processes of expert learners and novices were used as a framework to compare 1st and 2nd language learners of English in their processing for written texts. Of four generally accepted hypotheses; three were supported directly and the fourth has oblique support.

CHAPTER V

Explanation in terms of Expert/Novice Paradigm

Having examined the types of mental operations involved in the way learners process written information, for meaning, as a possible explanation of the difference between the NS/NNS performance, an analysis was made of the influence of the sheer amount of experience that each group had had with the language.

In contemporary schema theory these differences amount to that observed through the Expert/Novice paradigm (Chi, Glaser and Rees, 1982; Glaser, 1984; Fredericksen, 1984; Carey, 1986). It appears that the analogy between Expert/Novice and NS/NNS is sufficiently sound to seek guidance from this model.

The findings when Experts are compared with Novices is the performance of learning, comprehension, memory and problem solving tasks, tend to be generally consistent.

These are,

i) that Experts rely more on their memory than on their native intelligence.

ii) Experts show superior pattern recognition ability with superior recall for details.

iii) Experts perceive different and more meaningful chunks of task compenents than Novices.

(iv) Novices show inability to infer as much knowledge from the stimulus configuration as the Experts who generate these inferences from their knowledge structures. The reasoning behind this is that the knowledge of Experts is organized differently from that of the Novices. The expert knowledge comprises tightly connected and interrelated schemata which indicate to the learner, the likelihood of any particular set of meanings.

This theoretical formulation has been applied to learning, thinking and problem solving in general, and more recently to medical diagnosis (Feltovitch 1981; Boreham, 1985). It is somewhat surprising that it has not yet been applied as a means of guiding research into differences in performance between native and non native speakers of the same language.

Following this frame of reference one would expect that NS would show all of the characteristics mentioned as belonging to the Experts: They would perform better than NNS of equal intelligence.

1. They would therefore perform better on any task that relies heavily on schema organization, but not on tasks relying simply on straight intelligence.
2. When presented with an English text, they would show superior pattern or gist recognition ability.
3. They would also perceive different and more meaningful chunks of components in the text than NNS.

4. They would show higher scores on inference tests reading from the text.

If this model fits the previous data then the mechanisms which generate the consistent differences between the NS and NNS would be better understood.

The added advantage of testing the data against this paradigm is the theoretical support that would come from an adequate fit. The difference between NS and NNS performance would be seen as a special case in the application of a more general principal dealing with Experts and Novices.

Hypothesis 1

To test a relation, beginning with the first hypothesis, the performance of the NS/NNS were compared on the 3 categories of mental operations as shown in Table (IV.4) in the previous chapter. Hence it was revealed that the difference in performance of the NS and NNS was related to the schema functions and not to ability related or other functions. These results are therefore in conformity with the first of the four predictions arising from the Expert/Novice paradigm.

Hypothesis 2

The second prediction relates to the difference in pattern recognition. The question is whether the NS when presented with a text in English will show superior pattern recognition ability.

It has been repeatedly shown that NS tended to draw more pauses than NNS. That is, as well as accepting those pauses

made by the NNS, they made more. This was supported by Matembo, Thatha and Fourali's replications as well as Study I (Tables II-1,2,3,4 in Chapter II). The question that follows is 'Do more P.Us mean superiority in Pattern recognition?' First, it was shown from both Thatha's (ibid.) findings and the replication, that subjects tended to draw more pauses, the more acquainted they became with the information through trials, as shown below.

Table (V-1) shows the regular increase of P.Us' means over the 2 trials for Thatha's Study and 5 trials for the present one.

a) Thatha's Study

	Hiroshima			Heredity			Stem		
	Trials	Means	S.D	Trials	Means	S.D	Trials	Means	S.D
NNS	1	30.54	10.43	1	27.07	7.62	1	29.40	8.24
	2	38.26	6.89	2	33.20	4.57	2	36.67	6.19

b) Present Study

NS (Hiroshima)			NNS (Hiroshima)		
Trials	Means	S.D.	Trials	Means	S.D
1	64.42	14.15	1	60.27	21.58
2	70.00	14.92	2	63.18	22.49
3	78.00	13.84	3	64.82	24.43
4	80.83	32.35	4	65.86	23.97
5	85.67	27.07	5	67.18	22.28

Secondly, a significant correlation was obtained between P.Us and the comprehension test (r= .98, calculated on 5 trial basis; r =.27 for N=170;P<.01; r = .21 for NS = 60 ; P<.05; r = .25 for NNS = 110 ;P< .01) . This also suggests that the more P.Us the subjects drew, the more understanding they obtained.

Therefore, since NS tended to show a regular increase in P.Us allocation with experience and consistently drew more P.Us than NNS, it could be argued that they show a superiority in pattern recognition.

Hypothesis 3

The third prediction from the Expert/Novice paradigm is that NS should perceive different and more meaningful chunks of components in the text than NNS. It is believed that Expert (NS) do not perceive every individual unit as more meaningful, but rather they use the whole pattern of P.Us allocation to derive more meaning from the situation (Glaser, 1984; Cromer, 1970). Experts knowledge"is organized around principles and abstractions that subsume (these) objects" (Glaser, 1984 p.98/99).

The literature expresses this point ambiguously. The statement that Experts perceive more meaningful chunks can be taken to mean that Experts perceive more chunks than Novices, each of which is equally meaningful. The second interpretation refers to the degree of meaning contained in any one chunk

of information. This would imply that Experts select chunks, each of which is more pregnant with meaning than those perceived by novices. We shall proceed to consider each of these interpretations.

As applied to the NS versus NNS dichotomy, the first interpretation would simply state that NS perceive more units of information; this has already been amply demonstrated in the previous discussion.

The second interpretation however, can be tackled in two steps:

a - to show that comprehension score per unit P.U is greater for the NS.

b - to show that the rise in comprehension test (C.T.) scores with increase in P.Us is steeper for the NS than for the NNS.

Step a. In order to show that comprehension scores per unit P.U is higher for the NS a simple division of the C.T.total score by the P.Us total, was used as an index. This gives an amount of C.T per unit P.U.

The estimated CT/PU value for NNS was 0.189 comprehension unit (Table X-a in Appendix). The CT/PU value for the NS group was only 0.177 comprehension unit. This is contrary to prediction. Thus, at first sight the data seem to suggest a superiority of the NNS over the NS in terms of pattern meaningfulness, a result which would contradict the general findings concerning Experts versus Novices comparisons.

Indeed, NS, having a more developed English language schema, should show that they extract more meaning from every pattern/ chunk they perceive. One way of explaining this apparent 'anomaly' is by referring to a crude metaphor. In this example the text will be represented by an apple tree; NS as a strong man; and NNS as less strong than NS. The aim is to try to get, by shaking the tree, as many apples as one can.
It is commonly expected that the strong individual would not only be able to get as many apples as the second individual would get, but more. This is because, having more developed muscles, s/he would be able to shake the tree more strongly. So s/he will not only be able to shake down those apples that are not holding very strongly to the tree, but s/he will even manage to get other apples that are very well attached to the branches. Similarly, the text has two levels of 'understanding'; the first one may be called 'common understanding', represented by usual meanings that most individuals extract from written information. The second level, which is more specialized, is a deeper and less accessible level of processing. Hence it would be expected that both NS and NNS would be able to recognize the first level meaning to the given information. However, the second and higher level of understanding (Table X-b) in Appendix which extends beyond the threshold of comprehension of the NNS, would be expected from the NS. Subsequently a P.U value in terms of

non-obvious meaning was calculated(Appendix X-b),This was obtained by dividing the difference in comprehension between NS and NNS with the difference in P.Us. The result was 0.119 comprehension unit. This shows that the P.U value for the second, higher level of understanding is very low compared to the first level, represented by the NNS's C.T/P.U value (i.e0.189). Thus the overall semantic load per unit for the NS was lowered by a higher P.U investment to obtain the hidden meanings. It is worth noting here that the obtained P.U value does not have a C.T value per se but rather is a contributory value in relation to the overall perceived pattern of meaning.

The correlations obtained for the two groups between C.T results and P.U scores including all trials was r = .2506, N = 110 for NNS and r = .2177, N = 60 for NS.

Referring to the above stated argument, the coefficient of correlation for NNS could be higher because it includes only a regular amount of pauses for the first level of understanding. The lower correlation obtained for NS could be due to the inclusion of the deeper level of understanding with the corresponding 'irregular' number of P.Us it requires. It is also to be noted, that the obvious meaning does not require much effort to extract. On the other hand NS have to try more, i.e. provide more effort to get to the higher level of meaning(or to shake loose the more firmly attached apples) Hence, although the NS might have the means (or schema)

to extract the deep meaning, they still require a certain amount of effort to carry out this extraction. Therefore, it could be that even among NS some of the subjects did not reach the higher level of understanding.

Step b - concerning step 'b' both regression equations were calculated (Appendices XI -a,b) and are drawn in Fig. (V-1). This gives the results for both NS and NNS in terms of P.U and comprehension test scores. It shows both slopes for the two groups, representing the regression line drawn in on the basis of a least square estimate.

The figure can be considered at two levels; the first level extends from the noticeable difference between NS and NNS in the acquisition of meaning until their meeting point at around the middle of the picture. At this first level, an equal increase in P.Us for both groups would be reflected by a greater gain in comprehension scores for the NS group than the NNS. The meeting point of the two regression lines marks the beginning of the second level where the NNS seem to 'freeze' (maximum C.T. score = 12.68) and fail to go on improving their scores as the NS do (maximum C.T score = 14.42).

This interpretation seems to be supported by the first part of this analysis presented in step a. That is, when dealing with surface meaning NS tend to have higher C.T scores for a similar number of P.Us drawn by their counterparts the NNS. However, this group after exhausting the 'obvious'

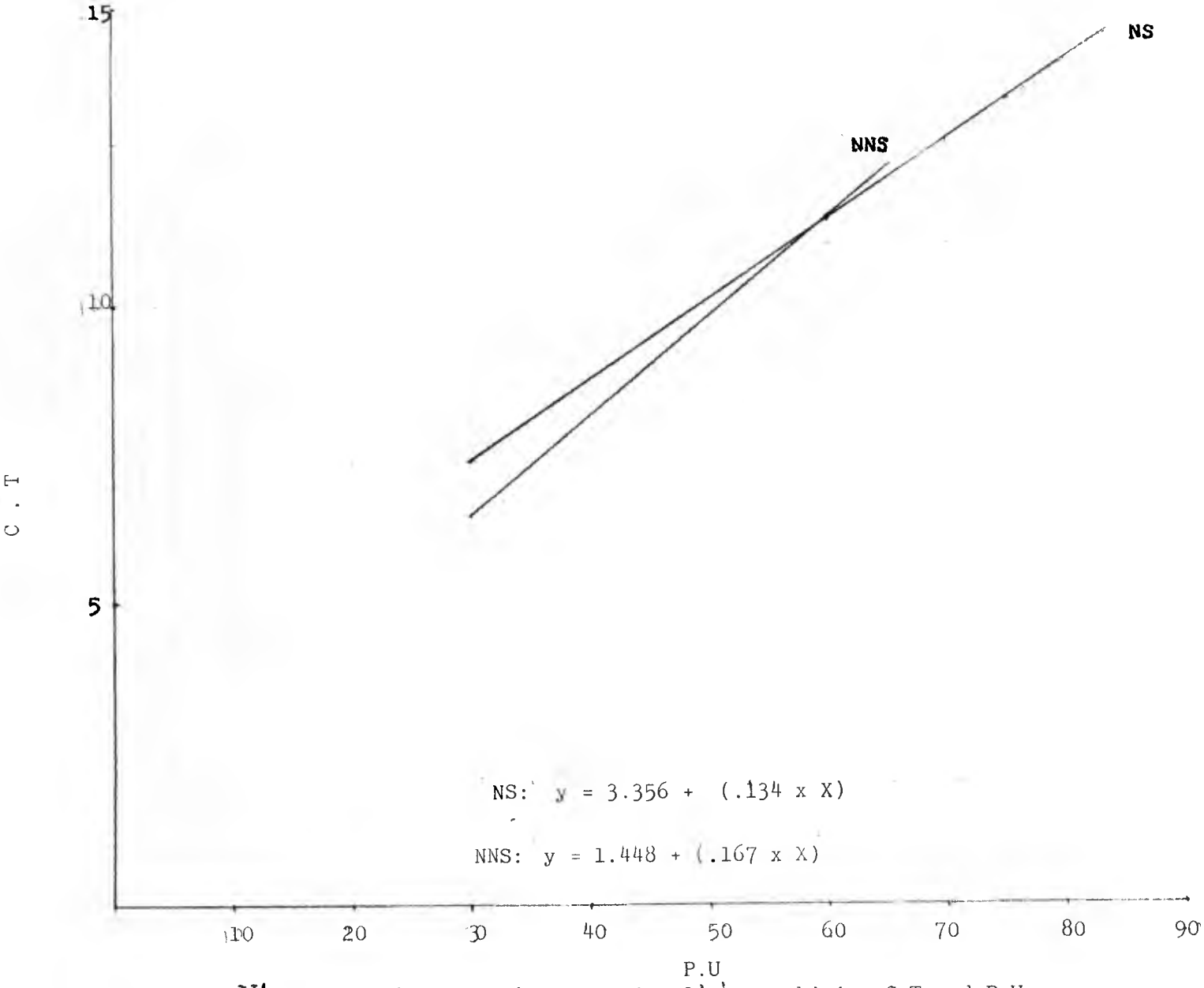


Fig.V-1 showing NS's and NNS's regression lines combining C.T and P.U scores

message of the text seems to find it hard to move on further to deeper meanings. Thus it starts to slow down and eventually comes to a halt which in this case happen to be at the C.T score of 12.68. On the other hand NS carry on obtaining more and more meaning with each new trial , but seem to require more P.Us for reaching a deeper understanding than they had for the surface meaning. This is illustrated by the shifting of the NS regression line towards that of the NNS's. The level of significance of the difference between the coefficients are shown in the Appendix, together with the calculated difference in slope between the two regression lines. The obtained significant difference in slope ($P<.05$) was expected (see Appendices XII, XIII).

Finally, it is quite tempting to advance an expectancy that arises from the above considerations. That is, if NS and NNS were compared on the basis of a scientific text with highest use of explicit learned information and minimal use of implicit messages and where both groups of subjects have the same academic level in the area of interest the outcome should be a similarity of results between NS and NNS in both P.Us and C.T. performance patterns.

Going back to the first step of comparison between the two groups in terms of more or less meaningful patterns perception, the answer is that, NS, when faced with general understanding, should show a higher load in meaning on their P.Us than NNS.

Hypothesis 4 .

As previously mentioned, another interesting finding regarding the Expert/Novice paradigm is that the experts tended to rely more on their inference capacity than the Novices.

From the previous chapter we see that the NS and NNS groups do not appear to differ in the capacity to infer from a written text. The t-test showed no significance. The question can still be asked as to the relative contribution of the inference and the ability processes in arriving at a final understanding of the text. Even if both groups, are on average equal in their ability to infer, the use each makes of the inference process could differ. Similarly their relative use of ability can also differ.

Thus considering NS as an expert group in the English language compared to NNS, it is expected that they rely more on the inferential power. This, being the case, the comprehension scores of the NS would reflect higher reliance on the inferential process. The present hypothesis can be verified through two steps:

a. The inference - CT correlation is higher for the NS than the NNS.

b. The ability - CT correlation is higher for the NNS than for the NS.

Groups	Inference	Deduction
NS	0.70	0.21
NNS	0.52	0.47

Table (V-2) obtained correlation coefficients between the inference and deduction processes and C.T for NS and NNS.

The table of results showing the various intercorrelations between the processes and the total C.T. scores for both NS and NNS supports the first step of the hypothesis. Thus the correlation between the inference process and the total C.T scores was higher for the NS (r = 0.70). as opposed to that of the NNS (r = 0.52).

The results also support the second step of the hypothesis. Since NNS had a higher correlation between their ability score, represented by the deduction process, and their total C.T. scores. The difference was noticeable; with an r = 0.47 for NNS and r = 0.21 for NS.

The correlation coefficients were significantly different on the directional hypotheses stated earlier (Appendix XIV). Two possible conclusions follow these results:

first, that NS having a more developed schema rely on it more heavily when answering the C.T questions. Secondly, the NNS having a less developed schema, seem to rely more on their ability in order to solve the problems.

Therefore it appears that P.U allocations are not completely schema directed. Rather, according to these results, there are two more no-less important factors which are also relevant to this task. These are: inference, which is mostly used by NS. This process, which, although was shown (Table V-2) to have some similarities with the schema category, did not completely adhere to it (Table IV-3) . The second

factor is ability; where NNS rely more than NS due to their deficiencies in schema availability.

SUMMARY

It would seem that the data conforms to the 4 theoretical expectations derived from the Expert/Novice paradigm. Hence it appears that the adoption of this broader model has shed more light on the issue of the NS/NSS information processing differences. There are however, some interesting deviations from normal expectations. One such deviation is the finding that ability plays a stronger role in performance for NNS than for NS.

CHAPTER VI

OVERVIEW

In order to test the effect of the experience with the subject matter on the processing performance of both NS and NNS, two investigations were carried out. The first one, a pilot, considered the pattern of improvement of the NNS subjects (N = 15) over two trials, with the introduction of a comprehension test in the second trial . This analysis was done for the three texts that were previously dealt with in the introductory chapters (i.e. Hiroshima, Stem and Heredity articles). The results showed an increase in P.Us allocation between the first and the second trial for all three articles.

In the next experiment, 34 NS and NNS subjects were given 5 trials of the same material to mark P.Us, as well as the Chahid Critical Thinking Test. The results showed:

A regular increase over trials in the C.T. performance in both groups.

A regular increase over trials in the P.Us allocation for both groups.

A higher increase in performance by NS over NNS for both the P.Us and the C.T tasks.

Further analyses also showed that the subjects tended to improve more on schema-relevant (S.R) items than those of Ability relevance (A.R,). However, NS improved significantly

more in S.R items than the NNS.

Both groups showed their greatest increase over the trials on the Unique component.

The results also showed a tendency of the NNS to use their ability more than the NS do; probably because of their disadvantage in schema backing.

CHAPTER VI

EXPERIENCE WITH SUBJECT MATTER

In addition to varying experience with the English language, a learner can find that he has little or no experience (or familiarity) with the content of the passage being processed. This factor should be taken into account as a likely explanation of the difference between the performance in processing of the 2 groups. A consequence of this reasoning would mean that with repeated exposure to the same material, the NNS would progressively resemble their NS counterparts in performance. In order to investigate the effect of increased familiarity with the subjects' content on the processing of the NNS, a pilot investigation was designed and undertaken.

Subjects, Material and Procedure

Fifteen NNS, from the London University, Institute of Education were used in this Pilot Study. They were all adult university graduates. The NNS spoke, as well as English, either Greek, Arabic, Malaysian, Egurube, Africaans or Spanish. The same 3 previously used passages in the initial pilot study were used again in this one. These are the Hiroshima, Heredity and the Stem texts (Appendices I-a,b,c).

To test the relationship between amount of processing and level of understanding for the NNS, a comprehension test

was made as an index of understanding. This was made up of 10 multiple choice and 10 short answer questions for each of the three articles (Appendices XV a,b,c). In constructing these tests, the experimenter obtained a number of suggested questions from volunteers and tested these out on five judges. The five judges were English native speaker postgraduate students from the Institute of Education, London University. They were asked to choose the items which were most adequate for assessing comprehension of each of the three articles. This was done by requesting them to tick their answers on a 1-5 scale ranging from Very bad, to Very well (Appendices XVI-b,c,d). All judges were English with some English grammar teaching background. The instructions for the judges were to read the three articles thoroughly and then to answer both sets of questions on each article. Then to indicate on the table provided, by ticking the response they felt best represented the knowledge in the article (Appendix XVI-a).

Therefore, on the basis of the judges' decisions and out of the 2 sets of 10 questions (multiple and forced choice questions) the investigation was able to draw up 10 test items. These were given to the subjects as a second part of this experiment (Appendices XVIIIa,b,c). Thus in the first part of this pilot study, the subjects were given the articles in a randomized order. They were asked to read each of them once, at their own usual reading speed. Then to insert a vertical line where they felt an appropriate pause was

missing (Appendix XVII).In a second stage, subjects were allowed to get more acquainted with the material. Thus they were allowed to read the passages as many times as they wanted. Again, they were presented with the randomized articles, and while reading, they were instructed to put vertical lines wherever they felt pauses occured.

Following this second presentation, the constructed comprehension test was administered to each of the subjects. The plan of the procedure was therefore as indicated by the table below:

Order	1	2	3	4	5
Subjects					
NNS	Read	pauses	read	pauses	comprehension test

Table VI-1. Plan of procedure adopted for the pilot study in P.Us allocation and C.T tasks .

Results

Table XIX in the appendix gives the raw data of the P.U scores for the first and second trials for the subjects in this pilot.

The table shows an increase in P.U allocations on the second trial. There was an increase of 7.73 for the second trial of the Hiroshima text . For the Heredity text, the increase was 6.13. For the text dealing with the Stem, the increase was 7.27 on the second attempt. A 3 by 2 Anova was calculated

(Appendix XX). The obtained F value for the effect of trials was highly significant (P<.001). The pilot at this point indicates that repeated exposure to the same text leads to more P.U allocations. The next step of the analysis is to identify whether the increase is affected by general ability or past experience i.e. schema.

The ANOVA was used to test the effect of ability on the gain scores. Using the C.T as an indirect if somewhat crude, measure of verbal ability, subjects were grouped into high, medium and low. The grouping was done on the basis of the first, middle and lower thirds. Table (VI.2), below, shows the average improvements for each group on each of the 3 texts used.

	P.U. Scores		
	High	Medium	Low
Hiroshima	9.4	6.2	7.6
Heredity	5	8.4	5
Stem	10.40	3.6	4.8
Total	24.8	18.2	17.40

Table (VI-2). Mean increases in P.Us according to level of verbal ability as indicated by performance on the comprehension test.

The results give a distinct trend with the highest increases in P.Us coming from those subjects with the highest comprehension scores. To test the significance of this trend,

separate ANOVAs were carried out for each article. Since each article was different in uncontrolled ways e.g. topic, length, style etc, no attempt was made to compare the articles. The ANOVAs give insignificant F. ratios all failing to achieve the required level for significance. (Appendices XXI - a,b,c).

The design of this pilot does not allow a comparison of the improvement of the NS and the NNS since the NS were not considered in this experiment nor does it permit a comparison of the improvement on the 3 dimensions of processing. A more detailed and extensive experiment was carried out to include such comparisons.

Main study for experience with the subject matter

A study was designed in which both NNS and NS groups were repeatedly presented with the same information for a total of 5 trials. Both P.Us and the C.C. thinking test were administered as indices of processing.

Procedure

Tests were administered individually. Thirty four subjects were presented with the Hiroshima passage and instructed as before to externalize processing by indicating locations of their natural pauses; and then to complete the C.C.T. test. This procedure allows a comparison of the improvement over repeated trials for NNS and NS and also permits a comparison of the improvement for the different types of mental operations. It also allows the whole analysis to be done separately for processing as indicated by C.C.T. test and by P.U scores.

Results

Taking the C.C.T test scores first, table (VI-3) shows how the performance varies over the 5 trials.

NS				NNS			
Trials	means	S.D	increase	Trials	means	S.D.	increase
1	11.25	2.89	-	1	11.64	3.13	-
2	13.50	2.32	2.25	2	11.83	3.05	0.19
3	14.25	1.66	0.75	3	12.23	3.04	0.41
4	14.00	1.91	-0.25	4	12.64	2.68	0.41
5	14.42	1.88	.42	5	12.68	3.01	0.04

Table (VI.3) gives performance as indicated by C.C.T test for processing of the same text over 5 trials

The overall trend on the repeated presentation is of an increase in performance. This is so for both NS and NNS subjects; although the NS progress to a significantly higher level of performance than NNS. A Friedman 2 way ANOVA was calculated to evaluate the trial effect. The obtained χ^2 r's were 13.37 (NS) and 20.31(NNS), df= 4, both of them significant at the .01 level (Appendices XXII, XXIII). The Trend analysis represented by the Page's L test supported the expectation regarding the direction of increase (P<.001-NS; P<.05-NNS)- (Appendices XXII, XXIII). The increase on the processing scores indicated by the C.C.T test substantiates the finding of the pilot study.

A similar pattern of performance with an even steeper gradient of increase is seen over the 5 trials of P.Us allocation. The results are tabulated below.

NS				NNS			
trials	means	S.D.	increase	trials	means	S.D.	increase
1	64.42	14.15	-	1	60.27	21.58	-
2	70.00	14.92	5.58	2	63.18	22.49	2.91
3	78.00	13.84	8	3	64.82	24.43	1.64
4	80.83	32.35	2.83	4	65.86	23.97	1.04
5	85.67	27.07	4.84	5	67.18	22.28	1.32

Table (VI-4) gives performance as indicated by P.Us task for processing of the same text over 5 trials.

The calculated Friedman 2 way ANOVA once more was significant for both groups (Appendices XXIV, XXV). Both the calculated Page's L values were also significant.

The improvement over the 5 trials is roughly 3 times greater for the NS than the NNS. The ratio for improvement is approximately the same on both tests. The means are for the C.C.T test 3.17 (NS) against 1.05 (NNS); a ratio of 3.01 to 1. For the P.U scores, the means are 21.25 against 6.91; a ratio of 3.07 to 1. Hence it appears that the degree of processing is positively related to the subject's improvement in his/her comprehension of the message as measured by C.T. However a closer look at the individual graphs of the

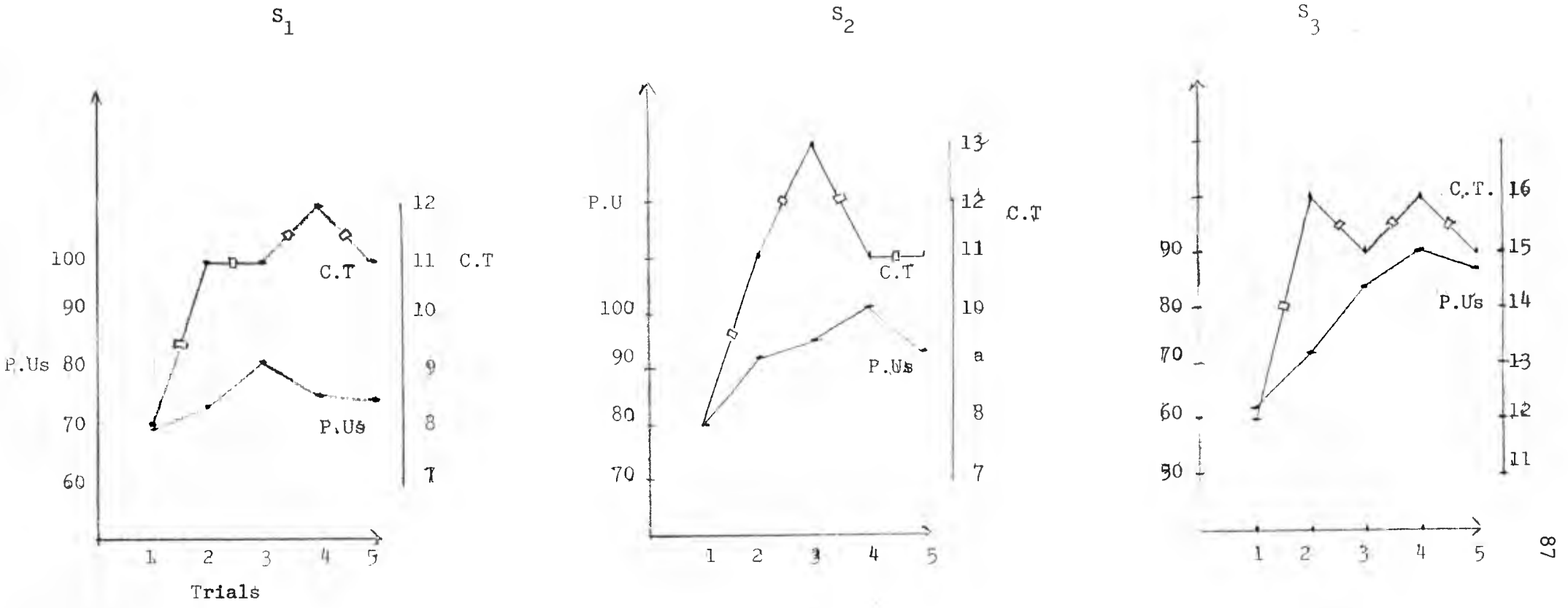
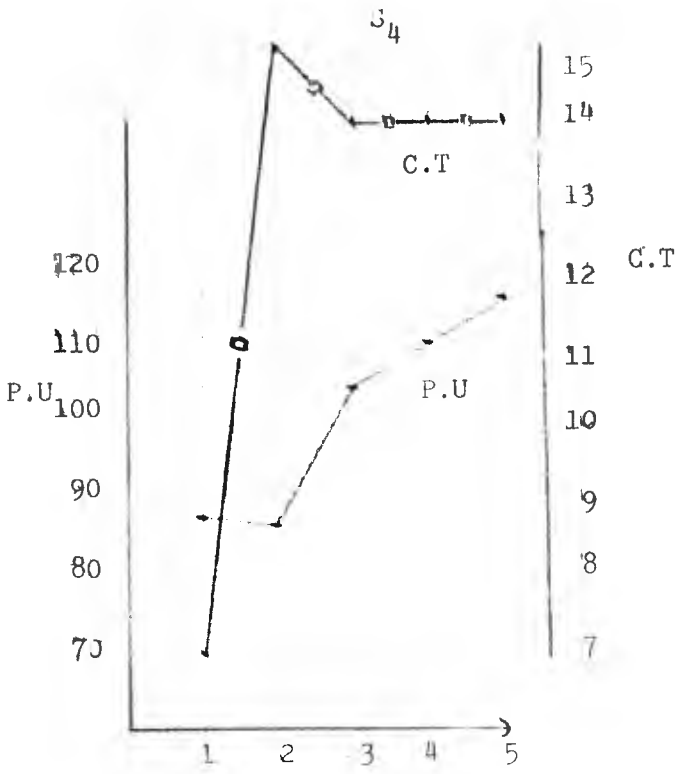


Fig VI-1 Individual profils of the CT x Trials function compared with the punctual (pausal) function for the NS

— P.Us

—□— C.T


S4
C.T
P.U
P.U
C.T
120
110
100
90
80
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14
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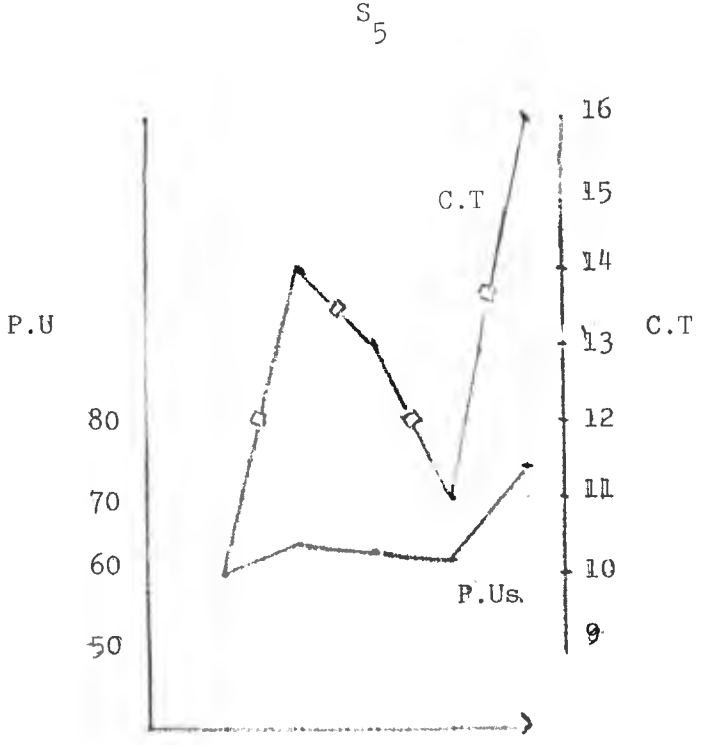
S5
C.T
P.U
P.Us.
C.T
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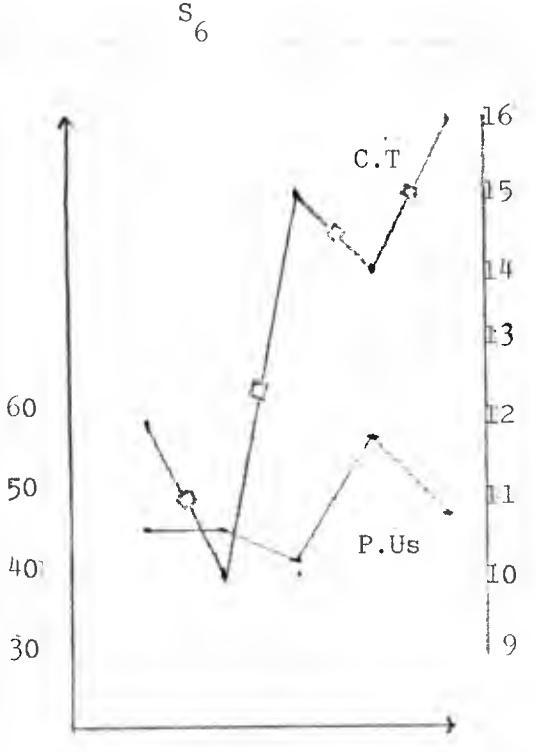
S6
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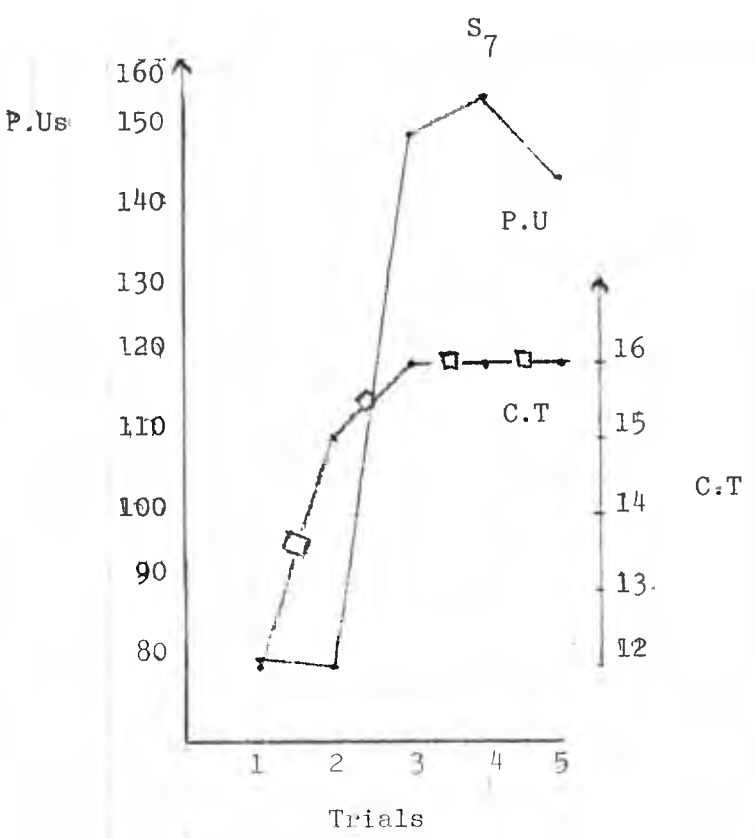
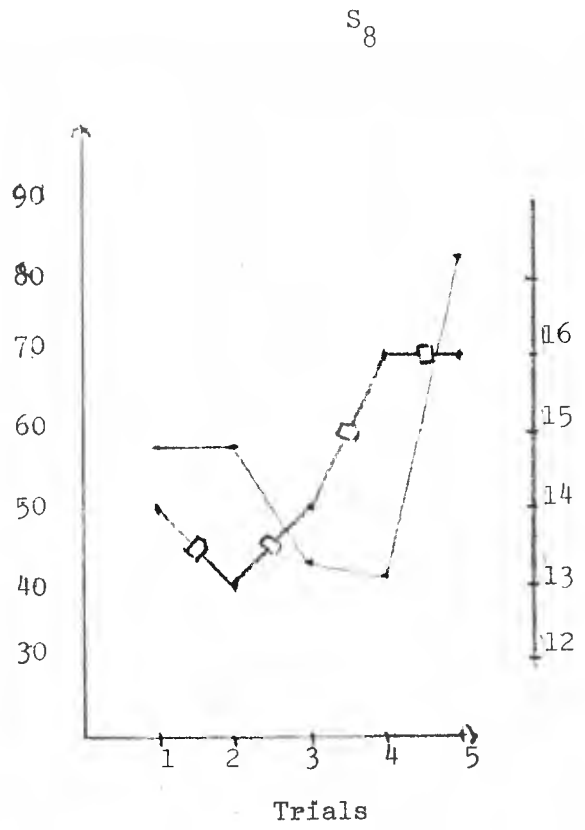
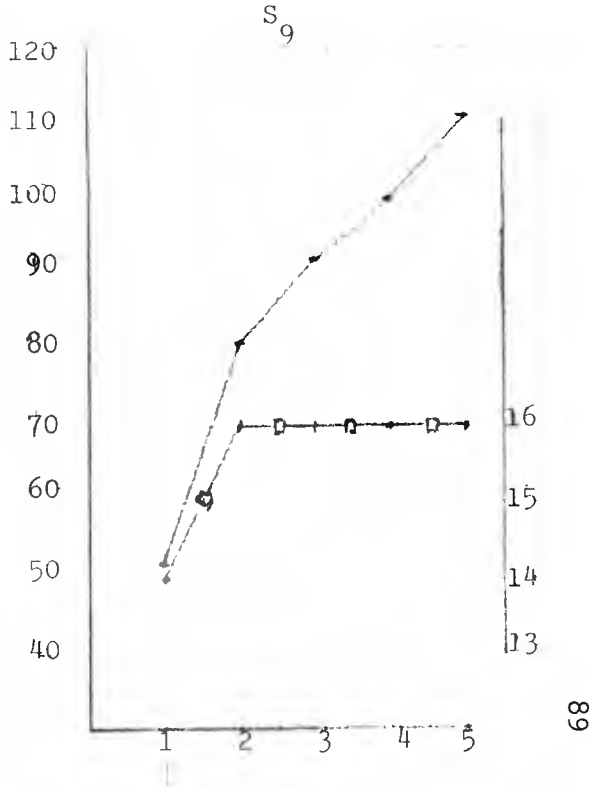


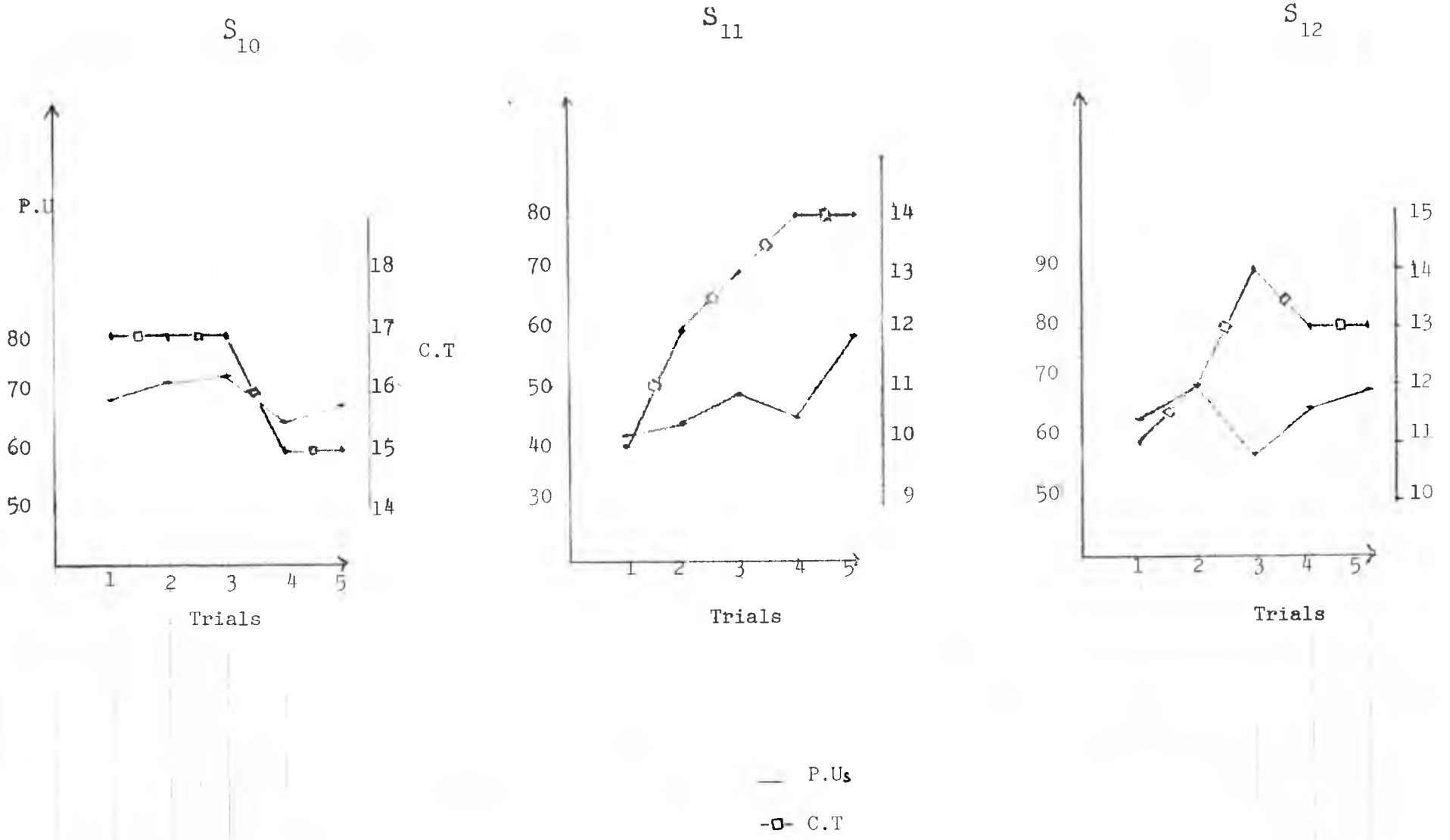




Native (Individual C.T scores X P.Us)

—— P.U

- - C.T


S10
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S12
P.U
C.T
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4
5
Trials
Trials
Trials
P.Us
C.T

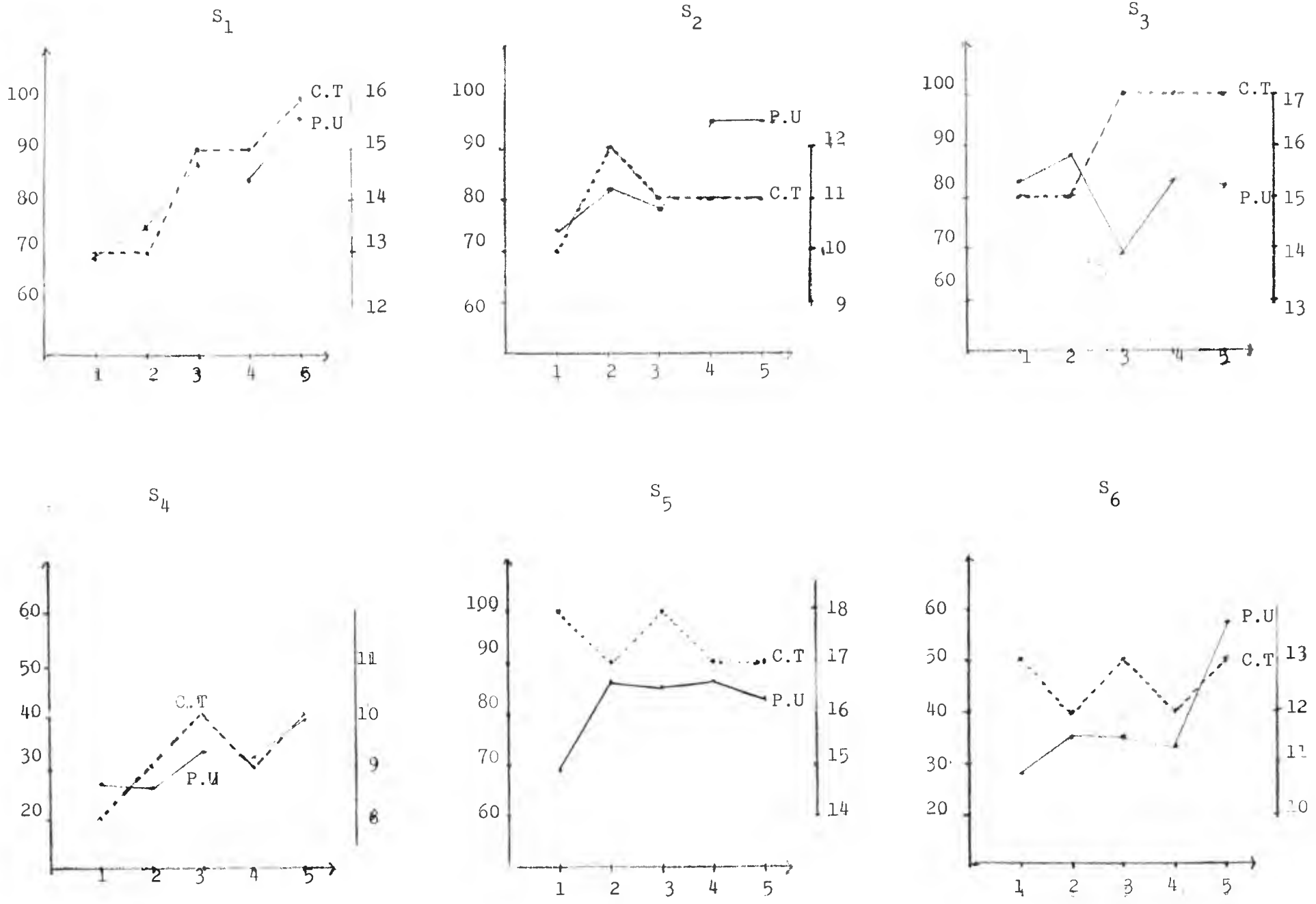
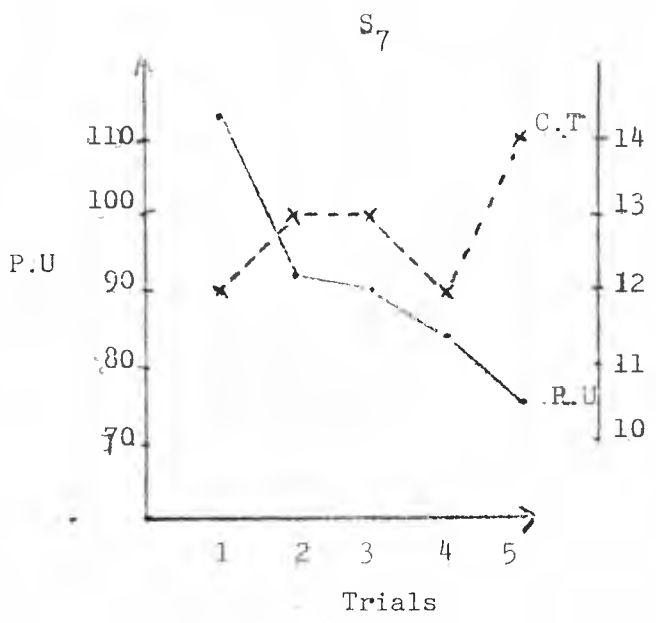


Fig.VI-2= Individual profils of the C.T x Trials function compared with punctual (pausal) function for the NNS.


S7
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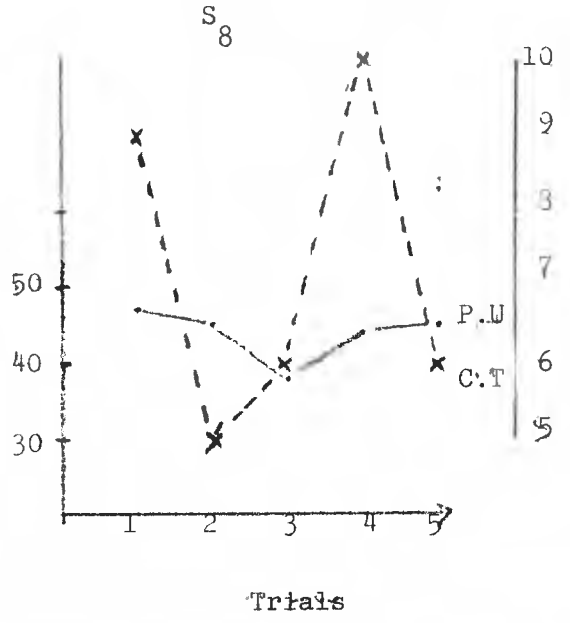
Trials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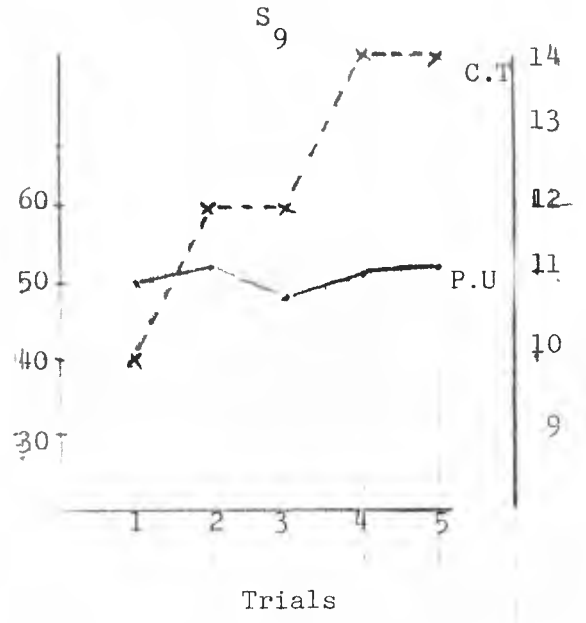
Trials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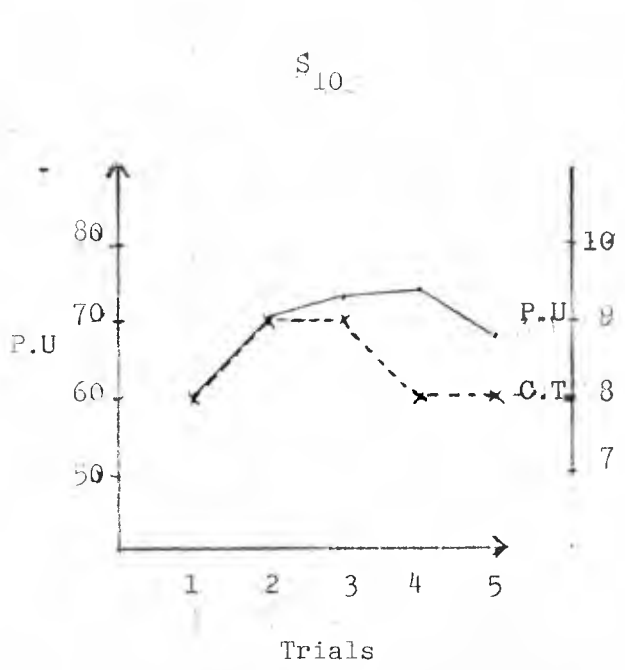
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P.U
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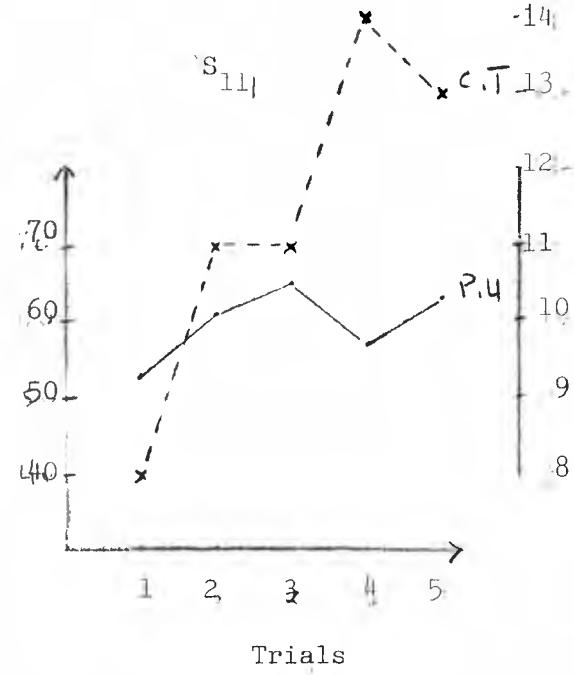
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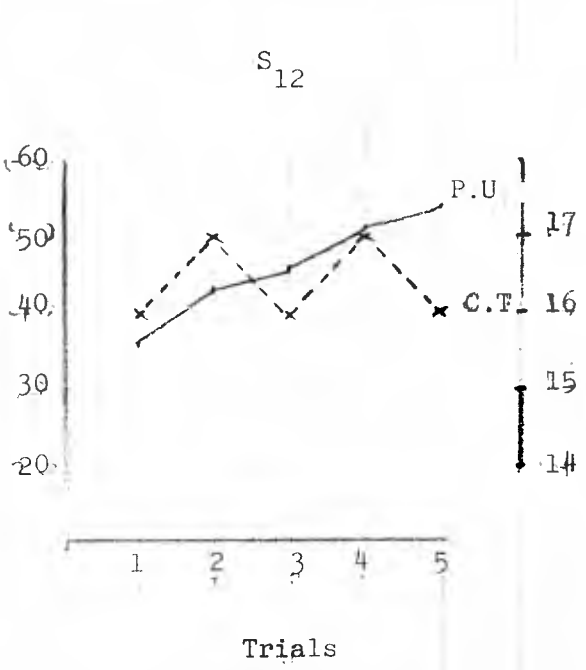
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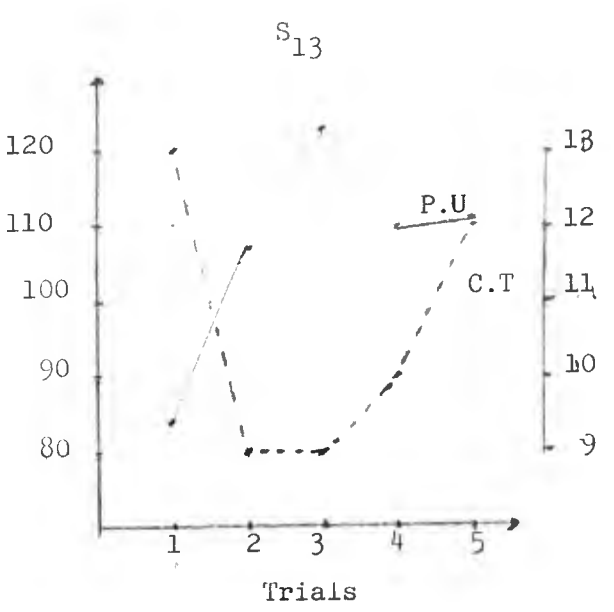
Trials


S13
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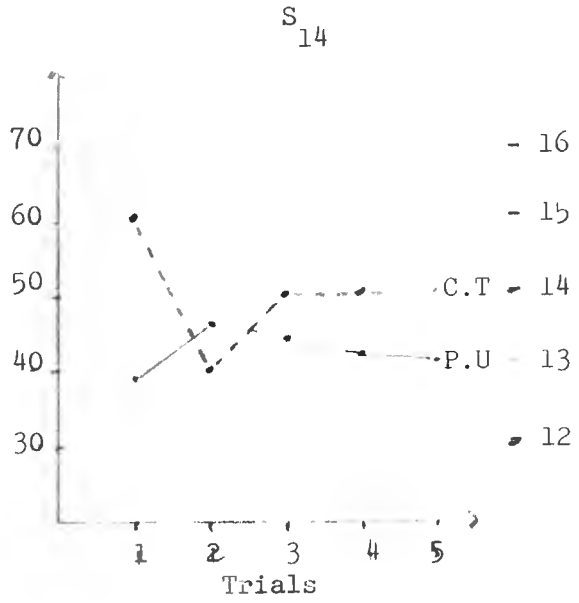
Trials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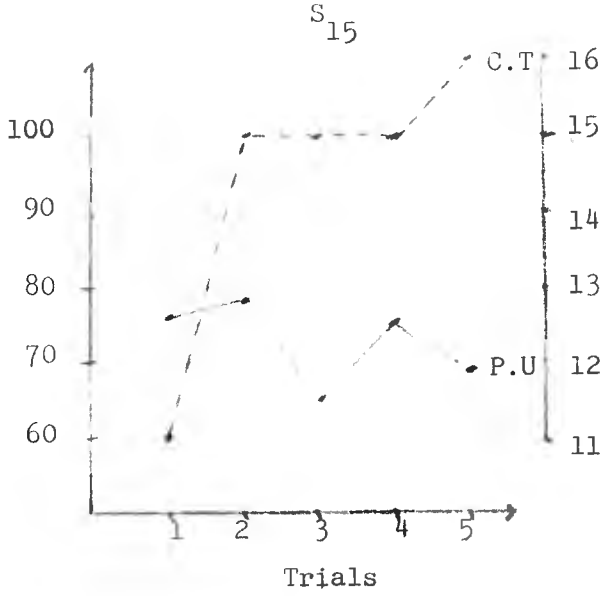
Trials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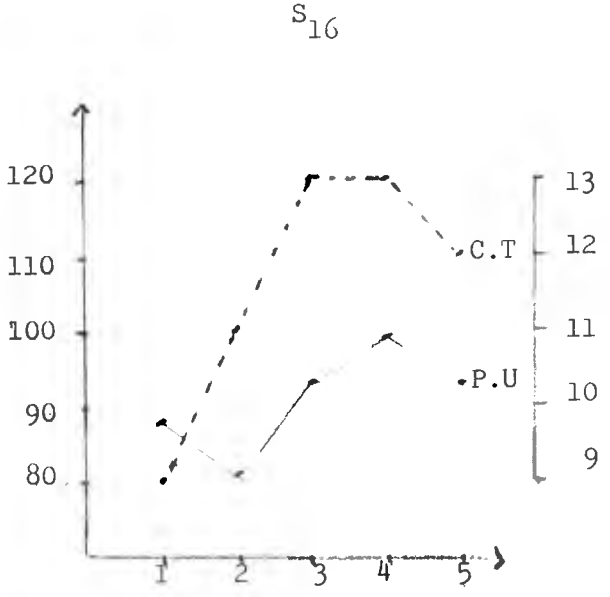
Trials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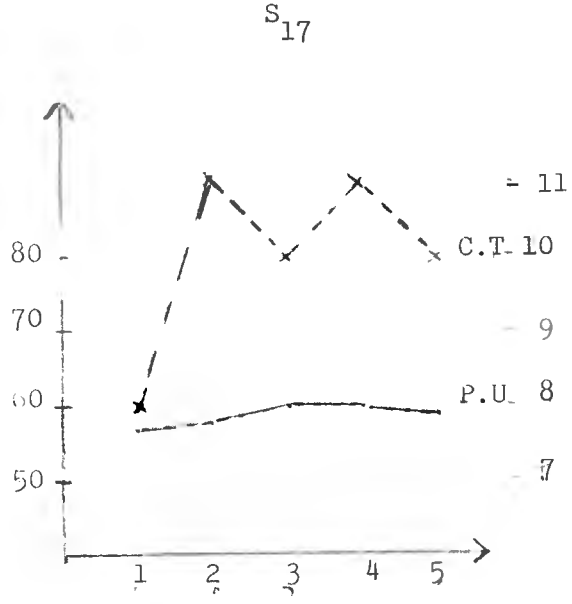
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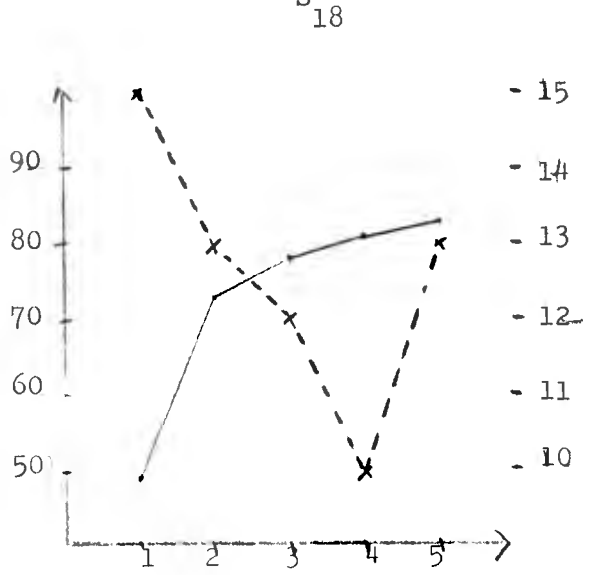
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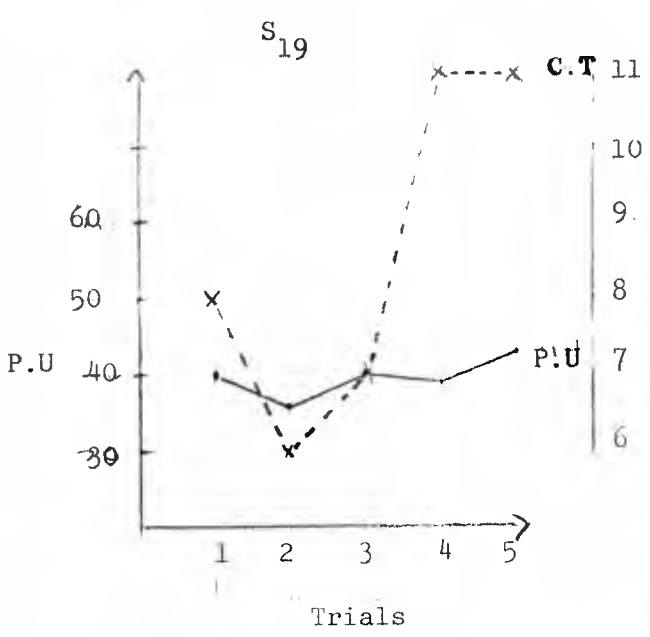
S19
C.T
P.U
P.U
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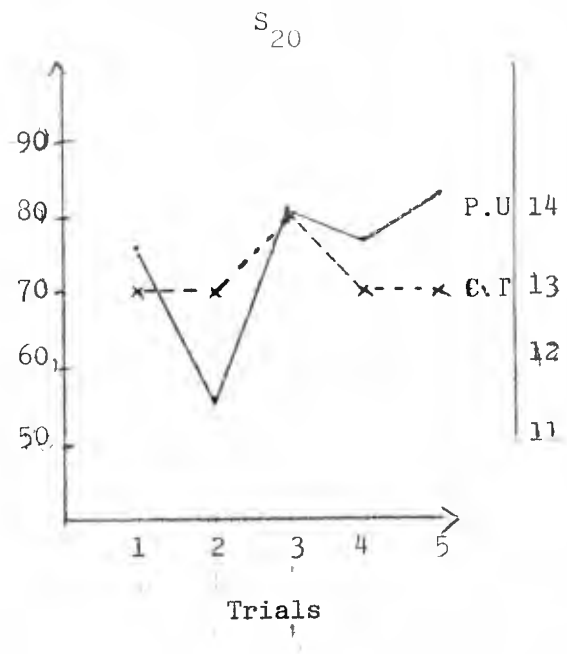
1 2 3 4 5
Trials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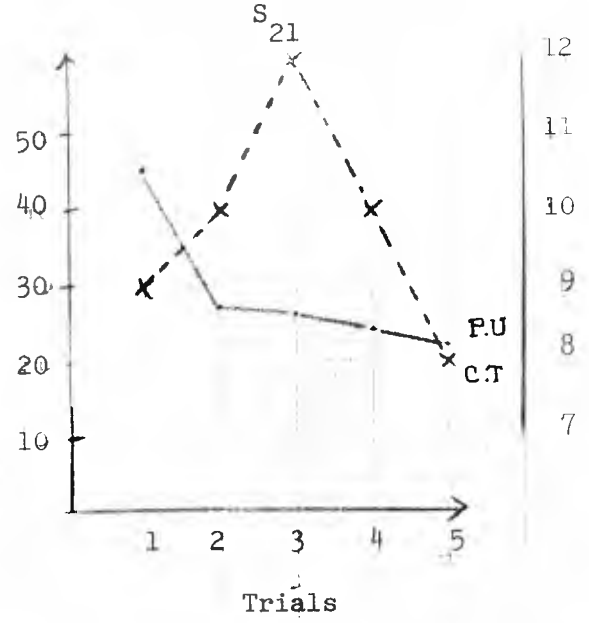
Trials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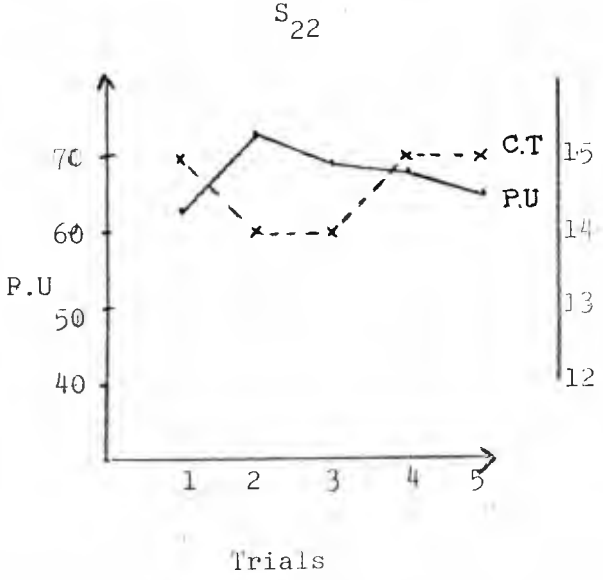
S22
C.T
P.U
P.U
70
60
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13
12
1 2 3 4 5
Trials

pattern of evolution over these 2 indices shows quite a varied picture (figures VI-1,2). Thus, in order to further understand the complexity of the picture, there followed the question whether the observed overall improvement over repeated exposure to the same material is related to the subject's schema, ability or some other factor. In order to address these questions, an analysis of the improvement scores was carried out. The design permits this analysis only for the C.C.T scores which could be broken down according to the items which were schema related, ability related or unique.

Analysis of improvement with repeated exposure

Improvement in C.C.T scores were calculated over 5 trials and broken down accordingly to the 3 dimensions of mental operations i.e. schema related (S.R.) ability related (A.R.) and unique (U.). This was done separately for the NS and NNS subjects. The data are given in the Table (VI-5).

		I	II	III	IV	Total
	S.R	1.99	2.09	2.03	2	2.11
NNS	A.R	1.95	2.28	1.82	2.04	2.09
	U	2.27	2.00	2.27	1.96	2.58
	S.R.	2.37	2.15	1.92	2.14	2.58
NS	A.R.	2.09	2.00	1.83	2.00	1.92
	U	2.59	2.08	1.25	2.17	2.75

Table (VI-5): Improvement per items of the C.C.T tests broken down under the 3 categories of processing (a modulus of 2 was added to data gains).

The improvement scores for S.R items were compared with those for A.R items to establish whether the apparent differences reached a level of statistical significance. Due to the nature of the scores and the lack of any clear evidence of a normal distribution, an analysis was carried out using a Wilcoxon signed rank non parametric test (Siegel, 1956). Results show

that subjects tended to improve more on items which demanded S.R processing than those which demanded A.R processing. The Wilcoxon test showed that the level of significance was at $P<.05$.

A more detailed inspection of the data showed that although the overall means supported this trend, there were exceptions for the NNS at trials 2 and 4. It is likely that the pattern of improvement could be different for the 2 groups of subjects. Therefore, further inspection of improvement between NS and NNS was made easier by an interaction profile:

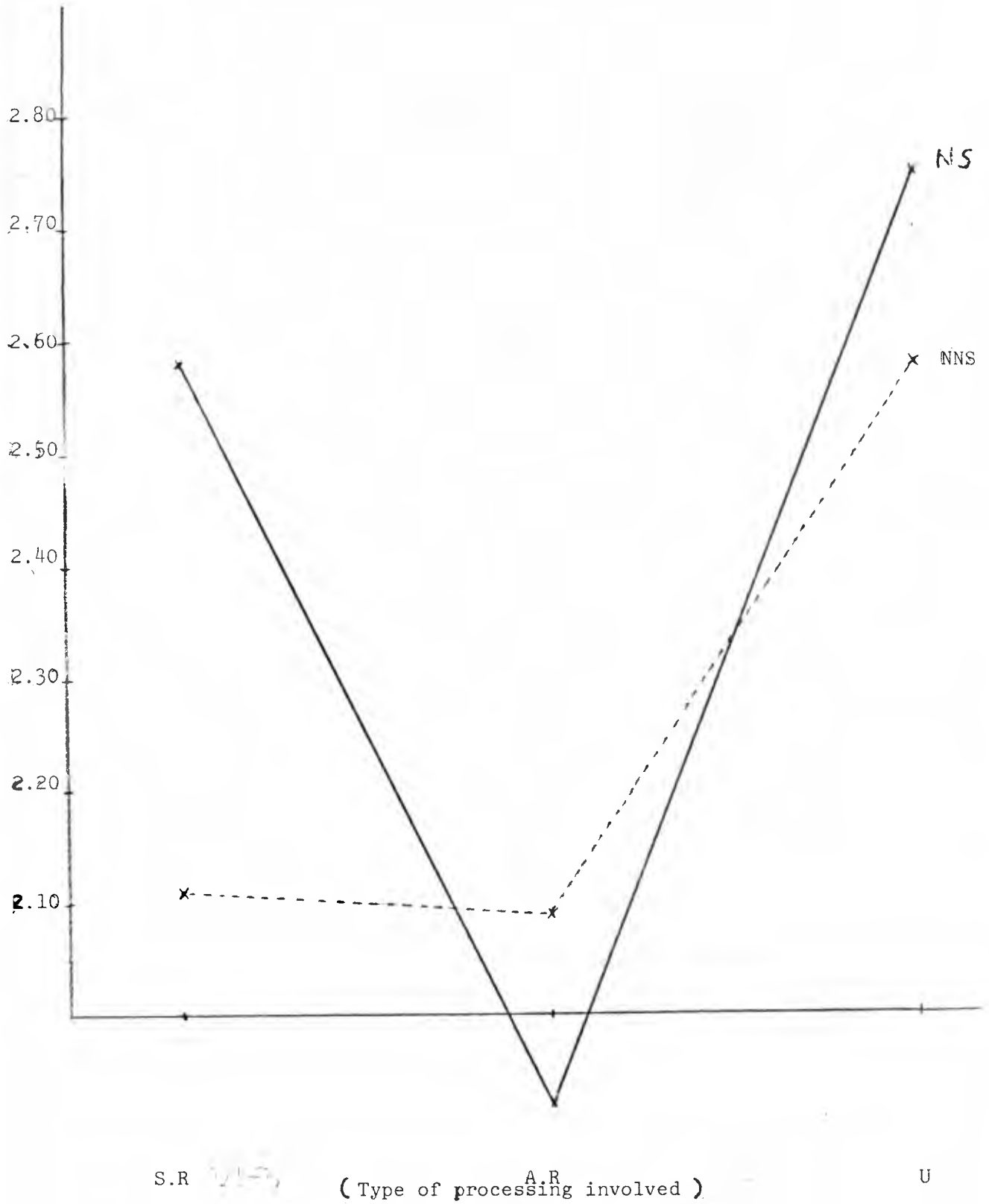

Figure: Interaction Profile showing patterns of NS and NNS performance on the 3 types of items

The profile shows that the pattern of improvement is similar for the NS and NNS over the 3 dimensions with the highest improvement for a U factor and the lowest for an A.R factor. The NS tended to improve more on the S.R factor. The view that NS superiority in performance is related more to S.R factor rather than A.R again receive support. An interesting suggestion from the profile is that the U factor plays the greatest part in improvement due to the repeated exposure. This is so for both NS and NNS subjects. This factor surely needs to be explored.

Summarizing the work reported in this chapter we may say that there is evidence to support the following statements:

1. repeated exposure to the same passage results in improvement in processing as measured by both tests used.
2. the increase in the degree of processing is positively related to the degree of understanding as measured by C.T.
3. this improvement is seen for the NS and the NNS.
4. the improvement is however, uneven over the groups with the NS improving 300% more than the NNS on both measures.
5. the improvement is most pronounced on items associated with a unique unexplored dimension.
6. the pattern of improvement for both groups over the 3 dimensions has a consistent rank order with greatest improvement for the U factor related items followed by the S.R items and lastly the A.R. items.
7. the NS differ from the NNS more in the degree of improvement in the S.R items where the NS subjects were significantly better.

8. there was a tendency for the reverse to be true with the NNS showing a higher improvement than the NS on the Ä.R. items. There is a slight suggestion here that NNS are forced back upon their ability when their past experience failed to cope with the task at hand.

Two issues suggest themselves at this point of the investigatio The first is the nature of the U dimension which is essentially measured by items related to the inferential process. This dimension was revealed more by accident than design and assumes prominence more in an explanation of the improvement itself than as a factor responsible for the difference between the groups. The second issue at this stage would be to put the finding on firmer footing by testing the general conclusions in a more controlled context. If it is the case that NS and NNS process differently because of the S.R factor then it could be argued that any group of learners who lack appropriate schematic development for a given task would be at a similar disadvantage when compared to a more knowledgeable learners.

The next stage of the investigation sets out to test this position in the context of conventional academic discipline. Two types of material were used: a science and an arts passage. Artists who read the arts passage and scientists who read the science passage constituted the schema relevant group. Artists reading the science passage and scientists reading the arts passage formed the non-schema relevant group. Cognitive processing

and the performance of each group were analysed in order to reveal the relative contribution of each of the 3 dimensions of processing identified so far in this research.

CHAPTER VII

Relative Contributions of Ability and Schema Related Processing in Subjects with High and Low Schema differentiations.

7.1 INTRODUCTION

This study is based on the assumption that the basic and most fundamental difference in the processing performance of NS and NNS subjects is at the level of schematic development in the English language. The next part of the investigation was designed as an analogue to the NS/NNS comparison by identifying and comparing subjects with high and low schematic development in a given topic. The groups chosen were science students who read a scientific passage; science students who read an arts related passage; arts students who read an arts related passage and arts students who read a scientific passage.[1]

The following hypotheses adopted from the findings and conclusions arrived at in Chapter VI , serve as a guide throughout the work reported in this chapter.

7.2 HYPOTHESES

The hypotheses fall into two categories.

(a) Firstly, those dealing with factors influencing the processes. These aim to demonstrate that the differences in processing, if any, are due mainly to schema related processes and minimally if at all, to ability related processes or to the unique factor previously discussed.

1 - The data for this study was collected in collaboration with Davou, D. (1985) and as required analysed independently.

1. Like NS, schema related (S.R) groups will show a different pattern in text processing from Non Schema Related (NSR) groups. This establishes or otherwise rejects the existence of a difference between the groups.

2. S.R groups, like the NS during text processing make use of the S.R processes of Assumption, Interpretation and Evaluation. Measures of their text processing performance should therefore correlate with their ability to perform these processes. This demonstrates the relationship between S.R processes and text processing.

3. S.R groups do not rely primarily on their deduction ability in text processing. This provides evidence of a fairly minor reliance on such cognitive abilities as Deductions during normal text processing. Therefore there should be a lower correlation between scores for deductive ability and scores for text processing i.e. P.Usor summarizing scores.

4. S.R. groups should make use of the unique factor ability in processing connected prose. From the evidence with NS and NNS groups, it is most likely that the unique factor measured mainly by Inference would play a part when SR groups process texts. Therefore the Inference component which measures the unique factor should be positively correlated with their score for text processing.

5. NSR groups cannot make optimal use of the S.R processes of Assumption, Interpretation and Evaluation not having the schema

required to use fully these processes. Therefore one expects low correlation between text processing and the ability to make use of these processes.

6. N.S.R groups like the NNS are expected to make more demand on their deduction ability than the SR group. Therefore one expects some correlation between the quality of text processing and the deduction ability.

7. NSR make use of the unique ability factor in their processing, this was amply demonstrated at the earlier stages of this research. Therefore their performance should correlate with the unique factor component of Inference.

(b) A second category of hypotheses aims to explore the nature of the unique factor which was unexpectedly thrown up by the data.

Method

Subjects.

Forty four individuals participated in the study, Twenty two of them had a first degree in Arts (languages, history or literature) and the remaining twenty two, a first degree in Science (physics, chemistry, biology, mathematics). Faculties such as geography, psychology, economics etc were excluded because of the difficulty of categorizing them as Arts or Sciences. All 44 subjects were given an 'experimental package' which consisted of three copies of the learning material related to interest, space available for the summary and the Watson and Glaser Critical thinking appraisal. (Ibid). The package is presented in Appendices(XXVII and XXVIII). Subjects with an Arts degree were randomly subdivided into two subgroups, one group reading an Arts related (literary) passage, and the other a scientific (biology) passage. Similarly, half of the subjects with a degree in Science read the artistic passage and half of them the scientific. After the 44 experimental packages had been returned to the experimenter, 5 of them were found to be incomplete or not properly answered, and therefore were dropped out of the analysis. Thus this experiment was based on a total of 39 subjects. These subjects were divided into four groups: (i) scientists who read the scientific passage; (ii) scientists who read the Arts related passage;

(iii) Arts student who read the Arts related passage, and (iv) Arts students who read the scientific passage . The Schema group was made up of nine scientists who read the scientific passage and ten Arts students who read the Arts related passage. The Non Schema group was formed by nine Arts students who read the scientific passage and eleven scientists who read the Arts related passage. The allocation of subjects to treatments is summarized in Table(VII-1) below.

Table (VII-1) Allocation of subjects to treatments.

		Group	
Subjects	Passage	Schema	Non-Schema
Arts student	Arts related	10	
	Scientific		9
Scientists	Scientific	9	
	Arts related		11
	Total	19	20

Thirty four subjects spoke English as their mother tongue, two spoke Greek, two Spanish and one subject spoke French. The criterion on the basis of which these Non-Native Speakers were included in this study is that they all hold a first degree from an English institution which demonstrated their familiarity with the scientific terminology. The ages of subjects ranged from 21 to 52. The characteristics of the subjects in each group, in terms of the mother-tongue and subject of degree appear in Appendix (XXVI).

Material

The subjects received a package which consisted of three copies of the experimental passage (either Arts related or scientific), with its punctuation removed, a space where the summary and additions to the summary would be written and the Watson and Glaser Critical Thinking Appraisal with its answer-sheet (two complete experimental packages, one with the scientific and one with the Arts related passage are presented in the Appendix XXVII).

Eight Arts related and scientific passages were tested for readability on the basis of Flesch's (1948) readability index. This was done to control for differences in performance caused by unequal comprehension difficulty.

The two passages selected were equated in terms of readability. They were taken from recent publications, so as to eliminate the possibility that the subjects might have been familiar to them. As the passages were not complete

readings but parts of an article and a novel, they were selected in order to represent a complete conceptual notion, and attention was given that the author's presentation of argument was included from the beginning to the end.

The arts passage was taken from the introduction of Umberto Eco's novel 'The Name of the Rose' (1984) (Appendix XXVII-b). The passage was 1175 words long, with 139.25 syllables per 100 words and 29.2 words per sentence. Its readability index was 59.4 which according to Flesch (1948) characterizes a passage as fairly difficult.

The scientific passage was part of an article entitled 'Molecular Approaches to Malaria Vaccines' published in the Scientific American (1985) (Appendix XXVIII-b). This passage consisted of 1119 words, and had 150 syllables per 100 words and 18.78 words per sentence. Its readability index was 60.87, which also characterizes the passage as fairly difficult. A short passage of 96 words was given as an example to help the subjects understand how they were to place the P.U s; This passage was taken from a novel entitled 'A Question of Power', written by Bessie Head. The same example was given to all subjects.

The Watson and Glaser Critical Thinking Appraisal (Ibid.) was again used to measure various types of cognitive processes. As before, the test was selected because it provides measures of five different types of processing of

connected discourse and may indicate the learner's weaknesses and strengths in various points of the cognitive process.

Procedure

Each subject was given the experimental package and asked to complete it according to the instructions. On the first page the subjects were asked to provide information about their mother-tongue, and subject areas in which their degrees were obtained. Then the instructions were presented as follows:

> "The following passage is part of the introduction of Umberto Eco's novel entitled 'The Name of the Rose' (or, for the science passage) part of an article published in the Scientific American, May, 1985, entitled 'Molecular Approaches to Malaria Vaccine'."

As you will notice, no commas, periods or other punctuations appear in this passage. Please, read it carefully and place a vertical line in every point where you feel there is a natural pause. Commas and other punctuations usually indicate where it would be convenient to pause, but they do not indicate all the possible places where the reader might stop, simply to catch his breath or to enhance the meaning. Thus while you are reading the passage, try to place the vertical lines in every place where it seems natural to you to pause. Some pauses may occur after very few words while others may occur after many more words (see example). In the end you will be asked to write a short summary of the passage."

Then, the example followed after which the subjects were instructed to go ahead to the next page and start.

As it appears in the instructions, in the Appendix (XXVII) the subjects were told in advance that after reading the passage they would be asked to write a short summary. This was done purposely, to reinforce the subjects to read the passage for understanding rather than read it mechanically or for rote-memorization. It was also done to make all subjects approach the passage from as similar a perspective as possible, so that differences in outcome due to different perspective would be minimized (Fass and Schumacher, 1981; Entwistle, 1981).

After the instructions, the passage was presented with all punctuations removed; only paragraphs were maintained. After reading and placing P.Us to the passage, subjects were asked to write a short summary of the passage without going back to it.

The subjects were then asked to complete the Critical Thinking Appraisal Test according to the directions that appeared on each sub-test and record their answers on the answer-sheet provided.

The next day, the subjects were required to read a copy of the article, placing vertical lines again, where a natural pause occured to them, but without access to the initial

article, so as not to be influenced by the first decision. The subjects were then asked to add any important points they thought should be included in their initial summary, without going back to the passage. After one more day, they were instructed to read the second copy of the passage, placing vertical lines again, where a natural pause occured to them.

After dividing the passage into subunits for a third time, the subjects were asked to add anything they thought was still missing from their summary and were then thanked for their participation in the project.

The period of one day was selected as the time interval between readings, because it was considered as long enough to secure that subjects did not remember the previous response to the P.U's task and allocate their pauses in their later readings accordingly. This period was also taken as short enough to allow for a schema to be developed by subsequent readings if this was probable.

For the analysis, each individual received a number of scores. These were, P.U s score on first reading, on second reading and on third reading. These scores were used as before to indicate the level of processing by the subjects. Scores in each of the five ability subtests and on Critical Thinking overall were also considered. The summary was evaluated in terms of quality of outcome on the basis of Entwistle's (Ibid.) method on three occasions, each time taking into consideration the additional points made.

Thus a summary which has been evaluated after the first reading as conclusion-oriented, mentioning; could be redescribed as conclusion-oriented, detailed, after some points were added to it, following the second reading. In this manner, it is possible to examine the improvement of performance throughout the repeated exposure to the material. Subjects had their summaries ranked as follows: conclusion oriented, detailed (4), conclusions oriented, mentioning (3), description oriented, detailed (2), and description-oriented, mentioning (1). A difference between the first and third summary scores (ranks) was also calculated to test if any improvement was made at this level of comprehension.

Results

Each subject received a set of scores that could be seen in the Appendices(XXIX, XXX) for all the groups. Those were number of P.Us for first, second and third reading respectively, total number of P.Us and difference in number of P.Us between first and third reading; first summary rating, second summary rating, third summary rating, difference in summary ratings (between first and third); Inferences score, Assumption's score, Deduction score, Evaluation of Arguments score, Interpretations score, and the overall Critical Thinking score.

Tests of Hypotheses Dealing with Factors Influencing Test processing.

A comparison was made between SR and NSR groups on the number of P.Us and summarization scores. The tables of means are presented below:

		S.R. learning	NSR learning	Combined
Art subjects	$\bar{x}$	143.55	132.80	138.43
	S.D	11.53	12.84	
		(Artists)	(Scientists)	
Science Subjects	$\bar{x}$	118.90	83.56	101.22
	S.D.	15.01 (Scientists)	13.41 (Artists)	
Combined	$\bar{x}$	132.45	109.47	
	S.D.	14.97	13.11	

(VII-2) Table of P.Us identifed by Science and Arts students when (i) tests are related (ii) are not related to their past experience in learning. Schema related situations lead to more P.U. allocations.

		S.R. learning			NSR learning		
		Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
Science Subjects	$\bar{x}$	2.66	2.88	3.90	1.82	2.36	2.82
	S.D	0.71	0.93	0.44	0.87	0.81	0.87
Arts Subjects	$\bar{x}$	2.60	2.90	3.10	1.33	2.00	2.33
	S.D	0.70	0.99	0.99	0.50	0.71	0.87
Combined	$\bar{x}$	2.63	2.89	3.67	1.60	2.20	2.60
	S.D.	0.82	0.99	0.99	0.93	0.84	0.89

(VII-3) Table of summarization scores for Science and Art students under condition of (i) schema related and (ii) schema unrelated learning. Each student had three trials. Quality of summaries increased over trials and was better for schema related learning.

Schema and cognitive processes

The analysis of variance showed a significant effect on processing (P.Us) scores due to whether or not the learning experience was schema related. The Knowledgable groups tended to allocate more P.Us. There was also an effect due to type of discipline. The science students consistently placed less P.Us than the Arts students. The

ANOVA table is given in the Appendix. These results support the first hypothesis of a difference in pattern of P.U. allocation between conditions of schema relatedness and non-schema relatedness.

A similar analysis was carried out for the summarization scores. Summarization scores are traditionally employed as an index of quality and depth of text processing (Entwistle 1979, Biggs 1979, Marton and Saljo 1976). The data were analyzed as a 2 x 2 x 3 factorial study with repeated measures on the last factor i.e. trials. The factors were schema relatedness with two levels; subject discipline with two levels and trials with three levels. Four groups of subjects were employed in the study each given three trials.

The results again confirm the finding that conditions of schema relatedness lead to significantly better processing than conditions of non-schema relatedness ($F=6.8$; $df1,38$; $P<.05$). The subject discipline effect failed to emerge when summarization scores were used. The effect of trials was significant ($F=26.47$; $df\ 2,38$ $P<.01$). There was a steady increase in performance over the three trials. The lack of a significant interaction between schema relatedness and trials suggests that the improvement was similar for the non-schema related and schema related conditions.

The pattern of processing obtained when students were compared under different conditions of schema relatedness was similar to those observed when NS were compared with NNS.

This observation strengthens an explanation of NS versus NNS differences in terms of schematic development in the language.

Thus a second attempt was made to replicate these findings. The results were similar in all respects and are reported in the Appendices (XXXI, XXXII).

P.Us and summary writing performance

As would be expected PU scores correlated significantly with scores for quality of written summaries. Correlation of total number of P.Us and summary scores was significant; $r = .51$, $n = 52$ $P<.001$. This supported the basic assumption that both scores could be said to reflect depth of processing.

To obtain a more detailed picture of this relationship separate correlations were calculated for the schema related and schema unrelated conditions. The schema related condition gave a correlation of $r = .21$, $n = 25$ which is not a significant coefficient . The schema unrelated condition gave $r = .57$, $n = 27$ with $P<.001$.

Thus, generally speaking number of P.Us appears to be related to summary writing performance. When however, background knowledge is taken into consideration, a more precise picture emerges. The correlation varies with schematic relatedness and is significant for the non-schema condition only. Performance under the schema condition, though correlated, is less so than that under the non-schema condition. We can

summarize this finding to mean that the relationship between processing (P.Us and summary writing performance depends on levels of schema involvement. The relationship investigated so far begins to acquire a greater degree of complexity.

Relation of Summary writing performance and 3 categories of mental operations

The five mental operations employed in the previous studies were correlated against summary writing performance under each condition.

Mental Operations		Summary Writing	
		S.R. condition	S. unrelated condition
Schema related	Assumption	0.40**	0.27
	Interpretation	0.44**	0.12
	Evaluation	0.45**	0.14
Ability related	Deduction	0.28*	0.45**
Unique	Inference	0.36*	0.32*
Sample size		46	45

Key** P<.01;* P<.05

Table (VII-4) showing correlations between the 5 mental operations and performance on summary writing in both S.R and Schema Unrelated conditions.

The schema related operations are highly correlated with performance but only under conditions where the learner has

the appropriate schematic development to deal with the processing task. All three correlations under the schema unrelated conditions are insignigicant.

The ability related operations are correlated at apparently different levels of coefficients under schema related and non schema related condition. The greater correlation is obtained under the schema unrelated condition. The coefficients are significantly different. (See Appendix XXXIII).

The unique factor seems equally correlated under both conditions.

The importance of those three types of mental operations interacts somewhat with the level of schematic background the learner possesses. Learners who possess a high level of schematic background knowledge understandably are making use of it. Those whose schematic development is at a lower level seem to be compensating by recourse to their deductive ability.

These findings logically indicate that cognitive processing when an appropriate schema is present is more related to those mental operations which rely on schema for their execution. Operations such as Assumption, Interpretation, and Evaluation that make use of past experience, are called into play when the learner is faced with a processing task relevant to his past experience. The logical exclusion of learners without the required past experience, from the use of these mental

operations shows itself in the low correlations for the schema unrelated conditions. None of the top three coefficients are significant.

It is interesting however to note the process of cognitive compensation which takes place when the learner does not have the necessary schematic background. The higher correlation with the ability related scores suggests this compensatory mechanism.

We can interpret the data accordingly. The way a learner processes text depends on whether he or she has the relevant schema as a means of interpretation. The learner approaches the task differently in the presence and absence of a schema. This study casts some light on the mechanisms that determine this difference. It seems to depend on the way and type of ability the learner brings into play.

When a relevant schema is not available, pure deductive reasoning is brought into play. When it is available, processing proceeds on the strength of the learner's ability to use operations like Assumptions, Interpretations and Evaluations. In either case, the unique ability measured by Inference seems unimportant. The learner makes use of different cognitive abilities according to the task presented and his/her assessment of his/her relevant past experience or schema.

Performance is only lightly related to ability measures when an appropriate schema exists. The influence of schema overrides that of ability in such cases. However, when there

is no relevant schematic representation, performance bears relationships to all types of abilities which contribute significantly to the understanding of the text.

In summary one may say that there is evidence of an influence in this study from both schema and learner's ability; the influence of ability is only brought into play when schema is absent. This potential on the part of the learner to interchange schema for ability when the situation demands, may throw some insight on the current debate concerning the relative contribution of information processing and background knowledge to the task of comprehension and reasoning (Glaser, 1984).

The unique factor

The consistent correlation of inference and performance under both schema related and schema unrelated conditions is open to interpretation. The previous study revealed slight significant correlations of this factor with both the learner's ability and past experience. No further guide into the nature of this factor is given in this last study except to provide support for its existence and dual correlations.

Interpretation can only be informed by theory and previous findings. Two theoretical concepts seem relevant to this factor. The first, the Steinberg's (1985) tacit knowledge concept which mediates between ability and performance. The second is the more topic relevant concept of (Van Dijk and Kintsch's 1983; Perrig & Kintsch, 1985) situation model.

According to these authors, a learner's ability to comprehend a text depends, among other things, on her/his ability to represent the situation being described:

> '... some psycholinguists have studied the syntactic and semantic processing of sentences, and a relatively "surface" level of representation (much of the work reviewed in Clark and Clark, 1977, falls in this category). Others have stressed phenomena that arise from the way discourse processors comprehend the meanings of texts (e.g. Kintsch 1974). A third level of representation has also been suggested that transcends both the verbal/ linguistic surface trace and the propositional text base; comprehending a text often involves the construction of a model of the situation described by the text.'
> (Perrig and Kintsch, 1985, p.503)

The next step in this investigation would be to study the relationship between inferencing and formulating Kintsch's situation model. This however must be left to another study or researcher.

CHAPTER VIII

The Effect of specific subject domain strategy on text processing

The previous stage of this investigation showed a significant influence of past experience or schema relatedness on the quality and depth of text processing. There was also a strong suggestion that the nature of scholastic discipline may play a part in determining the processing. This latter point if replicated poses a conceptual issue. One needs to determine how the influence of a specific subject's domain becomes apparent in the learner's processing of written discourse.

A number of studies have already shown that learners differ in depth of their approach to learning (Marton et al 1984; Entwistle, 1985 etc). Others have demonstrated that some external factors such as the attitude and expectations of varying teaching departments affect the learner's approach (Ramsden, 1979; Laurillard, 1979). What this present research adds is the suggestion that the latent structure of the subject discipline may affect the type and style of processing. Just as experience of the language is shown to produce differences in processing between native speakers of English and others, so it is argued that experience of an academic discipline may operate in a similar way to create a style of processing.

A study was therefore undertaken to investigate the effect of having studied physics as opposed to history in processing physics and history texts. The learners were sixth formers sitting the respective academic disciplines at 'A' level. Unlike the study in Chapter VII of this thesis, learners in the science group contained all Physics A. level students while the Arts group had only history A-level students. As far as possible an attempt was made to ensure that the history student was matched up with a physics student studying similar other A-level subjects (i.e. except for history or physics). This was not completely controlled due to the unavailability of sufficient sample. The final choice was made to ensure that all physics students were studying only science subjects and all history students were studying only Arts subjects. This served to focus more precisely on the effect of these two disciplines.

The specific questions asked of the data were:

1) Do physics and history A-level students differ in the quality and depth of processing as measured by:
   a - the quality of written summary
   b - depth of processing
   c - P.Us allocation

Answers to these 3 questions would reinforce or refute the argument that a specific subject's domain influences the way learners process written texts. The next step would, of course, be to ask why? It would be necessary to explore

the mechanisms whereby a specific subject's domain exerts such an influence. Hence, the second major question at this stage of study was: do different academic subjects foster the development of approaches to learning peculiar to that subject? The specific research query was formulated as follows:

> 'Do physics and history A-level students differ in their general approaches to learning which in turn influence their processing of text?'

Lastly, the study provided a further opportunity to verify the inpact of schema relatedness on processing. So the design permitted two separate conditions. The first, where the learners were asked to process information for which they were expected to have appropriate schema i.e. physics students processing physics texts and history students processing history texts. And condition 2, where physics students were processing history texts and vice versa. The first condition we referred to as the 'schema relevant (SR) condition' and the second as the 'non schema relevant (NSR) condition'.

Method

Fifty two sixth form students from two London schools were used for this study: one was a girls' school and the other a sixth form co-educational college. Thirty five of them were female and seventeen male, all between sixteen and nineteen years of age, the average age of the group being 16.98 years. The students were studying either History or Physics at advanced level. Contact was established with the school authorities and with the sixth form History and Physics teachers through a postgraduate, teaching 'A' level Physics at a 6th form College as part of his teaching practice. The researcher then visited the two schools on different days and conducted the experiment with the students. The co-operation of the deputy headmaster in the girls' school and of the History and Physics Teachers in both schools greatly facilitated the execution of the research.

The experiment took place in the Physics' Laboratory. Even in these schools it was difficult to meet any groups of students for a sufficient length of time due to school's time-table.

Sixth form students were chosen for this study because of the researcher's interest in the learning of students of this age group. From interviews with the teachers concerned, it became clear that in assessing the academic work of these students, emphasis is often placed on their ability to analyse facts, to assess views and statements critically and to give

reasoned answers. These cognitive skills will only exist in the product or outcome of learning if they are also brought to bear on the learning process. At the end of the advanced level History course, the student is expected to have acquired some of the basic skills historians use in evaluating historical data or documents. S/He is tested on her/his ability to assess the reliability of evidence, reconcile conflicting accounts and extract the essential from the irrelevant points in a document. The advanced level Physics student is also expected to have developed a 'mode of thinking about physical problems which enables him to tackle them effectively.' S/He is expected to be able to read and understand scientific and technical literature, to analyse an article critically, to draw conclusions from it and to assess the validity of arguments presented in it. The researcher therefore wanted to see if the approaches to learning adopted by these students fostered the development of these cognitive skills. Tables (VIII-1, VIII-2) below show the characteristics of the samples used. The next section will comment on these characteristics in greater detail.

Table (VIII-1)

Subjects characteristics in each treatment .

Group on the History Passage

High Relevance Group ('A' level History Student)	Self rating on knowledge	Verbal Ability	Age	Gender
1	5	46	17	F
2	3	47	18	F
3	3	39	18	F
4	4	39	17	F
5	4	44	18	F
6	3	23	17	F
7	4	30	17	F
8	4	18	17	F
9	4	31	17	F
10	3	31	17	M
11	5	31	17	M
12	4	26	17	M
13	3	28	16	M
	$\sum x=49$	$\sum x=433$	$\sum x= 223$	
	$\bar{x} = 3.77$ SD = 0.73	$\bar{x} = 33.31$ SD = 9.02	$\bar{x} = 17.15$ SD = 0.55	
Low Relevance Group (Physics Students)				
1	2	31	17	F
2	2	30	17	F
3	3	36	19	F
4	2	34	17	F
5	2	34	18	F
6	1	28	17	F
7	3	36	17	F
8	2	27	16	M
9	1	35	18	F
10	3	28	16	F
11	3	37	17	M
12	3	27	17	M
13	3	27	16	F
14	3	37	18	F
	$\sum x= 33$	$\sum x= 447$	$\sum x= 240$	
	$\bar{x} = 2.36$ SD = 0.74	$\bar{x} = 31.93$ SD = 4.03	$\bar{x} = 17.14$ SD = 0.86	

Table (VIII-2)

Subjects Characteristics in each treatment Group on the Physics Passage

High Relevance Group (A level Physics students)	Self-rating on knowledge	Verbal Ability	Age	Gender
1	3	26	17	F
2	0	27	17	F
3	3	29	16	F
4	0	43	17	F
5	0	33	16	F
6	4	30	18	F
7	3	37	17	F
8	4	27	16	F
9	4	33	17	M
10	4	33	17	F
11	3	14	17	M
12	3	32	17	M
13	4	29	16	M
14	4	27	16	F
	$\Sigma x = 42$	$\Sigma x = 420$	$\Sigma x = 234$	
	$\bar{x}$ 3.00	$\bar{x}$ = 30.00	$\bar{x}$= 16.71	
	SD 1.36	S.D=6.50	SD = 0.61	
Low Relevance Group (History Students)				
1	4	22	16	F
2	3	30	17	F
3	1	27	17	F
4	3	28	16	F
5	3	42	17	F
6	3	32	17	M
7	3	26	17	M
8	3	43	17	M
9	2	39	17	M
10	2	25	17	M
11	3	24	18	F
	$\Sigma \underline{x} = 30$	$\Sigma \underline{x} = 338$	$\Sigma \underline{x} = 186$	
	$\bar{x} = 2.73$	$\bar{x} = 30.73$	$\bar{x} = 16.91$	
	S.D = 0.79	S.D = 7.39	SD = 0.54	

Material.

Three passages were used for this experiment. The Group Test No 33, a vocabulary test,was used as a covariate to equate the different treatment groups on verbal ability. It consisted of 50 pairs of synonymes and antonyms. The respondent was asked to indicate whether the pairs meant the 'SAME', the 'OPPOSITE' or were 'UNKNOWN' to him/her. For example, Rich.... Poor - SAME OPPOSITE UNKNOWN. The student had to complete the exercise in three minutes. It was a power test. Since differences in language ability could interfere with performance in the learning experiment, a verbal ability test was included as a control.

A questionnaire was drawn up to elicit information about the student's age, gender, 'O' level and 'A' level subjects as well as the students' self-ratings on knowledge and interest in History or Physics. The section on 'O' level and 'A' level subjects were to provide information about their previous knowledge in either History or Physics. This information was necessary as it formed the basis for deciding whether a student had a high or low knowledge base in a subject, and for assigning them to experimental groups. From a preliminary enquiry , it was established that some of the students were studying both History and Physics at 'A' level and as these could not be assigned satisfactorily to either group in such an experiment, they were excluded.

Passages were chosen from History and Physics syllabuses. The understanding of these texts did not necessarily require the subject to have a grounding in the topics being discussed in them; that is the reader of either passage could start from scratch.

Two History passages were selected; the first from the English Tudor Period was an extract from "The Royal Divorce: Occasion or Cause?" by A.G. Dickens, quoted in Cook's book Documents and Debates: Sixteenth Century England 1450-1600. Section III of the book deals with the He rician Reformation or the Reformation documents and Debates written specifically for sixth form History students. The extract was written by a modern Historian and reflects the changing opinions on one of the most controversial themes of sixteenth century English History: Henry VIII's divorce which led to the schism with Rome . The learning task was within the ability of 'A' level History students, since this is one of the topics they discuss in lectures.

The second History passage was also based on a controversial issue, namely the British Policy of Appeasement at the 1938 Munich Conference. The extract was taken from T.O. Lloyd's 'Empire to Welfare State: English History 1906-1976', one of the Modern History text books recommended for 'A' level usage. The two passages were of approximately the same length - 220 and 215 words respectively. Both topics occur early on in the syllabus being studied and so would

have been covered by both first and second year students in their lectures.

Two passages were chosen for History because it was established that not all schools covered the same period and even within the same school the first and second year sixth forms were studying different periods. The experimenter thought of choosing either the first or the second years for the study, so that all the subjects could work on the same passage; but as he was not sure which class he would be allowed to meet when he arrived at the schools, he decided to select two passages reflecting both periods of History.

As all schools follow the same Physics syllabus, only one text was used, an extract on 'Superconductivity' from Harland's Comprehension and Data Assessment Tests in 'A' level Physics (1974). It concerned electrical resistance in metals and the phenomena exhibited by certain metals at a very low temperature: their electrical resistance drops. This zero resistance is referred to as 'Superconductivity'. The book from which the passage was taken is intended for students following courses in advanced level Physics or Engineering Science. According to the author, the use of comprehension questions in 'A' level examinations, represent a new outlook on examination techniques in science subjects. They are designed to test those abilities - logical thinking imagination and the students' ability to communicate with other scientists or engineers - which have remained largely untested by

conventional examination questions. "In the past, the emphasis of 'A' level Physics examination's had been laid too heavily on the acquisition of factual knowledge and the working out of rather routine problems" (Harland, 1974). The passage (211 words) was also within the ability of the students.

The passage was used to monitor the level of processing for both summary writing and P.USallocation.

Another set of material used for this study was the "short Inventory of Approaches to Studying" by Entwistle (1981). It consists of 30 items based on the seven scales used for describing various aspects of learning used by students. The scales were as follows.

The A scale gives a score out of 24 on the 'Achieving' orientation which indicates a well-organised study method, competitiveness and hope for success. There are 6 items on this scale.

The B scale also contains 6 items, gives a score out of 24, and describes the 'reproducing' orientation of surface approaches to learning, extrinsic motivation and syllabus boundness.

The C scale has 3 items and gives a score out of 12; it relates to comprehension learning, the attempts to relate ideas to real life and map out subject areas.

The D scale contains 6 items, is scored out of 24 and measures the 'meaning' orientations which indicates deep

approaches to learning or the attempt to look for meaning, motivated by an interest in topics and courses (i.e. intrinsic and academic motivation).

The E scale has 3 items and is scored out of 12; it indicates a tendency toward 'operation' learning or caution in using evidence, an interest in logical problems and rationality

The F scale is also scored out of 12, has 3 items and indicates 'improvidence' - the tendency to emphasise facts and details, and the inability to build an overall picture of the task.

The G scale has 3 items, is scored out of 12 and indicates another learning defect, 'Globetrotting' - a superficial approach by which the student tends to jump to premature conclusions or to seek generalisations without sufficient evidence. (Entwistle, 1981).

The Short Inventory has been developed by the Lancaster group of researchers (Entwistle et al, 1979) and it distinguishes different forms of motivation and includes the dimensions of study strategies and learning styles described by Marton (1976) and Pask (1979) as well as Biggs' (1976,1979) ideas on the SOLO taxonomy.

A factor analysis revealed three main dimensions of study strategies: a deep approach, a surface approach and a strategic or versatile approach. The inventory has also been used for sixth form students (Entwistle, 1979). According to its developers, it is still being improved upon, because

it is limited in its content. It concentrates only on the characteristics of the students and fails to address issues like the content and context of learning. The affective and emotional aspects of learning are also neglected. (See Appendix XXXIX).

Design

The experiment was designed to test the effect of the subject disciplines on the processing of the texts and on approaches to learning in four treatment groups. There were High and Low schema related conditions for each of the domains; that is, the 52 students were assigned to groups on the basis of their prior knowledge of either History or Physics.

The students doing Physics were randomly assigned to two conditions; and the History students were similarly allocated. The 13 History students who were given the History passage constituted the Schema Relevant Condition in History while the 14 Physics students given the Physics passage became the Schema Relevant condition in Physics. On the other hand, the 11 History students, asked to work on the Physics passage made up the Low-Knowledge or Non Schema Relevant group in Physics while the 14 Physics students asked to work on the History passage constituted the Low-Knowledge or Non Schema Relevant groups in History.

The four treatment groups were:

i) History Student in Schema Relevant condition
   i.e. given history text

ii) Physics Students in Schema Irrelevant condition
   i.e. given History text

iii) Physics Students in Schema Relevant condition
   i.e. given Physic text.

iv) History students in Schema Irrelevant condition
   i.e. given Physics Text.

Table VIII-3:

Treatment groups for Comprehension and Processing of written passages. Table shows number of learners in each condition.

Schema Conditions	SUBJECT MATTER		
	History	Physics	Total
Relevant	13	14	27
Non-relevant	14	11	25
Total	27	25	52

Twenty seven students summarised and processed (P.U allocations) the History passages and 25 summarised and processed the Physics passage. Table (VIII-3) shows the number of History and Physics A-level students and also indicates the number who were given schema relevant and non schema relevant conditions.

Approaches to studying were operationally defined as the ways a student normally studies - 'operation', 'comprehension'

or 'versatile' learning approaches (Entwistle, 1981). The Lancaster Study Inventory was used to monitor these. Comprehension in the narrow sense, refers to the mental process by which listeners take in the sounds uttered by a speaker and use them to interpret what they think the speaker intended to convey. It involves the construction of meanings from sounds or words. This aspect of comprehension has been called the 'construction process'. In its broader sense comprehension involves the 'utilisation process', that is, the way the listeners utilise this interpretation for further purposes (Clark & Clark, 1977). In this experiment ,comprehension was used in its narrow sense - the student's ability to interpret the passage. Operationally, it meant the quality of the summary they wrote down . These summaries were analysed in terms of the level of understanding reached - a 'deep' or a 'surface' level of understanding (Marton and Saljo, 1976; Entwistle et al, 1979).

Processing was defined as the number of pausal units (pauses), as before.

The researcher met the History and Physics students of the first and second years, sixth form, separately . When each group had assembled, the researcher was introduced and he briefly explained the purpose of the study and its relevance to their learning in school. The Physics Laboratory was the environment used for this experiment. For the Physics students this was a familiar setting but not for the History students who usually had lectures in a normal classroom.

Procedure

After filling in the general information sheet, subjects were given some directions to perform (i) the processing (P.Us) and (ii) the comprehension tasks. These were followed by (iii) the Inventory of Approaches form; and finally the group test No 33 (vocabulary test). The details are reported in Appendices (XXXIV to XL).

Analysis and Results

Subjects were given a set of 9 scores; 1) for understanding - measured by their summaries; 2) number of P.Us drawn on the text; 3) comprehension learning; 4) operation learning; 5) versatile learning; 6) Achieving orientation; 7) Reproducing; 8) Meaning; 9) Verbal Ability.
Tables (XLI, XLII) in appendix, show list of raw data with means and standard derivations for all groups. The table (VIII-4) shown below, presents the summary of the means, and standard deviations.

Table (VIII - 4) Means of Scores and Standard Deviations
for the 4 Treatment Groups

Knowledge Base		Understanding						Approaches to Studying											
Subject	Group	Summary		Verbal Ability		Paused Units		Compr.		Operat.		Versatile		Achiev.		Reprod.		Mean.	
Content		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
HISTORY	(H) High-knowledge	2,92	0.64	33.31	9.0	18.38	8.01	13.23	3.09	14.62	3.59	31.23	7.07	13.54	3.86	15.62	4.25	15.85	4.74
HISTORY	(P) Low-knowledge	1.43	0.51	31.93	4.0	20.43	6.47	12.71	2.46	15.64	3.67	36.57	5.36	17.5	2.65	15.29	3.95	18.14	3.25
PHYSICS	(P) High-knowledge	2.57	1.02	20.0	6.5	21.36	4.53	13.42	3.84	14.36	2.71	33.14	6.90	16.07	4.48	14.92	3.15	16.5	3.80
PHYSICS	(H) Low-knowledge	1.36	0.50	30.73	7.3	19.73	3.90	12.36	3.01	11.82	3.65	25.54	5.69	10.91	4.04	15.82	4.4	12.64	2.80

H : Historians

P : Physicists

The data was first analysed using the scores in the written four categories of summaries. These were identical to the techniques developed by Svensson (1977) and Entwistle (1979). According to these scoring categories, the students were given (4) for the deepest level answer indicated by a 'deep active' approach to learning in which the student tries to understand the author's meaning and shows that argument is supported by evidence.

They obtained (3) for a 'deep passive' approach to learning in which the student mentions the main argument, but does not relate the evidence to conclusion. This is also accepted as a deep level understanding.

They received a score of two (2) for a 'surface active' approach where the student describes the main points made without integrating them into an argument. This is considered as a surface level of understanding.

Lastly, they were awarded (1) for a 'surface passive' approach in which the student only mentions a few isolated points or examples. The level of understanding reached here, is said to be at surface level.

Two independent judges helped to evaluate the summaries for all the students according to the criteria described and in most cases they were in agreement. Where a few discrepancies occured, a third independent judge was asked for a decision.

Discipline relevance and quality of Summaries

The means and standard deviations for the summary data are shown in the table (VIII-5) below.

		STUDENTS	
		HISTORY	PHYSICS
S.R	HIGH	2.92 (0.64) (H)	2.57 (1.02) (P)
	LOW	1.36 (0.50) (P)	1.43 (0.51) (H)

P (indicates physics text given)

H (indicates history text given)

Table (VIII-5) shows means and standard deviation for both history and physics students under high and low schema relevance conditions.

To answer the question, does different subject discipline produce differences in processing as indicated by the quality of summaries, a 2 by 2 design was set up using the analysis of variance. The summary table is printed below:

Table (VIII-6) showing the source chart for discipline and schema relevance question

SOURCE	SS	DF	MS	F	P
Discipline (A)	.26	1	.26	.52	NS
Schema Relevance (B)	23.5	1	23.5	46.38	<.001
A x B	.56	1	.56	1.1	NS
Error	24.33	48	.51		

Factor A is not significant. This means that the history students did not differ significantly in the quality of their summary from the physics students. The table of means is given below.

Table (VIII-7) showing means for treatments.

	Mean
History students	2.21
Physics students	2.0
Schema Relevant	2.74
Schema Irrelevant	1.4

Discipline Relevance and depth of Summaries

A similar result was obtained using the depth of processing measures. This analysis was carried out to determine whether there was a difference in the pattern of processing of

the students between the two disciplines. The Table below (VIII-8) breaks down the depth of processing of each subject according to whether s/he falls in the history or physics group.

	Level of Processing	Category	History Students	Physics Students
HIGH RELEVANCE	Deep Active	4	2	3
	Deep Passive	3	8	4
	Surface Active	2	3	5
	Surface Passive	1	0	2
	Total		13	14
LOW RELEVANCE	Deep Active	4	0	0
	Deep Passive	3	0	0
	Surface Active	2	4	6
	Surface Passive	1	7	8
	Total		11	14

Table (VIII-8) showing results in depth of processing for history and physics students.

There is no noticeable difference in the depth of processing of the two groups. The data forces us to conclude

that in terms of ability to summarise written texts, the physicists and the historians were not distinguishable. One must therefore conclude that according to these measures of processing, the subject discipline does not seem to have much influence on the depth of processing. This is against expectation, and a final interpretation of these findings depends upon the analysis of the last index of processing. This will allow us to determine whether there is no noticeable discipline effect or whether such discipline effect as there is,can not be revealed through the writing of summaries.

S.R and quality of Summary

One factor of the analysis of variance dealt with schema relevance between the past experience of the learner and the information in the text read. Results are highly significant with an F ratio of 46.38; df(1,48);$p<.001$. It can be seen from the table of means that the summaries were of a much higher quality when the students were working with familiar material. It was concluded that, as in the previous study, relevance of appropriate schema affected the processing of the text. This has been shown to be the case with native/non native speakers of English, with science and arts students and with physics and history students.

From these results one may see a progression from the general to the particular in that the language's sphere of influence is more general than that of the field of study, and so on.

The influence therefore on any student engaged in learning could be cumulative so that learning can be most favourably facilitated when all 3 levels are in relevance. The negative extreme would occur if all 3 levels were in a state of irrelevance, an example of this being when a second language learner changes his/her field of discipline and focuses on a new discipline.

S.R and depth of processing.

Table (VIII-9) shows the depth of processing as indicated by the deep/surface dimensions used by Svensson and Entwistle.

Level of processing	Category	High Relevance	Low Relevance	Total
Deep Active	A (4)	5 (2H,3P)	0	5
Deep Passive	B (3)	12 (8H,4P)	0	12
Surface Active	C (2)	8 (3H,5P)	10(6H,4P)	18
Surface Passive	D (1)	2 (OH,2P)	15(8H,7P)	17
Total		27	25	52

Table (VIII-9) shows results of depth of processing for High and Low relevance groups.

The results are particularly striking as no member of the low relevance group achieved a deep level of processing although the groups were formed at random. 33 per cent of all the students (17/52) reached a deep level of understanding, amongst them 10 historians and 7 physicists.

On the other hand 67 per cent of these 'A' level students did not attain a deep level.

P.Us as an index of discipline group difference in processing

To complete the answer to the research question No.1 i.e. Do physics and history 'A' level students differ in the quality and depth of processing, a Mann Whitney non parametric U Test was carried out using P.Us as the index of processing. The obtained value was significant ($Z \geq 1.68$; $P<.05$). The detailed calculations are reported in the Appendix (XLIII).

Table (VIII-10) for Treatment Means

		High Relevance	Low Relevance
History Students	mean	18.38	19.73
	S.D	6.69	4
Physics Students	mean	21.36	20.43
	S.D	4.5	6.47

The discipline seem to exert an influence on the way students allocate their pauses in order to make text meaningful. The history students show the tendency to produce less P.Us while the physics students were more generous in allocating pauses throughout the text. The table of means shows that the difference between discipline was more pronounced when

the physicist worked on material relating to their discipline whereas the reverse was true for the historians.

Conclusion

The aforementioned studies show that the learner's approach to comprehension is dependent on a specific subject's domain. The recorded difference in processing is only apparent when using the P.U index but it is not evident from the 2 quantitative and qualitative scores on summary. This can be interpreted in a number of ways: perhaps the difference shown by the P.Us is accidental as false positive research results can occur on a chance basis. In contrast, the P.U index has been shown to be reliable over a series of experiments during this study.

A second interpretation could be that the summaries were not sensitive enough to pick up a difference that did in fact exist. This interpretation is also supported by the general finding that the relationship between summary scores and the depth of processing has always been inconsistent. (Schmeck, 1982; Entwistle 1985); refinement of summary procedures is unlikely to change this picture.

A third interpretation would accept the findings at face value and support the view that the P.Us measure an aspect of processing that is not directly measured by the summaries. This view could be strengthened if the groups could be shown to differ in some other processing variable, for example in their approaches to learning. The data was therefore analysed

in response to the second research question, that is: do different academic subjects foster the development of approaches to learning peculiar to that subject?

A comparison was made between physics students and history students in each of the 6 dimensions of approaches to learning. Table (VIII-11) gives the means, SDs and res ults of t. test, for both groups of subjects.

Approaches to learning	Physics Students		History Students		F. Value	P. Value
	$\bar{x}$	S.D	$\bar{x}$	S.D		
Comprehension	13.07	3.18	12.83	3.02	.28	NS
Operational	14.68	4.08	13.33	3.82	1.22	NS
Versatile	34.86	6.31	28.63	6.97	3.38	P<.01
Achieving	16.79	3.69	12.33	4.08	4.13	P<.001
Reproducing	15.11	3.51	15.71	4.23	.56	NS
Meaning	17.32	3.57	14.24	4.90	2.85	P<.01

Table (VIII.11) presenting the six approaches to learning with the obtained scores, and t. test.

There are 3 dimensions in which history and physics students differ significantly. The physics students show more versatility of approach, they seek a deeper meaning and are more achievement orientated than the historians. (The operational approach, though showing the same tendency had just failed to reach statistical significance).

A two way analysis of variance was carried out on the mean scores of historians and physicists, on the versatile approach.

Its purpose was to investigate the relative contributions of subject-content and knowledge relevance to the choice of a versatile approach. Table (VIII-12) below sums up the ANOVA.

SOURCE	SS	DF	MS	F	P
Subject discipline (A)	538.78	1	538.78		
				13.48	<.001
Schematic relevance(B)	16.39	1	16.39		
				.41	NS
A x B	267.35	1	267.35		
				6.69	<.05
Error	1918.18	48	39.96		

Table (VIII-12) Two way ANOVA for the versatility dimension.

The table reveals a highly significant tendency of the physics students to adopt a more versatile approach to learning. This tendency is reasonably attributed to the habitual learning strategy associated with the learner's subject discipline.

Similar analyses were carried out to compare the approaches of the physics and history students in the spheres of meaning and achievement.

Summary tables are set out below (VIII-13) (VIII-14).

Table (VIII-13) TWO WAY ANOVA Summary of results for the 'meaning' dimension

Source	SS	DF	MS	F	P
Subject (A) discipline	122.15	1	122.15	8.71	<.01
Schema (B)	7.9	1	7.9	.56	NS
A x B	75.79	1	75.79	5.4	<.05
ERROR	673.45	48	14.03		

Table (VIII-14). TWO WAY ANOVA summary of results for the 'achieving dimension'

Source	SS	DF	MS	F	P
Subject (A) discipline	267.84	1	267.94	18.52	<.001
Schema (B) relevance	4.64	1	4.64	.32	NS
A x B	53	1	53	3.66	NS
ERROR	694.57	48	14.47		

Although the ANOVA included the high/low relevance factor, the non significant result was expected. This is because physics students doing a high and low relevance task were randomly equated and as such, we would expect that they would reflect the same approach as was derived from their physics training . We interpret

the similarity in approach between the random subgroups of the same discipline, even when subjected to different conditions during the experiment, as strong support for the view that the approach is related to subject. The view is doubly reinforced by the fact that similar results are obtained with the history students. In a sense, there are 6 minor experiments all testing the view that students of the same 'A' level subjects will exhibit greater similarity of approach to learning (i.e. strategy) than students of different 'A' level subjects. There are 3 tests of this position, for each of the approaches of versatility, achieving and meaning, and for each there are two tests, one with physics and one with history. They all yielded the same results.

Based on such consistent results, there is sufficient evidence to answer the second research question affirmatively. Physics and history 'A' level students in spite of a certain similarity of general approach to learning e.g. comprehension learning, operational, and reproducing orientation , do differ in their approaches to learning. This in turn may reasonably be assumed to influence their processing of text. And this influence is evident in their P.U allocations. There is practical value therefore to be gained in measuring processing by summary and P.Us rather than through the use of summary scores alone.

One unexpected and interesting finding is the interaction between subject discipline and 3 dimensions of learning

strategies. These are versatility, meaning and operational learning. Although the same pattern of interaction tendency is observed for the achieving orientation, it just failed to reach statistical significance. The interaction profiles on these functions are drawn below. (Fig. VIII-1).

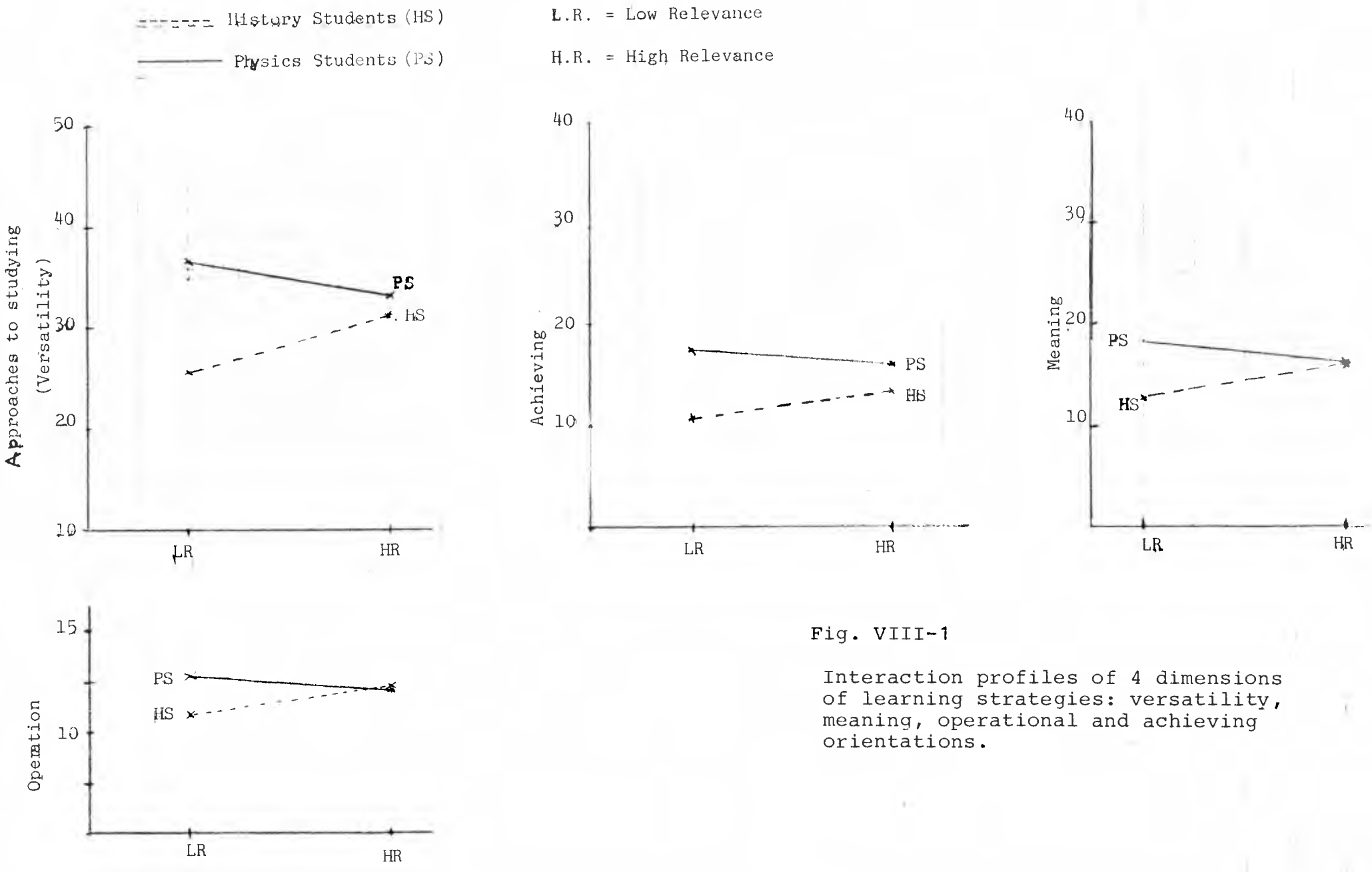

Fig. VIII-1

Interaction profiles of 4 dimensions of learning strategies: versatility, meaning, operational and achieving orientations.

It appears that a more general tendency distinguishes the two categories of students apart from the ones already mentioned. This tendency describes the reactions when confronted by the challenge of unfamiliar material. Whereas the physics students react positively to this challenge by becoming more versatile, more meaningful more operational, the history students performed better on the high relevance condition.

CHAPTER IX

GENERAL CONCLUSION

This investigation attempted to follow through a lead which arose from a serendipitous finding in a previous study. There it was noted that there was a consistent difference between the patterns of text processing responses offered by native and non-native speakers of English.

The findings proved repeatable over two further experiments. A qualitative analysis of the different processing patterns showed that non-native speakers identified the same positions for mental pauses during reading but missed a sub category of such pauses. This sub category was shown to consist of three linguistic structures. These were structures which:

1 - separated nouns from actions.

2 - separated descriptive phrases or ideas.

3 - separated repetitions of phrases or ideas.

Thus the difference in processing revealed itself quantitatively, in number of pauses and qualitatively, in a type of linguistic blindness to certain sentence structures.

To explore the psychological nature of these different patterns of text processing, five influential factors were investigated. These were

1) the type of mental operations which the learner performed when processing the text e.g. inferring, assuming, interpreting, evaluating, deducing.

2) the learner's experience with the content of the message e.g. amount of previous exposure to the text.
3) the learner's experience with the language, i.e. whether he/she is a first or second language speaker.
4) the learner's ability, as measured by the Watson and Glaser critical thinking test.
5) the learner's habitual approach to learning as assessed by the study skill inventory.

The type of mental operation was closely related to the pattern of text processing. These mental operations or processes which rely upon the learner's past experience with the language, accounted for much of the difference between the native and the non-native speakers of English. The study identified the processes of 'assumption', 'interpretation', and 'evaluation' as relying most on past experience. These were all schema related processes. The mental operation of 'deduction' was shown to rely mostly on the learner's ability as distinct from his/her past experience. Finally inferring seemed to be fairly independent of schema and deductive reasoning in their effect on text processing.

A test of these five mental processes was constructed specially for this investigation.

The learner's experience with the content of the message varied according to the number of times he/she was exposed to the same text. Both groups of learners improved in their depth of processing (as indicated by the number of mental pausal units identified; by the increase of comprehension scores and by the progressive alleviation of the linguistic blindness to the specified sub categories of pauses). However, the native speakers of the language improved significantly more. They improved especially in items which made use of the learner's past experience. The non-native speakers on the other hand improved more on items related to deduction. The maximum improvement was obtained for both groups on items which correlated with the unique independent contribution of inference. At this stage of investigation we concluded that non-native speakers of English need a type of presentation which takes less background information for granted and relies less on the mental processes of 'assumption', 'interpretation' and 'evaluation'.

The learners' experience with the English language also plays a part even if not the most important part, in the pattern of processing. This section of the study was conducted according to the current expert/novice paradigm. Native speakers are assumed to have the status of experts in the language. A comparison of the processing performance is made in the light of expectations arising from this paradigm. The study indicates that the main findings accounting for performance differences between Experts and Novices also account for differences between

the native and the non-native English speakers.

The native speakers perform better on those parts of the processing tasks which rely on schema organisation but not on those depending on ability. When presented with a text, they revealed superior pattern and gist recognition. On the third hypothesis which predicted recognition of more meaningful chunks, the result gave only indirect support. The paradigm also suggests that expert subjects would return higher inference scores. (This was verified).

The relative contribution of ability and past experience is now the subject of a great deal of research interest. This is motivated by the practical educational necessity to demonstrate that intervention procedures affect learning irrespective of, or in association with ability. This stage of the study tackles the question: to what extend does lack of background experience account for the difference in performance of learners? Tackling comprehension tasks, an experimental study was designed to vary the past experience of the learners by the level of similarity between the text and his/her previous learning. Thus, science students received science passages and artsstudents received artspassages in a condition which indicated a close relationship between past experience and the learning context. A minimal relationship was obtained where there was a low level of past experience in the condition where science students were given arts passages and artsstudents were given science passages. The ability dimension was monitered by scores on

the Watson and Glaser test. The results revealed striking differences in processing strategies when individuals were placed in a situation which was past experience relevant unlike those who had very little background knowledge to draw upon. Both measures of P.Us. and summarisation were used to monitor the effects.

It was also seen that the discipline of the students e.g. history, physics, had an effect on the pattern of processing performance with science students consistently placing less P.US than arts students. These findings are interpreted by extension to throw light on the performance of native versus non-native speakers of a language, as well as of individuals faced with schema relevant or schema irrelevant material.

The most interesting aspect of the data is revealed when separate analyses were done on the relationship between ability and past experience under schema relevant condition on the one hand and schema irrelevant condition on the other. A reciprocal function is seen where the learner maximizes his/her performance by a compensation device. When non-schema relevant groups are asked to process a text which relies on past experience, they compensate by making use of their deductive abilities, whereas learners in the more schema relevant condition, made minimal call upon these deductive abilities. This cognitive compensation mechanism cautions against a flat declaration in favour of greater influence in processing of either learners' abilities or learners' past experience.

The suggestion arising from this latter study, that a particular discipline (i.e. arts versus science subjects) may also influence the pattern of processing led to further investigations. Physics students were compared with history students both as regards P.U. allocations and also depth of processing as measured by Entwistle's inventory.

The study confirms the hypothesis that differential processing patterns are associated with different academic subjects. Physics students in two experiments (n_1=52; n_2=48) showed greater degree of versatile learning, achievement orientation and effort after meaning than the history students.

Application to Education

The serendipitous finding which led to this research pointed to a variety of differences between the way individuals processed written material depending on whether they were operating in their native language or not, the extent of their background knowledge and the nature of the discipline they were learning. The influence of their ability was not questioned but the study revealed an interesting method of compensation for inadequate background knowledge by recourse to ability. The relevance of these findings to educational practice is readily deducible.

On the question of the medium of instruction, the data suggests that some attempts be made to adopt a language of presentation that relies less on the processes of

assumption, interpretation and evaluation. The structures of the language itself must make clear the assumptions on which comprehension depends. The language could be made clearer by avoiding the specific area of linguistic blindness shown to be associated with second language learning. Implicit judgements of value and preference that are normally taken for granted should be overtly expressed.

Concerning background knowledge, the findings support the current view that background knowledge affects text comprehension . The results go further, however, and reveal the influence of background knowledge on the pattern of processing. From a practical point of view, it is useful to know that learners tend to process material differently with different loading on either schema organisation or straight intelligence. Depending on their background knowledge they display different pattern and gist recognition ability and perceive different level of meaningfulness in each chunk of text. They also draw different quality and quantity of inferences from the passage. Such information would enable a communicator to better adjust his/her method of presentation to suit the processing strategy of the learners. Not least of all the practical implication of this study is the possibility of adopting the simple, straight forward, method of P.Us allocation as an index of diversity in processing together with the commonly used summary writing scores.

As regards to the actual subject discipline, this research has merely initiated a probe into the influence of

discipline structure on the way learners process the information. The unexpected and replicated finding that physics 'A' level students reveal a consistently more versatile, more in depth and more highly developed achievement orientation than history students, should be further studied before it can be confidently stated.

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A P P E N D I C E S

APPENDIX I-a

HIROSHIMA

For some years scientists had known that if an atom could be split by bombardment from other atoms the energy released would be a million times as powerful as the equivalent amount of high explosive. In 1939 three physicists, Albert Einstein, Leo Szeland and Enrico Fermi, had fled to the U.S.A. to escape Fascist persecution. They warned President Roosevelt of the danger to the world if the Nazis produced such a bomb. At first Roosevelt did little about the matter but once America was at war he set up a special establishment for nuclear research. Within a short time Fermi created the self-sustaining nuclear reaction which is a halfway stage to creating an atomic bomb. As the work expanded from laboratory to factory proportions, a new town was built at Oak Ridge, Tennessee, to house the necessary workers and equipment. Finally, a disused school near Los Alamos in New Mexico was chosen to complete tests. In this lonely spot on 16th July, 1945, a flash seen 250 miles away quickly turned into a purple and orange fireball. The tall tower holding the device was vaporised.

President Truman saw in this terrible demonstration a way to end the war quickly. On 6th August, 1945 a B29 bomber, nicknamed Enola Gay and commanded by Colonel Paul Tibbetts, arrived over the Japanese city of Hiroshima with a nuclear bomb.

It was 8.15 a.m. on a beautiful summer morning. Tibbett's bomb aimer lined his instruments up; bomb doors were opened and the long device, weighing 10,000 lb., fell away. The big plane jerked violently upwards after losing such a load. Forty-three seconds later an atomic bomb exploded on human beings for the first time.

Survivors have different stories to tell of what they experienced in that awful moment. At first there seemed to be no sound, just blinding light. Its effect was to turn the centre of Hiroshima into an oven in which thousands were burnt to nothing. Only permanent shadows like blurred photographs, indicated where human beings had once been. Further away, people died more slowly and more horribly from radiation and fire. Even those miles from the city found that it burned everything black that faced it. People's faces, their bodies even the print in books, were affected.

The first fearful heat was followed by a 500 m.p.h. wind. It uprooted trees, flattened buildings and caused a 'rain' of flying glass which tore people to shreds. Clothes were ripped off, pillars under the explosion driven straight into the ground, blades of grass turned into dangerous objects which pierced people's bodies. In the harbour this hurricane produced tidal waves which drowned many of those who had hurled themselved into the water to escape. Simultaneously, the thousands of charcoal stoves being used to make breakfast started scores of fires to add to the gigantic blaze ignited

by the bomb. Flimsy wood and paper houses burnt fiercely; larger buildings collapsed in flames. For hours afterwards people continued to die. Five square miles of Hiroshima were turned into what an American observer described as a 'huge, dirty grey and rusty brown stain'. High up and far away another U.S. airman gazed at the mushroom cloud nearly four miles high and exclaimed 'My God, what have we done?'

Ordinary air raids had already killed more than the 80,000 who died at Hiroshima. But this time it was different. For weeks afterwards victims began to suffer from a mysterious illness. The skin became dis-figured with tiny bleedings. Their hair fell out. Then they died. Ever since this radiation disease, called by the Japanese the 'sickness of the original -child bomb', has continued to kill. Today people who were not even born in August 1945 die and suffer from the poison let loose that day, or in later atomic tests. Radioactive materials (Strontium 90) fall to earth thousands of miles away. There they are absorbed into the soil and so into plants. The animals who feed on them transmit the poison through their meat and milk. Once a human being has eaten enough he contracts cancer. So the bomb on Hiroshima and the one dropped three days later on Nagasaki continue to punish the innocent. In a terrible century, mankind has produced the final horror.

(Adapted from: L.E. Snellgrove - 'The modern world since 1070'; 1968)

APPENDIX I-b

The influence of heredity and maturation on behaviour

Each human being begins life as a single cell. The nucleus of this composite cell, like all other cells, contains rod-like structures called chromosomes. Each chromosome is made up of strands of deoxyribonucleic acid (DNA), complex protein molecules that are elementary transmitters of hereditary influences.

All that is inherited is DNA. These protein molecules are the chemical patterns which guide the growth of the new organism, both before birth and after. The single fertilized cell divides and divides again. The descendants of the original fertilized egg differentiate; some become skin cells, some muscle cells, some neurons. Cells develop into functional organs and systems. This growth process, which is dependant on heredity, is called maturation.

Maturation cannot take place unless the environment in which it is taking place provides the proper materials. Thus, before birth the developing organism receives oxygen, nutrients and other substances from the environment of its mother's body. After birth, he continues to develop in accordance with the hereditary blueprint. He still depends on his environment to provide the surroundings required for growth. Now he needs

not only nutrients and oxygen to keep him alive, but also certain kinds of experiences in order to develop normally.

Some behaviour depends chiefly on neural maturation. This behaviour results from the activation of built-in circuits in the nervous system. A reflex is an automatic unlearned response that takes place in the presence of the appropriate stimulus as soon as the neurons involved are functional. When a bright light shines on the eye, the pupil contracts reflexively.

In lower animals, unlearned connections mediate complex responses to a complex series of stimuli. Such complex patterns of behaviour, which are dependant to a large extend on built-in circuitry, are called instincts. Investigators identify a pattern of behaviour as an instinct by these criteria: (a) the particular type of stereotyped sequence of behaviour is typical of every member of the species in the appropriate situation (b) the behaviour is performed adequately the first time; (c) the behaviour differs from a reflex in that the instinct involves more complex inter-relations between stimuli and responses over a period of time.

Each phase of the instinctive behaviour is elicited by specific cues. The stimulus that elicits each portion of the instinctive behaviour is called a sign stimulus and investigators have isolated the properties that make some sign stimuli effective.

Mating rituals and maternal behaviour are common examples of behaviour that is labelled instinctive. In predicting the occurrence of such behaviour we need not investigate the previous experience of the organism but we need to know only that it is a member of a particular species in its ordinary environment. One of the phenomena that caused psychologists to re-evaluate their thinking in the nature of instinct was imprinting.

Why do baby geese follow the mother goose? The obvious answer is instinct. This may be obvious, but it is inaccurate. Controlled laboratory studies have shown that a number of birds will show a following response to whatever moving object they see during a critical period shortly after birth. The strength of the response depends on several factors. Stimuli of certain sizes and shapes tend to be more effective for certain species. Also, the greater the amount of effort exerted by the baby bird the first time he follows it, the more persistent are his later following responses.

The "following" responses belong to the category known as imprinted behaviour. Imprinted behaviour depends both on inheritance and an event early in the life of the organism that has lasting effects. In purely instinctive behaviour, neural connections are built in by heredity and maturation in such a way that only the specific stimulus is needed to elicit the behaviour. In the case of imprinted behaviour, the built-in circuit has a missing part that is filled in by the first

experiences of the young animal.

The major reason it took so long for scientists to realise the importance of the early experiences for the goslings' "mother following responses" and later mating behaviour was that the same behaviour was typical of every member of the species. Almost every gosling born in a natural habitat will be hatched by a mother goose. Under normal conditions, the first moving object the gosling sees is its mother and it will follow her. Only when the gosling is taken out of the natural habitat and subjected to laboratory manipulation can we see the manner in which the following responses will vary as early experiences varied.

(Adapted from: McKeachie and Doyle - "Psychology".)

APPENDIX 1-c

THE STEM OF A FLOWERING PLANT

The cells in the stem of a plant are living and obtain a supply of oxygen from the air via porous openings, stomata or lenticels, in their epidermis. Older stems are supported by woody and fibrous tissues which are added layer by layer, so increasing their thickness. Young stems depend for their rigidity on the turgidity of their cells, the cylindrical distribution of their conducting tissues and the opposing stresses of the pith and epidermis. Running through the stem are tubes which conduct water from the soil up to the leaves and food from the leaves to various parts of the plant.

The functions of the stem are that it (a) supports the structures of the shoot; (b) spaces out the leaves so that they receive adequate air and sunlight; (c) allows conduction of water from soil to leaves, and food from leaves to other parts of the plant; (d) holds flowers above the ground, thus assisting pollination by insects or wind; (e) if the stem is green, photosynthesis may occur in it.

The detailed structure of a fairly typical stem is in the form of a cylinder. The outer layer of cells forms a skin, the epidermis, the inner cells make up the cortex and pith. Between the cortex and pith is a number of vascular bundles containing specialised cells which carry food and water:

A. Epidermis - The single layer of closely fitting cells is

effective in holding the inner cells in shape, preventing loss of water, affording protection and preventing the entry of fungi, bacteria and dust. This layer is relatively impermeable to liquids and gases, and oxygen can enter, and carbon dioxide escape, only through stomata in young stems and lenticels in older stems. The lenticels are small gaps in the bark, usually circular or oval and slightly raised on the bark surface. The epidermis is usually in a state of strain, in which it tends to shrink along its length. This shrinking effect contributes to the rigidity of the stem.

B. Cortex and Pith - These are regions consisting of fairly large, thin-walled cells with air spaces between them. The air space system is continuous throughout the living tissues and allows air to circulate from the stomata or lenticels to all living regions of the stem. The cortex and pith are tissues which contribute to the rigidity of the stem by pressing out against the epidermis. These tissues also space out the vascular bundles and have a general value as packing.

C. Vascular Bundles - These are sometimes called veins, and are made up of vessels and sieve tubes, with fibrous and packing tissue between and around them.

D. Vessels - These consist of long tubes several feet in length. They are formed from columns of cells whose walls have become impregnated with a woody substance and whose protoplasm has died. The horizontal cross-walls of these cells have broken down, thus forming a long continuous tube. In these vessels

water is carried from the roots, through the stem and into the veins in the leaves.

E. Sieve tubes form columns of living cells, the horizontal walls of which are perforated. These perforations allow dissolved substances to flow from one cell to the next, so carrying food made in the leaves to the other parts of the plant, for example, to ripening fruits and so on.

Vessels and tubes are surrounded by cells that space them out and support them. The tissue, consisting of vessels and the long fibre-like cells among them, is called xylem. The sieve tubes and their packing cells are called phloem.

F. Cambium - Between the xylem and the phloem is a layer of narrow, thin-walled cells called cambium.

Once cells have been formed from the growing point and have grown to their full extent, they are no longer capable of dividing to make new cells. The cells in the cambium, however, do not lose their ability to divide and are able to multiply and make new cells.

Although at first the cambium is restricted to the vascular bundles, it later forms a continuous cylinder within the stem between the cortex and pith. Its cells divide in such a way as to make new xylem cells on the inside and new phloem cells on the outside. In woody plants like trees, this continues throughout their lifetime and as the cambium continues to divide and add new cells, the stem increases in thickness, a process called secondary thickening.

(Adapted from Mackean: Introduction to Biology, 1962)

APPENDIX II

Commas and other punctuation marks usually indicate where it would be convenient to pause. They do not indicate all the possible places where a reader could naturally pause. Your task is to put a line through all the places where it occurs to you that there is a pause. I imagine that some pauses will occur after just a few words while others will occur after many more words. This does not matter, neither is it important if the different pauses occur for different reasons. For example, it is likely that one pause may occur simply to enable the reader to catch his or her breath. Another may serve to enhance the meaning and so on. The only restriction on where you place the pause is that it should seem natural to you.

(Appendices III a, b, c)

III - a (Hiroshima Text)

NNS Yes	NS No	NS Yes	
	X		Hiroshima
		X	oven
		X	shadows
	X		slowly
	X		Horribly
	X		radiation
	X		city
	X		buildings
	X		glass
	X		explosion
	X		objects
	X		harbour
	X		waves
	X		stoves
X		X	breakfast
	X		tires
	X		blaze
	X		afterwards
	X		described
	X		as
	X		a
	X		grey
	X		up
	X		away
	X		cloud
	X		high
X		X	exclaimed
	X		80000
	X		time
X	X		afterwards
	X		Since
	X		Japanese

NNS Yes	NS No	NS Yes	
	X		years
	X		known
	X		that
		X	atoms
	X		1939
	X		Szeland
	X		USA
	X		Roosevelt
	X		world
	X		first
		X	matter
	X		war
		X	time
		X	reaction
	X		expanded
	X		Alamos
	X		Mexico
	X		spot
	X		flash
	X		away
	X		device
	X		demonstration
	X		1945
		X	Gay
	X		Hiroshima
	X		spened
	X		upwards
	X		later
	X		being
	X		tell
	X		first

	today	1945	die	suffer	materials	Strcntium 90	Soil	Animals	them	enough	Hiroshima	Nagazaki
Yes					X	X					X	X
No	X	X	X	X			X	X	X	X		
Yes										X		X
No	X	X	X	X	X	X	X	X	X		X	

	NS	NNS
NA	15-45	15-45
A	50-95	50-75

NA = Non Accepted

A = Accepted

Appendix III-a. Total P.Us as rated by NS and NNS for the Hiroshima passage. Pauses got a 'Yes' (i.e. accepted) whenever 50% or more of the group agreed on it. A 'No' was given for the pauses that were below the 50% level of acceptance. The range of acceptance for Yes and No categories is also given.

NNS		NS			NNS		NS		
No	Yes	No	Yes		No	Yes	No	Yes	
X		X		circuits	X		X		being
X		X		reflex	X		X		structures
	X		X	response	X		X		chromosomes
	X		X	stimulus	X		X		acid
X		X		responses	X		X		molecules
X		X		dependant	X		X		transmitters
X		X		extent	X		X		molecules
X		X		investigators	X		X		patterns
X		X		behaviour	X		X		birth
X		X		instinct	X		X		cell
X		X		(a)	X		X		divides
X		X		behaviour	X		X		descendant
X		X		typical	X		X		egg
X		X		species	X		X		develop
X		X		(b)	X		X		organs
X		X		(c)	X		X		maturation
	X		X	reflex	X		X		place
X		X		interrelations	X		X		environment
X		X		stimuli	X		X		place
X		X		responses		X	X		birth
X		X		behaviour	X		X		nutrient
	X		X	behaviour	X		X		substances
X		X		called	X		X		develop
	X		X	stimulus	X		X		environment
X		X		properties	X		X		surroundings
X		X		rituals	X		X		needs
X		X		behaviour	X		X		nutrients
X		X		behaviour	X		X		oxygen
	X		X	behaviour	X		X		also
	X		X	organism		X	X		experiences
X		X		only	X		X		behaviour

	NS Yes	NS no	NNS Yes	NNS No
species		X		X
phenomena		X		X
psychologists		X		X
thinking		X		X
instinct	X			X
is		X		X
studies		X		X
birds		X		X
response		X		X
see		X		X
period		X		X
response		X		X
sizes		X		X
shapes		X		X
effort		X		X
bird		X		X
persistant		X		X
responses		X		X
category		X		X
behaviour		X		X
look		X		X
inheritance	X			X
event		X		X
life		X		X
organisation		X		X
in		X		X
heredity		X		X
maturation	X			X
way		X		X
needed		X		X
circuit		X		X

	NS Yes	NS No	NNS Yes	NNS No
part		X		X
in		X		X
reason		X		X
scientists		X		X
experiences		X		X
goslings		X		X
responses	X			X
behaviour	X			X
behaviour		X		X
was		X		X
that		X		X
habitat		X		X
object		X		X
sees		X		X
mother	X			X
habitat		X		X
manipulation	X		X	
manner		X		X
vary	X			X

Range

	NS	NNS
NA	15-45	15-45
A	50-90	50-80

Appendix III - b: Total P.Us rating by NS and NNS for the Heredity passage. Rating belonging to the 'Yes' category represent a 50% or more acceptance level. A 'No' was given to the pauses that did not reach the 50% criterion. The table is followed by the range of accepted and non accepted P.Us .

NNS		NS		
No	Yes	No	Yes	
X		X		cells
X		X		cells
X		X		effective
X			X	protection
X		X		bacteria
X		X		impermeable
X			X	stems
X		X		lenticels
X		X		circular
X			X	oval
X		X		effect
X			X	cells
X		X		system
X		X		continuous
	X		X	tissues
X		X		stomata
X		X		lenticels
X		X		pith
X		X		tissues
X		X		stem
X			X	bundles
X		X		vessels
X		X		tissue
X		X		between
X		X		tubes
X			X	cells
	X		X	substance
X		X		vessels
X		X		stem
X		X		tubes
X		X		which

NNS		NS		
No	Yes	No	Yes	
X		X		plant
X			X	living
X		X		oxygen
X		X		air
X		X		stems
	X	X		tissues
X		X		added
X		X		stems
X		X		rigidity
	X		X	tissues
X		X		stem
X		X		tubes
X		X		soil
	X		X	leaves
X		X		leaves
X		X		are
X		X		that
X			X	it
X			X	(a)
X		X		(b)
X		X		leaves
X		X		(c)
X		X		water
X		X		leaves
X		X		(d)
X		X		(e)
	X	X		stem
X		X		cells
X		X		cells
X		X		pith
X		X		bundles

Appendix III - c = Showing Total Pill rating for Accepted and Non Accepted pauses for the Stem passage.
A pause was 'Accepted' (Yes) when 50% or more of a group agreed on it. It was 'Non Accepted' when less than 50% agreed on it.
The range of acceptance is also given.

	NS Yes	NS No	NNS Yes	NNS No
perforations		X		X
flow		X		X
food		X		X
leaves		X		X
tubes		X		X
surrounded		X		X
cells		X		X
out		X		X
vessels		X		X
tubes		X		X
cells		X		X
oxlem		X		X
phloem		X		X
cells		X		X
forward		X		X
point	X		X	
dividing		X		X
divide	X		X	
multiply		X		X
although		X		X
first		X		X
cylinder		X		X
stem	X			X
way		X		X
cells		X		X
inside	X			X
cells		X		X
plants		X		X
lifetime	X		X	
divide		X		X
called		X		X

Range

	NS	NNS
NA	15-45	15-45
A	50-85	50-75

Appendix IV - a (1)

Chi Square calculation for the Hiroshima article

$$\text{Chi Square} = \frac{(fo - fe - \frac{1}{2})^2}{fe}$$

Observed fo	Expected fe
7	1,906
6	11,093
4	9,093
58	52,906

$$\frac{(|7 - 1.906| - 0.5)^2}{1.906} = 11.072$$

$$\frac{(|6 - 11.093| - 0.5)^2}{11.093} = 2.819$$

$$\frac{(|4 - 9.093| - 0.5)^2}{9.093} = 3.440$$

$$\frac{(|58 - 52.906| - 0.5)^2}{52.906} = .3989$$

$$\chi^2 = 17.72$$

---

a(2). Contingency coefficient calculation (Croxton and Cowden, 1962) for the Hiroshima passage

$$r = \frac{a_1 b_2 - a_2 b_1}{\sqrt{(a_1+b_2)(a_2+b_2)(a_1+a_2)(b_1+b_2)}}$$

a_1	a_2
b_1	b_2

$$= \frac{406 - 24}{\sqrt{(13)(62)(11)(64)}} = \frac{382}{753.276} = .507$$

Appendix IV - b (1)

Chi Square for the Heredity passage

$$\text{Chi Square} = \frac{(fo - fe - \frac{1}{2})^2}{fe}$$

Observed fo	Expected fe
8	1.339
2	8.660
7	13.660
95	88.339

$$\frac{(|8 - 1.339| - 0.5)^2}{1.339} = 28.347$$

$$\frac{(|2 - 8.660| - 0.5)^2}{8.660} = 5.919$$

$$\frac{(|7 - 13.660| - 0.5)^2}{13.660} = 3.752$$

$$\frac{(|95 - 88.339| - 0.5)^2}{88.339} = 0.429$$

$$\chi^2 = 38.45$$

---

b(2). Contingency coefficient calculation (Croxton and Cowdon, 1962) for the Heredity passage

$$r = \frac{a_1b_2 - a_2b_1}{\sqrt{(a_1+b_1)(a_2+b_2)(a_1+a_2)(b_1+b_2)}}$$

a_1	a_2
b_1	b_2

$$= \frac{(8 \times 95) - (14)}{\sqrt{(15)(97)(10)(102)}} = \frac{746}{1218.236} = .612$$

Appendix IV - c (1)

Chi Square calculation for the Stem article

$$\text{Chi Square} = \frac{(fo - fe - \frac{1}{2})^2}{fe}$$

Observed fo	Expected fe
7	1.741
11	16.258
2	7.258
73	67.741

$$\frac{(|7 - 1.741| - 0.5)^2}{1.741} = 13.008$$

$$\frac{(|11 - 16.258| - 0.5)^2}{16.258} = 2.039$$

$$\frac{(|2 - 7.258| - 0.5)^2}{7.258} = 4.568$$

$$\frac{(|73 - 67.741| - 0.5)^2}{67.741} = .334$$

$$\chi^2 = 19.94$$

---

c (2). Contingency coefficient calculation (Croxton and Cowdon, 1962) for the Stem passage

$$r = \frac{a_1b_2 - a_2b_1}{\sqrt{(a_1+b_1)(a_2+b_2)(a_1+a_2)(b_1+b_2)}}$$

a_1	a_2
b_1	b_2

$$= \frac{(7x73) - (22)}{\sqrt{(18)(75)(9)(84)}} = \frac{489}{1010.247} = .484$$

V-a Instructions for the non-punctuated text.

Instruction

Punctuation marks do not indicate all possible places where a reader could naturally pause. Some pauses will occur after one or two words while others occur after many more words. This could be due to reasons such as to catch your breath, to enhance meaning and so on.
The article you have been given is not punctuated. Please read it through at your normal reading speed. The task consists of putting a vertical line whenever you feel you would naturally pause. This should be done while you are going through the article. It does not matter if you think you have made a mistake; just carry on until you finish the whole text. Then you will have another chance to do the same task again.

APPENDIX V- b

Hiroshima article with no punctuation marks .

For some years scientists had known that if an atom could be split by bombardment from other atoms the energy released would be a million times as powerful as the equivalent amount of high explosive in 1939 three physicists Albert Einstein Leo Szeland and Enrico Fermi had fled to the U.S.A. to escape Fascist persecution they warned President Roosevelt of the danger to the world if the Nazis produced such a bomb at first Roosevelt did little about the matter but once America was at war he set up a special establishment for nuclear research within a short time Fermi created the self sustaining nuclear reaction which is a halfway stage to creating an atomic bomb as the work expanded from laboratory to factory proportions a new town was built at Oak Ridge Tennessee to house the necessary workers and equipment finally a disused school near Los Alamos in New Mexico was chosen to complete tests in this lonely spot on 16th July 1945 a flash seen 250 miles away quickly turned into a purple and orange fireball and tall tower holding the device was vaporised

President Truman saw in this terrible demonstration a way to end the war quickly on 6th August 1945 a B29 bomber nicknamed Enola Gay and commanded by Colonel Paul Tibbetts arrived over the Japanese city of Hiroshima with a nuclear bomb it was 8.15 a.m. on a beautiful summer morning Tibbett's bomb aimer

lined his instruments up bomb doors were opened and the long device weighing 10,000 lb. fell away the big plane jerked violently upwards after losing such a load forty three seconds later an atomic bomb exploded on human beings for the first time Survivors have different stories to tell of what they experienced in that awful moment at first there seemed to be no sound just blinding light its effect was to turn the centre of Hiroshima into an oven in which thousands were burnt to nothing only permanent shadows like blurred photographs indicated where human beings had once been further away people died more slowly and more horribly from radiation and fire even those miles from the city found that it burned everything black that faced it people's faces their bodies even the print in books were affected

The first fearful heat was followed by a 500 m.p.h. wind it uprooted trees flattened buildings and caused a rain of flying glass which tore people to shreds clothes were ripped off pillars under the explosion driven straight into the ground blades of grass turned into dangerous objects which pierced people's bodies in the harbour this hurricane produced tidal waves which drowned many of those who had hurled themselves into the water to escape simultaneously the thousands of charcoal stoves being used to make breakfast started scores of fires to add to the gigantic blaze ignited by the bomb flimsy wood and paper houses burnt fiercely larger buildings collapsed in flames for hours afterwards people continued to die five square miles of Hiroshima were turned into what an

American observer described as a huge dirty grey and rusty brown stain high up and far away another U.S. airman gazed at the mushroom cloud nearly four miles high and exclaimed my god what have we done

Ordinary air raids have already killed more than the 80,000 who died at Hiroshima but this time it was different for weeks afterwards victims began to suffer from a mysterious illness the skin became disfigured with tiny bleedings their hair fell out then they died ever since this radiation disease called by the Japanese the sickness of the original child bomb has continued to kill today people who were not even born in August 1945 die and suffer from the poison let loose that day or in later atomic tests radioactive materials Strontium 90 fall to earth thousands of miles away there they are absorbed into the soil and so into plants the animals who feed on them transmit the poison through their meat and milk once a human being has eaten enough he contracts cancer so the bomb on Hiroshima and the one dropped three days later on Nagasaki continue to punish the innocent in a terrible century mankind has produced the final horror.

Table VI - a
Showing the Words after which 50% and above of the NS paused

	Trials						Trials					
	1	2	3	4	5		1	2	3	4	5	
years	16	75	58	58	75	up	91	100	83	91	91	
atom	75	75	83	75	83	opened	33	50	50	33	33	
explosion	83	91	91	91	100	away	100	100	100	91	100	
1939	33	8	25	33	50	load	100	83	91	91	91	
physicists	58	75	58	75	91	time	100	100	100	100	100	
Einstein	66	75	66	91	91	moment	91	100	83	91	83	
Fermi	33	58	50	66	66	sound	66	75	83	66	75	
persecution	100	100	100	91	100	light	100	100	91	100	91	
bombs	100	100	100	91	91	oven		25	50	41	50	
matter	83	75	83	66	91	nothing	100	100	91	91	100	
war	41	66	58	58	58	been	91	100	83	91	91	
research	83	100	83	83	100	slowly	33	41	33	33	50	
time	25	58	33	33	50	fire	100	91	83	83	91	
reaction	41	58	50	58	58	it	75	91	83	91	91	
bomb	100	91	100	91	91	faces	66	91	75	91	100	
proportion	66	83	75	75	83	bodies	75	83	83	75	91	
Tennessee	16	50	33	41	41	affected	58	83	75	83	83	
equipment	100	100	91	91	100	wind	100	91	75	91	91	
tests	75	91	58	66	91	trees	75	91	83	83	83	
spot	33	33	50	50	41	building	33	41	50	50	50	
1945	75	58	50	50	58	shreds	100	100	91	100	91	
fireball	100	100	83	91	100	off	50	75	83	91	91	
vaporised	58	75	83	83	91	ground	91	91	83	91	91	
quickly	91	91	100	100	91	bodies	66	66	83	83	83	
1945	25	50	33	33	50	harbour	50	58	58	41	41	
Gay	25	25	33	58	41	escape	91	91	75	83	91	
Tibbet	33	50	50	50	41	simultanely	16	16	50	58	50	
bomb	100	100	91	91	100	breakfast	25	41	50	41	50	
morning	75	100	75	75	83	blaze	25		58	50	41	

	Trials				
	1	2	3	4	5
bombs	91	100	75	75	91
fiercely	91	91	91	83	91
flames	91	100	91	91	91
die	91	100	91	91	91
stain	75	83	75	83	83
explained	75	91	75	83	91
done	66	83	91	83	91
Hiroshima	91	83	75	91	91
different	91	100	100	83	83
illness	91	100	100	91	91
bleedings	91	100	91	83	100
out	50	58	50	66	75
died	100	91	91	91	91
since	16	25	41	58	50
disease	58	66	50	41	50
bomb	50	66	58	66	75
kill	50	66	66	66	66
today	16	25	50	33	50
1945	41	25	25	50	25
day	50	50	50	50	66
tests	58	83	83	66	83
materials	16	16	25	50	50
90	16	16	25	41	50
away	58	66	83	75	66
plants	91	83	66	83	91
milk	83	91	91	91	100
enough	16	16	25	58	41
cancer	66	75	83	66	91
Hiroshima	16	25	41	50	33
Nagazaki	25	25	58	58	41
innocent	91	83	91	75	83

Table VI-b
Showing the Words after which 50% and above of the NNS paused

	Trials						Trials						Trials				
	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5
years	27	36	45	45	54	moment	77	86	86	95	82	bleedings	77	91	91	82	91
atoms	50	59	73	63	63	light	68	86	91	95	95	out	68	54	63	73	59
explosive	77	77	86	86	86	nothing	82	86	82	86	86	died	68	59	68	77	77
1939	41	45	45	50	59	been	63	73	82	77	82	kill	59	54	59	45	45
physicists	27	36	50	45	50	fire	68	91	77	91	95	tests	59	63	59	59	68
Einstein	54	54	59	54	54	it	50	59	50	68	63	away	73	50	59	54	59
persecution	82	95	95	91	100	faces	36	45	63	59	59	plants	82	86	82	91	91
bomb	95	91	91	95	95	bodies	41	41	32	54	45	milk	86	82	91	82	95
matter	59	63	59	59	63	affected	59	73	68	68	77	enough	41	27	41	41	50
war	27	50	41	36	23	wind	82	77	86	86	82	cancer	54	77	77	63	77
research	68	77	59	82	86	trees	41	63	63	73	68	innocent	59	50	54	54	54
time	45	54	59	41	50	buildings	18	27	41	50	41						
bomb	86	81	86	86	95	shreds	77	73	91	86	86						
proportion	63	41	59	50	63	off	63	63	54	63	68						
Tennessee	13	36	13	50	36	ground	63	54	77	63	73						
equipment	86	82	100	91	95	bodies	50	50	68	50	63						
tests	59	63	54	77	73	harbour	50	45	54	68	45						
spot	32	32	45	32	54	escape	54	77	77	82	82						
1945	41	56	45	63	45	bomb	50	59	77	68	82						
fireball	86	77	95	95	91	fiercely	68	86	77	86	95						
vaporise	59	68	68	63	77	flames	54	63	54	63	73						
quickly	77	86	86	95	95	die	73	77	77	91	91						
1945	36	45	45	50	45	stain	54	73	68	73	68						
bomb	86	95	95	95	95	away	41	32	36	50	50						
morning	68	68	68	77	86	exclaimed	41	45	50	45	63						
up	63	73	73	82	82	done	63	77	73	77	73						
away	63	82	73	86	91	Hiroshima	68	73	73	77	77						
load	73	82	82	91	91	different	73	77	82	82	86						
Time	86	82	95	91	95	illness	82	86	91	82	86						

VII a) Hiroshima article showing the words after which the 8 pausal differences occured.
b) Also showing the story grammar divisions

For some years scientists had known that if an atom could be split by bombardment from other atoms the energy released would be a million times as powerful as the equivalent amount of high explosive in 1939 three physicists[1] Albert Einstein Leo Szeland and Enrico Fermi[2] had fled to the U.S.A to escape Fascist persecution they warned President Roosevelt of the danger to the world if the Nazis produced such a bomb at first Roosevelt did little about the matter but once America was at war he set up a special establishment for nuclear research within a short time Fermi created the self sustaining nuclear reaction[3] which is a halfway stage to creating an atomic bomb as the work expanded from laboratory to factory proportions a new town was built at Oak Ridge Tennessee to house the necessary workers and equipment finally a disused school near Los Alamos in New Mexico was chosen to complete tests in this lonely spot on 16th July 1945 a flash seen 250 miles away quickly turned into a purple and orange fireball the tall tower holding the device was vaporised

President Truman saw in this terrible demonstration a way to end the war quickly on 6th August 1945 a B29 bomber nicknamed Enola Gay and commanded by Colonel Paul Tibbetts arrived over the Japanese city of Hiroshima with a nuclear bomb it was 8.15 a.m. on a beautiful summer morning Tibbett's bomb aimer lined his instruments up bomb doors were opened and the long device weighing 10,000 lb. fell away the big plane jerked violently upwards after losing such a load forty three seconds later an atomic bomb exploded on human beings for the first time Survivors have different stories to tell of what they experienced in that awful moment at first there seemed to be no sound[4] just blinding light its effect was to turn the centre of Hiroshima into an oven in which thousands were burnt to nothing only permanent shadows like

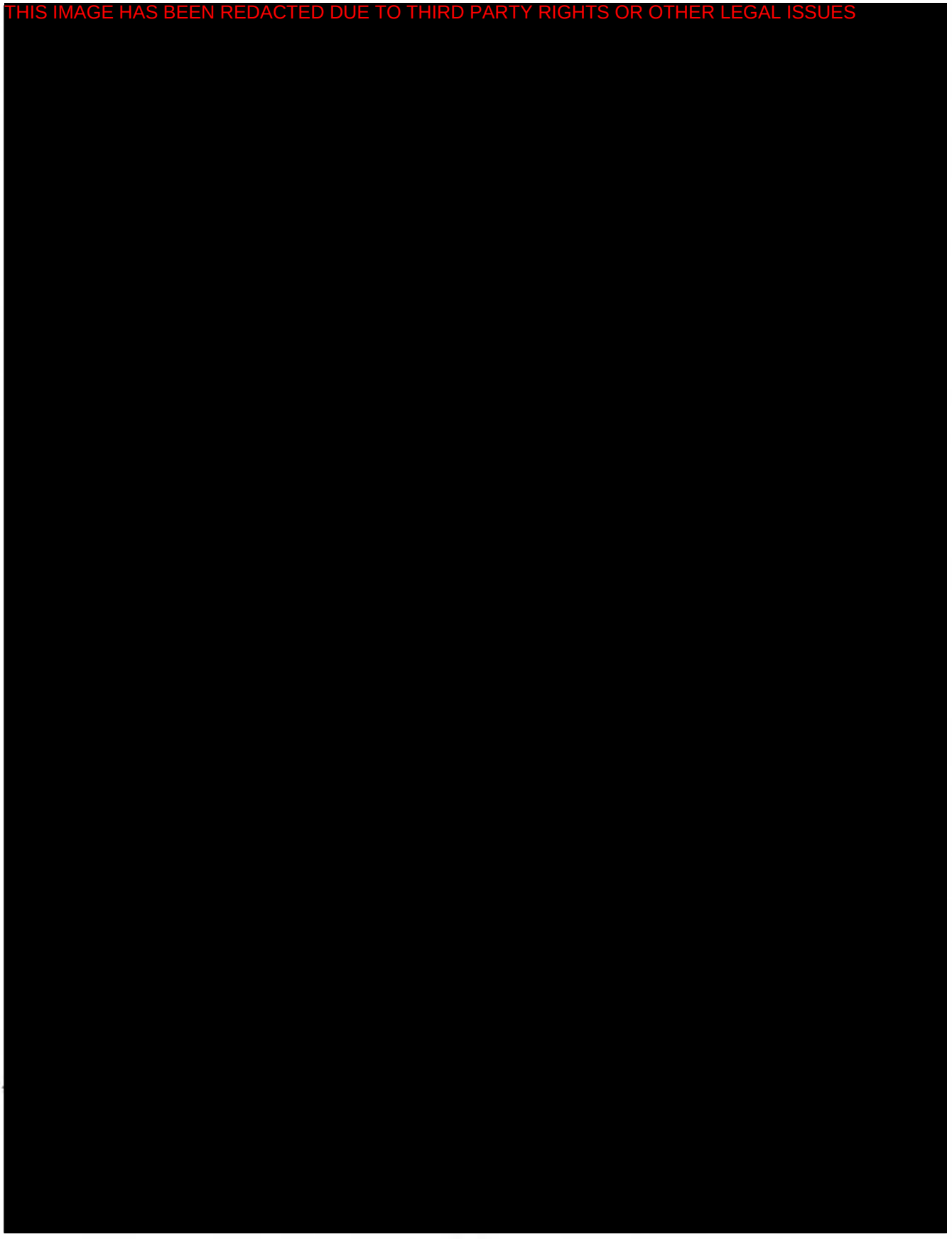
blurred photographs indicated where human beings had once been further away people died more slowly and more horribly from radiation and fire even those miles from the city found that it burned everything black that faced it people's 5 faces their 6 bodies even the print in books were affected

The first fearful heat was followed by a 500 m.p.h. wind it uprooted trees flattened buildings and caused a rain of flying glass which tore people to shreds clothes were ripped off pillars under the explosion driven straight into the ground blades of grass turned into dangerous objects which pierced people's bodies in the harbour this hurricane produced tidal waves which drowned many of those who had hurled themselves into the water to escape simultaneously the thousands of charcoal stoves being used to make breakfast started scores of fires to add to the gigantic blaze ignited by the bomb flimsy wood and paper houses burnt fiercely larger buildings collapsed in flames for hours afterwards people continued to die five square miles of Hiroshima were turned into what an American observer described as a huge dirty grey and rusty brown stain high up and far away another U.S. airman gazed at the mushroom cloud nearly four miles high and exclaimed my god what have we done

Ordinay air raids had already killed more than the 80,000 who died at Hiroshima but this time it was different for weeks afterwards victims began to suffer from a mysterious illness the skin became disfigured with tiny bleedings their hair fell out then they died ever since this radiation 7 disease called by the Japanese the sickness of the original child bomb has contined to kill today people who were not even born in August 1945 die and suffer from the poison let loose that 8 day or in later atomic tests radioactive materials Strontium 90 fall to earth thousands of miles away there they are absorbed into the soil and so into plants the animals who feed on them transmit the poison through their meat and milk once a human being has eaten enough he contracts cancer so the bomb on Hiroshima and the one dropped three days later on Nagasaki continue to punish the innocent in a terrible centruy mankind has produced the final horror

RESOLUTION

VIII - Watson & Glaser Test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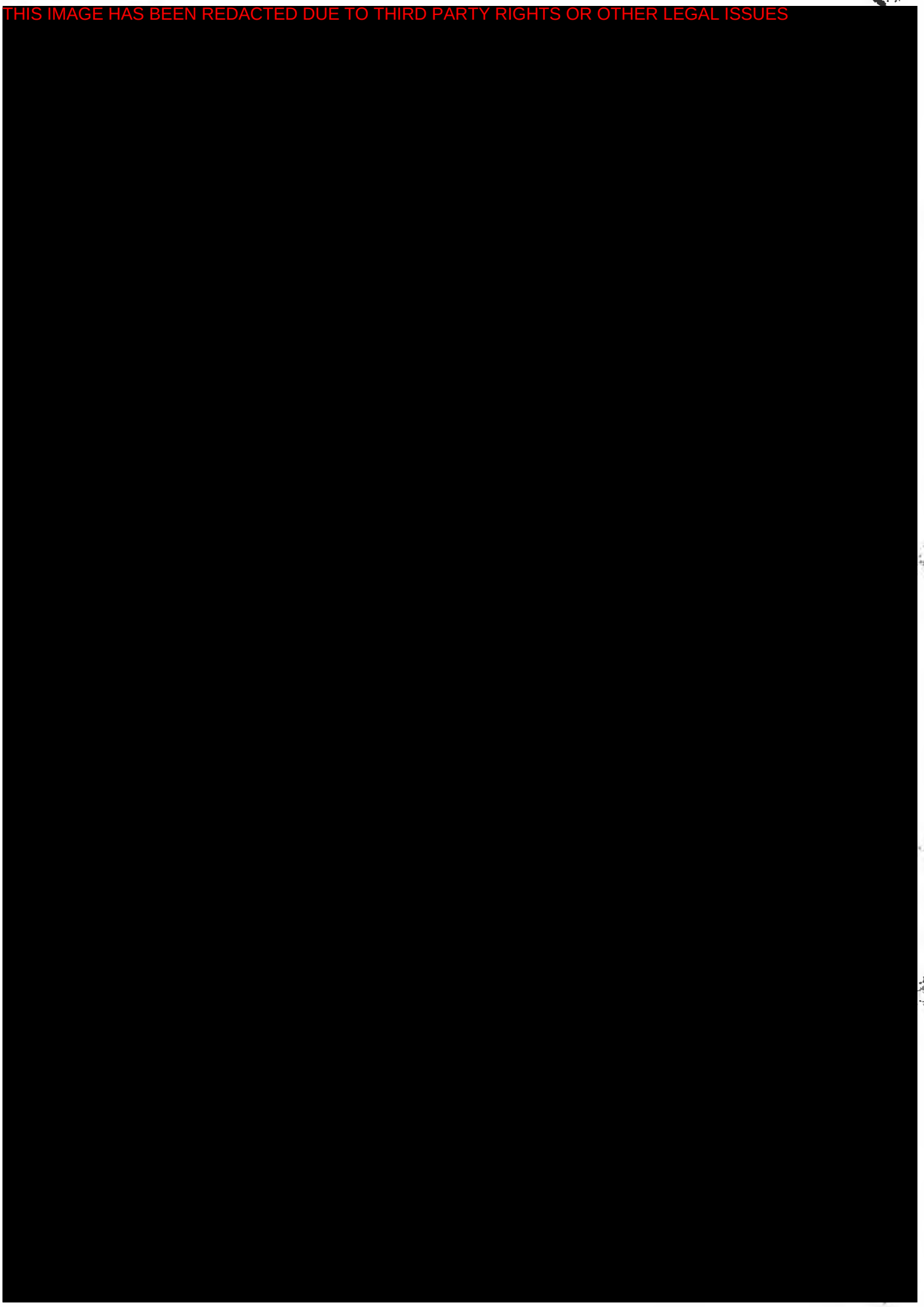
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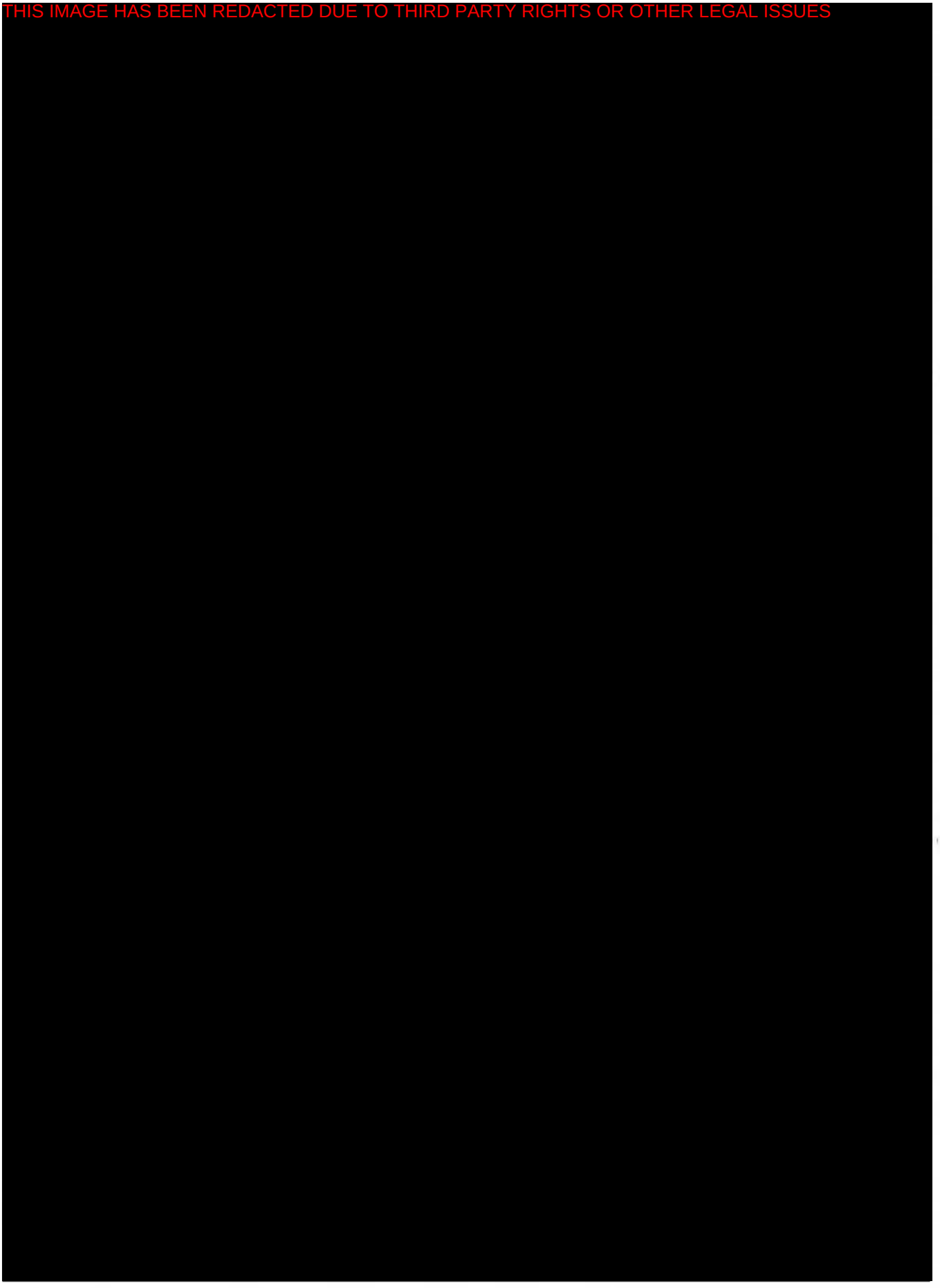
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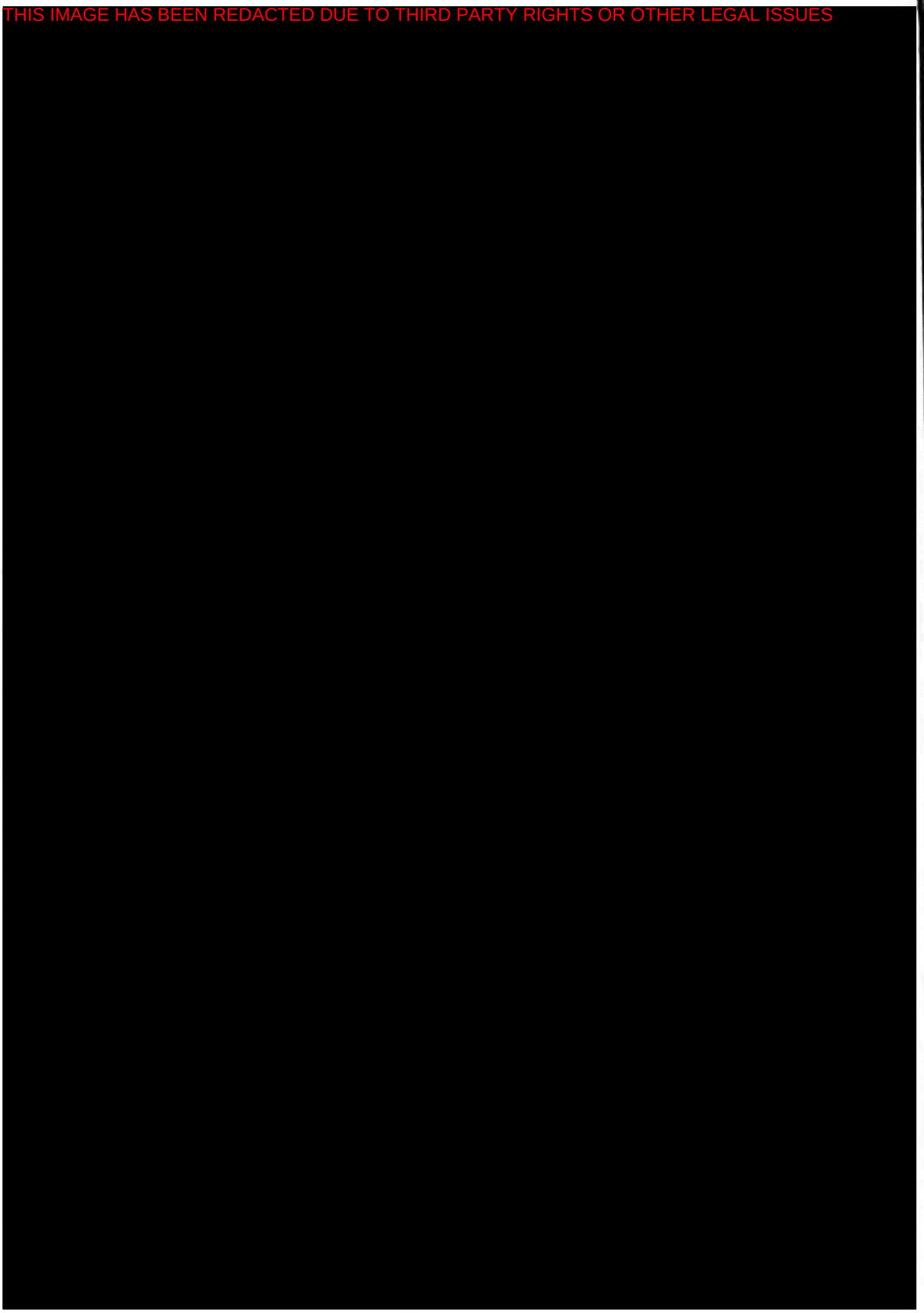
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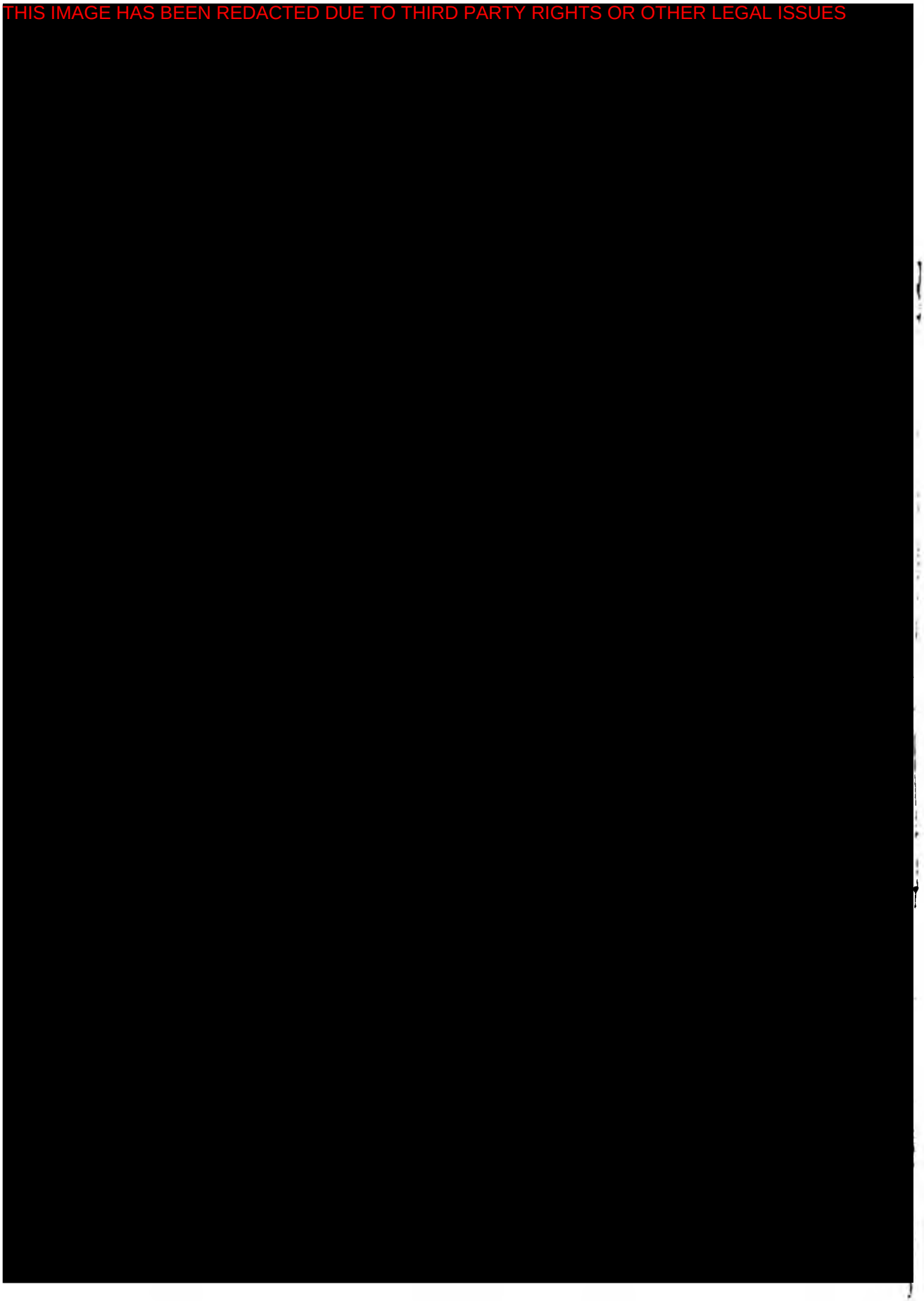
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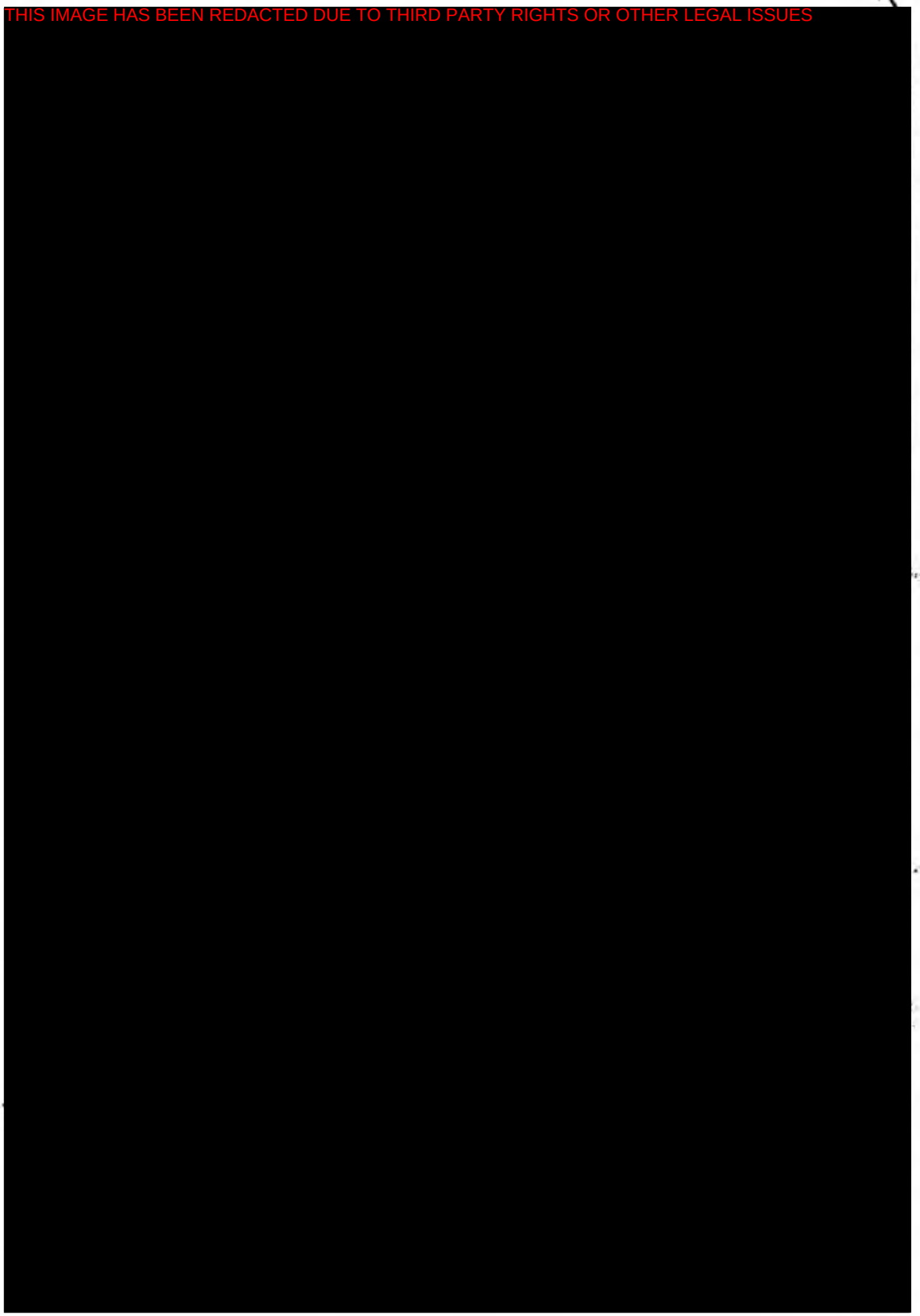
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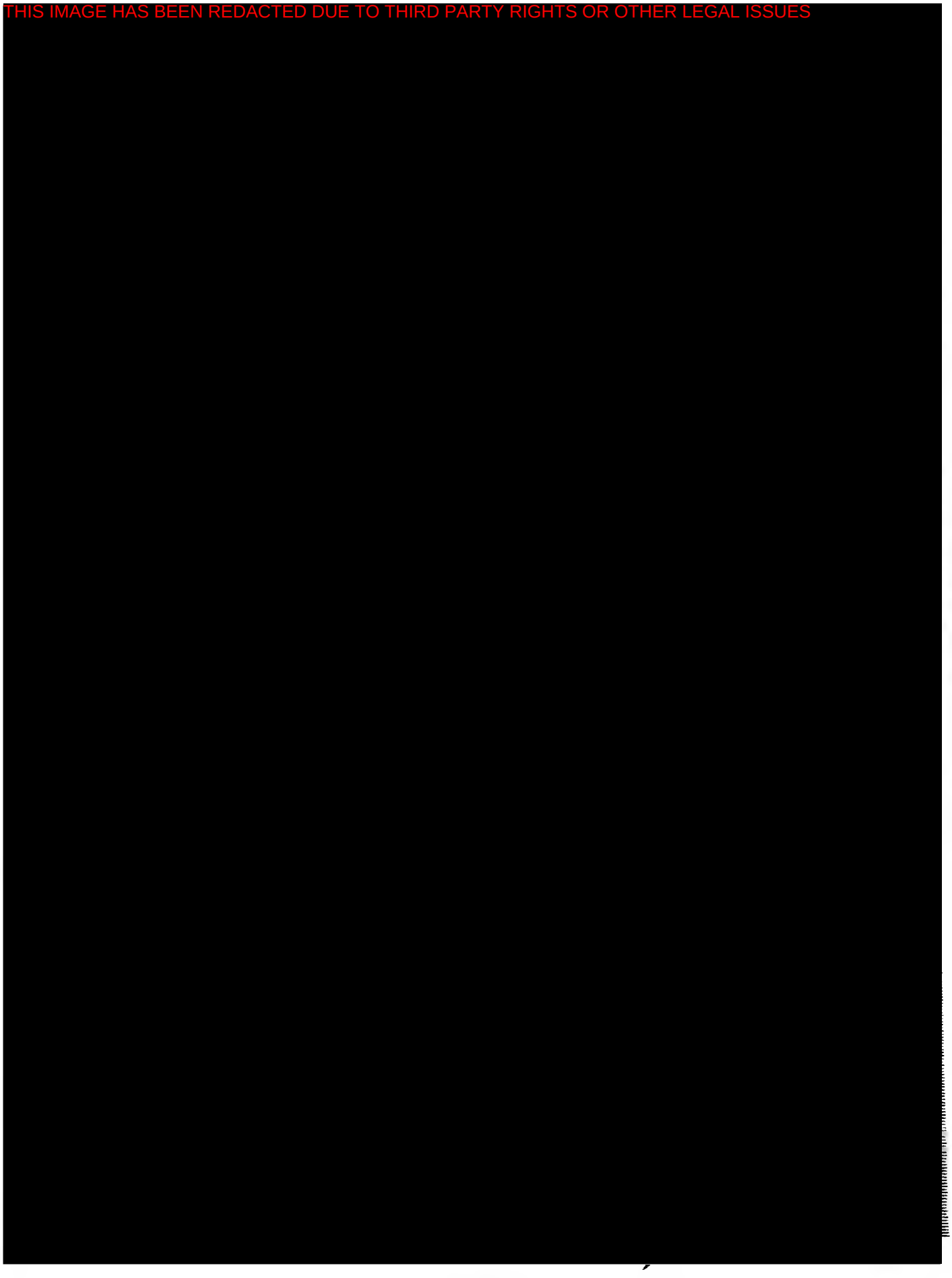
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IX - Modified version of the Watson and Glaser test

a) Instruction

In this test, each exercise begins with a statement. After each statement, you will find several possible answers these could be either deductions, assumptions, interpretations, evaluation of arguments or inferences drawn from the text you have read. You can have more than one correct answer for each question, therefore examine each answer separately and make a decision as to its degree of truth by ticking the ones you think are right.

b) Modified version of the Watson and Glaser test :

C. Critical Thinking Test

(* right answers)

1. The school near Los Alamos was chosen to carry on the final testing because:
   * a. there was no inhabitant living in the area
   b. the climate was best for these kind of testing
   c. there has not been any other testing of this kind in the area
2. The persecution of scientists cut down the German's chances of winning the war because:
   a. scientists who work in fear of their life are usually not efficient
   b. of the international protest against this persecution
   * c. because the key figures of the researches that led to the creation of the atomic bombs had been working in German laboratories

3. Both atomic bombs that were dropped on Japan:
   a. had detrimental effects on every country in the world
   b. had some bad effects on every country in the world
   * c. their effects was noticeable even on fishes that are found on the Japanese waters
4. Considering the consequences of the atomic bomb would you say:
   a. being vegetarian would have helped avoiding cancer
   b. all Japanese who had cancer had eaten meat
   * c. they would have contracted it even through vegetarian meals
5. President Truman saw in this terrible demonstration a way to end the war quickly. Tick the assumption(s)that follow from this statement.
   a. it would be better if the American-Japanese conflict was solved through political means
   b. the Japanese could have been developing an atomic bomb of their own
   * c. the atomic bomb was powerful enough to demoralize a nation's will to fight
   * d. the atomic bomb would be more efficient than the use of repeated air raids
   * e. the effect of the bomb as demonstrated in Los Alamos would be the same in Japan

6. If the atom was split before 1939, it is more likely that:
   a. the Japanese would have been first to make an atomic bomb
   * b. the Germans would have been first to make an atomic bomb
   c. the U.S.A would have been first anyway to make an atomic bomb
7. Had it not been for the persecution of scientists
   * a. the Nazis would have probably won the war
   b. the U.S.A would not have involved themselves in the war
   c. Roosevelt would have been quicker in reacting to the Nazis' threat
8. Looking at the text as a whole; it seems that the writer:
   a. was a Fascist
   b. did not like the American military officials
   * c. does not like the atoms when used as a power
9. It seems that the main reason why in both instances the Japanese did not react to the planes that were carrying the atomic bombs towards Hiroshima and Nagasaki well before they dropped them is that:
   * a. they were flying quite high and probably acting on their own
   b. the Japanese did not expect an attack around the time where the bombs were dropped
   c. because the Americans outwitted the Japanese by keeping them occupied with another attack a couple of miles away from their atomic bomb target

10. Did the American authorities know most of the consequences of the atomic bomb well before hand?
    a. Yes - because they did try it before
    b. No - they did not have enough time
    * c. No - their previous experiments were not that all embracing
11. The effect of the first bomb was such that:
    a. Nobody in the city survived
    b. Only those who were in the centre of the city died
    * c. More people survived outside the city
12. When President Roosevelt was warned of the danger to the world if the Nazis produced such a bomb:
    * a. the importance of the atomic bomb project was not fully grasped at first by some important people
    b. He thought that he could lose the Nazis' friendship if he started competing with them
    c. He thought that the best thing he could do was to try to improve the atomic researches as quickly as possible
13. The author was present at the time when the bomb was dropped on Japan
    a. Probably yes, because otherwise he would not have got the information about the event in such details
    * b. Probably not, because he had his information indirectly
    c. No, because the Japanese would not have welcomed him at that time

14. The author believed that many people who have been killed by the bomb.

* a. did not take the U.S.A. as their enemy

* b. did not have any strong opinion about the war

c. were pro-U.S.A. policy

15. The German authorities have persecuted the 3 scientists

* a. probably because of their origin

b. because they were really plotting against the government

c. because they were likely to give their research findings to the Americans

* d. they were considered a threat to the welfare of the German nation

Table (X): Calculation of P.U value for obvious and non-obvious meaning

a) obvious meaning

NS		NNS	
Σx	= 4547	Σx	= 7069
Σx^2	= 382757	Σx^2	= 510053
Σy	= 809		
Σy^2	= 11249	Σy	= 1342
Σxy	= 62094	Σy^2	= 17328
$\overline{X}$	= 75.78	Σxy	= 88071
$\overline{Y}$	= 13.48	$\overline{X}$	= 64.26
r	= .2177	$\overline{Y}$	= 12.20
		r	= .2506

Value of 1 P.U = .177 comprehension unit

Value of 1 P.U = .189 comprehension unit

b) Non-obvious meaning

Difference in comprehension:

$$\overline{Y} \text{ (NS)} - \overline{Y} \text{ (NNS)} = (13.48 - 12.20) = 1.28$$

Difference in P.Us:

$$\overline{X} \text{ (NS)} - \overline{X} \text{ (NNS)} = (75.78 - 64.26) = 11.52$$

Estimated value for every P.U in term of non-obvious meaning.

$$\frac{1.28}{11.52} = .119 \quad \text{comprehension unit}$$

Table (XI) - a) - Regression equation for NS scores

LINEAR REGRESSION AND CORRELATION

DATA

X	Y
64.42	11.25
70	13. 5
78	14.25
88.83	.14
85.67	14.42

THE DATA HAVE THE FOLLOWING LIMITS:

VARIABLE	MINIMUM	MAXIMUM
X	64.42	85.67
Y	11.25	14.42

$Y = 3.356 + (.134 \times X)$

X = 60; Y = 11.396
X = 70; Y = 12.736
X = 30; Y = 7.376

NUMBER OF DATA POINTS = 5

COEFFICIENT OF DETERMINATION R^2 = .773

CORRELATION COEFFICIENT R = .879

ESTIMATED STANDARD ERROR = .71

MEAN OF X VALUES = 75.78
S.D. OF X VALUES = 8.52

MEAN OF Y VALUES = 13.48
S.D. OF Y VALUES = 1.3

Table (XI - b) - Regression equation for NNS scores

LINEAR REGRESSION AND CORRELATION

DATA	
X	Y
60.27	11.64
63.18	11.82
64.82	12.23
65.86	12.64
67.18	12.68

THE DATA HAVE THE FOLLOWING LIMITS:

VARIABLE	MINIMUM	MAXIMUM
X	60.27	67.18
Y	11.64	12.68

$Y = 1.448 + (.167 * X)$

X = 60; Y = 11.468
X = 70; Y = 13.138
X = 30; Y = 6.458

NUMBER OF DATA POINTS = 5

COEFFICIENT OF DETERMINATION R^2 = .904

ESTIMATED STANDARD ERROR = .17

CORRELATION COEFFICIENT R = 951

MEAN OF X VALUES = 64.26
S.D. OF X VALUES = 2.67

MEAN OF Y VALUES = 12.2
S.D. OF Y VALUES = .47

(XII) - Level of significance of the difference between the coefficients

	NS	NNS
r :	.88	.95
z :	1.38	1.84

$$\sigma_{dz} = \sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}$$

$$\sigma_{dz} = \sqrt{\frac{1}{5-3} + \frac{1}{5-3}} = 1$$

$$\overline{Z} = \frac{1.84 - 1.38}{1} = .46 \quad (NS)$$

(XIII) Significance Tests relating to the obtained regression lines

(XIII-a) Significance Test for NNS/NS regression lines

NNS

$$\text{Total SS} = \text{Corr SSy} = \Sigma y^2 - \frac{(\Sigma y)^2}{n} = 745.33 - \frac{3722.22}{5} = 0.8860$$

$a = 1.45$
$b = 0.167$

$$\text{Reg SS} = b \text{ Corr SP}_{xy} = b\left(\Sigma xy - \frac{(\Sigma x)(\Sigma y)}{n}\right) = 0.167\ (3925.39 - \frac{19603.12}{n}) = .78$$

Source	SS	df	MS	F
Regression	.78	1	.78	19.5
Residual	.11	3	0.04	
Total	.89	4		

$P < .05$

Since $t^2 = F$; $t = 4.42$ $P < .05$

NS

$$\text{Total SS} = \Sigma y^2 - \frac{(\Sigma y)^2}{n} = 915.81 - 909.09 = 6.72$$

$b = 0.13$
$a = 3.36$

$$\text{Reg SS} = b\left(\Sigma xy - \frac{(\Sigma x)(\Sigma y)}{n}\right) = 0.13\ (5148.21 - 5109.36) = 5.05$$

Source	SS	df	MS	F	P
Regression	5.05	1	5.05	9.01	$< .05$
Residual	1.67	3	.56		
Total	6.72	4			

$$t^2 = F;\ t = \sqrt{9.01} = 3 \quad P < .05$$

The F values show that there is a good degree of fit between the line of best fit and the observed values.

(XIII - b) Difference between slopes: comparison of two regression coefficients

	NNS	NS
	$b_1 = 0.167$	$b_2 = 0.13$
(Residual)	$RSS_1 = 0.11$	$RSS_2 = 1.67$
(X's SS)	$SSx_1 = 28.49$	$SSx_2 = 290.70$
	$n_1 - 2 = 3$	$n_2 - 2 = 3$

$$t = \frac{b_1 - b_2}{\sqrt{\frac{SSres_1 + SSres_2}{(n_1-1)+(n_2-2)}\left(\frac{1}{Corr\ SSx_1} + \frac{1}{CorrSSx_2}\right)}} \qquad df = (n_1-2)+(n_2-2)$$

$$t = \frac{0.167 - 0.13}{\sqrt{\frac{0.11 + 1.67}{6}\left(\frac{1}{28.49} + \frac{1}{290.70}\right)}} = \frac{.04}{0.013} = 3.08$$

$P < .05$

$\therefore\ b_1 \neq b_2$

(XIV) Difference between correlation coefficients for the inference and education processes

	NS	NNS
Inference	.70	.52
Z	.87	.58
Deduction	.21	.47
Z	.22	.51

$$\sigma_{dz} = \sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}$$

$$= \sqrt{\frac{1}{60-3} + \frac{1}{110-3}}$$

$$= 0.11$$

$$\text{(Inference)}\quad Z = \frac{.87 - .58}{0.11} = 2.64 \therefore < .05$$

$$\text{(Deduction)}\quad Z = \frac{.51 - .22}{0.11} = 2.64 \therefore < .05$$

(XV) Initial comprehension test items for the 3 texts.

(XV-a) HIROSHIMA

Forced choice questions

1. Three American scientists warned their President of the danger to mankind if Germany produced an atomic bomb.

YES _____

NO _____

2. Roosevelt immediately reacted to the scientists' warning of the atomic bomb manufacture. YES _____

NO _____

3. Within thirty days from its successful test, an atomic bomb was dropped on Hiroshima. YES _____

NO _____

4. The victims of the Hiroshima bomb included those who were born many years after 6th August 1945.

YES _____

NO _____

5. Like the tower that held the bomb when tested, everything in Hiroshima was vaporised to nothing. YES _____

NO _____

6. A missile carrying the atomic bomb fell directly in the centre of Hiroshima. YES _____

NO _____

7. The poison of the radiation was also transmitted through animal products hundreds of miles away YES _____

NO _____

8. The article explicitly states that the bomb was never intended to be used against Germany because scientists in Los Alamos objected to it.

YES _____

NO _____

9. Those who ran into the sea were drowned by tidal waves generated by the bomb.

YES _____

NO _____

10. According to the article the only way to end the war was to use the bomb against Japan.

YES _____

NO _____

TEST ON HIROSHIMA ARTICLE

Short answer questions

1 According to the article, what was the most important event that took place in Los Alamos in July 1945?

2. On what city was the second atom bomb dropped?

3. What happened to those people who ran into the sea when the bomb exploded?

4. How were radioactive diseases transmitted to people born after the bomb?

5. What is the sickness of the original child bomb?

6. How many people died at Hiroshima on 6th August 1945?

7. Name the American President who approved the use of the bomb against Japan.

8. Who was the Italian scientist who played the greatest part in the creation of the atomic bomb?
9. Name one of the bad effects of the bomb outside the town of Hiroshima.
10. Name one of the three scientists who warned the American President of Germany's Bomb.

(XV-b) HEREDITY

Forced choice questions

1) The following of a baby goose of its mother is an example of instinctive behaviour

YES _____

NO _____

2) According to the article, rod-like structures in the human all contain protein molecules that transmit hereditary influences.

YES _____

NO _____

3) Environment contributes nothing to the human growth before birth.

YES _____

NO _____

4) All human behaviours are the result of intellectual development.

YES _____

NO _____

5) Human growth is guided by protein molecules up to birth whereby their functions cease.

YES _____

NO _____

6) There is a great difference between an instinctive and imprinted behaviour.

YES _____

NO _____

7) The theme of the article is on the controversy over the relative contributions of heredity and environment on maturation.

YES _____

NO _____

8) According to the article experience is essential for normal human development. YES _____

NO _____

9) The inter-relations between stimuli and response are less complex; when reflex behaviours are involved.

YES _____

NO _____

10) Instinctive behaviour can be identified as that which involves more complex inter-relations between stimuli and responses over a period of time. YES _____

NO _____

Short answer questions

1) According to this article transmitters of hereditary influences are called _____

2) How did the skin, the muscles and neurons in the human body come about? _____

3) Where does the foetus get its oxygen? _____

4) Besides nutrients and oxygen what does the developing human being need after birth? _____

5) What makes the pupil of the eye contract? _____

6) According to this paper unlearned connections which mediate complex responses to a complex series of stimuli are called _____

7) A baby goose following her mother is an example of _____

8) According to the article what kind of behaviour is dependent on inheritance and event early in life that has lasting effects?

_____

9) Why did it take the scientist so long to realise the importance of the early experiences for the goslings' mother following responses and later mating behaviour?

_____

10) What is the difference between instinctive and imprinted behaviour?

_____

(XV-c) THE STEM

Forced choice questions

1) Cells in the stem of living plants obtain oxygen via stomata.

YES _____

NO _____

2) The most important activity of the stem according to the paper, is to conduct photosynthetic process.

YES _____

NO _____

3) Plants always need rain from above for survival because water in the soil cannot move up against gravity.

YES _____

NO _____

4) The structure of the stem of the plant consists of an outer layer called the pith and an inner layer called the epidermis.

YES _____

NO _____

5) The epidermis prevents the loss of water from the stem and the entry of disease from outside.

YES _____

NO _____

6) The enormous vascular bundles found in the inner layer of the stem is due to the fact that food and water cannot be transported horizontally through the stem.

YES _____

NO _____

7) The cambium of the stem contains a layer of living cells which are capable of dividing and multiplying.

YES _____

NO _____

8) Lenticels have the same function as the stomata.

YES _____

NO _____

9) The aim of the article was to show the importance of the flowering plant to man. YES _____

NO _____

10) Vascular bundles carry water from the roots of leaves.

YES _____

NO _____

Short answer questions

1) What are the functions of the lenticels in the stem of the plant? _____

2) According to the article how does the water get into the veins in the leaves? _____

3) What is the most important function of the leaf of a growing green plant? _____

4) According to the article what is the least important function of the stem? _____

5) Name one function of the epidermis _____

6) Why do sieve tubes have horizontal perforations?

_____

7) The living cells between the xylem and phloem that are capable of dividing into new cells are called _____

8) What is meant by secondary thickening in the stem of the plant? _____

9) What are the contributions of the cortex and pith to the stem of the growing plant? _____

10) The outer of the plant consists of the epidermis - what does the inner part consist of? _____

(XVI)- Test items selection

Judgement of suitability of Test Items

(XVI-a) Instructions

We need to know which test items are most adequate for assessing comprehension of the 3 articles provided.

Please read the articles thoroughly and then answer both sets of questions on each. Then indicate on the table provided by ticking the response you feel best represents the knowledge in the paper.

Thank you.

(XVI - b) . ARTICLE I - HIROSHIMA

Questions	Test I					Total	Test II					Total
	Very badly	Badly	Reason-able	Well	Very well		Very badly	Badly	Reason-able	Well	Very well	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

(XIV - c) ARTICLE II - THE STEM

Questions	Test I				Total	Test II				Total
	Very badly	Badly	Reason-able	Well	Very well	Very badly	Badly	Reason-able	Well	Very well
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

(XVI - d) ARTICLE III - HEREDITY

Questions	Test I					Total	Test II					Total
	Very badly	Badly	Reason-able	Well	Very well		Very badly	Badly	Reason-able	Well	Very well	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

XVII - INSTRUCTIONS

Punctuations do not indicate all possible places where a reader could naturally pause. Some pauses will occur after a few words while others occur after many more words. This does not matter nor is it important if pauses occur for different reasons such as to catch your breath, to enhance meaning and so on.

The articles you have been given are inadequately punctuated. Please read each article through once at your usual reading speed. Then insert a vertical line where you feel an appropriate pause is missing.

You will be asked to answer 10 questions on each of the articles at the end.

Please fill in the following information:

Mother tongue .....

Sex .....

Your course of study.....

Thank you.

(XVIII) COMPREHENSION TEST

You have been given 10 questions from each of the articles you have read, Please answer by ticking the correct answer or giving a short answer where appropriate

THANK YOU

(XVIII-a)

HIROSHIMA

1) According to the article, what was the most important event that took place in Los Alamos on 16th July 1945? _____

2) On what city was the second bomb dropped? _____

3) Within thirty days from its successful test, an atom bomb was dropped on Hiroshima YES _____ NO _____

4) The victims of the Hiroshima bomb included those who were born many years after 6th August 1945. YES _____ NO _____

5) What was the sickness of the original child bomb? _____

6) How many people exactly died at Hiroshima on 6th August 1945? _____

7) Name the American President who approved the use of the bomb against Japan. _____

8) Who was the Italian scientist who played the greatest part in the creation of the atomic bomb? _____

9) Those who ran into the sea were drowned by the tidal wave created by the atomic bomb. YES _____ NO _____

10) Name one of the scientists who warned the President of Germany's bomb. _____

(VIII-b)

THE STEM

1) What are the functions of the lenticels in the stem of the plant?

_____

2) According to the article how does water get into the veins in the leaves? _____

3) Plants always need rain from above for survival because the water in the soil cannot move up against gravity. YES _____

NO _____

4) The structure of the stem of the plant consists of an outer layer called the pith and an inner layer called the epidermis.

YES _____

NO _____

5) Name one function of the epidermis. _____

6) Why do sieve tubes have horizontal perforations?

_____

7) The living cells between the Xylem and phloem that are capable of dividing into new cells are called _____

8) What is meant by secondary thickening in the stem of the plant?

_____

9) What are the contributions of the cortex and the pith to the stem of the growing plant? _____

10) Vascular bundles carry water from the roots of the leaves.

YES _____

NO _____

(XVIII-c) :

HEREDITY

1) According to the article transmitters of heriditary influences are called _____

2) How did the skin, the muscles and the neurons in the human body cells come about? _____

3) Where does the foetus get its oxygen? _____

4) Besides nutrients and oxygen what does the developing human being need after birth? _____

5) There is a great difference between instinctive and imprinted behaviour. YES _____

NO _____

6) A baby goose following its mother is an example of

_____

7) According to the article what kind of behaviour is dependent on inheritance and an event early in life that has lasting effects?

_____

8) Why did it take scientists so long to realise the importance of the early experiences for the gosling's mother following responses and later mating behaviour? _____

9) What makes the pupil of the eye contract? _____

10) Instinctive behaviour can be identified as that which involves more complex inter-relations between stimuli and responses over a period of time. YES _____

NO _____

(XIX) Raw Data

NNS	Hiroshima			Heredity			Stem		
	Pauses First Attempt	Comp Test	Pauses Second Attempt	Pauses First Attempt	Comp Test	Pauses Second Attempt	Pauses First Attempt	Comp Test	Pauses Second Attempt
1	37	7	51	40	8	42	46	8	50
2	42	9	44	37	6	34	32	5	38
3	46	7	45	32	9	38	37	4	43
4	33	8	41	24	9	27	22	6	38
5	11	5	33	29	1	30	27	3	32
6	33	4	35	20	7	31	32	7	38
7	48	2	48	38	6	41	41	5	45
8	15	4	35	13	5	33	18	3	32
9	28	7	36	24	4	30	28	9	31
10	35	5	38	24	8	33	30	7	32
11	26	7	36	22	3	28	25	3	35
12	22	2	33	27	5	31	22	0	31
13	24	3	29	22	2	30	23	8	29
14	28	5	27	21	7	32	20	5	33
15	30	8	43	33	9	38	38	4	43
Σx	458	83	574	406	89	498	441	77	550
$\bar{X}$	30.54	5.54	38.26	27.07	5.93	33.20	29.40	5.13	36.67
Σx^2	15506	529	22630	11802	621	16826	13917	477	20704
S.D.	10.43	2.23	6.89	7.62	2.57	4.57	8.24	8.41	6.19

XX - Anova for pilot study

TWO WAY ANOVA: EQUAL GROUPS

	A 1	2	3
B	Hirosh.	Hered.	Stem
1			
	37	40	46
	42	37	32
	46	32	37
	33	24	22
	11	29	27
	33	20	32
	48	38	41
	15	13	18
	28	24	28
	35	24	30
	26	22	25
	22	27	22
	24	22	23
	28	21	20
	30	33	38
2			
	51	42	50
	44	34	38
	45	38	43
	41	27	38
	33	30	32
	35	31	38
	48	41	45
	35	33	32
	36	30	31
	38	33	32
	36	28	35
	33	31	31
	29	30	29
	27	32	33
	43	38	43

THE MEANS OF LEVELS OF A AND B
ARE AS FOLLOWS:

VARIABLE A LEVEL 1 MEAN = 34.4
VARIABLE A LEVEL 2 MEAN = 30.13
VARIABLE A LEVEL 3 MEAN = 33.03

VARIABLE B LEVEL 1 MEAN = 29
VARIABLE B LEVEL 2 MEAN = 36.04

F TABLE

SOURCE	SS	DF	MS	F
A	284.82	2	142.41	2.5
B	1116.54	1	1116.54	19.62
A X B	10.16	2	5.08	.09
ERROR	4780.94	84	56.92	
TOTAL	6192.46	89		

(XXI) - ANOVAs testing the effect of ability levels on P.U scores.

(XXI - a) Hiroshima

	High	Medium	Low		
	2	8	2		
	8	-1	20		
	13	-1	5		
	14	22	11		
	10	2	0		
E	47	31	38	116	(4614)
$\bar{X}$	9.4	6.2	7.6		
Ex^2	533	559	550		

$$K = \frac{116^2}{15} = 897.07$$

$$S.S_{abil} = \frac{47^2}{5} + \frac{31^2}{5} + \frac{38^2}{5} - K = 25.73$$

$$SS_{total} = 1642 - K = 744.93$$

Summary Table

Source	SOS	df	MS	F	P value
Ability	25.73	2	12.86	0.21	NS
Error	719.20	12	59.93		
Total	744.94	14			

(XXI -b) Heredity

	High	Medium	Low	
	2	11	8	
	6	11	4	
	3	-3	6	
	9	3	6	
	5	20	1	
$\bar{X}$	5	8.4	5	
Ex	25	42	25	= 92
Ex^2	155	660	153	= 968

$$K = \frac{92^2}{15} = 564.27$$

$$SS_{Total} = 968 - 564.27 = 403.73$$

$$S.S_{ability} = \frac{1}{5}(25^2 + 42^2 + 25^2) - K = 38.53$$

Summary Table

Source	SS	df	MS	F	P value
Ability	38.53	2	19.27	.63	NS
Error	365.2	12	30.43		
Total	403.73	14			

(XXI - c) Stem

	High	Medium	Low	
	13	4	2	
	14	6	1	
	10	4	3	
	9	2	16	
	6	2	2	
	52	18	24	94 (3604)
$\bar{X}$	10.40	3.6	4.8	
Ex	52	18	24	94 (3604)
Ex^2	582	76	274	

$$K = \frac{94^2}{15} = 589.07$$

$$SS_{total} = 582 + 76 + 274 - K = 342.93$$

$$SS_{ability} = \frac{1}{5}(52^2 + 18^2 + 24^2) - K = 131.73$$

Source	SS	df	MS	F	P value
Ability	131.73	2	65.86	3.74	NS
Error	211.20	12	17.60		
Total	342.93	14			

(XXII) - Friedman 2 way Anova (b) and Page's L Test (a) for comprehension test and NS group

5	12	4	15	2	16	2	16	2	16
3.5	14	5	13	3.5	14	1.5	16	1.5	16
5	14	2.5	16	2.5	16	2.5	16	2.5	16
2	17	2	17	2	17	4.5	15	4.5	15
5	10	4	12	3	13	1.5	14	1.5	14
5	11	4	12	1	14	2.5	13	2.5	13
5	7	1	15	3	14	3	14	3	14
5	10	2	14	3	13	4	11	1	16
4	12	5	10	2	15	3	14	1	16
5	8	3	11	3	11	1	12	3	11
5	8	3	11	1	13	3	11	3	11
5	12	1.5	16	3.5	15	1.5	16	3.5	15
a) Rj 54.5		37		29.5		30		29	
5		4		3		2		1	
272.5	+	148	+	88.5	+	60	+	29	= 598 $P < .001$ (Page's L Test)

b) $$\chi_r^2 = \frac{12}{\pm 2(5)(5+1)} [(54.5)^2+(37)^2+(29.5)^2+(30)^2+(29)^2]-3(12)(5+1)$$

$$= 13.37 \quad df = 5-1 = P < .01$$

(XXIII) - Friedman 2 way Anova (b) and
Page's L Test (a) for comprehension
Test and NNS Group

Trials	1		2		3		4		5
	5	8	2	13	3.5	10	1	15	3.5	10
	1	15	3.5	12	3.5	12	5	11	2	13
	5	12	2	15	4	13	1	17	3	14
	2	9	2	9	4.5	6	2	9	4.5	6
	5	10	1.5	17	4	12	1.5	17	3	14
	4.5	8	1.5	12	3	9	1.5	12	4.5	8
	5	8	4	9	2	11	3	10	1	13
	2	16	5	13	2	16	4	14	2	16
	4	8	1.5	15	5	7	1.5	15	3	11
	2	13	5	11	4	12	2	13	2	13
	4	9	2.5	11	1	12	2.5	11	5	8
	1.5	15	4	13	3	14	5	10	1.5	15
	3.5	13	3.5	13	2	15	5	12	1	16
	3.5	10	5	5	1.5	11	3.5	10	1.5	11
	3	15	5	12	1.5	17	4	14	1.5	17
	4.5	8	3	9	1.5	10	4.5	8	1.5	10
	1.5	18	5	11	1.5	18	4	14	3	17
	4	13	1.5	17	4	13	1.5	17	4	13
	1	13	5	6	4	9	3	11	2	12
	1	15	4.5	13	2.5	14	4.5	13	2.5	14
	3	11	4.5	10	2	15	4.5	10	1	16
	5	9	2	14	2	13	1	15	4	12

a) Rj $\begin{matrix} 71 \\ 5 \end{matrix}$ $\begin{matrix} 69.5 \\ 4 \end{matrix}$ $\begin{matrix} 63 \\ 3 \end{matrix}$ $\begin{matrix} 61.5 \\ 2 \end{matrix}$ $\begin{matrix} 57 \\ 1 \end{matrix}$

$355 + 278 + 189 + 123 + 57 = 1002$ $P < .05$ (Page's L Test)

b) $\chi^2_r = \frac{12}{NK(K+1)} \sum_{j=1}^{K} (Rj)^2 - 3N(K+1)$

$= \frac{12}{22(5)(5+1)} [(71)^2+(69.5)^2+(63)^2+(61.5)^2+(57)^2] - 3(22)(5+1)$

$= 20.31$, $df = 4$, $P < .001$

(XXIV) - Friedman 2 way Anova (b) and
Page's L Test (a) for P.Us and NS Group

4	81	5	80	2	150	1	155	3	144
2.5	58	2.5	58	4	43	5	41	1	83
5	52	4	81	3	92	2	100	1	111
3	69	2	72	1	73	5	65	4	68
5	42	4	44	2	49	3	45	1	59
4	64	1	70	5	58	3	66	2	69
4	88	5	87	3	105	2	111	1	117
5	60	2	64	3	63	4	62	1	74
3.5	46	3.5	46	5	42	1	58	2	48
5	71	4	74	1	82	2	76	3	75
5	80	4	92	2	95	1	101	3	93
5	62	4	72	3	84	1	90	2	87

a) Rj = 51 41 34 30 24

5 4 3 2 1

255 + 164 + 102 + 60 + 24 = 605 $P < .001$

(Page's L Test)

b) $$\chi_r^2 = \frac{12}{NK\,(K+1)} \sum_{j=1}^{K} (Rj)^2 - 3N\,(K+1)$$

$$= \frac{12}{12x5(5+1)} [(51)^2+(41)^2+(34)^2+(30)^2+(24)^2]-3x12(5+1)$$

$$= 12.16, \quad df = 4, \quad P < .05$$

(XXV) - Friedman 2 way Anova (b) and Page's L Test (a) for P.Us and NNS Group

DATA

	1		2		3		4		5
5	69	4	75	3	87	2	84	1	96
5	74	3	82	4	78	1.5	95	1.5	95
2.5	83	1	88	5	69	2.5	83	4	82
4	27	5	26	2	33	3	32	1	39
5	69	1.5	86	3	85	1.5	86	4	83
5	28	2.5	35	2.5	35	4	33	1	57
5	84	4	107	1	123	3	110	2	111
5	39	1	46	2	44	3	42	4	41
2	76	1	78	5	65	3	75	4	69
4	88	5	81	2.5	93	1	99	2.5	93
5	57	4	58	1	60	2	60	3	59
5	49	4	73	3	78	2	81	1	83
1	113	2	92	3	90	4	84	5	75
1	47	2.5	45	5	38	4	44	2.5	45
4	50	1.5	52	5	48	3	51	1.5	52
5	60	3	70	2	73	1	74	4	68
5	53	3	61	1	65	4	57	2	63
5	36	4	43	3	46	2	51	1	54
2.5	40	5	36	2.5	40	4	39	1	43
4	76	5	56	2	81	3	77	1	83
1	45	2	27	3	26	4	24	5	22
5	63	1	73	2	69	3	68	4	65

a) R_j = 86 (5), 65 (4), 63 (3), 60.5 (2), 56 (1)

430 + 260 + 189 + 121 + 56 = 1056 $P < .05$ (Page's L Test)

b) $$\chi_r^2 = \frac{12}{NK(K+1)} \sum_{j=1}^{K} (Rj)^2 - 3N(K+1)$$

$$= \frac{12}{22(5)(5+1)} [(86)^2+(65)^2+(63)^2+(60.5)^2+(56)^2] - 3(22)(5+1)$$

$= 9.95$, df = 5-1 = 4, $P < .05$

(XXV - 1)

Wilcoxon matched-pairs signed-ranks test comparing SR with AR for all subjects

Dif. in scores:-	+.04	-.19	+.21	-.04	+.28	+.15	+.09	+.14
Rank of diff.	3	1	7	2	8	6	4	5
T		1		2	=3			

with N=8; T=3 $P < .05$

XXVI

Characteristics of subjects in each group

	Mother-tongue	Degree
Artists/ Artistic pas.		
1	English	Arch/Hist
2	English	Hist.
3	English	Hist.
4	English	Lang.
5	English	Engl.
6	English	Engl.
7	French	Lang.
8	English	Hist.
9	English	Engl.
10	English	Lang.
Scientists/ Scientific pas		
1	English	Math/Phys
2	English	Bio.
3	English	Math.
4	Spanish	Phys/Chem
5	English	Bio.
6	English	Ch/Phys/Mat
7	English	Chem.
8	English	Bio.
9	English	Chem.
Artists/ Scientific pas		
1	English	Engl.
2	English	Engl.
3	English	Engl.
4	English	Engl.
5	English	Engl.
6	Greek	Engl.
7	English	Lang.
8	English	Hist.
9	English	Engl.
Scientists/ Artistic pas.		
1	English	Phys.
2	English	Bio.
3	English	Phys.
4	English	Bio.
5	Greek	Chem.
6	Spanish	Bio.
7	English	Math/Phys
8	English	Bio.
9	English	Chem.
10	English	Phys.
11	English	Chem.

XXVII

XXVII-a Experimental package for the arts passage

Mother tongue _____

Education _____

(please state subject areas in which your degrees were obtained).

Instructions

The following passage is part of the introduction of Umberto Eco's novel entitled "The Name of the Rose". As you will notice, no commas, periods or other punctuations appear in this passage. Please, read it carefully and place a vertical line in every point where you feel there is a natural pause. Commas and other punctuations usually indicate where it would be convenient to pause, but they do not indicate all the possible places where the reader might stop, simply to catch his breath or to enhance the meaning. Thus, while you are reading the passage, try to place the vertical lines in every place where it seems natural to you to pause. Some pauses may occur after very few words, while others may occur after many more words (see example). In the end, you will be asked to write a short summary of the passage.

Example: ... The year ended in a roar of pain/ sudden and terrible headaches descended on her/ she lost track of the details of that period / none of the images and pictures of Medusa or Sello were retained nor their activities together / it was

like a black roaring sea of obscenity on the high tide of which Medusa rose and stared down at her from an immense height / by day Elizabeth crawled around painfully / by night / she lay back a pinned-lown victim of approaching death / Medusa had the air of one performing a skilled and practised murder /

Now please turn to the next page.

(XXVII-b)

In the beginning was the Word and the Word was with God and the Word was God this was beginning with God and the duty of every faithful monk would be to repeat every day with chanting humility the one never-changing event whose incontrovertible truth can be asserted but we see now through a glass darkly and the truth before it is revealed to all face to face we see in fragments alas how illegible in the error of the world so we must spell out its faithful signals even when they seem obscure to us and as if amalgamated with a will wholly bent on evil.

Having reached the end of my poor sinner's life my hair now white I grow old as the world does waiting to be lost in the bottomless pit of silent and deserted divinity sharing in the light of angelic intelligences confined now with my heavy ailing body in this cell in the dear monastery of Melk I prepare to leave on this parchment my testimony as to wondrous and terrible events that I happened to observe in my youth now repeating verbatim all I saw and heard without venturing to seek a design as if to leave to those who will come after if the Antichrist has not come first signs of signs so that the prayer of deciphering may be exercised on them

May the Lord grant me the grace to be the transparent witness of the happenings that took place in the abbey whose

name it is only right and pious now to omit toward the end of the year of our Lord 1327 when the Emperor Louis came down into Italy to restore the dignity of the Holy Roman Empire in keeping with the designs of the Almighty and to the confusion of the wicked usurper simoniac and heresiarch who in Avignon brought shame on the holy name of the apostle I refer to the sinful soul of jacques of Cahors whom the impious revered as John XXII

Perhaps to make more comprehensible the events in which I found myself involved I should recall what was happening in those last years of the century as I understood it then living through it and as I remember it now complemented by other stories I heard afterward if my memory still proves capable of connecting the threads of happenings so many and confused

In the early years of that century Pope Clement V had moved the apostolic seat to Avignon leaving Rome prey to the ambitions of the local overlords and gradually the holy city of Christianity had been transformed into a circus or into a brothel riven by the struggles among its leaders though called a republic it was not one and it was assailed by armed bands subjected to violence and looting ecclestiastics eluding secular jurisdiction commanded groups of malefactors and robbed sword in hand transgressing and organizing evil commerce how was it possible to prevent the Caput Mundi from becoming again and rightly the goal of the man who wanted to assume

the crown of the Holy Roman Empire and restore the dignity of that temporal dominion that had belonged to the Caesears

Thus in 1314 five German princes in Frankfurt elected Louis the Bavarian supreme ruler of the empire but that same day on the opposite shore of the Main the count Palatine of the Rhine and the Archbishop of cologne elected Frederick of Austria to the same high rank two emperors for a single throne and a single pope for two a situation that truly fomented great disorder

Two years later in Avignon the new Pope was elected Jacques of Cahors an old man of seventy-two who took as I have said the name now so distasteful to the righteous a Frenchman devoted to the King of France the men of that corrupt land are always inclined to foster the interests of their own people and are unable to look upon the whole world as their spiritual home he had supported Philip the Fair against the Knights Templars whom the King accused I believe unjustly of the most shameful crimes so that he could seize their possessions with the complicity of that renegade ecclesiastic

In 1322 Louis the Bavarian defeated his rival Frederick fearing a single emperor even more than he had feared two Johns excommunicated the victor who in return denounced the Pope as a heretic I must also recall how that very year the chapter of the Franciscans was convened in Perugia and the

minister general Michael of Cesena accepting the entreaties of the Spirituals of whom I will have occasion to speak proclaimed as a matter of faith and doctrine the poverty of Christ who if he owned something with his apostles possessed it only as usus facti a worthy resolution meant to safeguard the virtue and purity of the order it highly displeased the Pope who perhaps discerned in it a principle that would jeopardize the very claims that he as head of the church had made denying the empire the right to elect bishops and asserting on the contrary that the papal throne had the right to invest the emperor moved by these or other reasons John condemned the Franciscan propositions in 1323 with the decretal Cum inter nonnullos

It was at this point I imagine that Louis saw the Franciscans now the Pope's enemies at his potential allies by affirming the poverty of Christ they were somehow strengthening the ideas of the imperial theologians namely Marsilius of Padua and John of Jandun and finally not many months before the events I am narrating Louis came to an agreement with the defeated Frederick descended into Italy and was crowned in Milan

This was the situation when I a young Benedictine novice in the monastery of Melk was removed from the peace of the cloister by my father fighting in Louis's train not least among his barons he thought it wise to take me with him so that I might know the wonders of Italy and be present

when the Emperor was crowned in Rome but the siege of Pisa then absorbed him in military concerns left to myself I roamed among the cities of Tuscany partly out of idleness and partly out of a desire to learn but this undisciplined freedom my parents thought was not suitable for an adolescent devoted to a contemplative life and on the advice of Marsilius who had taken a liking to me they decided to place me under the direction of a learned Franciscan Brother William of Baskervill about to undertake a mission that would lead him to famous cities and ancient abbeys thus I became William's scribe and disciple at the same time nor did I ever regret it because with him I was witness to events worthy of being handed down as I am now doing to those who still come after us

(XXVII-c)

Please write a short summary of the passage, without going back to the passage.

Now, please complete the following short tests according to the directions that appear on the tests, but please use the answer sheet to record your answers. Go to the next page.

(XXVII-d)

Watson and Glaser

Critical Thinking Test

(same as Appendix VIII)

(XXVII-e)

Now, please leave the whole test aside for one day, and tomorrow read the first copy of the passage, placing vertical lines again, where a natural pause occurs to you, but please don't go back to the initial passage, so as not to be influenced by your first decision.

(XXVII-f)

Umberto Eco's text (i.*e*. XXVII-b)

(XXVII-g)

Do you have any important points to add to your initial summary?
(please don't go back to the passage).

Again please, leave the whole test aside for one more (and last!) day. Tomorrow read the second copy of the passage, placing vertical lines again, where a natural pause occurs to you, but please don't go back to the initial passage or its first copy.

(XXVII-h)

Umberto Eco's text (i.e. XXVII-b)

(XXVII-i)

Do you have any other important points to add to your initial summary of the passage?

Thank you very much for your participation in this project!
Your cooperation has been of great help.

- / -

XXVIII-a Experimental package for the science article

Mother-tongue _____

Education _____
(please state subject areas in which your degrees were obtained).

Instructions

The following passage is part of an article published in the Scientific American, May, 1985, entitled "Molecular approaches to Malaria Vaccines". As you will notice, no commas, periods or other punctuations appear in this passage. Please, read it carefully and place a vertical line in every point where you feel there is a natural pause. Commas and other punctuations usually indicate where it would be convenient to pause, but they do not indicate all the possible places where the reader might stop, simply to catch his breath or to enhance the meaning. Thus, while you are reading the passage, try to place the vertical lines in every place where it seems natural to you to pause. Some pauses may occur after very few words, while others may occur after many more words (see example). In the end, you will be asked to write a short summary of the passage.

Example: ... The year ended in a roar of pain | sudden and terrible headaches descended on her | she lost track of the details of that period | none of the images and pictures of Medusa or Sello were retained nor their activities together | it was like a black roaring sea of obscenity on the high tide of which Medusa rose and stared down at her from an immense height | by day Elizabeth crawled around painfully | by night | she lay back a pinned-lown victim of approaching death | Medusa had the air of one performing a skilled and practised murder |

Now, please turn to the next page.

(XXVIII-b)

Two species of Plasmodium are important agents of human malaria P. falciparum the most prevalent and most lethal and P. vivax in the course of its life cycle in its mosquito and human hosts the unicellular parasite undergoes an astounding series of developmental and morphological changes the stage that infects man the lanceshaped sporozoite resides in the mosquito's salivary gland and is delivered into the victim's bloodstream when the insect takes a blood meal within an hour each sporozoite finds its way to a liver cell there it undergoes a complex series of transformations eventually a giant multinucleate stage the schizont fissions into small roughly spherical merozoites the result is an enormous amplification of parasites a liver cell infected by one sporozoite releases into the blood-stream from 5,000 to 10,000 merozoites

Each merozoite invades a red blood cell where it multiplies asexually until the cell bursts and releases from 10 to 20 new merozoites that go on to invade more red cells it is the periodic lysis of the blood cells with concomitant release of merozoites and toxic waste products that causes the regular fevers and chills of malaria

Some merozoites develop into male and female gametocytes germ-cell precursors thus initiating the parasite's sexual cycle the gametocytes are sucked up with red cells by a mosquito mature in the mosquito gut and fuse to form a zygote the

zygote undergoes yet another series of divisions transformations and migrations eventually a mature sporozoite appears in the salivary gland ready to initiate a new infective cycle

Each developmental stage of Plasmodium has its characteristic shape and distinctive set of functions it inhabits a particular microenvironment and interacts with a specific target tissue to the molecular biologist this means that although all the stages have the same genome or complement of genes in each stage a different part of the genome is being expressed different genes are turned on and off in a programmed sequence

A gene is composed of DNA a double helix whose two complementary strands are made up of subunits called nucleotides each nucleotide is characterized by one of four bases adenine (A) guanine (G) thymine (T) and cytosine (C) genetic information is encoded in the sequence of the bases a gene is expressed when one strand of its DNA is transcribed into a complementary strand of messenger RNA (mRNA) which is then translated into a sequence of amino acids the subunits of proteins

One way to understand a developing organism at the molecular level is to isolate the genes being expressed at a particular stage of development and study their structure and that of the proteins they encode in the case of Plasmodium such studies have been focused on the parasite's surface one reason is that the proteins of the cell's outer coat are highly stage-specific each is expressed in only a single developmental

stage their genes must therefore be subject to stringent regulation whose mechanisms are of considerable fundamental interest the other reason is that these proteins are surface anti-gens and as such are likely to be implicated in triggering or in evading the host's immune response studying their genes is therefore important not only for understanding the mechanism of stage-specific gene expression but also for developing stage-specific malaria vaccines

Some years ago my colleagues and I at the New York University Medical Center set out to isolate and study the gene encoding the major surface antigen of a sporozoite the so-called circumsporozoite (CS) protein the protein had been studied for many years by Ruth S. Nussenzweig of N.Y.U and had been shown to be stage-specific synthesized only in sporozoites it is the major protein synthesized by sporozoites in the salivary gland and it covers the entire surface of the cell we chose to work with P. knowlese the agent of monkey malaria largely because the Anopheles species that carries it generates some 10 times as many sporozoites as a mosquito infected with one of the human parasites infected mosquitos were supplied by Robert W. Gwadz and Louis H. Miller of the National Institute of Allergy and Infectious Diseases (NIAID). who provide many investigators worldwide with malaria-parasite material

To isolate an active stage-specific gene one ordinarily begins with the total mRNA of the stage under study and so

we tested several laborious methods for separating sporozoite material from infected mosquitoes eventually we found that instead of having to purify sporozoites we could begin with the total mRNA of infected mosquitoes or their thorazes in the mixture of sporozoite and mosquito mRNA we could clone the parasite gene directly from the total mRNA

The total mRNA was converted with the enzyme reverse transcriptase into a DNA copy (cDNA) the cDNA fragments were inserted into plasmide small circles of bacterial DNA in the middle of a gene coding for a plasmid protein a recombinant plasmid incorporating the parasite cDNA should therefore express a fusion product part plasmid protein and part parasite protein

Recombinant plasmids were introduced into the bacterium Eschrichia coli the bacteria were grown and the resulting clones colonies descended from a single cell were screened with the monoclonal antibody to the CS protein by means of a two-site immunological assay developed by Fidel P. Zvala of N.Y.U Joan Ellis a student in my laboratory found three clones to which antibody bound showing that these bacteria had synthesized an active fusion protein

When the plasmide in the positive E. coli clones were analyzed we found that the fragment of sporozoite cDNA inserted in one of them was extremely short only 340 base pairs or long enough to encode only about 110 amino-acids since each aminoacid is specified by a codon of three nucleotides this

was a serendipitous finding with remarkable ramifications it meant that this small fragment of sporozoite cDNA must include the region of the gene coding for the immunoreactive part of the CS protein the epitope or antibody-combining site

To locate the epitope-encoding region of the small cDNA insert more precisely we turned to transposon mutagenesis this mapping technique depends on bacterial transposons bits of DNA often encoding a gene for antibiotic resistance that can jump from one plasmid to another almost at random a transposon inactivates gene function beyond the point at which it is inserted so that by mapping the insertion sites that result in deactivation one can delimit functional regions of genes by this means James R. Lupski another student in the laboratory was able to show that the antigen-combining site is encoded within a segment some 110 base pairs long at the extreme left-hand and what is called the 5' end of the 340 base-pair insert

Please, go on to the next page.

The rest of the package is similar to that of the arts passage (see Appendix XXVII)

SUBJECT CHARACTERISTICS		PAUSAL UNITS				QUALITY OF SUMMARY				ABILITIES						PU DIF
	SUBJECT NUMBER	1ST TRIAL	2ND TRIAL	3RD TRIAL	TOTAL	1ST TRIAL	2ND TRIAL	3RD TRIAL	DIF (3RD-1ST)	INF.	REC. ASS.	DED.	INTER.	EVAL ARG.	TOTAL	(1ST-3RD)
SCIENTISTS - SCIENCE PASSAGE	1	119	118	127	364	3	3	3	0	14	14	24	22	13	87	-8
	2	60	36	28	124	3	4	4	1	11	14	18	21	10	74	32
	3	52	41	50	143	1	1	3	2	14	13	25	22	10	84	2
	4	51	42	48	141	3	4	4	1	17	15	16	20	16	84	3
	5	105	104	125	334	3	3	3	0	17	13	21	21	9	81	-20
	6	102	100	105	307	3	3	3	0	16	12	22	20	10	80	-3
	7	180	163	162	425	3	3	3	0	10	14	22	20	9	75	18
	8	95	90	93	278	3	3	3	0	12	13	21	20	10	76	2
	9	65	58	60	183	2	2	3	1	14	15	20	18	9	76	5
	Total	829	752.9	798.4	2267.7	24	26	29	5	125	123	189	184	96	717	31
	Mean	92.11	83.56	88.67	255.44	2.66	2.88	3.9	0.56	13.9	13.67	21.0	20.4	10.67	79.67	3.44
	S.D.	41.51	42.84	44.87	110.76	0.71	0.93	0.44	0.73	2.52	1.0	2.78	1.24	2.35	4.66	14.82
ARTISTS - ARTS PASSAGE	1	117	126	102	345	4	4	4	0	13	15	22	22	8	80	15
	2	119	104	104	327	1	1	1	0	8	16	20	23	13	80	15
	3	124	130	126	331	3	3	4	1	12	16	20	18	12	78	-3
	4	137	157	122	416	3	4	4	1	12	13	22	21	10	78	15
	5	156	173	165	494	2	2	2	0	14	13	21	22	10	80	-9
	6	145	172	160	477	3	4	4	1	17	16	23	23	15	94	-27
	7	68	68	68	207	3	3	4	1	12	10	15	19	9	65	0
	8	129	135	127	391	2	2	3	1	14	11	20	20	9	74	2
	9	80	86	79	245	3	3	3	0	12	10	21	24	14	81	1
	10	162	177	157	496	3	3	3	0	16	15	22	18	10	81	5
	Total	1237	1328	1211	3776	26	29	31	5	130	135	206	210	110	721	14
	Mean	123.7	132.8	121.10	377.6	2.6	2.9	3.1	0.5	13.0	13.5	20.6	21.0	11.0	72.1	1.4
	S.D.	30.27	37.96	23.41	100.25	0.7	0.99	0.99	0.53	2.49	2.46	2.22	2.16	2.36	7.14	12.93

SUBJECT CHARACTERISTICS		PAUSAL UNITS				QUALITY OF SUMMARY				ABILITIES						PU DIF
	SUBJECT NUMBER	1ST TRIAL	2ND TRIAL	3RD TRIAL	TOTAL	1ST TRIAL	2ND TRIAL	3RD TRIAL	DIF (3RD-1ST)	INF.	REC. ASS.	DED.	INTER.	EVAL ARG.	TOTAL	(1ST-3RD)
SCIENTISTS - ARTS PASSAGE	1	137	144	132	413	2	2	3	1	13	15	20	18	10	76	5
	2	128	132	138	398	1	2	2	1	14	12	17	19	8	70	-10
	3	241	250	248	739	1	2	2	1	10	14	22	20	9	75	-7
	4	69	54	67	190	3	4	4	1	11	14	18	21	10	74	2
	5	131	174	134	439	3	3	3	0	13	16	23	21	12	85	-3
	6	89	101	87	277	1	2	3	2	8	12	20	4	8	62	2
	7	174	170	165	509	1	1	2	1	15	13	18	17	7	70	9
	8	137	142	137	416	1	2	2	1	11	15	19	20	11	76	0
	9	461	184	132	477	2	2	2	0	16	14	22	25	12	89	29
	10	111	103	95	309	2	3	4	2	14	13	20	19	10	76	16
	11	131	125	414	370	3	3	4	1	15	15	25	21	13	89	17
	Total	1509	1579	1149	4537	20	26	31	11	140	153	224	215	110	842	60
	Mean	137.18	143.5	131.73	412.45	1.82	2.36	2.82	10	12.7	13.9	20.36	19.55	10.0	76.55	5.45
	S.D.	45.3	51.53	47.49	141.91	0.87	0.81	0.87	0.63	2.45	1.3	2.42	2.77	1.9	8.3	11.54
ARTISTS - SCIENCE PASSAGE	1	165	197	181	543	1	2	2	1	16	16	25	23	12	92	-16
	2	88	40	54	182	1	2	3	2	7	14	21	17	12	71	34
	3	77	74	61	212	1	1	2	1	9	13	19	15	8	64	16
	4	98	105	98	301	2	3	4	2	14	16	25	23	11	89	0
	5	193	193	169	555	1	1	1	0	13	14	23	22	13	85	24
	6	125	122	145	392	1	2	2	1	13	14	23	20	10	80	-20
	7	86	84	85	255	2	2	2	0	15	13	22	21	12	83	1
	8	101	90	76	267	1	2	2	1	8	12	20	17	9	66	25
	9	164	165	164	493	2	3	3	1	14	16	24	22	13	89	0
	Total	1097	1070	1033	3200	12	18	21	9	109	128	202	180	100	719	64
	Mean	121.89	118.9	114.78	355.56	1.33	2.0	2.33	1.0	12.11	14.22	22.44	20.0	11.11	78.9	7.11
	S.D.	42.07	55.01	49.9	144.39	0.5	0.71	0.87	0.71	3.26	1.48	2.13	2.96	1.76	10.45	18.76

XXXI

Effect of Schema relatedness and discipline and P.Us

ANALYSIS OF VARIANCE TABLE

SOURCE	SS	DF	MS	F
BET.TR. A	13219.43	1	13219.43	5.9
BET.TR. B	5139.42	1	5139.42	4.29
A * B	1463.37	1	1463.37	.65
ERROR	78411.43	35	2240.33	

(XXXII)

Schema relatedness by subject discipline by trials. a 2 x 2 x 3 Anova

F TABLE

SOURCE	SS	DF	MS	F
BET. S'S	127.03	38		
A	20.52	1	20.52	6.8
B	.43	1	.43	.14
A X B	.42	1	.42	.14
ERROR BET	105.67	35	3.02	
WITH S'S	22.67	78		
C	9.38	2	4.69	26.47
A X C	.84	2	.42	2.38
B X C	.02	2	.01	.05
AXBXC	.02	2	.01	.05
ERROR WITH	12.41	70	.18	

XXXlll

Difference between correlation coeffecients

SR		NSR	
Deduction	r = 0.28	Deduction	r = 0.45
	Z = 0.29		Z = 0.48
	N = 46		N = 45

$$\sigma_{dz} = \sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}$$

$$= \sqrt{\frac{1}{45-3} + \frac{1}{46-3}}$$

$$= \sqrt{.024 + .023}$$

$$= .047$$

$$Z = \frac{0.48 - 0.29}{.047} = \frac{0.19}{.047} = 4.04 \quad (<.05)$$

(XXXIV)

General Information Questionnaire

Dear Student,

I should be very grateful if you would kindly fill in this questionnaire, which would provide me with information which I need for my dissertation.

Thank you.

Student No._____Gender:M_____ F_____

Age _____Mother tongue_____

1) What are your A/Level subjects?

1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

---

2) What were your O/Level Subjects?

1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

---

3) Did you do General Science in School? Yes/No (Delete one)

---

4) Did you do History or Social Studies? Yes/No (Delete one)

5) Which subject are you most interested in?

6) Please, rate your knowledge of Physics on this scale:

1	2	3	4	5
very low	low	average	high	very high

7) Please rate your knowledge of History on this scale:

1	2	3	4	5
very low	low	average	high	very high

8) Please, rate your interest in Physics on this scale:

1	2	3	4	5
very low	low	average	high	very high

9) Please rate your interest in History on this scale

1	2	3	4	5
very low	low	average	high	very high

XXXV

Processing of Physics Passage

Instructions (Pausal Units - PUs)

As you will notice, there are no punctuation marks e.g. commas, full-stops, etc. in the following passage. Please read it carefully and place a vertical line in every point where you feel there should be a pause. Commas and other punctuation marks usually indicate where it would be convenient to pause, but they do not indicate all possible places where the reader might stop, either to take a breath or emphasis the meaning, Therefore, while reading this passage, place vertical lines wherever it seems natural to you to pause. Some pauses may occur after a few words, while others may occur after many words. Here is an example.

Example: this would at first seem to be an unnecessary question/we all know/that students need to be able to read effectively/take useful notes/ write good essays/solve problems and so on/ unfortunately such an analysis/does not take us very far/what/for example/does effective note taking actually consists of/again/we might think the answer obvious/not so/

When an electric current flows in a metal charge is carried by free electrons if these electrons were completely free to move there would be no resistance to their flow but

because they interact with vibrating atoms and transfer energy to the atoms the metal exhibits the property of 'electrical resistance' because of the energy transfer which gives rise to this phenomenon heat is produced whenever current flows through a metal the amount of heat depending on the magnitude of the current and electrical resistance it also means that a continuous supply of energy must be available to maintain the current without this supply the current dies rapidly to zero

In 1911 a Dutch physicist discovered that the electrical resistance of mercury drops to zero at a temperature of about 4K since then many metals have been found to have the same property but all of them have different 'critical temperatures' at which the phenomenon occurs the highest known critical temperature is 20.7K for a niobium compound many possible applications of this zero resistance which is known as 'superconductivity' have been suggested but difficulty arises in maintaining the very low temperatures needed this requires expensive and complex apparatus and is the main barrier to the wide application of superconducting devices.

XXXVI

Processing of History Passage

Instructions (Pausal Units - PUs)

As you will notice, there are no punctuation marks e.g. commas, full stops, etc in the following passage. Please, read it carefully and place a vertical line in every point where you feel there should be a pause. Commas and other punctuation marks usually indicate where it would be convenient to pause, but they do not indicate all possible places where the reader might stop, either to take a breath or emphasise the meaning. Therefore, while reading this passage, place vertical lines wherever it seems natural to you to pause. Some pauses may occur after a few words, while others may occur after many words. Here is an example:

Example: this would at first seem to be an unnecessary question/we all know/that students need to be able to read effectively/take useful notes/write good essays/solve problems and so on/unfortunately such an analysis/does not take us very far/what/for example/does effective note taking actually consists of/again/we might think the answer obvious/not so/..

The Munich settlement has not been regarded kindly by posterity the name has been applied - even by Germans - to policies thought to err in the direction of softness and compliance and appeasement has remained a term of abuse

historians are more ready to see something to be said for Chamberlain he could reasonably argue that if a war had started in 1938 the English-speaking world would not have been ready to join in the British Empire would have been divided because men like Hertzog in South Africa and Mackenzie King in Canada would not have gone to war over the Sudtenland and the United States would have felt less sympathy for England and France than she did a year later against this support from outside Europe must be set the fact that Czechoslovakia had a better equipped army than any other eastern European country and a strong defensive position if England and France were to fight for any of the states created at Versailles Czechoslovakia was the best ally they could have had

other supporters of the Munich settlement have pointed out that the Royal Air Force improved its strength so much between 1939 and 1940 that it was eventually able to win the Battle of Britain and retain control of the air over England

(XXXVII)

Processing of History Passage

Instructions (Pausal Units - PUs)

As you will notice, there are no punctuation markes e.g. commas, full-stops, etc. in the following passage. Please, read it carefully and place a vertical line in every point where you feel there should be a pause. Commas and other punctuation marks usually indicate where it would be convenient to pause, but they do not indicate all possible places where the reader might stop, either to take a breath or emphasise the meaning. Therefore, while reading this passage, place vertical lines wherever it seems natural to you to pause. Some pauses may occur after a few words, while others may occur after many words. Here is an example:

Example: this would at first seem to be an unnecessary question/we all know/that students need to be able to read effectively/take useful notes /write good essays/solve problems and so on/ unfortunately such an analysis/does not take us very far/what/for example/does effective note taking actually consists of/again/we might think the answer obvious/notso/....

The place of the Royal divorce in the history of the Reformation will always remain a subject for argument Protestant writers have tended to dismiss it as a mere

'occasion' rather than a genuine cause Catholics have sometimes regarded the divorce as the chief cause of the catacysm and supposed that had it not been pressed England might well have remained a Catholic nation to the present writer neither of these views seems wholly acceptable the Protestants have too readily assumed the inevitability of a Reformation similar in timing and in character to the one which actually occurred the divorce was something more than a mere 'occasion' without it the schism would not have been consummated by 1533-4 had Henry either abandoned or obtained his divorce he would most likely have tried to hold his realm in some sort of spiritual allegiance to Rome though it seems inconceivable that he or his people would tamely have reverted to any earlier situation we may well agree with Pollard that the Pope's refusal of the divorce 'alientated the only power which might have kept in check the anti-papal and anti-sacerdotal tendencies then growing up in England'

on the other side we must avoid the temptation to equate the Henrician Schism with the Protestantism or those anti-papal and anti-sacerdotal forces which smoothed its path

(XXXVIII)

Answer Sheet for the Comprehension Task

Student No.....

1. Please, write a short summary of the passage you just read in one or two sentences.

.....

.....

.....

.....

.....

.....

Scoring Instructions

The letter code after each item indicates the scale to which that item belongs. Enter the code number circled, under the appropriate letter code below for every item. Adding up the columns provides the first set of scores. Combining these, as shown in the second box below, provides the main scores on approaches to and styles of studying.

	A	B	D	C	G	E	F
1.							
2.							
3.							
4.				-	-	-	-
5.				-	-	-	-
6.				-	-	-	-
	A	B	D	C	G	E	F
Scores							

Scores

C + G		H
E + F		S
D + C + E		V
B + G + F		P
A + V + 48 - P		T

(XXXIX)

SHORT INVENTORY OF

APPROACHES TO STUDYING

Please answer every item quickly by giving your immediate response.
Circle the appropriate code number to show your general approaches to studying.

4 (✓✓) = Definitely agree

3 (✓) = Agree with reservations

1 (x) = Disagree with reservations

0 (xx) = Definitely disagree

2 (?) = is only to be used if the item doesn't apply to you or if you find it impossible to give a definite answer.

	//	/	x	xx	?	
1. I find it easy to organise my study time effectively.	4	3	1	0	2	A
2. I try to relate ideas in one subject to those in others, whenever possible.	4	3	1	0	2	G
3. Although I have a fairly good general idea of many things, my knowledge of the details is rather weak.	4	3	1	0	2	C
4. I like to be told precisely what to do in essays or other set work.	4	3	1	0	2	B
5. The best way for me to understand what technical terms mean is to remember the text-book definitions.	4	3	1	0	2	F
6. It's important to me to do really well in the courses here.	4	3	1	0	2	A
7. I usually set out to understand thoroughly the meaning of what I am asked to read.	4	3	1	0	2	D
8. When I'm reading I try to memorise important facts which may come in useful later.	4	3	1	0	2	B
9. When I'm doing a piece of work, I try to bear in mind exactly what that particular teacher/lecturer seems to want.	4	3	1	0	2	A
10. I am usually cautious in drawing conclusions unless they are well supported by evidence.	4	3	1	0	2	E
11. My main reason for being here is so that I can learn more about the subjects which really interest me.	4	3	1	0	2	D
12. In trying to understand new ideas, I often try to relate them to real-life situations to which they might apply.	4	3	1	0	2	C
13. I suppose I am more interested in the qualifications I'll get than in the courses I'm taking.	4	3	1	0	2	B
14. I'm usually prompt at starting work in the evenings.	4	3	1	0	2	A
15. Although I generally remember facts and details, I find it difficult to fit them together into an overall picture	4	3	1	0	2	F
16. I generally put a lot of effort into trying to understand things which initially seem difficult.	4	3	1	0	2	E
17. I often get criticised for introducing irrelevant ideas into essays or discussions.	4	3	1	0	2	G
18. Often I find I have to read things without having a chance to really understand them.	4	3	1	0	2	B
19. If conditions aren't right for me to study, I generally manage to do something to change them.	4	3	1	0	2	A
20. Puzzles or problems fascinate me, particularly where you have to work through the material to reach a logical conclusion.	4	3	1	0	2	E
21. I often find myself questioning things that I hear in lessons/lectures or read in books.	4	3	1	0	2	D
22. I find it helpful to 'map out' a new topic for myself by seeing how the ideas fit together.	4	3	1	0	2	C
23. I tend to read very little beyond what's required for completing assignments.	4	3	1	0	2	B
24. It is important to me to do things better than my friends, if I possibly can.	4	3	1	0	2	A
25. Tutors/teachers seem to want me to be more adventurous in making use of my own ideas.	4	3	1	0	2	F
26. I spend a good deal of my spare time in finding out more about interesting topics which have been discussed in classes.	4	3	1	0	2	D
27. I seem to be a bit too ready to jump to conclusions without waiting for all the evidence.	4	3	1	0	2	G
28. I find academic topics so interesting, I should like to continue with them after I finish this course.	4	3	1	0	2	D
29. I think it is important to look at problems rationally and logically without making intuitive jumps.	4	3	1	0	2	E
30. I find I have to concentrate on memorising a good deal of what we have to learn.	4	3	1	0	2	B

TEST I. OPPOSITES.

(Time allowed, 3 minutes.)

Where the two words mean the same or nearly the same, draw a line under SAME.
Where they mean the opposite or nearly the opposite, draw a line under OPPOSITE.
Where you do not know which they are, draw a line under UNKNOWN.

EXAMPLES:—

Rich ... Poor ... SAME ... OPPOSITE ... UNKNOWN.
Big ... Large ... SAME ... OPPOSITE ... UNKNOWN.

1.	Dry	Wet	SAME	OPPOSITE	UNKNOWN	1
2.	Hot	Cold	SAME	OPPOSITE	UNKNOWN	2
3.	Sick	Ill	SAME	OPPOSITE	UNKNOWN	3
4.	Lost	Found	SAME	OPPOSITE	UNKNOWN	4
5.	Kind	Cruel	SAME	OPPOSITE	UNKNOWN	5
6.	Dirty	Unclean	SAME	OPPOSITE	UNKNOWN	6
7.	Asleep	Awake	SAME	OPPOSITE	UNKNOWN	7
8.	Pull	Push	SAME	OPPOSITE	UNKNOWN	8
9.	Scarce	Rare	SAME	OPPOSITE	UNKNOWN	9
10.	Tender	Tough	SAME	OPPOSITE	UNKNOWN	10
11.	Preserve	Destroy	SAME	OPPOSITE	UNKNOWN	11
12.	Blunder	Mistake	SAME	OPPOSITE	UNKNOWN	12
13.	Belief	Doubt	SAME	OPPOSITE	UNKNOWN	13
14.	Haughty	Arrogant	SAME	OPPOSITE	UNKNOWN	14
15.	Adversity	Prosperity	SAME	OPPOSITE	UNKNOWN	15
16.	Droll	Odd	SAME	OPPOSITE	UNKNOWN	16
17.	Abandon	Discard	SAME	OPPOSITE	UNKNOWN	17
18.	Cultivated	Wild	SAME	OPPOSITE	UNKNOWN	18
19.	Permissible	Prohibited	SAME	OPPOSITE	UNKNOWN	19
20.	Backwards	Reversed	SAME	OPPOSITE	UNKNOWN	20
21.	Slow	Tardy	SAME	OPPOSITE	UNKNOWN	21
22.	Cancel	Annul	SAME	OPPOSITE	UNKNOWN	22
23.	Frank	Candid	SAME	OPPOSITE	UNKNOWN	23
24.	Culpable	Innocent	SAME	OPPOSITE	UNKNOWN	24
25.	Feasible	Practicable	SAME	OPPOSITE	UNKNOWN	25
26.	Creditable	Disreputable	SAME	OPPOSITE	UNKNOWN	26
27.	Slanting	Oblique	SAME	OPPOSITE	UNKNOWN	27
28.	Inanimate	Dead	SAME	OPPOSITE	UNKNOWN	28
29.	Indefinite	Vague	SAME	OPPOSITE	UNKNOWN	29
30.	Deprive	Restore	SAME	OPPOSITE	UNKNOWN	30
31.	Ratify	Confirm	SAME	OPPOSITE	UNKNOWN	31
32.	Inevitable	Avoidable	SAME	OPPOSITE	UNKNOWN	32
33.	Infamous	Notorious	SAME	OPPOSITE	UNKNOWN	33
34.	Precise	Erroneous	SAME	OPPOSITE	UNKNOWN	34
35.	Lasting	Transitory	SAME	OPPOSITE	UNKNOWN	35
36.	Sagacity	Imbecility	SAME	OPPOSITE	UNKNOWN	36
37.	Docile	Recalcitrant	SAME	OPPOSITE	UNKNOWN	37
38.	Malevolent	Propitious	SAME	OPPOSITE	UNKNOWN	38
39.	Enmity	Animosity	SAME	OPPOSITE	UNKNOWN	39
40.	Conclusive	Irrefutable	SAME	OPPOSITE	UNKNOWN	40
41.	Naive	Disingenuous	SAME	OPPOSITE	UNKNOWN	41
42.	Methodical	Capricious	SAME	OPPOSITE	UNKNOWN	42
43.	Relinquish	Cede	SAME	OPPOSITE	UNKNOWN	43
44.	Munificent	Parsimonious	SAME	OPPOSITE	UNKNOWN	44
45.	Inimitable	Unique	SAME	OPPOSITE	UNKNOWN	45
46.	Ambiguous	Equivocal	SAME	OPPOSITE	UNKNOWN	46
47.	Lugubrious	Hilarious	SAME	OPPOSITE	UNKNOWN	47
48.	Disparaging	Derogatory	SAME	OPPOSITE	UNKNOWN	48
49.	Miscellaneous	Heterogeneous	SAME	OPPOSITE	UNKNOWN	49
50.	Satiety	Repletion	SAME	OPPOSITE	UNKNOWN	50

	Verbal Ability	Understanding Summary		Processing Paused Units	Approaches to Studying: Comprehension	Operation	Versatile	Achieving	Reproducing	Meaning
High Knowledge	46	B	3	16	13	11	38	19	08	21
	47	A	4	13	10	12	36	14	15	21
	39	B	3	19	16	14	36	13	15	17
	39	B	3	25	14	16	40	12	09	20
	44	B	3	32	10	15	32	15	13	19
	23	C	2	21	18	15	41	18	21	22
	30	B	3	32	13	19	27	10	21	12
	18	B	3	12	19	23	36	20	15	16
	31	A	4	23	09	12	25	14	19	11
	31	B	3	09	15	09	28	07	15	17
	31	B	3	11	12	16	23	14	13	10
	26	C	2	08	12	13	20	11	20	08
	28	C	2	18	11	15	24	09	19	12
	= 433		38	239	172	190	406	176	203	206
	$\vec{X}$ = 33.31	$\bar{X}$ =	2.92	$\bar{X}$=18.38	$\bar{X}$=13.23	$\bar{X}$=14.62	$\bar{X}$=31.23	$\bar{X}$=13.54	$\bar{X}$= 15.62	$\bar{X}$=15.8
	SD = 9.02	SD =	0.64	SD= 8.01	SD= 3.09	SD=3.59	SD= 7.07	SD= 3.86	SD= 4.25	SD= 4.7
Low Knowledge	31	C	2	17	12	14	43	17	09	21
	30	C	2	24	10	11	40	17	14	21
	36	C	2	19	10	15	34	17	12	19
	34	C	2	18	11	10	32	19	14	18
	34	C	2	31	12	16	28	21	20	11
	28	D	1	26	16	16	38	18	18	18
	36	D	1	19	11	16	36	16	16	20
	27	D	1	12	14	18	45	21	13	22
	35	D	1	20	11	20	41	17	16	20
	28	D	1	14	14	15	36	17	13	19
	37	C	2	16	17	20	39	17	12	20
	27	D	1	19	11	09	26	10	13	13
	27	D	1	35	12	20	35	19	23	14
	37	D	1	16	17	19	39	19	21	18
	= 447		20	286	178	219	512	245	214	254
	$\bar{X}$ = 31.93	$\bar{X}$ =	1.43	$\bar{X}$ = 20.43	$\bar{X}$=12.71	$\bar{X}$=15.64	$\bar{X}$=36.57	$\bar{X}$=17.5	$\bar{X}$=15.29	$\bar{X}$=18.14
	SD = 4.03	SD =	0.51	SD = 6.47	SD= 2.46	SD= 3.67	SD= 5.36	SD= 2.65	SD= 3.95	SD= 3.25

(XLII) High and Low-Knowledge Physics Groups

	Verbal Ability	Understanding Summary		Processing Paused Units	Approaches to Studying: Comprehension	Operation	Versatile	Achieving	Reproducing	Meaning
High Knowledge	26	A	4	15	17	18	40	11	16	20
	27	C	2	18	12	14	27	14	23	14
	29	C	2	24	12	16	30	19	15	15
	43	A	4	22	17	17	42	21	16	22
	33	B	3	18	11	12	30	14	12	14
	30	A	4	21	18	14	37	19	19	20
	37	B	3	30	09	09	22	18	15	11
	27	C	2	18	09	11	24	08	13	13
	33	B	3	18	10	12	38	21	14	21
	33	C	2	26	15	15	43	24	13	22
	14	D	1	17	11	14	25	13	10	12
	32	D	1	26	21	18	38	13	15	17
	29	B	3	27	16	14	33	13	13	15
	27	C	2	19	10	17	35	17	15	15
	420		36	299	188	201	464	225	209	231
	$\bar{X}$=30	$\bar{X}$ =2.57		$\bar{X}$=21.36	$\bar{X}$=13.42	$\bar{X}$=14.36	$\bar{X}$=33.14	$\bar{X}$ = 16.07	$\bar{X}$ = 14.92	$\bar{X}$=16.5
	SD=6.50	SD =1.02		SD=4.53	SD=3.84	SD=2.71	SD= 6.90	SD=4.48	SD=3.15	SD=3.8
Low Knowledge	22	C	2	26	15	11	32	07	09	13
	30	D	1	20	07	11	19	05	11	12
	27	D	1	24	10	17	21	07	16	10
	28	D	1	13	15	16	24	15	18	12
	42	C	2	17	16	07	27	10	21	12
	32	D	1	19	11	10	20	15	20	11
	26	D	1	23	12	14	37	18	16	18
	43	C	2	22	10	11	21	09	15	11
	39	D	1	20	10	14	31	12	20	18
	25	C	2	15	16	05	24	09	09	10
	24	D	1	18	14	14	25	13	19	12
	338		15	217	136	130	281	120	174	139
	$\bar{X}$=30.73	$\bar{X}$ = 1.36		$\bar{X}$=19.73	$\bar{X}$=12.36	$\bar{X}$= 11.82	$\bar{X}$ =25.54	$\bar{X}$=10.91	$\bar{X}$ = 15.82	$\bar{X}$=12.64
	SD=7.39	SD = 0.50		SD= 3.90	SD= 3.01	SD=3.65	SD= 5.69	SD= 4.04	SD= 4.4	SD= 2.8

(XLIII) Mann Whitney U Test for P.Us as an index of discipline group difference in processing

History Students		Physics Students	
P.Us	Rank	P.Us	Rank
32	50.5	35	52
32	50.5	31	49
26	44.5	30	48
25	42	27	47
24	40	26	44.5
23	37.5	26	44.5
23	37.5	26	44.5
22	35.5	24	40
21	32.5	24	40
20	31	22	35.5
20	31	21	33.5
19	26.5	20	31
19	26.5	19	26.5
18	20	19	26.5
18	20	19	26.5
17	15	19	26.5
16	12	18	20
15	9.5	18	20
13	6.5	18	20
13	6.5	18	20
12	4.5	18	20
11	3	17	15
9	2	17	15
8	1	16	12
		16	12
		15	9.5
		14	8
		12	4.5
$R_1 = 585.5$		$R_2 = 791.5$	
$N = 24$		$N = 28$	

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$(24)(28) + \frac{24(24+1)}{2} - 585.5$$

$$= 111$$

$$Z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\frac{(n_1)(n_2)(n_1+n_2+1)}{12}}} = \frac{111 - \frac{(24)(28)}{2}}{\sqrt{\frac{(24)(28)(24+28+1)}{12}}} = \frac{-225}{133.45} = 1.68$$

$P < .05$