ATTENTIONAL STYLE, LINGUISTIC COMPLEXITY AND THE TREATMENT OF READING DIFFICULTY

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ABSTRACT.

Part One. Early or 'apprentice' reading is widely assumed to necessitate phonological encoding as mediational between the printed stimulus and meaning. Mature reading appears to be able to avoid phonological encoding, proceeding directly to meaning. In order to determine preference for encoding modality, 149 'apprentice' readers were subjected in separate conditions to auditory-phonological and visuographic interference of possible meaningfulness whilst reading prose passages. Subjects preferring the visual modality had greater reading difficulty than subjects showing preference for auditory processing, whilst subjects who showed no distinct preference for either tended to be better readers.

Part Two. Prose passages of graded difficulty were analysed in terms of word-origin or mode of generation, number of morphographemes, and congruence of syllabic/morphographemic segmentation. All three variables were significantly correlated with age norm levels for word-recognition and comprehension for the passages. The results were taken to suggest an alternative basis for a readability index whereby prose materials could be assigned to levels of difficulty for 'apprentice' readers.

Part Three. To investigate the modified model of the reading process, a corpus of words of a predictably high level of difficulty was derived according to the findings of Part 2. Children with 'specific reading difficulty' were taught to recognize and understand the words by (a) a specially-devised unimodal, visual method and (b) a 'normal', bimodal, phonics method. The results of the application of a comprehension test suggested the superiority of the unimodal method over the bimodal. Within the unimodal group, visual-preferents performed significantly better than auditory-preferents, but auditory-preferents in the unimodal group performed significantly better than auditory-preferents in the group taught by the bimodal method. The results were taken to suggest the usefulness of the modified model of reading automaticity, whereby the direct grapheme-to-meaning path is possible for 'apprentice' readers, in the treatment of 'specific reading difficulty'. The implications of the findings for the treatment of other communication difficulties were also discussed.

Attention. Dyslexia, Language, Reading, Remediation.

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INTRODUCTION

Introduction.

Reading difficulty appears to be one of the most intractable problems of pedagogy in this country, particularly because of the lack of an established direct relationship between reading performance - whether defined as oral reproduction consequent upon word recognition <u>or</u> as comprehension, the interpretation of the significance of the printed word - and intellectual ability or intelligence. It is the incidence of the discrepancy between reading performance and intellectual ability as expressed in the oral language, where reading performance is 'below par', that perhaps gives rise to much anxiety on the part of pupil and parent, and also to educationists (the Bullock Report, D.E.S. 1975, q.v.). Probably as a result of this anxiety, occurring at a time of systematic readjustment of British education (particularly at the secondary stage where there has been a growth in the assignment of children to separate 'remedial' treatment within the school concomitant with the expansion in size of the schools), there has been considerable interest in the prediction or diagnosis of vulnerability to 'specific reading difficulty'. So far, however, the results of research on the treatment of reading difficulty appear to be sparse and not very significant (Miles, 1974). This study is an attempt to develop and test a treatment programme or regime resulting from (a) a study of auditory-visual modal preference for information processing as an attentional style variable, and (b) a study of levels of linguistic complexity relevant to material read by, or prepared/selected for, the 'apprentice' reader, that is, the reader who has not reached the stage of automaticity in reading.

In the context of 'mature' reading, there are merely two variables, the reader and the text. It is possible to study the cognitive strategies or attentional styles that the reader brings to the text by keeping the text constant and studying the varying behaviour of readers. Conversely, it is possible to study the levels of linguistic complexity by varying the characteristics of the language of the text and studying the varying responses of the reader, from which we would infer the level of difficulty that a particular reader was having with regard to each text. These two approaches are attempted in Parts 1 and 2.

In the context of 'apprentice' reading, however, there is a complicating variable, the constraints imposed by the teacher upon the range of available strategies open to the 'apprentice' reader. This may be termed 'the instructional set of the classroom', but, as such, it may not be thought of as uniform, rather does it vary according to the teacher's perception of the pupil's level of performance in reading and of what actually constitutes reading for that teacher. Whilst dispute continues over the merits and demerits of 'phonics' and 'look-and-say', a more pertinent distinction appears to be that between word-recognition or ability to 'bark at print' and reading for meaning. The very disputation over 'phonics' and 'look-and-say' appears, to the writer, to indicate emphasis upon the word-recognition aspect.

For the processing of printed words with meaning as the end product, a strategy or approach will be presented in Part 3 which, having been developed from Parts 1 and 2, may be considered as an alternative in rationale to that widely accepted for the 'apprentice' reader. This approach will, however, be compatible with what we understand as 'mature' reading.

P A R T   O N E

A STUDY OF ATTENTIONAL STYLE AND ITS IMPLICATIONS FOR CHILDREN WITH READING DIFFICULTIES.

PART ONE: A STUDY OF ATTENTIONAL STYLE AND ITS IMPLICATIONS FOR CHILDREN WITH READING DIFFICULTIES.

1.0.0. SURVEY OF LITERATURE.

Of the numerous purposes of reading, perhaps the oldest is a mnemonic one, stemming from the need to retain accurate information, such as accounts of sales or production of goods, beyond the normal powers of recall. A further and obvious purpose is that of communication. Whatever the particular purpose, however, we basically read because we need to, and literacy depends upon being able to extract information from print for innumerable reasons and in a number of ways. Studies of the ways in which information may be extracted from the text may be expected to contribute much to our understanding of the reading process and to the formulation of strategies for the improvement of reading performance. This extractive process is characterised by selectivity and may be termed 'perceptual learning'. In the following section, the main features of perceptual learning and development are described as a prelude to their application to reading.

1.0.1. Perceptual Learning.

Perceptual learning may be held to result in extraction of relevant information from a variety of available stimulation, following Gibson & Levin (1975), the available stimulation is "the invariant information that specifies the permanent layout of the environment". It is not the addition of anything, rather the increase of specificity of discrimination to the stimulus input, or an increase in the differentiation of the stimulus information. The modification, being in WHAT is perceived, may be regarded as having two aspects, the distinctive features of the things that occur in the environment, and the invariants of events that enable us to predict outcomes and detect causes.

Gibson (1975) characterises perceptual learning and development in four ways:-

(i) It is adaptive to the needs of the person.

(ii) It is active in that the receptor systems are also effector systems for exploration and search for useful information.

(iii) It is selective, for not all the potential information is useful. From the welter of information, we learn to extract what is useful to us in the reduction of uncertainty in our lives. As each species has adapted to its environment in characteristic ways, the adaptive development of man has apparently favoured the ability to differentiate minuscule graphic symbols and the rapid scanning of them; this has given rise to our writing and number systems.

(iv) Perceptual learning progresses towards finer and finer differentiation, that which is confusible becoming increasingly structured and specific.

In considering what is learnt in the reading process, then, we may first consider what is learnt in the learning processes in general; in order to adapt and to perceive, the human must be able to distinguish people, objects, processes .... and symbols. The characteristic ways in which we distinguish such depend on the feature contrasts that we judge are shared or not shared in different degrees by the members of (finite) sets.

The feature contrasts or distinctive features referred to above are not absolute, however, but relational and contrastive. Jacobson & Halle (1956) applied the concept of distinctive features to the phonemes of human speech, concluding that a small set of feature contrasts (consonant - vowel, voiced - unvoiced, plosive - non-plosive etcetera) is sufficient to distinguish all the phonemes of all the languages in the world. Further, these contrasts are invariant when produced by different voices or even by machine. This invariance suggests that the features, and consequently the feature contrasts, do not inhere in the 'stimuli' but are attributed by the perceiver.

Gibson, Osser, Schiff & Smith (1963) used a matching-judgments method, explicated in Gibson (1969), to obtain a confusion matrix of the objectively-obtained set of features which are used in distinguishing one letter from another.

Distinctive features can also be used to differentiate more complex features than letters, but it is more difficult to define them.

The differentiation of distinctive features may be extended to include the invariant relations of events in time. For example, Bell & Tronick (1971) showed how, even for a 20-day-old infant, an event like looming has adaptive significance or meaning which, conversely, is rooted in the perceptual learning provided by experience. Gibson (1975) thinks it highly probable that a child's own attempts at writing letters conduces to the learning of the critical features that distinguish one letter from another, the invariants.

The relationships between distinctive features or events may now be thought of as in a hierarchy, superordinate or embedded, in which an event or thing can be specified. Martin (1972), in presenting convincing evidence for rhythmic patterning in speech, puts forward a hypothesis of present timing, that 'since the accented elements dominate the temporal organisation of an utterance, they must in some sense be planned first." (Martin, 1972, p. 199) Lashley (1951) also stressed that the serial organisation of behaviour involves complex, hierarchic systems which are particularly important in both the spoken and the written language. Learning to perceive these structures, concludes Lashley, cannot be explained as a process of association. The structure creating the higher-order variables can be thought of as a set of rule-systems, phonological, syntactic and semantic, that describes the organisation of subordinate relations. Fries (1962) studied the patterns of distinctive features and concluded that once the reader has 'found' higher-order structures, he can cope with larger units of information, processed as 'chunks', thus achieving cognitive economy.

Phonemic contrasts are abstracted from the flow of speech, even from quite different voices, and are then ordered. The generalisation of the ordering to other possible instances is held to indicate that the relationship has been perceived. This process is similar to William James' process of 'dissociation from varying concomitants', and cannot be explained by the associative theory of learning. Velten (1943), in observing his own child's language development, found that an abstract contrastive relation, the voiced - unvoiced feature contrast, was applied systematically to all relevant classes, obviously not by repeated associative response. Werner (1961) supports this view, again using infant subjects: "Having grasped the fact that it was the larger with respect to the smaller .... they made a correct choice even when presented with variations of these contrastive pairs. The child understands, and is able to transpose diverse opposites: outline vs. solid, symmetrical vs. asymmetrical, thick vs. thin, small vs. large, round vs. angular etc." This bears a close resemblance to the subset differentiation procedure of 'Modern Mathematics".

The salience of a relation may be made by enhancing a feature contrast and/or giving 'neat' examples of the invariant property. Hull (1920) showed how this could be done in respect of the learning of Chinese characters, the learning of radicals in complete characters being facilitated by drawing the radicals in red. Lashley (1938) and Gibson (1969) support the usefulness of starting with maximum contrast and progressing towards smaller contrasts. Redundancy correlation, however, should be used with caution; children taught letters differentiated by colour-coding associated with name-rhyming were surprisingly poor at naming the letters when the normal black version was presented (Gibson & Shepela, 1968), and it was concluded that the ability to use redundancy develops slowly.

Nodine & Evans (1969) and Nodine & Lang (1971) studied the looking behaviour of young children when reading to find out if two strings of letters were the same or different. It was concluded that, if 'different' strings of high confusibility were fixated longer, the child was giving specific attention to the examination of the distinctive features of the letters. This work appears to support further the developmental interpretation, the older children tending to scan from word to word systematically, whilst kindergarten children scanned more within words than between. Thus visual scanning quality increased in specificity and economy, the older children attending selectively to informative details in the display and tending to ignore irrelevant ones. These findings are further confirmed by Nodine & Stuerle (1973). However, the reader must know where the information is, or is likely to be, in order to search effectively; the location of the informative areas of the display is complemented by comparison of distinctive features. It is not clear from the works of Nodine et al. whether this is by systematic active manipulation of the receptor mechanisms or by some internal attention process, or both.

Distinctive features and invariants, then, being extracted from stimulation, an active filter or gate, whose function would be to prevent the 'noise' or irrelevant information from entering, may be postulated. Such irrelevant information may be minimally perceived or even rejected, and so would not be processed.

In summary, whilst the discrimination of the distinctive features of letters may be a feature, perhaps a necessary one, of prereading activity, this skill may be counterproductive in later stages of reading where increasing specificity is required. This situation is somewhat similar for speech production. The increase in specificity appears to develop with age, and is an ability to suppress or reject information that is irrelevant whilst accepting other information. Such an ability presupposes the ability to organise and structure experience into larger units, perhaps on a hierarchical basis, so that comparisons may be made between larger an larger units prior to acceptance or rejection. The next section looks more particularly at the code of the written language and the ways in which it may be processed.

1.0.2. The Code of the Written Language.

It is widely accepted that different types of material are processed by the human organism in different ways, speech being processed differently from pictures and from mathematical symbols.

Pictures may be held to be in some degree representational, and some writers (e.g. Farnham-Diggory, 1972) regard graphic displays, such as maps, graphs and diagrams, as midway between representation and the arbitrary coding of speech. Bruner (1964) considers that the capacity for graphic symbolisation develops with age, initially enactive in the very young, then giving way to the iconic and then the symbolic in older children. Vernon (1945) studied the confusions in comprehension of graphic material, pressing the point that the graph and the chart are no less symbolic than are verbal and mathematical statements, and that specific instruction is required for these, in contrast with the fluency with which we make verbal statements of ideas and meanings. Vernon found a strong tendency to report on the appearance of the graphs and charts rather than reporting on the information that they were intended to convey. From Vernon's findings, it would appear that graphic symbolism is in no way inferior to that required to express verbal and mathematical statements, contrary to the value judgment of Farnham-Diggory that graphics are midway between representation and speech and consequently developmentally inferior.

The picture-coding process appears to be one of almost instantaneous semantic expectation, and if this is not met when expected, confusion may arise. Farnham-Diggory (1972) found that pictures may distract a subject from deriving information from map-codes, these latter being held to be processed in a way more akin to that of language processing. The apposition of a concrete model of a landscape with the map-symbols caused confusion, which could be avoided if the symbols were studied before the 'work'. Farnham-Diggory interpreted this as the blocking of verbal mediation, considered by her as essential for relating the symbol to the concrete referent. Younger children expected immediate meaning as with picture processing. Farnham-Diggory, then, thinks that ' something like 'picture-processing dominance' may interfere with our symbolic abilities on graphic materials". She then suggests, by way of remediation, the development of a verbal programme "for threading our way through academic visuals". Piaget, like Bruner, holds that the development of symbolic imagery is a facet of general operational development, and to Piaget the use of graphic symbols is an advanced operational skill. Piaget also takes the view, contrary to that of Farnham-Diggory, that the important operational developments are not dependent upon language. Farnham-Diggory explicitly takes the view that "Reading and graphic comprehension both depend upon language: Words and graphic symbols are really codes for verbal statements, which they represent in visual form." The mathematic-coding process will not be treated here, except to say that it is widely held that the concepts necessary to arithmetical operations appear to require no necessary verbal mediation, though this may be used, being perhaps grounded in sensorimotor experiences.

Farnham-Diggory, above, not only holds that verbal mediation is essential for relating symbol to concrete referent, but seems to regard verbal mediation and phonological or speech mediation as synonymous. This assumption leads to the view that the coding process of the written language is necessarily very closely parallel to that of speech-processing, which may to some extent be drawn from the present popularity of 'phonic' reading methods and corresponding disrepute of 'look-and-say' approaches. Since Chall's (1967) study of reading retardation in American children, the 'look-and-say' approach has been widely held to be responsible for illiteracy, the reason offered being that children using that method are forced to rely on model-matching procedures which are not the 'natural' human system for perceptual analysis and comprehension. 'Look-and-say' methods are also held to use numerous pictures, which Farnham-Diggory and others have found to tend to stimulate associations of their own which may interfere with the language associations held to be necessary to reading comprehension. Samuels (1967) found that children learning to read a number of small words were distracted by pictorial representations of the words. Samuels studied the distraction in both laboratory and classroom settings and found that the presence of pictures was especially damaging to the learning efficiency of children below the median in reading ability, and even more so in the classroom setting. 'Look-and-say' methods were held to discourage children from attending to the phonological code, thereby preventing them from developing their own word-attack skills.

The phonological or speech-parallel coding process as applied to reading may be thought to embody several systems: Farnham-Diggory describes four:-

(i) Letter-sound association systems.

(ii) Spelling-pattern sight-and-sound systems.

(iii) Word - sound systems.

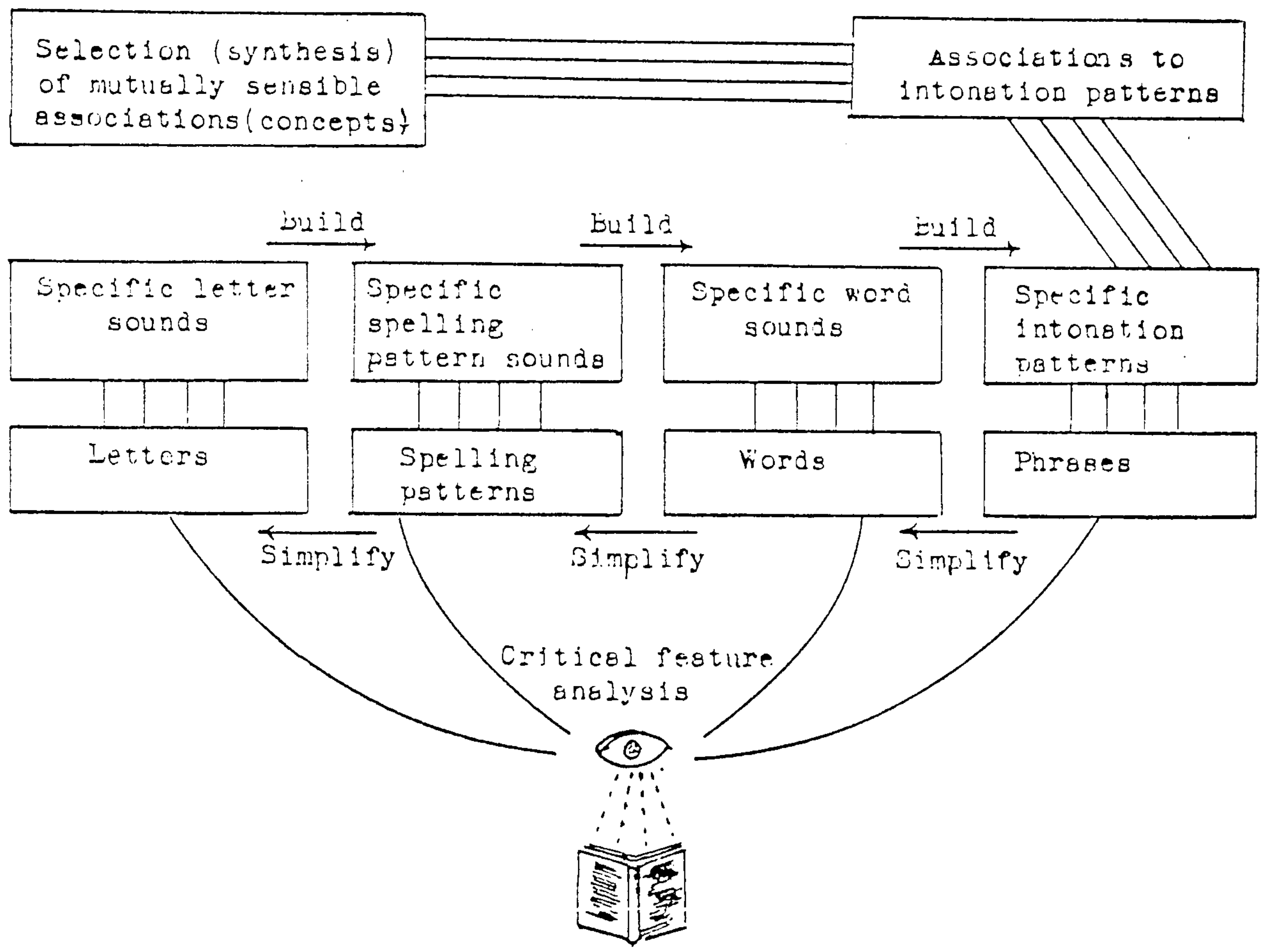
(iv) Phrase - sound systems.

to which, presumably, could be added:-

(v) Sentence - sound systems,

each of which can be built from the preceding system, the more complex systems requiring more skill and consequently allowing fluency to be acquired with age. The model is graphically presented in Fig. 1 and it is held that the 'build' and 'simplify' aspects of the system are advantageous in making self-remedy possible.

Fries (1963) believes that much of the controversy over reading methods arises from the belief that there is only one proper code method of teaching (or learning, for that matter). Farnham-Diggory (1972) interprets this as meaning that the coding stages of her model (see Fig. 1) are variously applicable to different levels of development. She holds that all the stages are necessary, though at a particular level of a child's development emphasis on one of the stages would be appropriate. Thus a six-year-old who has not properly mastered system (i) but has proceeded to system (ii) may not be as fluent a reader as the child who has mastered the systems in order. According to this view, the main criterion for evaluation of proprietary reading schemes would be whether they omit or underemphasize stages, particularly the earlier ones, in the basic process or progression, for the child of lower intelligence would not be able to supply the missing material and teach himself the code.



<u>Figure 1</u>. <u>Schematisation of the Paths to Reading Comprehension</u>; after Farnham-Diggory, 1972.

On the first stage of the model, useful research has been done on the discriminant features of letters, focussing on the degree of confusibility among letters. Gibson et al (1963) have charted possible features for letter discrimination, and Gibson's possible feature chart for Roman capital letters is presented in

Figure 2. Pick (1965), using 'letter-like forms' developed by Gibson, measured children's ability to recognize previously unknown visual stimuli. Pick theorised that the children were learning these discriminations in one of two ways:-

(i) by MODEL-MATCHING, the children matching the test forms to a mental model of the standard as a whole, and

(ii) by FEATURE-TESTING, the children attending to changes in particular features of the test stimuli, curved lines for example.

Pick used transfer tests on two groupings of children: Group I received new test forms (from those presented to both groups initially) embodying rotations and reversals which were intended to achieve a model-matching set, whilst group II learned new materials that had the same type of feature changes, such as straight and curved lines, which were intended to give a critical-feature discrimination set. Group II performed significantly better on the transfer or generalisation test, for although they were seeing a new model, its features were being changed in a familiar way. The results were held to confirm the intrinsic superiority of critical-feature discrimination as a strategy in early reading. It is possible that, in this experiment, the superiority was achieved as much through the induction of verbal control ('curved', 'straight' etc.) as of critical feature discrimination, though there may be a connection between the two.

Some feature changes are, of course more difficult to discriminate than others: Children may confuse p and q, or b and d, which differ in the direction of the critical features. Dunn-Rankin (1968) obtained confusibility scales by comparing all pairs of letters with target letters, for example:-

Target Letter	Comparison Letters Which letter in each pair looks most like the target letter?	
	a	b
	y	c
e	w	d
	u	e
	t	f

Figure 3. Example of Feature Comparison used in Preparation of Confusibility Scales, (Dunn-Rankin, 1968).

Other studies (Nodine & Hart, 1970; Nodine & Evans, 1969) have investigated the ways in which confusibility affects word analysis. It was found that children took longer to make decisions about words containing high confusibles. The children scanned and fixated more frequently, and for longer periods of time, for the high-confusible words than for the low-confusibles. There was therefore an increase in decision time, which was interpreted by Nodine & Evans (1969) as implying that children bring with them to the early reading act a well-developed strategy for solving this type of problem: They did not wholistically match word with pseudo-word at a single glance but compared them letter by letter, feature by feature, in a serial manner:

> "The results are consistent with the hypothesis that pre-reading (children) search and compare pseudowords letter by letter, alternating between members of the (comparison) pair. When children detect a mismatch between letters of the two words, they terminate the search. If no mismatch is detected, the search continues exhaustively.......... The analysis of eye movements has provided a tentative desription ion of the search process used by beginning readers in making discriminations among words."
>
> (Nodine & Evans, 1969, pp 40-41.)

Farnham-Diggory (1972) suggests that 'natural' word-discrimination systems may involve search strategies of this sort, and that teaching methods that emphasize whole-word-shape memorisation might therefore conflict with a child's 'natural' system for analysing and comparing the distinctive features of his new visual code.

Without necessarily criticising the usefulness of the coding model, schematised in Fig 1, page 5, the word 'natural is confusing to the present writer: If the child 'naturally' brings critical-feature discrimination to the early reading act, then, presumably, Samuels (1967) would not be able to conclude that look-and-say methods were discouraging children from attending to the phonological code because the children already have a set (and 'natural' suggests that it is innate) for critical feature analysis which, being the 'correct' way, could hardly fail to produce success in frustrating the knavish tricks of the 'look-and-say' teacher.

So far, it appears that children may bring a variety of information strategies to the early reading act, two of which, model-matching and critical feature discrimination, may be in competition. For the purpose of attending to phonological encoding of the printed letters, it would appear (according to Farnham-Diggory, 1972) that critical feature differentiation is generally superior to model matching. The results of the studies already referred to are, however, only generalisable to pre-reading and very early reading stages. It is quite possible that these, and other strategies, are differentially useful at the different levels or stages of reading, and even that each has its application at the earliest level. It is further possible that two such different perceptual strategies may achieve similar results on a particular printed word in the reader's bid to make it have meaning.

There arises the possibility that readers might be differentiated by the particular cognitive strategy, if any be preferred, that they prefer or tend to bring to the reading act. The studies of Farnham-Diggory, Nodine and others appear to opt for the phonological coding model because they are basically associationist in outlook. It could well be that, whilst some learners may exhibit a set in a particular activity such as reading, others might be more flexible and able to switch strategies according to the perceived demands of the task.

The phonological-coding approach to reading appears to be preoccupied with, at the early stages at least, precise letter identification, followed at later stages by exact, detailed, sequential perception and identification of words (in the whole-word approach), spelling patterns and then larger language units. McCracken & Walcutt (1965) justify the incorporation of a letter-by-letter approach in their reading scheme thus:-

"In short, following this program the child learns from the beginning to see words exactly as the most skilful readers see them... as whole images of complete words with all their letters."

Goodman (1967) regards this view as a misconception and offers, as an alternative:-

"Reading is a selective process. It involves partial use of available minimal language cues selected from perceptual input on the basis of the reader's expectation. As this partial information is processed, tentative decisions are to be confirmed, rejected or refined as reading progresses."

Goodman, 1967, pp 126-127

In this view, reading involves an interaction between thought and language, rather than language controlling thought, and efficient reading does not result from the (precise) identification of all elements but from the reader's skill in selecting the fewest, most productive cues necessary to produce guesses that are right first time. The reader must anticipate what he has not yet seen, as he must anticipate what he has not yet heard when he is listening.

The two views of the reading process may be revealed in teachers' attitudes towards errors in reading aloud or in such activities as cloze tests of comprehension. Using the associationist model, all deviations must be treated as errors, as indications that the reader has been careless or lacking in knowledge. Deviation from the word that occupies the space in the original of the cloze test would be marked wrong even though the child's own response might be semantically superior. Miscues in reading also seem to have little effect on meaning, and it could well be that insistence upon precise identification of every word in oral reading could inhibit the active anticipation of, and search for, grammatical information and force the reader to use only graphic information in the text.

Goodman's (1967) model emphasises the selectivity characteristic of perceptual learning, the study of readers' miscues or 'errors' strongly suggesting that reading is a selective, tentative and anticipatory process that is quite different from the process of precise, sequential identification postulated by the Farnham-Diggory model. The reader brings to the 'act' his total experience and also his total language and thought development. By the age of five when a child begins to learn to read, his use of language has reached a largely automatic, intuitive level: In a number of studies hypothesizing 'linguistic deprivation' as a cause of reading retardation amongst urban schoolchildren, oral language expression has been more than adequate to support the low-level reading requirements of the infant and junior school. Hazel Francis (1972, 1974, 1975) found that, although reading ability in such children was related to vocabulary skill, there was no correlation with speech-structuring skill, which was generally adequate in both groups ('socially-advantaged' and 'socially-disadvantaged' children) to support reading. The belief that some children are irrevocably handicapped in language when they come to school because of their social background is now difficult to justify, except in perhaps a small proportion of individuals who also present other symptoms. The total experience that the child brings to the reading act is, then, usually more than sufficient to support a reasonably high level of reading skill, as also is the child's language-structuring ability. Although these children would find it difficult or impossible to describe the use they make of grammar in encoding and decoding speech, yet they do display a high degree of skill in syntax.

The child who has to read aloud must produce an oral language which is the equivalent of the graphic input (the signal in reading), and he must also reconstruct the meaning of what he is reading. When, however, the complexity of the process begins to be unravelled, both the order and nature of the coding processes become problematical.

In reading aloud, there are three possible arrangements of the phonological and semantic recoding:

(i) The reader may recode graphic input as oral language and then decode for meaning, or

(ii) he may recode and decode simultaneously, or

(iii) he may decode first and then encode the meaning encode the meaning as oral output.

On the basis of his own studies, Goodman (1967) suggests that skilled readers encode directly from the graphic stimulus and then encode from the 'deep' structure, as in the Chomsky model, so that oral output is not directly related to the graphic stimulus and may even involve transformation in vocabulary and syntax, even if there is no impairment in meaning. If there is inaccuracy in comprehension, this will be encoded in oral output.

George Miller (1965) exhorts psycholinguists to "formulate performance models that will .... incorporate hypothetical information storage and information-processing components that can simulate the actual behaviour of language users." Goodman (1967) presents such a model, which is reproduced here in full:-

"1. The reader scans along a line of print from left to right and down the page, line by line.

2. He fixes at a point to permit eye focus. Some print will be central and in focus, some will be peripheral; perhaps his perceptual field is a flattened circle.
3. Now begins his selection process. He picks up graphic cues, guided by constraints set up through prior choices, his language knowledge, his cognitive styles and the strategies he has learned.
4. He forms a perceptual image using these cues and his anticipated cues. This image then is partly what he sees and partly what he is expecting to see.
5. Now he searches his memory for related syntactic semantic and phonological cues. This may lead to selection of more graphic cues and to reforming the perceptual image.
6. At this point, he makes a guess or tentative choice consistent with graphic cues. Semantic analysis leads to partial decoding as far as possible. This meaning is stored in short-term memory as he proceeds.
7. If no guess is possible, he checks the recalled perceptual input and tries again. If a guess is still not possible, he takes another look at the text to gather more graphic cues.
8. If he can make a decodable choice, he tests it for semantic and grammatical acceptability in the context developed by prior choices and decoding.
9. If the tentative choice is not acceptable semantically or syntactically, then he regresses, scanning from left to right along the lines and up the page to locate a point of semantic or syntactic inconsistency. When such a point is found, he starts over again at that point. If no inconsistency can be identified, he reads on, seeking

some cue which will make it possible to reconcile the anomalous situation.

10. If the choice is acceptable, decoding is extended, meaning is assimilated with prior meaning and prior meaning is accommodated, if necessary. Expectations are formed about input and meaning that lies ahead.

11. Then the cycle continues."

(Goodman, 1967, pp 134-135.)

Goodman's model offers a description of the process of skilled reading which might be at variance with teaching techniques now practised in the the early stages. His model would form a sound basis for the continuation teaching of reading that is remarkable for its absence in upper-primary and in secondary schools. Further, teaching methods may be viewed as a function of the perceptions of the teacher, and foremost amongst these will be the cognitive 'set' brought to the classroom and resulting from initial teacher-training. It might also be profitable to consider the cognitive 'set' that the individual learner brings to the act of reading. Whilst Goodman points out that insistence on the precise idendification of each word may cause a reader to stop seeking grammatical information and be thrown back on the use of graphic information, many readers do succeed by the 'phonic' method, presumably by a similar process to that put forward by Farnham-Diggory. Of course, the criterion may, and does, vary: It may involve the comprehension of what is read, resulting in oral or written output, perhaps with grammatical transformation, or in an action; or it may only involve the accuracy and fluency of reading aloud, 'mechanical' reading or 'barking at print'.

In summary there arises the possibility that children, and adults for that matter, bring with them to the reading act a number of cognitive strategies, some of which, e.g. picture-processing, may be held by some schools of thought or practice to be inefficient or counter-productive for reading. Nevertheless, there remains the possibility that, at most if not all the levels of reading development, the phonological coding process may be supplemented or even supplanted by a graphic processing strategy. The discrimination of distinctive features may certainly be useful for the early stage of letter and word recognition where doubts arise as to the meaning of referent of the spoken, printed or written word. Goodman, however, reverses the direction of control, insisting upon the idea of central control and the consequent reduction of input sampling. Such a model cannot accomodate both central control and the phenomenon of 'barking at print'. What is apparently needed is a much more complex model of information processing that can account for the conflicting actualities of 'barking at print' and for rapid reading with comprehension which may involve grammatical transformation; and also account for the possibility of the opperation of different or alternative cognitive systems. Such a model will be presented in the following section.

1.0.3. Attention and Information Processing.

The definitions of attention in terms of mental faculties or subjective experience appears to have proved sterile for empirical research. Accordingly, interest has focussed on models of control and communication, with the prospect of support or refinement of these models by the identification of neural structures thought to underlie the functional processes inferred from psychological studies.

A consideration of the limits which the individual places on the incoming information would appear to be important in the study of reading difficulties, particularly as reading is usually conceived as a bisensory task. Broadbent (1958) developed a comprehensive analysis of selective attention using the dichotic listening technique. In Broadbent's classical experiment, two quite different messages were put into the two ears of a subject, using earphones, and the subject instructed to listen to only one ear. Broadbent found that the subject can reproduce much more information for the listened-to ear than the ignored ear. Treisman (1964) found, however, that subjects could retain information entering through the ignored ear (or unattended ear) if the information is important to them. Treisman concluded that information entering the ignored ear must reach a point in the brain where evaluation can be made in relation to the subject's memory store and general judgment of what is important or significant. Treisman's analysis leads to the conclusion that the location of the brain processes responsible for attention, defined as stimulus selection, must be beyond the primary sensory systems. Raw sensory input must be analysed and coded into the language of the brain before it can be evaluated for remembering or forgetting.

Treisman showed not only that a subject cannot take in two signals in the same modality, but that they are able to respond to either of the two messages if no response is required to the other. Mowbray (1953) obtained similar results when one message was visual and one auditory. Cherry (1953) avoided competition between motor responses, a possible alternative explanation, by requiring successive responses to simultaneous messages, whilst Brown (1975) required one written response, at choice within a time limit, to simultaneous auditory and visual 2-digit messages. Both support the suggesting that part, at least, of the interference must occur at some central stage rather than at the periphery (peripheral masking), either in the identification of words/digits or in a memory stage. This central limit is not set so much by the information load or the number of messages that apparently compete for processing but by the predictability and/or information content of the messages. This is a qualitative limitation from which we must infer that, in order to assess the quality, both messages available to the primary sensory 'surface' must be processed in some way or to some minimal level because the possibility of predictability and/ or information content must have been ascertained. Broadbent's model seems to imply, however, that irrelevant messages are extracted before the identification of any verbal content.

Deutsch & Deutsch (1963) have put forward an alternative explanation whereby all inputs are fully analysed so that the limits of attention apply only to 'awareness', memory and response. The physical characteristics of the messages must, however, be discriminated either before or by the filter, as they can be used as the basis of selection. The inputs might first be channelled functionally by the discrimination of physical features and then passed to a filter which discards some messages and admits others, or the filter might operate at an earlier stage by the selection of those physical features which will be discriminated. It is unlikely that two irrelevant messages that differ from each other only in localisation or quality of voice, as in Treisman (1964), would always be separately channelled in the brain, for this would not allow them to be discarded together when they had been distinguished from the relevant message.

Treisman suggests, then, that the selective blocking or attenuation is a separate process from the analysis onto different channels, and does not, as perhaps Broadbent's 'filter' implies, coincide with it. The discrimination of all classes of sounds at this analytic stage seems to be 'compulsory' and determined by the requirements of the task rather than optional. Treisman's results were interpreted in terms of Broadbent's filter' theory to suggest that there were three functional stages:

1 The discrimination of classes of signals, or different input channels, on the basis of general physical characteristics of the sounds, this stage (as in the previous paragraph) being apparently compulsory for all inputs, at least in the listening task.

2 The selective discarding or attenuation of signals from irrelevant channels by a filter which may become overloaded and inefficient when more than one speech channel is active.

3 The identification of words and meaning, carried out only for selected signals.

So far, however, limitation of information input has been been considered only in relation to dichotic listening experiments.

When two or more modalities are involved, the above model needs some modification in order to be useful for the study of attentional processes in bisensory activities, such as reading aloud, and activities often assumed to be bisensory, such as silent reading.

Senf (1969) conducted three experiments to assess memory and attentional differences between samples of retarded and adequate readers. He used an auditory-visual analogue of the dichotic-listening paradigm, presenting three pairs of simultaneous, discrepant items for free and directed recall. All Senf's subjects preferred to recall the digit items in two-modality sets, though adequate readers increasingly ordered items in auditory-visual pairs (with increasing age) when induced to do so. Retarded readers preferred the auditory modality, whilst normal showed no modality preference. With the retarded readers, improvements with age were limited to recall of visual stimuli. Senf postulated that retarded readers store information input to different modalities in distinctive forms so that it becomes less easily combined for recall, though it may possibly be well remembered independently.

In an earlier study, Senf et al. (1967) found that the effects of stimulus rate on recall order could be almost completely ameliorated by inducing different strategies in the subjects. The data suggests that the effect of the inter-pair interval found by Broadbent and others may only be a set effect and not therefore explicable by his 'mechanical' model. More recent data, however, suggest that both the inter-pair interval and the set of the subjects have an effect on recall order (Madsen et al. 1968). Accordingly, Senf (1969) posed three questions with regard to normal and retarded readers:

1 Does receptivity to instructional sets pertaining to attentional strategies develop with age?

2 Does receptivity to such sets fail to develop in children with learning disorders?

3 Do the children with learning disorders tend not to order stimuli into audio-visual pairs, rather favouring a modality ordering of stimuli?

Deficiency of audio-visual pairing is an underlying hypothesis of the VAKT (Visual, Auditory, Kinesthetic, Tactile) technique of remediation of reading difficulties. Assuming the breakdown of audio-visual pairing, Fernald (1943) suggested that the teacher should introduce another modality as a bridge between the two, requiring the child to trace the visual stimulus with his hand, thus providing a kinesthetic bridge. The learning-disordered child is supposed to have particular difficulty in translating from the auditory to the visual, and vice-versa, direct. Senf cites the above underlying hypothesis of the VAKT approach as occasioning his third question, though the present writer cannot see why retarded readers should find the interpolation of the kinesthetic and/or tactile modalities anything but LESS conducive to success IF the translation is the problem.

Senf (1969) found that the development of the ability to give pair-order responses only occurs in normal children, who increase this behaviour even under the penalty of increased errors and, apparently increased strain, whereas the children with reading difficulties recal information in modality groups at all ages. Two possible interpretations are suggested:

1 Failure to adopt the pair-order strategy may be linked to to a difficulty in switching attention rapidly from one modality to another.

2 There is a tendency to store information in modality categories, making pair-order more difficult, whatever the rate of stimulus presentation.

At this stage, Senf is slightly inclined towards the hypothesis that the retarded readers have difficulty in associating visual and auditory material. This would agree with Birch & Belmont (1964) who concluded that retarded readers were significantly less able to integrate auditory and visual tap-dot patterns than were normal readers, suggesting that defects in auditory-visual integration contribute to reading incompetence. Further work on this aspect, however, particularly that of Bryden (1972), indicates that the problem is not specific to auditory-visual integration but is a more general one involving the modalities separately, possibly involving verbal coding.

Senf (1969) also found that normal readers failed to show a strong auditory of visual preference, assuming that the two modality sets of stimuli were translated into a common internal representation. The preference of the retarded readers for auditory stimuli (by a 5 to 1 ratio) was given "the obvious explanation" that the retarded readers have conditioned avoidance responses to visual stimuli due to their constant failure with reading materials. The present writer does not find this at all plausible as (i) the visual stimuli used in Senf's Experiment 3 were pictorial, and there is no strong evidence to suggest that retarded readers are, or are likely to be, significantly awed by pictorial displays; indeed, the reverse is true in the writer's experience, for retarded readers will happily scan comics and picture books without attending to the print, and (ii) the emphasis which prevails in the teaching of reading in the 'reading age' range 5 to 9 years is strongly auditory, with much reading aloud with phonemic segmentation and clustering. It is also possible that Senf may have unwittingly given a set to the experimental activities in that they were conducted in a "learning institution" by someone who, probably having due deference accorded him by the class teachers, might be regarded as some kind of superordinate teacher himself.

A plausible explanation of the failure of retarded readers to make cross-modal matches (as in Birch & Belmont, 1964; Senf, 1969; and Bryden, 1972) was suggested by Blank & Bridger (1966) who argued that retarded readers had not developed an effective coding strategy for dealing with patterns, whilst good readers had. Although such a coding deficit may be present in retarded readers, however, it cannot be universal in them, for Bryden's (1972) two groups showed a high degree of overlap on a matching test which used three different modes of presentation, auditory, visual sequential, and dot patterns in the nine different ways in which pairs of the three patterns may be presented. Bryden also found that matching performance was only a good predictor of reading ability in poor readers; once a certain level of matching ability has been acquired, it no longer serves to predict reading performance. Bryden's study also provides some evidence to indicate that matching a sequential pattern with a spatial pattern is more difficult than matches that do not involve a temporal transformation. This is regardless of sensory modality, and is supported by Sterritt et al. (1971). If children tend to use similar coding strategies with both auditory and visual sequential patterns, and somewhat different strategies - perhaps dependent more on a purely visual code - with spatial patterns, then the differences between the various tasks becomes clearer. With sequential patterns, for example, coding is difficult and results in many errors, but since the same coding system is used for both auditory and visual patterns, a cross-modal task produces only a small decrement. A rather different coding system appears to be employed with spatial patterns, and matching a temporal with a spatial results in errors on tasks that involve such a transformation. The letters on the printed page may thus be seen by some readers as spatially rather than temporally patterned, which would lead to difficulty in translation to a temporal phonemic pattern where the task is reading aloud. Such readers would not necessarily have any difficulty in translation where the letters were presented singly.

There appears to be general agreement that the central processing system is of limited capacity and that at some point in the processing there is some kind of preference given to one message over others. There is dispute, however, over the level at which the selection occurs, Broadbent suggesting the peripheral and Treisman suggesting the central processing level. Deutsch & Deutsch (1963) suggested the high probability that "a message will reach the same perceptual and discriminateory mechanisms whether attention is paid to it or not." (p 83). Dichotic listening experiments are difficult to control, however, so that switching of attention to the 'unattended' message is possible, and insensitive measures such as recall and overt responses, detract from any indication that the unattended message is not processed.

In dichotic listening experiments, consequently, confusion arises over the use of 'attended' and 'unattended', which can refer to the instructional set intended by the experimenter or to the responses actually made by the subject ..... or both. This difficulty was resolved by Bryden (1972) by strict control of various intended instructional sets. Lewis (1970) also used the dichotic listening paradigm, presenting simultaneous pairs of words from three classes of relationship:-

associatively related

semantically related

unrelated

to the message words to which the subject was required to attend. The subjects were required to shadow the 'attended' words but also to repeat the words from the 'unattended' messages. Whilst no subject was able to report any word from the unattended message while maintaining errorless shadowing, the effects on the subjects' reaction times for shadowing responses were noted for the different classes of unattended message words. Lewis concluded that the unattended messages are processed at a semantic level, the results suggesting a sequence of processing of an unattended message whereby perceptual (semantic) analysis occurs followed by selection (e.g., filtering, attenuation etc.), then by storage or admission to awareness.

The possibility then arises of retarded, and for that matter 'normal', readers bringing a variety of perceptual sets to the reading act required by the teacher in the classroom. The dichotic listening paradigm, as used by Lewis, or an analogue, as in Senf, which permits messages to be presented in two modalities, would appear to offer scope for the study of such perceptual sets. However, the subject, rather than the experimenter, would need to control the perceptual set equivalent to the instructional set of the above studies. In Lewis's study, the unattended message was not filtered out at the peripheral level, but was processed at the semantic level even when the subject was unable to report it. An experimental design to study the perceptual sets brought by subjects to the classroom reading act would therefore need to omit direction by the experimenter as to precisely what should be attended to, whilst recording what the subject <u>does</u>, in fact, attend to.

There appears to be some limitation of the amount of information input which can be semantically processed or encoded. It was at first thought (Broadbent) that information was sifted only by a peripheral filter, but subsequent work in this field suggests that semantic processing or encoding CAN occur for a supposedly unattended message in dichotic listening experiments. The dichotic listening paradigm as used by Lewis, and its bisensory analogue as used by Senf, having proved useful in studying the levels of processing and attentional strategies or induced sets, it seems appropriate to use the paradigm or a variant of it to study the perceptual sets, <u>if any</u>, that children bring to reading tasks typical of their level of schooling. There is, then, also the possibility that some children bring no consistent perceptual set to their reading. In the next section, more complex information-processing models will be discussed as a basis for experimentation.

1.0.4. Information processing and reading.

Reading can be regarded as a very complex skill involving several stages of information which, in the fluent reader, are required to be completed in a very short time. If each stage of the process requires attention, the performance of the reading act would be impossible because the capacity of attention would be exceeded. Automatic processing of components of the reading process is therefore necessary in order to reduce the load on attention.

It is assumed in this study that all stimuli that have been learnt are processed upon presentation into a code or internal representation, regardless of where attention is directed. Thus, for example, the letters L. l or *ℓ*, regardless of differences in distinctive features, can be transformed intentionally into a behaviour that can act as a signal in a communication system. This intentional transformation can include the combination of letter codes l,o,g, into 'log' or even the transformation of the complete word: The words 'Ladies' and 'Gentlemen may be encoded wholistically, when presented on toilet doors, even by apparent non-readers. This is compatible with the Deutsch & Deutsch (1963) model.

LaBerge & Samuels (1974) propose further that attention can selectively activate codes at any level of the system, not only at deeper levels of meaning, but at the visual and auditory levels nearer the sensory surface. There is, however, a limitation in that only one code of any kind can be activated by a postulated attention centre at any given moment. On the other hand, a large number of codes can be simultaneously activated be external stimuli independent of attention. It is assumed, then, that attention can only be paid to one thing at a time, but that many things may be processed at one time provided that no more than one requires attention.

In reading, visual words are processed automatically through numerous stages to meaningfulness. The research of Sternberg (1969) and Clark & Chase (1972) suggests that these stages overlap in processing: If a skill is described as automatic, then the sub-skills and their interrelations must also be automatic.

Whether a skill can be described as automatic or not depends upon whether the processing can be completed when the attention is directed elsewhere. Attention apparently paid to two things at the same time would thus be merely a rapid shifting of attent-ion between tasks. In the laboratory, a cue may be presented just prior to the stimulus a subject is to identify, inducing a set for that particular stimulus. It is also possible to introduce an 'intruder' stimulus at random in order to observe its effect on the response salience, which would indicate either (a) that time for processing and attention switching was required, or (b) that it was not and was therefore automatically processed. Varying the nature of the 'intruder' stimulus presented alongside an activity requiring attention switching would then reveal something of the nature and level of the encoding performance.

For reading, the encoding is usually assumed to begin at the printed or written letters. The building block of the reading process is usually termed the 'grapheme', which has been defined as "One or more printed or written symbols used to represent a particular phoneme" (Chapman & Hoffman, 1977). At first sight, this definition appears to have few problems, even when a phoneme is rendered by a digraph such as 'sh'. Chapman & Hoffman, however, present "Wessex" as having the grapheme structure "W-e-ss-e-x-": Whether one regards the 'ss' in "Wessex" as one or two phonemes is either debatable or a matter of individual perception, as also is one's view of 'x' as one or two ('k' and 's') phonemes. In view of these problems and also because individual letters may have meaning unconnected with any corresponding phoneme, it is probably better to define a grapheme simply as a printed or written letter.

A model of automatic processing may be described on the assumption that written stimuli are transformed into meaning by a sequence of stages of information processing (Posner et al. 1972), the first stage of which is purely visual: "Learning the grapheme code assumes that the incoming information from the printed page is analysed by detectors specialised in two ways:-

(i) in processing features (lines, angles etc.),

(ii) in processing relations (left, right; up, down etc.).

(Rumelhart, 1970).

Gibson (1969) thinks that it is possible that relational aspects may be important in this kind of learning.

The application of such a model of automatic processing to the reading act would, however, necessitate greater complexity and flexibility, for it could not be held, except at the lowest level of 'primer' reading, that words were processed letter by letter. Spelling patterns, syllables, phrase patterns etc. must be accommodated, as also must the shift in encoding from visual to phonological units.

Estes (1972) suggests a hierarchical coding scheme, which has been developed by LaBerge & Samuels (1974) into a more elaborate model of automaticity in reading, accommodating a shift from visual (graphic) to phonological encoding at various levels. As reading must begin with the printed or written word, LaBerge & Samuels concentrate initially on a model of visual memory in which information flow is possible with or without attention. This part of the model is presented in Figure 4: Every circle (o, •) represents a visual code in long term memory (LTM), o indicating that the code can only be activated with the assistance of attention, ● indicating that the code can be activated without attention.

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Because they are not well learnt, only o codes attract attention. If an o code is activated by external stimulation when attention is elsewhere, attention will not be switched to it unless the stimulus is intense or unless the code automatically activates autonomic responses or other systems which mediate the importance (Deutsch & Deutsh, 1963) or 'pertinence' (Norman, 1968) of that code to the hypothetical attention centre, denoted by A in Fig.4. As the attention centre activates only one code, the model represents the limited capacity model of attention. A ● code may be so well learnt and the encoding so automatic that even when attention is required to be drawn to it by a specific task, a subject may experience great difficulty in attending. An amusing example is afforded by an 'intelligence' test published in the popular press:-

HOW INTELLIGENT ARE YOU?

Read the sentence in the box below:-

FINISHED FILES ARE THE RE- SULT OF YEARS OF SCIENTIF- IC STUDY COMBINED WITH THE EXPERIENCE OF MANY YEARS.

Count aloud the F's in the sentence in the box. Count them once. Do not go back.

Figure 5. Popular 'intelligence' test, illustrating the difficulty of paying attention to codes that are automatic in the mature reader.

The majority of fluent or mature readers identify only three of the six F's in the example in Fig. 5, the remaining three occurring in the word 'OF' which is one of the earliest words in the reader's history to be processed automatically. Failure to identify the six F's is obviously no measure of lack of intelligence; on the contrary, it may indicate semantic control of reading.

LaBerge & Samuels introduce the possibility of the formation of set, the activation of a code prior to the presentation of its corresponding stimulus being assumed to increase the rate of processing when that stimulus is presented. Activation of a code can also arouse other codes to which it has been associated.

In teaching a new letter to a child, the child is induced to organise the separate features into a unit. Thus the lines linking f_7 or f_8, in Fig.6, to ℓ_5 would eventually become as strong as those linking f_4 or f_5 to ℓ_2. Estes (1970) points out, however, that the acquisition of automaticity appears to be a very much slower process than paired-associate learning.

Reading is generally regarded as a bisensory activity which involves a relationship between the visual and phonological systems. Rubinstein et al. (1971) and Wicklund & Katz (1970) presented evidence that recognition of visually-presented words typically involves phonological recoding. The model in Figure 4 can thus be extended to accommodate both phonological recoding and a (phonological) response system:-

LaBerge & Samuels (1974) estimate that the role of the attention activator during fast reading is one in which no attention is given to the visual system, the highest visual unit available activating the phonological code. In slow reading, they suspect that attention is directed to the visual system where smaller units are given added activation, resulting in the activation of smaller phonological units. Once a visual word code makes contact with the phonological word code in reading, it is assumed that the meaning of the word can be elicited by means of a direct associative connection between the phonological unit, $p(w_1)$, and the semantic or meaning unit, $m(w_1)$, and events e_1 and e_2 in the episodic code c. The episodic memory is thought of as a store of the previous occurrences of a code, and a word would, with frequent association, elicit its meaning automatically. The generation of spoken or written responses by activation of semantic structures would also be capable of being automatic.

Assuming that reading is a bisensory act, particularly in the earlier stages of the acquisition of automaticity, the description of reading (aloud) behaviour in terms of speed or fluency and of accuracy of response can give rise to inference about the levels at which the shift from visual to phonological encoding takes place, that is to say, the coding mode (visual or phonological) and the level within the mode (e.g. single letter or spelling pattern) where information is largely being processed ONLY with attention. The stage of the model presented in Figure 6 allows a response to be made (reading aloud) without necessarily activating the 'higher' semantic codes. Presumably, an alternative response mode would be writing or copying, rather than reading aloud, though this might not be widely accepted as constituting reading. So far, the LaBerge & Samuels model can accommodate a range of reading behaviour from 'barking at print' to reading words with understanding.

There is, however, the possibility, raised by Goodman (1967), Bower (1970) and Kolers (1970) that a visual word code may be directly associated with a semantic or meaning code so that a unit, $v(w_1)$, activates its meaning, $m(w_1)$, without mediation through the phonological system.

For a general model of automaticity in reading, a given route is defined not only in terms of the particular systemic code encountered along the way but also in terms of whether or not attention adds its activation to any of these codes. LaBerge & Samuels (1974) list five optional processing routes:-

OPTION 1. The graphemic stimulus is automatically encoded into a visual word code $v(w_1)$, which automatically activates the meaning code $m(w_1)$.

OPTION 2. The graphemic stimulus is automatically encoded into a visual word code, which automatically activates the phonological word code, $p(w_2)$. This code automatically excites the meaning code $m(w_2)$.

OPTION 3. The graphemic stimulus is automatically coded into two spelling patterns, sp_4 and sp_5, which activate the phonological codes, $p(sp_4)$ and $p(sp_5)$. These two codes are blended, with attention, into the phonological word code, $p(w_4)$ which activates, with attention, the episodic code c_1. This code, in turn, is activated, with attention, to excite the meaning code $m(w_4)$. The word 'skylab' might be processed in this way by an 'apprentice' reader.

OPTION 4. The graphemic stimulus is automatically encoded into the visual word-group code $v(wg_1)$, which automatically activates the phonological word-group code $p(wg_1)$, which in turn activates automatically the meaning code of the word group $m(wg_1)$.

OPTION 5. The graphemic stimulus is coded with attention into the visual word code $v(w_5)$. Attention activates this code to excite the episodic code c_2. When attention is shifted to c_2, it generates the meaning code $m(w_5)$."

Fluent reading may be held to be in accordance with options 1 and 2, the reader maintaining attention continuously on the meaning units of semantic memory, the decoding from visual to semantic systems proceeding automatically. Options 3 to 5 indicate other ways of processing a given word or group of words. When the reader encounters a word he does not understand, attention may be shifted to the visual level in an attempt to associate spelling patterns with phonological units. Fluent reading is thus characterised by lack of attention to decoding processes other than the semantic.

According to the model, reorganisation into larger units requires attention initially, but, unfortunately, we do not know specifically how to train a child to organise codes into higher units. The organisation into higher units would presumably not take place if attention were not focussed at the meaning level, but processing could continue through codes that are already laid down and are automatic.

A critical factor in forming higher units may be the number of word meanings that can be comprehended in one chunk in the semantic memory. Units at the semantic level may determine the chunk size at phonological level which, in turn, may influence attention to visual codes. The implication of this for teaching is that the progression should be from deeper levels to sensory levels, rather than the reverse.

The apprentice reader, in attempting to reorganise word codes into higher codes, may temporarily slow down and may make more errors. To encourage chunking, it may be wise not to demand accuracy, for, as suggested by Archwamety & Samuels (1973), the development of word recognition and understanding strategies may be inhibited because of success at lower levels or organisation. If the apprentice reader is focussing attention on the decoding of visual words into their phonological form, without comprehension, the words could be spoken aloud without comprehension, a feature often noted amongst beginner readers. Conversely, if the apprentice writer were focussing attention on the decoding of phonological words into their visual form, without comprehension, the words could be spelt correctly even though oral reading might be relatively deficient, circumstance investigated by Carbonell de Grampone (1974).

So far, admittedly, this discussion treats words as the units of meaning. This is no accident. Whilst linguists may differentiate morphemes as unitary, and may even postulate higher order units or sememes, the word is more generally perceived as a unit of meaning than either of them, possibly because inter-word boundaries are highly consistent regardless of whether words are written, printed or spoken. It will be shown in Part 2 that syllable boundaries do not always coincide with morpheme boundaries within words. We are reminded of G. A. Miller's admonition "that not all physical features of speech are significant and not all significant features are physical." (Miller, 1965.) Where syllable boundaries do not coincide with morpheme boundaries, as in the word "corporation" (which can be segmented into syllables - 'cor/por/a/tion' - or into morphemes - 'corp/or/at/ion'), the recoding of (graphic) letter clusters into phoneme clusters or syllables would necessarily inhibit or preclude the clustering into morphemes, which would mean that, for long and problematic words, recoding at the meaning or semantic level could not take place until the phonological encoding at the complete word level had been accomplished. Subject to comments on the differences between the Teutonic and Latinate modes of lexication in the English Language, to be found in Part 2, it is held that the word can be claimed to have some special status as a unit of meaning.

1.0.5. SUMMARY.

Perceptual learning may be regarded as abstractive, and the imposition of invariants upon the welter of available stimulation at the sensory surface. Children may attempt to recognize previously unknown stimuli by Model-Matching or by Feature-Testing, the latter strategy being found to be intrinsically superior in early reading (Pick, 1965). The distinctive features are relational and may be hierarchically organised, which implies prior planning. Following Hull (1920), the salience of a relation may be made by enhancing a feature contrast or by giving a neat example.

There are, however, differences between the processing of graphic displays and speech. Picture-processing tends to be of immediate semantic expectation whilst the semantic expectation from speech is sequential and cumulative. Further, picture-processing dominance may interfere with symbolic verbal activities, even on graphic materials (Farnham-Diggory, 1972). Verbal mediation, however, is widely held to be synonymous with speech- or phonological-mediation; the connection may not be a necessary one.

There appear to be limits to the individual's capacity for taking in information, and this has led to the postulation of a filter to exclude insignificant information, the criteria for ascribing significance being under central control. Treisman (1964) showed that a subject cannot take in two messages in the same modality, and concluded that the selective blocking is a separate process from the analysis of information onto different channels. Subject to no physiological impairment of sensory function, a message may be held to reach the same perceptual mechanism whether attention is paid to it or not (Deutsch & Deutsch, 1963), and the rigid analysis onto separate (modality) channels may in itself be a handicap (Senf, 1969).

The operation of a filter appears to be task-specific and may be thought of as a perceptual set. An analogue of the dichotic-listening paradigm offers the opportunity to investigate what is attended to, and what is not, in reading (Senf, 1969; Lewis, 1970). As attention can be paid only to one process or level of processing at a time, it is necessary to achieve automaticity in processing at lower levels of encoding, visual and phonological, in order to proceed to higher (semantic) levels with efficiency (LaBerge & Samuels, 1974). Reorganisation into higher units requires attention initially. The difference between 'apprentice' and fluent or mature reading may thus be described in terms of the level of automaticity achieved, and also by the speed and efficiency of semantic encoding afforded by the choice of optional coding path or route (Goodman, 1967; LaBerge & Samuels, 1970).

For the 'apprentice' reader in the school environment, the choice of coding path would appear to be dictated by the instructional set of the teaching regime, which can be assumed, whether it be 'Phonic 1', 'Phonic 2', 'Mixed' or 'Look-and-Say' (Bullock Report), to correspond to LaBerge & Samuels' Options 2, 3 and 4. The assumption that reading, at whatever level, necessarily involves mediatory phonological encoding is widespread, but is challenged by Goodman (1969) as justifiable in describing the reading behaviour of the mature and fluent reader. Further, the notion of successful reading at higher levels does not entail the oral recoding (reading aloud) required by the 'apprentice' reading regime nor does it entail the strict correspondence of the visuo-graphic and (decoded) phonological codes.(Lewis, 1970).

Recent developments in Information Processing Theory, then, particularly the model of LaBerge & Samuels (1972) appear to offer a useful description of many of the complexities of the reading process and of the importance to it of:

a. visual, phonological and semantic coding processes and their possible interrelationships.

b. the importance of attention in relation to levels of processing.

c. the possibility of central, as opposed to peripheral, control of coding path and level by a postulated 'attention centre'.

The deficiency of the model perhaps lies in the absence of an account of the choice of the optional paths through the information processing system. A possible line of enquiry towards rectifying such an omission appears to be that of 'modal preference', a construct arising from the writer's previous study.

1.1.0. Aim of the Investigation.

The aim of this investigation is to refine the 'modal preference' construct and, using an analogue of the dichotic-listening paradigm, to study its relationship to information processing in the context of 'apprentice' reading with a view to improving pedagogical procedures designed to promote reading skills in those children who 'suffer' from 'specific reading difficulty'.

1.1.1. Specific Reading Difficulty.

The terms 'retardation' and 'underachievement' are widely applied to reading difficulties. The criterion for such classification usually involves comparison of individual performance or attainment on word recognition tests, usually with oral response, with national norms of attainment on those tests. Such word recognition tests are, even now, very widely used in primary schools (Jackson, 1974), mainly because of the ease with which they can be applied and the 'reading age' computed. The Schonell Graded Word Reading Test R1 appears to be the most popular; others widely used are the Burt, Vernon and Holborn. There is a list of comprehension questions for the Holborn, but the norms are only available for mechanical reading. The Schonell test featured in the 1965 N.F.E.R. inquiry into reading standards (Morris, 1966). In the tests mentioned, attention is directed solely to the mechanical or speech decoding aspect of reading.

Although the mechanical aspect of reading does not correlate highly with mental ability as measured by verbal intelligence tests, any disparity between mental ability and the ability to process printed or written material is likely to be worrying to a child in school, particularly if the computed Mental Age is significantly above the (mechanical) Reading Age. For this reason, the term "specific reading difficulty" has been used and loosely defined by the Tizard Report (Great Britain, 1972) to describe "the problems of the small group of children whose reading (and perhaps writing, spelling and number) abilities are significantly below that which their abilities in other spheres would lead one to expect". The labelling of such children, it should be recognized, must be an arbitrary matter, for their scores on measures of their abilities tend to conform to the normal distribution. In practice, the classification of such children depends more upon the parents' and/or teachers' perception of the disparity between oral language ability and attainment in the written or printed language. The term "specific reading difficulty" (SRD) is useful to the investigator in that it allows consideration of the problem of children whose attainment in mechanical reading is significantly below their ability to comprehend and use the spoken language, whereas the concept of "retardation" as used by Morris (1966) and others does not. Morris defined intelligence solely in terms of non-verbal test scores in order to avoid dependence on the ability to read.

1.1.2. Information Processing and Reading.

Information Processing Theory appears to provide a useful description of the various possible levels and classes of coding activity that can be regarded as the subskills of reading, and it can, with refinement, accommodate a description of deficiency and proficiency in encoding and recoding the written language.

Although LaBerge & Samuels (1974) list optional paths through the visual and phonological sectors of information processing relevant to the reading process, no account is forthcoming of the "importance" (Deutsch & Deutsch, 1963) or the "pertinence" (Norman, 1968) of a particular channel of mediation of a particular code to the attention centre, and thus no criterion is available for the choice of LaBerge & Samuels Option 1 or Option 2, though it should be possible from the responses, if any be required, to estimate the level of coding achieved.

The writer's previous (minor) study suggested the occurrence of a 'set' or mediational channelling, possibly of a peripheral nature akin to that postulated by Broadbent (1965) or to that of Hernandez-Peon et al. (1957) who found that when an animal attends to a given stimulus, input to other sensory modalities is filtered out or attenuated. Thompson & Shaw (1965) found, in cats, that when a stimulus was presented there was a depression of ALL modalities of stimulation accompanied by an increase in ongoing single neuron activity. It was as if the neurons were processing information of significance and were not available to process other stimuli. This suggested a central mode of action.

The study sample for this investigation is taken from a population which is likely to exhibit reading problems, i.e. coming from Social Priority Area schools, but is characterised by having no significant problem with information processing where

(a) only the phonological encoding path is used - that is, in the aural-oral mode - and

(b) only the visual or graphic encoding path is used.

The basis for this assumption will be discussed later in the description of the sample. Subject to these assumptions, it may be hypothesised that, for those children classed as having "specific reading difficulty" (SRD), that the problem must lie in the flow of information through the dual-coding process path.

According to the model of automatic information processing in reading presented earlier, readers would be judged to be 'mature' if attention were generally directed to the semantic encoding stage whilst processing at preceding stages was automatic.

Thus an 'apprentice' reader would be characterised by much slower processing of the printed word and also by lack of automaticity at one or both of the mediational encoding stages, the visuo-graphic or the auditory-phonological. It may thus be hypothesised that:

H_1 If a reader is attending predominantly to ONE of the two modality-bound encoding stages of three-stage information-processing, then he will be (a) an underachieving reader, (b) a slow reader.

Again assuming the three-stage model, the precise order of the encoding stages would appear to be very significant. An adequate level of automaticity acquired, perhaps previous to instruction in reading, at the auditory-phonological stage might prove critical if not supported by adequate automaticity at the visuo-graphic stage. At first sight it would appear that the achievement of an adequate level of automaticity at the visuo-graphic stage without a commensurate level of automaticity at the auditory-phonological stage would present little problem. The remedy would lie in the encouragement of 'cross-modal matches'; the overteaching of the 'Phonic 1' or 'Phonic 2' skills of the Bullock Report. In a previous minor study, the present writer postulates that in a task involving two or more stages of encoding mediational to semantic encoding, the successful achievement of semantic encoding would be inhibited by a preference or set for one mode of encoding as opposed to another. The effect of such a set for visuo-graphic encoding would be, according to the LaBerge & Samuels model, that attention would tend to be maintained at the grapheme (letter) or grapheme cluster (spelling pattern or word) level of processing before it could be switched, grapheme by grapheme or cluster by cluster, to the auditory-phonological encoding stage. The visual processing preferent reader would presumably be attending to the identification or recognition of letters and letter clusters by reference to visual episodic memory (LaBerge & Samuels, q.v.) before attempting to encode the complete word at the auditory-phonological stage, where there would be reversion to individual phoneme-grapheme correspondence before reference should be made to auditory-phonological episodic memory. Such a reader would tend towards accuracy of word recognition, but would be very slow. The very slowness of the process could inhibit consequent semantic encoding and thereby affect comprehension. To explore the relationship between fluency of reading and preference for visuo-graphic encoding, a further hypothesis, subordinate to H_1, may be generated:-

H_2 If an underachieving reader is predominantly attending to the visuo-graphic stage of encoding, then he will exhibit depressed fluency of reading relative to mechanical accuracy of reading.

Attention given by the underachieving reader predominantly to the auditory-phonological stage would also be problematic, according to the model. The sequence of encoding stages is, assuming the three-stage model implicit in the instructional set of 'apprentice' reading,

Visuo-graphic --> Auditory-phonological --> Semantic.

Not only would semantic processing be inhibited, but, if automaticity had not been achieved at the preceding visuo-graphic stage or there were any reluctance to switch attention to the visuo-graphic encoding stage momentarily as required, attention given to the auditory-phonological stage would tend to result in inaccuracy in word recognition. Reference would be made to auditory-phonological episodic memory (LaBerge & Samuels) on the basis of scant and inadequate visuo-graphic cues. Given that the reader has adequate proficiency in the oral (unimodal) language, the fluency of reading aloud would not tend to be depressed by this strategy, but would tend to be achieved at the expense of accuracy or word recognition. A further hypothesis, subordinate to H_1, may thus be generated:-

H_3 If an underachieving reader predominantly attends to the auditory-phonological stage of encoding, then he will exhibit depressed mechanical accuracy relative to fluency of reading aloud.

The goal of reading behaviour is assumed to be semantic encoding, and in the conventional prose reading test attention would be directed to this stage of processing by the instructional set:

".... At the end, I shall ask you some questions, so try to remember the story as you read it." (Neale, 1966, page 18.)

The conventional prose reading test, such as the Neale, emphasizes the three aspects of reading behaviour:

1. Accuracy of auditory-phonological (second-stage) encoding;
2. Fluency or speed of auditory-phonological (second-stage) decoding; and
3. Semantic encoding.

The last aspect, above, thus yields the most important criterion of reading ability, the others being useful criteria for the differentiation of reading styles and also for performance of tasks such as compositing (in the printing industry) whose requisite skills overlap with those of reading.

The technique used in this study is interference, and two measures of the effects of (modality) interference on reading are used, comprehension or the adequacy of semantic encoding, and fluency or the rate of processing. If a reader is attending to one of the mediational stages of encoding, then it may be predicted that interference with that particular stage of processing will affect both the rate of processing or fluency, and comprehension or semantic processing. As a check on the internal consistency of the modal preference construct, a further hypothesis may be generated to explore the relationship between the two measures:-

H_4 Under conditions of (auditory-phonological OR visuo-graphic) interference during reading, a reader who exhibits depressed comprehension will also exhibit depressed fluency of reading.

MacFarlane Smith (1964) and others have drawn attention to the relationship between spatial ability and early or 'apprentice' reading. It would appear that there is a higher incidence of reading difficulty in those 'apprentice' readers who show higher spatial ability than verbal ability. Moseley (1974) has developed a spatial test restricted to those visuo-graphic skills that are likely to be connected with early reading. Opinion seems to vary as to the significance of (high) visuo-spatial skills or ability in early reading, whether they are an asset or a handicap. However, according to the model of automaticity in reading, it would not appear to matter if the 'apprentice' reader had a high or low level of visuo-spatial ability, subject to his having no great impairment of visual acuity which would prevent the differentiation of sufficient of the distinctive features of the printed stimulus array. It is accordingly postulated that, for under-achieving readers, it is not the degree of unimodal or unisensory encoding ability brought to the task of reading, but the direction of attention where there are two, or perhaps more, successive encoding stages mediational to the semantic encoding stage. It would not, therefore, be expected that there would be any significant relationship between visuo-spatial ability, even of a kind involving visuo-graphic encoding akin to that required for letter recognition and differentiation, and the direction of attention to the visuo-graphic encoding stage. To explore this relationship, a further hypothesis may be generated:-

H_5 If an underachieving reader exhibits a set or preference for visuo-graphic encoding during reading, then he will not exhibit enhanced visuo-graphic encoding ability in a unimodal or unisensory task.

As stated above, the technique to be used in this experiment is interference. Senf (1969) found that retarded readers preferred to recall simultaneous discrepant items in two-modality sets, particularly preferring the auditory modality, whilst the adequate readers increasingly ordered items by (cross-modality) pairing. Senf was, however, using discrepant items. In this experiment, the reader, whilst reading a piece of continuous prose, is subjected to interference from material of possible meaningfulness. The interference is presented separately in the audit - ory-phonological and the visuo-graphic modalities, the degree and direction of the interference effect being held to indicate the the preference for auditory-phonological or for visuo-graphic encoding as mediational to semantic encoding in three-stage reading. In a previous minor study, for ease of administration, the present writer used the modality of immediate recall of 2-digit clusters as the criterion of modality encoding preference. In his audio-visual analogue of the dichotic listening paradigm, Senf (1969) also used digits. The processing of digits, however cannot be assumed to be identical with the processing of printed verbal material, nor can it be assumed that it conforms to the three-stage sequence of the instructional set of 'apprentice' reading. In this experiment, the reading passages and the material chosen for the (possible) interference condition have been chosen for their similarity to materials used in classroom learning, and the experiment conducted in the school environment.

1.1.3. Operationalising the Hypotheses.

Hypothesis H_1 comprises two hypotheses which may be labelled H_{1a} and H_{1b} for the purposes of investigation. They may be operationalised thus:-

H_{1a} If a subject, whilst being subjected to a reading task comprising the three sub-tests of a stage of a standardised prose reading test, exhibits depressed comprehension as measured by the salience of intrusions from materials of possible meaningfulness presented for (possible) unisensory encoding, then he will be an underachieving reader as measured by a depressed reading (aloud) accuracy quotient relative to reading comprehension quotient obtained from the application of a parallel form of the above standardised reading test.

H_{1b} If a subject, whilst being subjected to a reading task comprising the three sub-tests of a stage of a standardised prose reading test, exhibits depressed fluency in reading aloud in a condition of possible interference from material of possible meaningfulness presented for possible interference in one (unisensory) modality as opposed to the other, then he will be a slow reader as measured by a reading rate or fluency quotient obtained from the application of a standardised prose reading test.

The remaining hypotheses may be operationalised thus:

H_2 If a subject is predominantly attending to the visuo-graphic aspects of a prose passage from a standardised reading test, as measured by the salience of intrusions of possible meaningfulness from visuo-graphic interference material, then he will exhibit depressed fluency of reading relative to mechanical accuracy of reading (aloud) as measured by quotients obtained from the application of a standardised prose reading test.

H_3 If a subject is predominantly attending to the auditory-phonological aspects of a prose passage from a standardised reading test, as measured by the salience of intrusions of possible meaningfulness from auditory-phonological interference material, then he will exhibit depressed accuracy of reading (aloud) as measured by quotients obtained from the application of a standardised prose reading test.

H_4 A subject who exhibits preference for one of two possible modalities of mediational encoding as indicated by the salience of intrusions into responses to comprehension questions from one as opposed to the other modality of presentation of interference respectively, will exhibit depressed fluency or rate of reading aloud, in words per minute, in that modality of presentation of interference as opposed to the other, under the same conditions of interference.

H_5 A subject who exhibits a preference for visuo-graphic encoding as measured by the salience of intrusions into responses to comprehension questions from interference material presented in the visuo-graphic mode as opposed to responses from (possible) interference material presented in the auditory-phonological mode, will not exhibit superior unisensory or unimodal visuo-graphic encoding ability as indicated by quotient of more than 100 obtained from the application of a standardised test of (unisensory) visuo-graphic ability.

1.1.4. Statistical Hypotheses.

As in the previous section, Hypothesis H_1 must be regarded as comprising two independent hypotheses H_{1a} and H_{1b}. It is thus possible to compare, for H_{1a}, the deviation of the values for the comprehension component of modality preference in general, which may be summarised as GMPC and is irrespective of the specific modality, with the deviation of the values obtained from comparison of Neale Comprehension quotients (NC) with correlated Neale Accuracy quotients (NA), the derived variable being summarised as $\frac{NC}{NA}$ or NC ÷ NA. The relationship between GMPC and $\frac{NC}{NA}$ may be investigated by testing the null hypothesis:-

For H_{1a}: $R\ (GMPC/\frac{NC}{NA}) = 0$

Hypothesis compares the salience of the rate or fluency component of modality preference in general, which may be summarised as GMPR and is irrespective of the specific modality, with the Neale reading rate quotients, NR. The relationship between GMPR and NR may be investigated by testing the null hypothesis:-

For H_{1b}: $R\ (GMPR/NR) = 0$

For the purpose of investigating a possible relationship, the salience of the effects of visuo-graphic and auditory-phonological interference may be combined in a single continuous scale for the comprehension effect, AVMPC, and for the rate depression effect, AVMPR, so that values greater than 100 indicate the salience of visuo-graphic interference and values less than 100 indicate the salience of auditory-phonolocail interference. For hypotheses H_2 and H_3, the composition of the derived variable $\frac{NR}{NA}$ which compares accuracy of reading (NA) and rate of reading aloud (NR) is the same, subject to converting the direction of the comparison.

The relationships to be investigated by hypotheses H_2 and H_3 may thus be investigated by one statistical hypothesis:-

For H_2 and H_3: $R\ (AVMPC/\frac{NR}{NA}) = 0$

The effects of visuo-graphic and auditory-phonological interference having been reduced to a single continuous scale of values, Hypothesis H_4 simply predicts a relationship between the comprehension and rate depression components, AVMPC and AVMPR. The possibility of a relationship may be investigated by the statistical hypothesis:

For H_4: $R\ (AVMPC/AVMPR) = 0$

The degree of preference for visuo-graphic encoding being indicated by the AVMPC scalar values, it is possible to investigate the relationship of AVMPC to quotients obtained on the PoP test of visuo-spatial ability by means of the null hypothesis:-

For H_5: $R\ (AVMPC/PoP) = 0$

The acceptance of the null hypothesis, in this case, would entail the acceptance of H_5 rather than its rejection.

<u>Summary of Statistical Hypotheses.</u>

(H_{1a}) $R\ (GMPC/\frac{NC}{NA}) = 0$

(H_{1b}) $R\ (GMPR/NR) = 0$

$(H_2 + H_3)$ $R\ (AVMPC/\frac{NR}{NA}) = 0$

(H_4) $R\ (AVMPC/AVMPR) = 0$

(H_5) $R\ (AVMPC/PoP) = 0$

....

1.2.0. Design of the Experiment.

For discussion of the complex relationships amongst a number of variables, the two-treatment group design is inadequate. For this purpose, it is necessary to go beyond the critical ratio or t-test to the related analysis-of-variance statistics. By transforming all scores to continuous scalar values, as described in the succeeding section, it is possible to compare the mean and the variance by means of a coefficient of correlation. The design of the experiment is a function of its two-fold purpose:

1. The refinement and validation of the measure of general and specific modal preference by comparison with other variables.
2. The exploration of the relationship between the general and specific modal preference variables and 'established' reading ability variables.

from which it is proposed to suggest improvement of reading instruction.

It is proposed to use a factorial design which allows post hoc consideration of relationships with other variables, such as chronological age (Campbell & Stanley, 1963), the detailed knowledge of interactions being relevant to the external validity problem. The design to be used is a correlation matrix design which indicates the degrees and significance of possible interaction by means of a Product Moment Correlation Coefficient (Pearson r). The Pearson r is computed by the method of difference between each subject's scores on two variables (Downie & Heath, 1970, p 95), and indicates the degree of correlation between the two sets of scores and also the direction of the relationship. The significance of the relationship is computed according to the degrees of freedom, n-2.

1.3.0. Variables Involved in the Experiment.

This section describes the variables and derived variables involved in the experiment, and also considers those variables whose control affects validity.

1.3.1. Auditory-Visual Modal Preference, AVMP.

The AVMP construct was derived from a previous study in which 2-digit numbers were presented simultaneously, aurally and visually, the chosen modality of immediate recall and the simple reaction time being held to indicate the degree of suggested modal preference. A significant correlation was found between the salience of visual-mode preference and underachievement. However, it was appreciated that digits may not be processed in the same way as letters and letter clusters, and also that the construct needed some refinement for application to the study of the 'reading act' in the context of the 'apprentice' reader and the classroom.
In effect, the writer's previous minor study used interference or distractors which might or might not be perceived as meaningful by the subject, and this principle was retained for the present study.

The three alternative forms of the Neale Analysis of Reading each offered a series of six passages graded in difficulty (see Appendix 1) with exceptionally high inter-form correlations in the reliability study (Neale, 1966, pp 13-14). Two passages, the second and the third of the series of six, were selected on the basis of widest application to the earlier stages of reading intruction, or 'apprentice' reading. These two passages for Form A were presented as part of the reading test given to all the children in the sample.

The parallel alternative forms of the Neale Analysis of Reading are labelled A, B and C, and the selected prose passages were relabelled 1 and 2. Thus A1 and A2 were used as part of the normal application of Form A as a reading test, B1 and B2 were used as prose passages read under the condition of possible visuo-graphic interference, and C1 and C2 were used as prose passages read under the condition of possible auditory-phonological interference.

Visuo-Graphic Interference:

Passages B1 and B2, see Appendix 1, were modified in the following way:-

Cartoon-type pictures, similar in size to those in children's comics, were inserted in the text (see Figure 7). The pictures

were designed to appear relevant to the content of the reading particularly at the onset of reading, after which there were 'semantic departures' (again see Fig. 7).

The same treatment was applied to prose passage B2:-

The fluency or rate of reading aloud was measured in words per minute:-

$$\text{RATE} = \frac{\text{Number of words in passage}}{\text{Time in secs. to read}} \times 60.$$

In addition to the measurement of the possible effect of interference upon rate of reading, the effect of interference was also measured by recording the semantic intrusions into the answers to comprehension questions. The comprehension questions used were those of the standardised reading test, and are presented in Figs. 9, and 10. There were eight comprehension questions after each passage; The questions were put orally and oral responses were required. Question and response were therefore assumed to involve a single modality.

QUESTION.		CORRECT RESPONSE.
1	What were John and Ann doing at the lake?	Fishing.
2	What noise did they hear?	A splash.
3	What had happened?	A woodman had fallen into the lake.
4	Why could the man not swim ashore?	He was hurt.
5	What did the children try to do?	To pull him out.
6	Why were they unable to pull him ashore?	He was too heavy.
7	How did John help the man?	He held the man's head above water.
8	How did Ann help?	She ran for help.

Figure 9. Comprehension Questions and Answers to accompany reading passage B1.

QUESTION.		CORRECT RESPONSE.
1	What was the Swiss puppet watching in the beginning of the story?	The children (fixing) arranging the theatre.
2	Why did he feel useless?	He was not chosen often for the plays.
3	Why was the Swiss puppet not chosen often for the plays?	Because he had unusual (different) clothes.
4	What kind of hero did the boy want for the new play?	Someone brave.
5	What kind of work would the hero have to do in the play?	Rescue someone on a mountain?
6	What did all the puppets hope?	Each puppet hoped to be chosen as the hero.
7	How do you know that every-everyone was pleased with the hero that was chosen?	They cheered.
8	How did the Swiss puppet feel when he was chosen?	Happy. Shy. Pleased.

Figure 10. Comprehension Questions and Answers to accompany reading passage B2.

Auditory-Phonological Interference.

Prose passages C1 and C2 were presented for reading aloud in the normal way, except for the omission of the original clue picture which precedes each Neale passage. The auditory-phonological material for possible interference was designed to include semantic departures from the printed material. It comprised a tape-recorded version of similar length, level of vocabulary and syntactic complexity to that of the original Neale passage. The recording was played back at a fixed amplitude and paced to the delivery (of the oral reading) of each subject by means of a pause button with the locking device inactivated. The pacing was conducted by an assistant.

Reading Passage.	Interference Passage.
Tom stopped on his way to school. The milkman's horse had wandered in the fog. The horse and cart blocked the centre of the road. Traffic was coming. There was no time to call the milkman. Quickly Tom led the horse to safety just as the frightened milkman returned. (49 words).	Tom ran all the way to school. He saw a dog chasing the milkman's horse. It was raining hard. The horse was right down the road, so Tom went to call a policeman. The milkman came back just in time to catch the horse. He was pleased that his horse had not done any damage. (55 words).

Figure 11. Prose reading passage C1 and the text of passage for auditory-phonological interference.

The material for auditory-phonological interference was recorded by an adult male in order to contrast sufficiently with the feedback to the child subject from his/her own voice.

Reading Passage.	Interference Passage.
The lions' final act was in progress. Jack stood waiting to clear the ring. Tonight the thunder outside the circus tent made the lions restless. Suddenly Tess, the lion trainer, stumbled. Her whip fell. The youngest lion sprang towards her. Swiftly Jack leaped inside the cage, cracking the whip with great skill. His prompt action enabled Tess to regain control quickly. During that brief adventure, however, Jack had decided upon his future work. (74 words).	The lions were in the ring for the first act at the circus. Jack was waiting to enter the ring for the very first time. He accidentally made a great noise and disturbed the lions. Jack went into the ring and lost his whip. Tess shouted for help. Jack got out of the ring as fast as he could. He thought that he would like a better and safer job outside the circus. (73 words).

Figure 12. Prose reading passage C2 and the text of the auditory-phonological interference passage.

The amplitude of the tape-recorder output was adjusted in trial runs to approximate to the amplitude of the vocal delivery of a male teacher reading aloud in the classroom, and was then kept constant throughout the experiment. The amplitude peaked at 8 millivolts into 1 ohm through the integral loudspeaker of a

Philips 2202 Tape Recorder.

As with the reading of the B1 and B2 passages under the condition of possible visuo-graphic interference, the fluency or rate of reading aloud was measured in words per minute:-

$$\text{RATE} = \frac{\text{Number of words in passage}}{\text{Time in secs. to read}} \times 60.$$

In addition to the measurement of the possible effect of interference upon rate of reading, the effect of interference was also measured by recording the semantic intrusions into the answers to comprehension questions. As before, the comprehension questions used were those of the standardised reading test, and are presented in Figs. 13 and 14, together with answers and possible intrusions from the tape-recorded material.

Question.	Answer.	Intrusion.
1 Where was Tom going?	To school.	
2 What did he see on the way?	Horse and cart blocking road.	Dog chasing horse.
3 What had happened to the horse?	It had strayed into the middle of the road.	It was right down the road.
4 What was the weather like?	Foggy.	Raining.
5 Why was it dangerous for the horse and cart to stay there?	Traffic (a car) was coming.	
6 Why didn't Tom call the milkman?	There was no time.	
7 What did Tom do?	Led the horse to safety.	Went to fetch a policeman.
8 How did the milkman feel as he came running back?	Afraid, Frightened. Worried.	Pleased.

Figure 13. Comprehension Questions and Answers to accompany reading passage C1.

Question.	Answer.	Intrusion.
1 Where did this story take place?	Circus. Tent.	
2 Were the lions near the beginning, near the middle or near the end of their act?	End.	Beginning.
3 What was Jack waiting to do?	Clear the ring.	Enter the ring for the act.
4 Why were the lions restless?	Because of the thunder.	Jack made a loud noise.
5 What happened to Tess?	Stumbled. Lost whip. Lion jumped at her.	Shouted for help.
6 What did Jack do?	Cracked whip. Saved Tess. Drove lions back.	Got out of the ring.
7 Who finished the act?	Tess.	Jack.
8 What did Jack decide after this adventure?	That he would be a lion-tamer. Future work - (requires expl.)	That he would quit the circus for a safer job.

Figure 14. Comprehension Questions and Answers to accompany reading passage C2,

There were eight comprehension questions after each passage; the questions were put orally and oral responses were required. Question and response were therefore assumed to involve a single modality.

The Auditory-Visual Modal Preference (Rate) Variable, AVMPR.

Scalar values for the AVMPR variable were obtained by comparing the saliences of response (measured in words per minute) under both conditions of possible interference. The difference was then computed and subtracted from 100 if auditory-phonological interference lowered the reading rate. The difference was added to 100 if visuo-graphic interference lowered the reading rate. It was thus possible to obtain a continuous variable.

The Auditory-Visual Preference (Comprehension) Variable, AVMPC.

Scalar values were obtained for the AVMPC variable by comparing the saliences of intrusions from the interference material into the answers to the comprehension questions under both conditions. The difference in salience of intrusion response was computed and added to 5 if visuo-graphic interference accounted for the intrusions, and subtracted from 5 if auditory-phonological interference accounted for the intrusions. It was thus possible to obtain a continuous variable.

The General Modal Preference (Rate) Variable, GMPR.

Values for this variable were not required to reflect the particlar modality in which the reading rate was lowered, merely the salience of general preference or distractibility. The differences were computed, as above, for AVMPR, and were all regarded as positive integers. This was done by merely recording the salience of the depression of reading rate, irrespective of modality of origin.

The General Modal Preference (Comprehension) Variable, GMPC.

Values for this variable were not required to reflect the particular modality in which the interference material intruded into the answers to comprehension questions. The differences were computed as above for AVMPC, and were all regarded as positive integers.

1.3.2. Measurement of Reading Ability.

Most of the assessment of reading ability conducted in schools has involved the use of tests of word recognition such as those of Schonell (Schonell, 1950) and Burt (The Burt (Rearranged) Word Reading Test). These tests are quick and simple to administer by unskilled testers, and also offer the further attraction in that they are standardised, age norms being available for the comparison of attainment. Such tests are, however, of little value to the class teacher, in that they provide no quantification of the retention and recognition of words taught, nor to the re-mediator, in that they provide no foundation for diagnosis.

For the purpose of this investigation, it is necessary to turn to tests that go beyond the measure of recognition of isolated words to those that offer usefulness in diagnosis of difficulty. The oral prose tests of Burt and Schonell do offer norms for fluency, accuracy and comprehension of reading. For the present purpose, however, they have the disadvantage that alternative forms are not available, and a further disadvantage that they have been 'on the market' for many years and appear to lack stimulation for the 'poor' reader.

The Neale Analysis of Reading Ability (Neale, 1966) retains the best features of the Burt and Schonell prose reading tests, having sub-test norms for fluency, accuracy and comprehension. There are also alternative forms for re-testing. It is probably the most widely used descriptive-cum-diagnostic test used in England.

The Neale test consists of six passages of prose forming a continuous reading scale for children aged from six to thirteen years, each test being a narrative designed to suit the interests of the assigned age level. The progressive grading of difficulty, which is important to the second investigation in this study, is achieved in three ways:-

(i) by reference to published word lists:-

Thorndike & Lorge (1944), Rinsland (1945),
Dale & Chall (1948), Vernon (1949).

It is ironic that three of the above are American compilations and one is Scottish. However, the following does much to ameliorate this criticism.

(ii) by reference to the achievements of children who participated in the experimental work which preceded the test formation.

(iii) by grading the successive passages according to their length and according to the complexity of their sentence structure.

The administration of the test takes about ten to fifteen minutes, according to the ability of the subject. The subject's errors, time for reading, and oral comprehension scores are recorded and may be converted to quotient form by comparison with the chronological age (CA) after conversion of scores to the appropriate age norms for each of the three sub-tests.

The RELIABILITY of the test was ascertained by the use of parallel forms and computed inter-form correlations. The reliability data for the Neale Analysis of Reading Ability may be found in Appendix 2.

The VALIDITY of the Neale test was established by factor-analysis, using a number of well-standardised tests (Neale, 1966, page 15) from which evidence was obtained of group factors which could be interpreted as distinct aspects of reading related to:

(i) the mechanical aspects of reading,

(ii) the understanding of words and ideas,

(iii) the rate of mechanical reading.

High coefficients were obtained in the validation study.

1.3.3. Visuo-Graphic Ability, PoP.

The measure of Visuo-Graphic Processing Ability used in this investigation was the Problems of Position Test (PoP) developed by Moseley (1972). Age norms for the 6 to 12 year-old age range were available, thus enabling the computation of PoP Quotients by comparison of the age norms with the chronological age of the subject. A copy of the test may be found in Appendix 3.

The PoP Test was chosen for three reasons:-

(i) Apart from the instructions, which are supplemented by samples worked by the subject, no auditory-phonological mediation is required.

(ii) Performance on the test has been found to correlate significantly with reading disability (Moseley, 1972).

(iii) The test is easy to administer, being amenable to group or individual administration.

The test consists of 25 items of graded difficulty preceded by 5 practice items. The subject is required to identify the dot configuration presented on the left side of the form in the dot display on the right. The dot configuration is located with a pencil and must have the same orientation as the model.

1.3.4. Variables affecting Validity.

This section considers the control of variables affecting consideration of internal and external validity.

Control for Internal Validity.

Campbell & Stanley (1963) postulate 8 classes of extraneous variables whose effects, if not controlled, become confounded with the effect of the independent variable. These are listed, together with control methods:

1. History. The testing régime for each subject was of short duration and involved a single application.
2. Maturation. Maturation was controlled as for 1 above.
3. Testing. Any possible interaction between the initial reading test (the Neale Analysis of Reading Ability, Form A) and the AVMP tests would be evenly distributed in the conditions of Auditory-phonological and Visuo-graphic interference, the reading test having been applied approximately one week prior. Further, the instructional set, reading aloud etc., of the reading test was held to be that of usual classroom reading practice. The interaction of the effects of order of application of the Auditory-phonological and Visuo-graphic interference conditions was controlled by reversing the order of application of the conditions for alternate subjects. The means of the AVMPR and AVMPC values for the two groups:

Group 1	Auditory-phonological interference condition presented first.
Group 2	Visuo-graphic interference condition presented first.

could thus be compared by means of a further hypothesis:

$H6_R \qquad H_0 \qquad \overline{AVMPR_1} = \overline{AVMPR_2}$

$H6_C \qquad H_0 \qquad \overline{AVMPC_1} = \overline{AVMPC_2}$

The acceptance of the null hypothesis would indicate the effectiveness of the control.

4. Instrumentation. The settings or calibrations of all mechanical or electrical instruments were maintained throughout the investigation. The measurements of rates of reading were conducted by an assistant skilled in the administration of the Neale tests. The measurement of comprehension intrusions was made by the investigator and the assistant jointly, using the appropriate standardised instrument, a subtest of the Neale Analysis.

5. Regression. There was no consideration of pre-test/ post-test gain.

6. Selection Bias. The experimental conditions were applied to all subjects.

7. Experimental Mortality. Only one application of the experimental conditions was made.

8. Selection-Maturation Interaction. Control of this was not necessary.

Control for External Validity.

Of the four classes of extraneous variable postulated by Campbell & Stanley (1963) which may act upon the experimental treatments to inhibit generalisation, two only appear relevant:

1. Interaction between selection and the experimental variable was controlled by the stipulation of criteria for the definition of the population and by some variation of the sources of the sample.

2. The reactive effects of the experimental conditions were likely to be limited to the set effects controlled by the alternation of the interference régimes in (3) above (see control for internal validity).

Reliability.

Reliability constitutes the ability of a measuring instrument to produce the same answer on successive occasions when no change has occurred in the thing being measured (Burroughs, 1971). The prose passages for the respective conditions of auditory and visual distraction were not identical, but were taken from parallel forms of the Neale Analysis of Reading Ability which had been carefully controlled and matched for passage length, sentence length and vocabulary. It was appreciated, however, that the very high inter-form reliability coefficients for the Neale (see Appendix 2) did not necessarily apply to individual component passages. Accordingly, some indication of the reliability of the supposed parallel passages was sought, in terms of the comparative difficulty found by the respondents (each of whom was subjected to both passages), by comparing the resultant scores for the two passages.

The most frequently-used index of reliability, the correlation coefficient, was considered inappropriate due to the modality effect which would (according to the hypotheses) confound the passage difficulty effect if paired values of data were used. The two-sample t statistic appeared to be appropriate, and it was hypothesised that there would be no significant difference between the mean scores, for both the Rate and Comprehension measures, for the passages for visual and auditory distraction, M_V and M_A:-

H_{7R} $\quad H_0 \quad M_V = M_A$

H_{7C} $\quad H_0 \quad M_V = M_A$.

The acceptance of the null hypothesis would suggest some degree of reliability for the instrument.

1.4.0. The Subjects.

The subjects were drawn from two schools in Birmingham, one primary and one secondary comprehensive, both of which were designated "Social Priority Schools" and deemed by the Department of Education and Science to be in need of additional teaching and other resources. The catchment areas of both schools were of 'mature' urban development, the parents of the pupils being largely non-skilled and semi-skilled workers. This gave rise to the expectation that both schools' pupils would exhibit some depression of reading ability.

The subjects from the primary school comprised 3 classes from 3 successive year groups. Each class was of mixed ability.

The subjects from the secondary school comprised 2 mixed ability classes from successive year groups, with addition of 12 pupils of 13 to 16 years who were considered by remedial staff to be adequate in the oral language but were underachieving in reading.

The distribution of the subjects according to age is given in Table 1:-

Age of Subject.	Frequency.
8 - 9 years	31
9 - 10 years	25
10 - 11 years	26
11 - 12 years	41
12 - 13 years	14
13 - 14 years	6
14 - 15 years	4
15 - 16 years	2

Table 1. The distribution of subjects according to age.

The incidence of recent immigrants with language difficulties in combination with the limited range of application of the Neale Analysis of Reading Ability also contributed to the thinning at the higher ages.

No subject had defective hearing, all having received at least one medical examination at school. Verbal Intelligence levels were not computed, but it was the opinion of the teaching staff that all the subjects in the sample had sufficient ability in the oral language to support a 'reading age' commensurate with their chronological ages. This assumption is in keeping with the findings of Francis (1974, 1975). The opinions and judgments of the teaching staff with regard to the oral fluency and ability of the subjects were borne out by the investigator, who spent an acclimatisation' period in the school before testing commenced. No subject exhibited any reluctance to participate in the experiment; rather was there some apprehension about the possibility of not being included.

1.5.0. Experimental Conditions and Procedure.

The tasks were administered individually in a quiet room during the mornings of a six-week period in May/July, 1976, when there was a low probability of disturbance.

The Neale Analysis of Reading Ability was administered according to the procedure laid down in the manual (Neale, 1966) and the scores were recorded for the Accuracy, Rate and Comprehension subtests. The Problems of Position Test (PoP) was administered to each subject after the reading test and according to the directions (Moseley, 1974).

The passages to be read under the conditions of Auditory-phonological and Visuo-graphic interference were administered to each subject two to three weeks after the administration of the Neale reading test. The order of administration of the two passages was reversed for alternate subjects. Times for reading aloud the passages were recorded by means of a stopwatch. Answers to the comprehension questions were recorded as correct, i.e. accord- to the range of answers permitted by the appropriate alternative form, B or C, of the Neale Analysis, or intrusive, i.e. from the interference material. Where any doubt arose, the subject's answer was recorded and assessed by the investigator and his assistant at a later time. Ambient lighting was kept constant throughout the experiment by use of a light meter. The loudspeaker of the tape-recorder was centrally situated in relation to the subject, and the relative positions of subject, tape-recorder and administrators were standardised.

The subjects responded well, and no problems arose during the administration of the tests. This was probably due to the procedural similarity of the interference régimes to each other and to the Neale reading test from which they were derived.

The instructions were clear and understood by all subjects: "Read the story to me. If you come to a hard word, try it aloud by yourself before I help you. At the end I shall ask you some questions, so try to remember the story as you read it."

1.6.0. Derivation of Scalar Values for the Rate and Comprehension Components of the General Modal Preference and Auditory-Visual Modal Preference Measures.

For these measures, scalar values were obtained by the difference method, the difference between rates of reading and between the numbers of comprehension intrusions for the two interference conditions being held to indicate the salience of the interference and also the direction of the interference.

1.6.1. General Modal Preference Measure, GMPR/GMPC.

The rates of reading were computed for each subject for each passage/interference condition in terms of words per minute by dividing the number of words in the passage by the time for reading in seconds and then multiplying by 60. The difference in rate between the two interference conditions was computed. The range of differences was from 1 to 66 words per minute, the values being presented in Appendix 4.

The comprehension intrusions were computed for each subject for each passage/interference condition, and the difference between the numbers for each interference condition computed. The range of differences was from 0 to 3, the values being presented in Appendix 4.

1.6.2. Auditory-Visual Modal Preference Measure, AVMPR/AVMPC.

The rates of reading and the differences in rate between the two interference conditions were computed as above (1.6.1). The differences favouring the visuo-graphic interference condition were given a positive value, and those favouring the auditory-phonological interference condition were given a negative value.

The computed differences in rate were then added to 100 so that those difference favouring the auditory-phonological interference condition were subtracted from 100, those least favouring that condition being nearer to 100. Those differences favouring the visuo-graphic interference condition were added to 100, those least favouring that condition being nearer to 100. The distribution of values on the AVMPR scale is presented in Figure 15. The relationship between this distribution and that for the GMPR values may be observed by folding the histogram at the 100 point and adding the percentages.

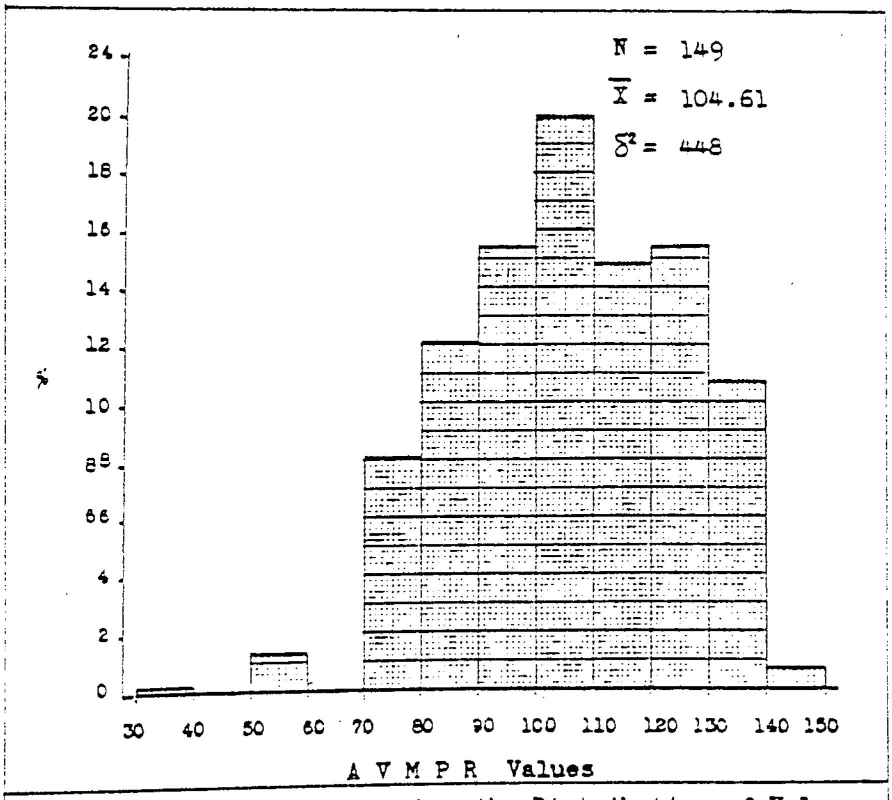

Figure 15. Histogram to show the Distribution of Values on the Auditory-Visual Modal Preference Rate (AVMPR) Scale for the present sample.

The numbers of comprehension intrusions and the differences between those for the two interference conditions were computed as above (1.6.1). The differences favouring the visuo-graphic interference condition were given a positive value, and those favouring the auditory-phonological interference condition were given a negative value.

The computed differences in comprehension intrusions were then added to 5 so that the differences favouring the auditory-phonological interference condition were in effect subtracted from 5, those least favouring that condition being nearer to 5. Those differences favouring the visuo-graphic interference condition were added to 5, those least favouring that condition being nearer to 5. The distribution of values on the AVMPC scale is presented in Figure 16. The relationship between this distribution and the GMPC distribution may be observed by 'folding' the histogram at the 5 point and adding the percentages for each interval.

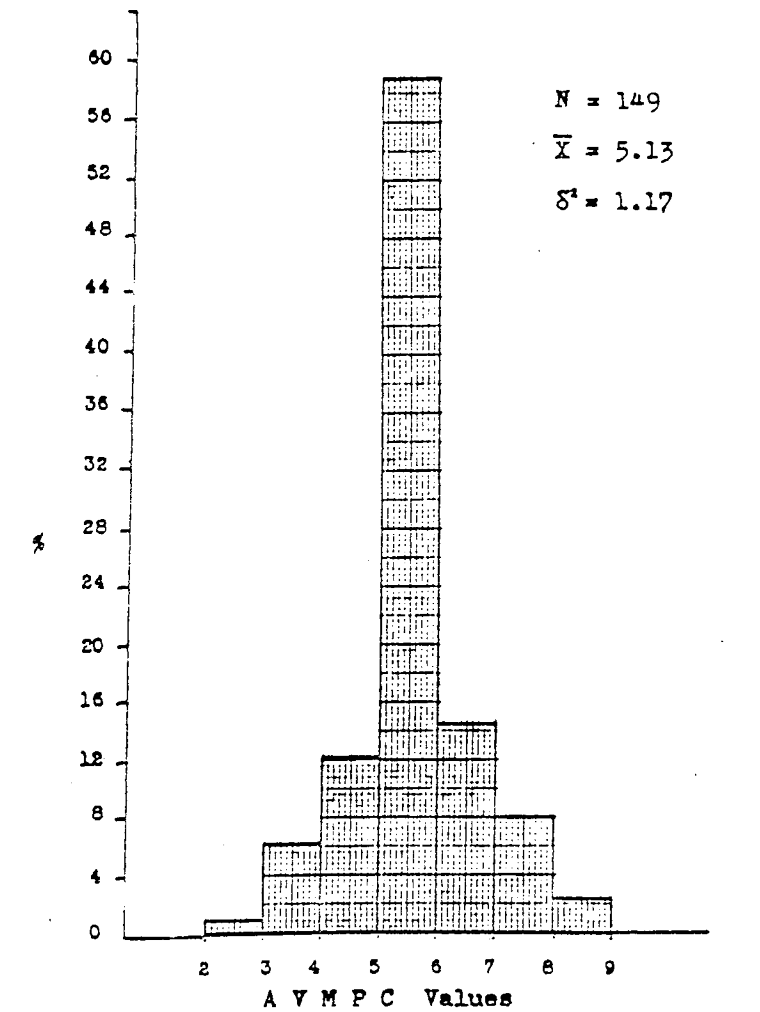

Figure 16. Histogram to show the Distribution of Values on the Auditory-Visual Modal Preference Comprehension (AVMPC) Scale for the present sample.

The values for the AVMPR and AVMPC variables, continuously scaled as described above, are presented in Appendix 4.

1.7.0. Results.

In this section, the results of the application of the various tests to the present sample, N = 149, are presented. The transformation of raw scores on the reading tests and on the test of visuo-graphic ability into quotient form has been described in 1.3. The method of transformation of raw scores into continuous scalar values for the General Modal Preference, Rate and Comprehension, variables and for the Auditory-Visual Modal Preference, Rate and Comprehension, variables has been described in the previous section.

1.7.1. Results of the application of the Neale Analysis of Reading Ability sub-tests.

The Distribution of quotients for the present sample on the Accuracy sub-test of the Neale, together with the Mean and Variance, is shown in Figure 17. There is slight positive skew and slight leptokurtosis. The low Mean (M = 89.97) reflects the low mechanical reading or word recognition achievement of the present sample relative to age norms: This was to be expected from the choice of schools for the study sample.

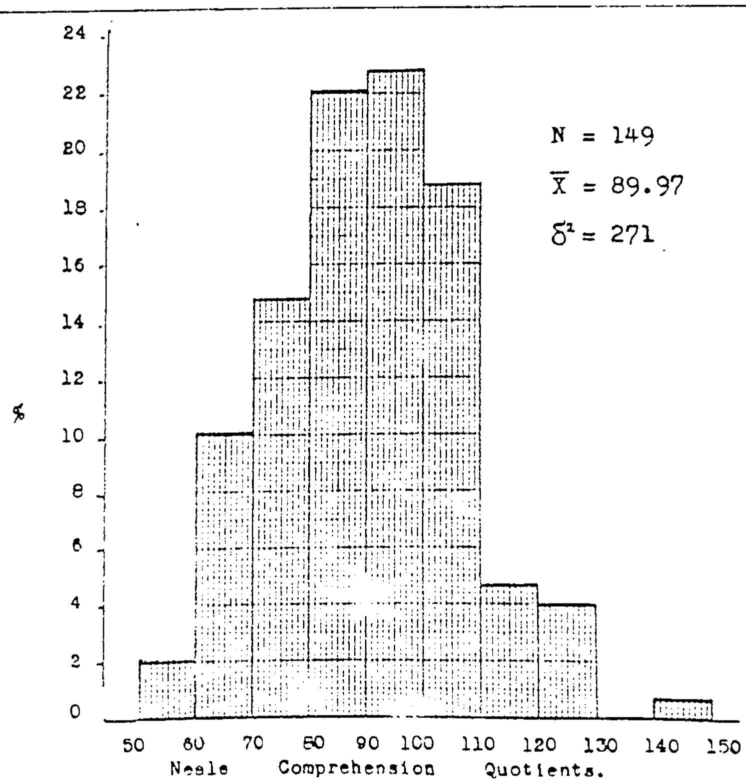

Fig. 17. Histogram to show the Distribution of Neale Accuracy Quotients.

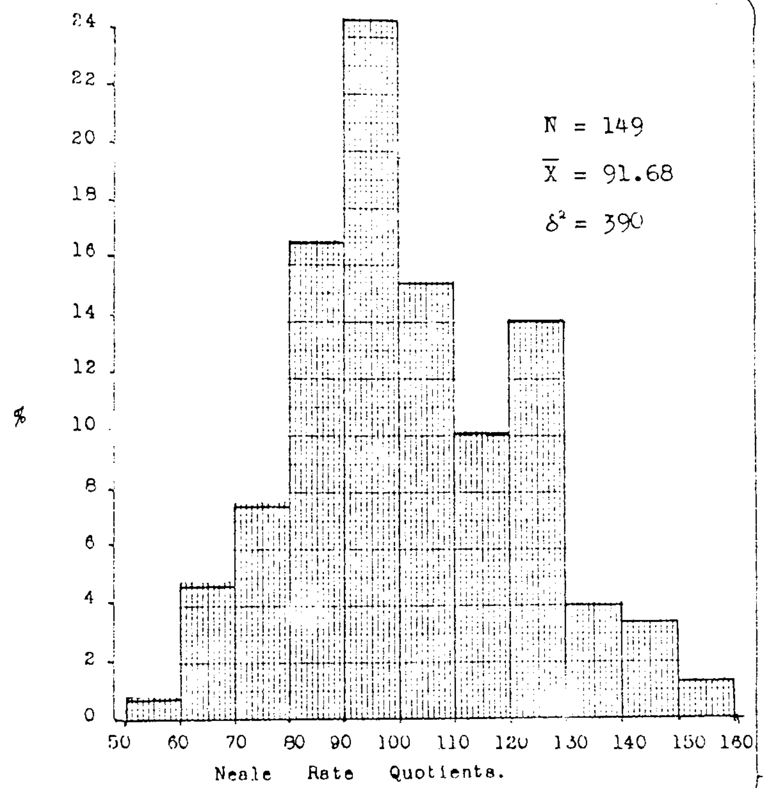

Fig. 18 Histogram to show the Distribution of Neale Rate Quotients.

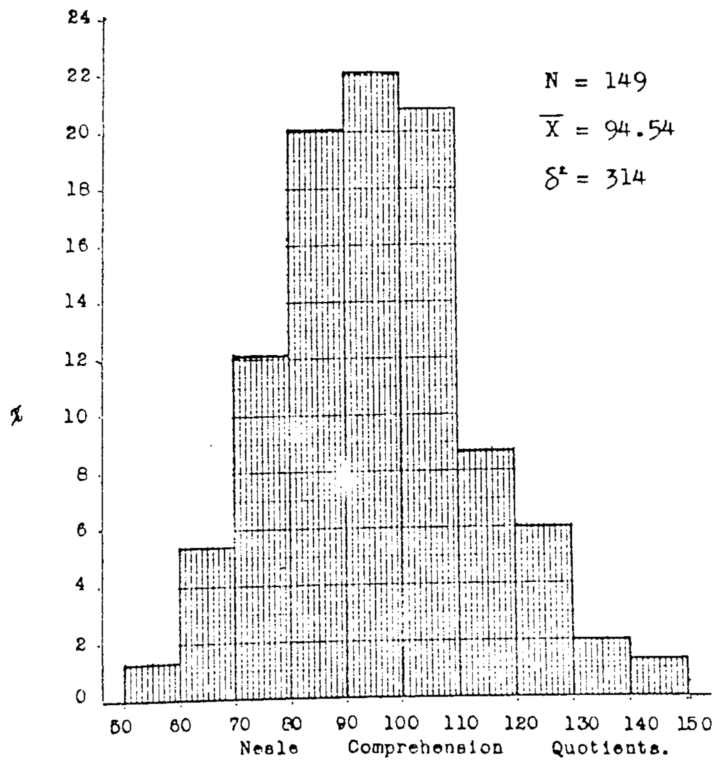

Fig. 19. Histogram to show the Distribution of Neale Comprehension Quotients.

The distribution of quotients for the Rate sub-test of the Neale Analysis, for the present sample, together with the Mean and Variance, in Figure 18, shows some positive skew with slight leptokurtosis. The values for the NR variable may be found in Appendix 4.

The distribution of quotients for the Comprehension sub-test of the Neale Analysis, for the present sample, together with the Mean and Variance, is shown in Figure 19 and shows some positive skew. The values for the NC variable may be found in Appendix 4.

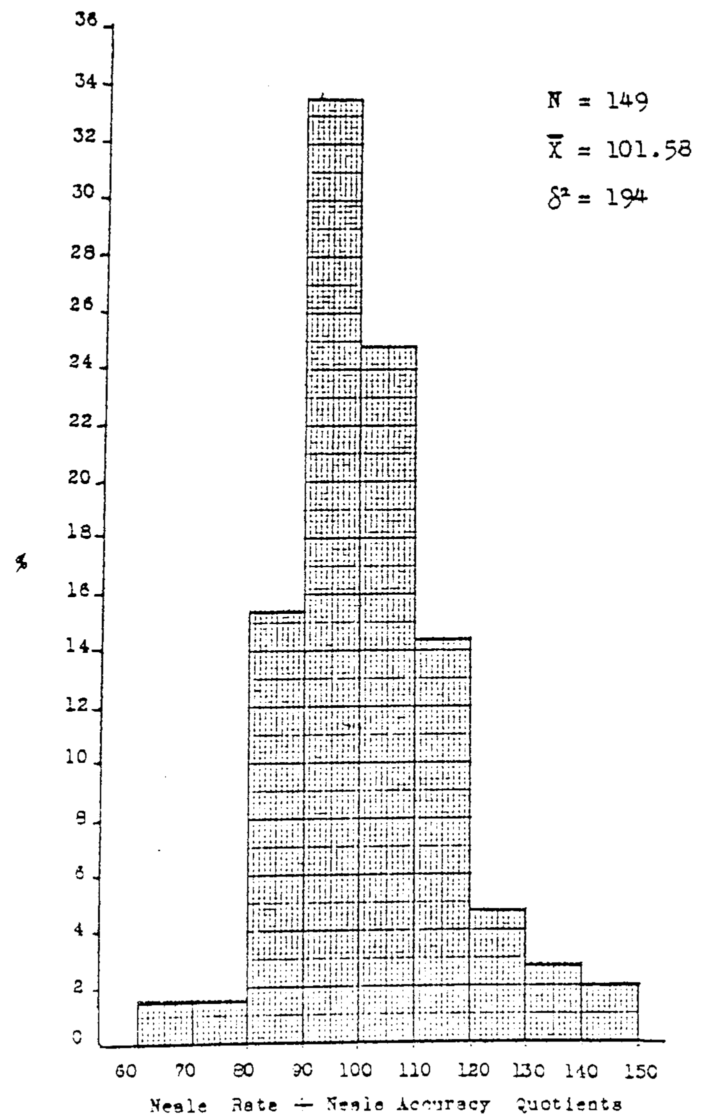

Fig.20 Histogram to show the Distribution of Neale Rate Quotients ÷ Neale Accuracy Quotients.

The distribution of the values of the derived variable, the Neale Rate quotient divided by the Neale Accuracy Quotient (NR ÷ NA, or $\frac{NR}{NA}$) for the present sample, together with the Mean and Variance, is presented in Figure 20.

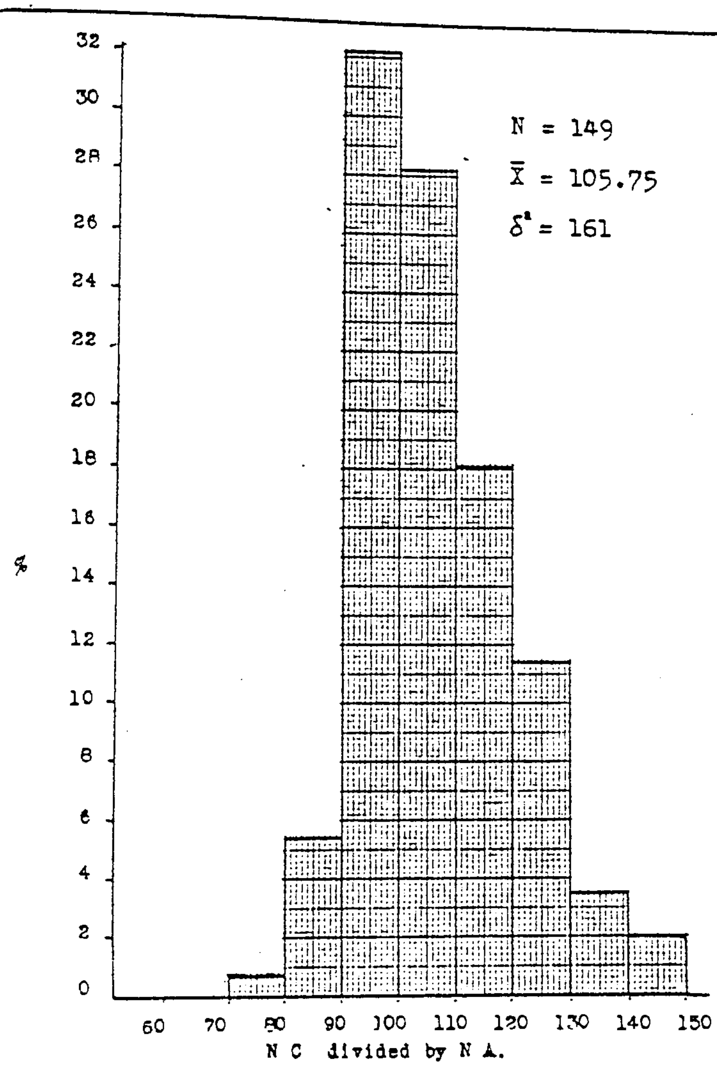

Fig. 21. Histogram to show the Distribution of Neale Comprehension ÷ Neale Accuracy.

The distribution of values for the derived variable, Neale Comprehension Quotient divided by Neale Accuracy Quotient (NC ÷ NA or $\frac{NC}{NA}$), together with the Mean and Variance, for the present sample, is presented in Figure 23, the values being tabulated in Appendix 4.

Both distributions were leptokurtic, as would be predicted from the distributions of values for their three root variables.

Of particular interest for this study is the distribution of values of the $\frac{NC}{NA}$ derived variable which provides the criterion of 'specific reading difficulty' in this study. Approximately 62% of the present sample (N = 149) would, according to the criterion $\frac{NC}{NA} > 100$, be held to have comprehension ability superior to word recogition ability, and could thus be classed as 'suffering' some degree of 'specific reading difficulty'. Further, approximately 34% of the present sample might be classed as seriously so (though this is a statistical artefact) according to the criterion level suggested by the Tizard Report (Great Britain, 1972) to which earlier reference was made.

On the other hand, using the same criteria, just over 6% might be said to be significantly overachieving in that their word recognition ability was much superior to their ability to comprehend, and 38% might be classed as overachieving to some degree. With the proportion of the present sample that exhibits some degree of S R D ('specific reading difficulty'), it should be noted that the comprehension is functionally related to some extent to the accuracy measure, in spite of the auditory correction feedback of the test adminstrator, and perhaps also to the rate measure, which raises the possibility that the disparity between 'verbal ability' and word recognition ability for this already high proportion (62%) might be greater, and therefore even more problematic, than is indicated above.

The distribution of Neale Accuracy reading ages, calculated from the scores without controlling for chronological age, is shown in Figure 22 (tabulated in Appendix 4 as RA) and roughly follows the distribution of chronological ages in the present sample, as described in section 1.4.

1.7.2. <u>The Results of the application of the Problems of Position Test</u>, PoP.

The raw scores were transformed, using the standardised norms, to PoP quotients. The distribution of PoP quotients is shown in Figure 23 and exhibits pronounced leptokurtosis. The PoP quotients are tabulated in Appendix 4.

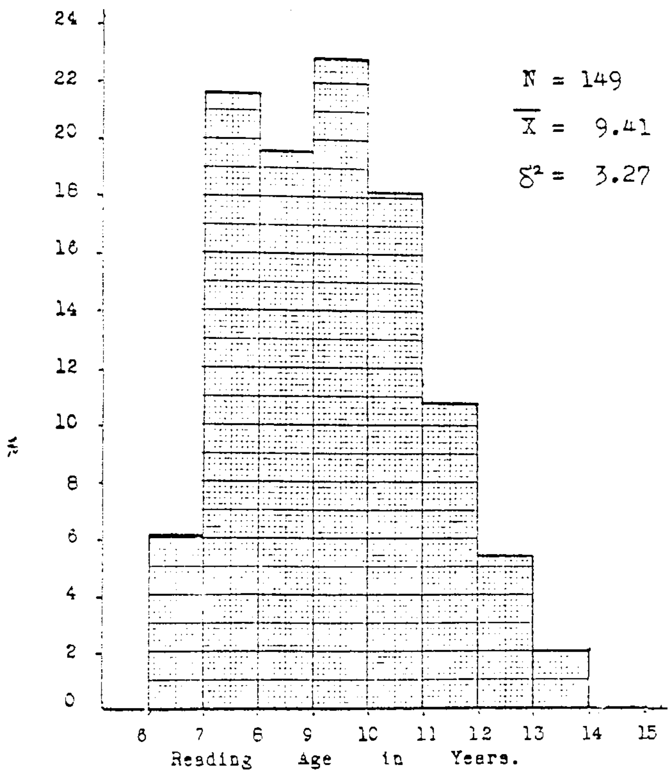

Fig. 22 Histogram to show the Distribution of Reading Ages, in years.

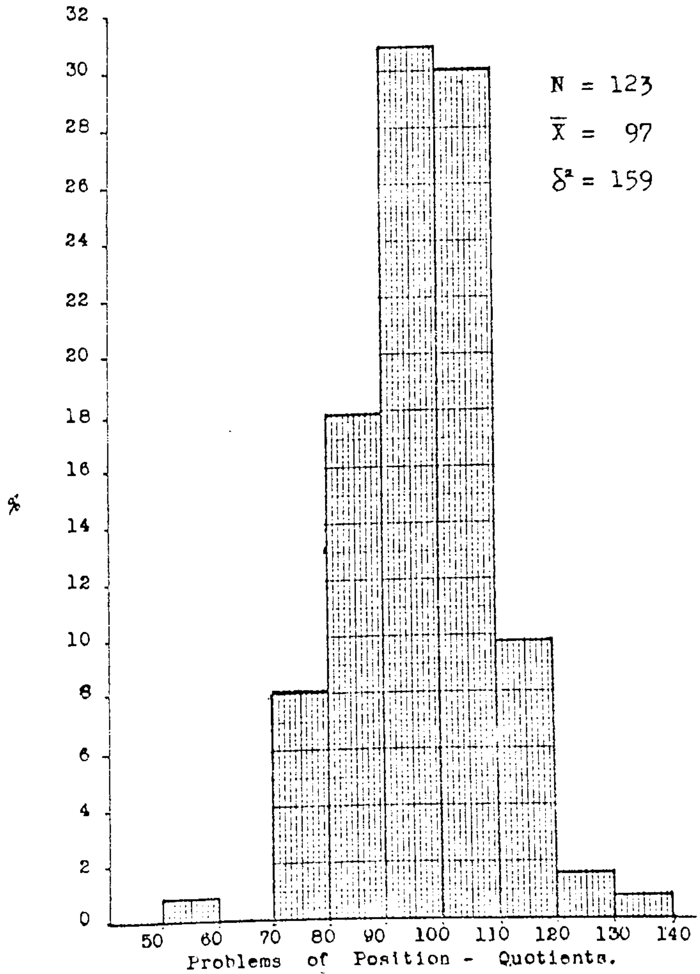

Fig. 23 Histogram to show the Distribution of Problems of Position Test Quotients.

1.7.3. Summary of Results.

The distributions of values for the GMPR and GMPC, AVMPR and AVMPC variables having been presented in section 1.6, the means, standard deviations, variances and standard errors of the means for all variables may be tabulated thus:-

Variable	Mean	St. Dev.	Variance	St. Error
NA	89.97	16.51	272.58	1.35
NC	94.54	17.79	316.48	1.46
NR	91.68	19.82	392.83	1.62
RA	9.42	1.81	3.28	.15
$\frac{NR}{NA}$	101.58	13.98	195.44	1.14
$\frac{NC}{NA}$	105.77	12.80	163.84	1.05
PoP	96.92	12.68	160.78	1.14
GMPR	17.40	12.93	167.18	1.06
GMPC	.66	.87	.76	.07
AVMPR	104.61	21.23	450.71	1.74
AVMPC	5.13	1.09	1.19	.09

Table 2. Means, Standard Deviations, Variances and Standard Errors of Means for all Variables used in the study.

1.8.0. Analysis of Results.

The populations for the three sub-tests of the Neale Analysis of Reading Ability and for the Problems of Position Test exhibit a normal distribution of scores. The study sample distributions of values for these variables also approximated to the normal. Although more robust statistics, such as the t-statistic, would tend to yield relationships of higher significance (Burroughs,1971) for the correlated data, particularly with regard to the distributions of the GMPR, GMPC, AVMPR and AVMPC variables, these possibilities have been sacrificed in order to obtain a conservative assessment. The Pearson r can be described as the ratio of the covariance to the geometric means of the variances. The advantage of using the geometric means is that it reduces the effect of small proportions of unusually high or low values on the means. The Pearson r was computed for each pair of variables by first computing the standard deviations from the means and then the covariance of the variables. The sample size being reasonably large (N = 149), the standard deviations and covariances were computed by the n rather than the n-1 method. The r was then computed according to the formula:

$$r_{xy} = \frac{\text{covariance of x and y}}{(\text{s.d. of x})\ (\text{s.d. of y})}$$

The significance of each Pearson r was ascertained by consulting tables (Burroughs, 1971) according to the degrees of freedom.

The statistics used in the computation of the Pearson r correlation coefficients are presented in Appendix 5, and the matrix of the r coefficients, with levels of signficance, is presented in Table 3 overleaf.

1.8.1 Significance of Correlation Coefficients.

Highly significant correlations ($<.001$) were found between the results of the three Neale sub-tests, +.8019 between Accuracy and Comprehension, +.7700 between Accuracy and Rate, and +.5300 between Comprehension and Rate. These supported the reputation of the Neale Analysis of Reading Ability for internal consistency.

The correlation between Reading Ages (RA) and the Chronological Ages (CA) in the present sample, r = +.4480, is significant at

NA	NC	NR	NR÷NA	NC÷NA	PoP	AVMPR	AVMPC	GMPR	GMPC	RA	CA
1.0000	+.8019$_{3}$	+.7700$_{3}$	-.0898$_{0}$	-.2735$_{2}$	+.3887$_{3}$	-.2495$_{2}$	-.2783$_{2}$	+.0001$_{0}$	+.2567$_{2}$	+.6350$_{3}$	-.4063$_{3}$
	1.0000	+.5300$_{3}$	-.2121$_{2}$	+.3067$_{3}$	+.3837$_{3}$	-.1218$_{0}$	-.1021$_{0}$	-.0669$_{0}$	-.0802$_{0}$	+.6315$_{3}$	-.1752$_{1}$
		1.0000	+.5368$_{3}$	-.3904$_{3}$	+.2372$_{2}$	-.3420$_{3}$	-.4053$_{3}$	+.1334$_{0}$	-.2419$_{2}$	+.4382$_{33}$	-.4119$_{3}$
			1.0000	-.2497$_{2}$	-.0961$_{0}$	-.2737$_{2}$	-.0324$_{0}$	+.1856$_{1}$	-.0467$_{0}$	-.1527$_{0}$	-.1122$_{0}$
				1.0000	+.0672$_{0}$	+.2478$_{2}$	+.3469$_{3}$	-.0417$_{0}$	+.3133$_{3}$	-.0226$_{0}$	+.3476$_{3}$
					1.0000	+.0305$_{0}$	-.0292$_{0}$	-.0461$_{0}$	-.1025$_{0}$	-.3680$_{3}$	-.0080$_{0}$
						1.0000	+.3284$_{3}$	+.0069$_{0}$	+.2561$_{2}$	-.0912$_{0}$	+.1887$_{1}$
							1.0000	+.1421$_{0}$	+.2535$_{2}$	-.1560$_{0}$	+.1450$_{0}$
								1.0000	+.1309$_{0}$	-.0417$_{0}$	-.0257$_{0}$
									1.0000	-.2540$_{2}$	+.0109$_{0}$
										1.0000	+.4480$_{3}$
											1.0000

0 not significant.

1 significant at $<.05$ level.

2 significant at $<.01$ level.

3 significant at $<.001$ level.

Table 3 Correlation Matrix of Variables used in the Study.

the $<.001$ level. Incrementation of mechanical reading ability or word recognition ability would be expected to increase with schooling and consequently with age. A correlation of +.4480, suggests that, for the present sample, word recognition lags further and further behind that level expected from consultation of the age norms for Neale Accuracy, otherwise the correlation would be near-perfect. This may be partly accounted for by the inclusion of a small number of older, underachieving subjects in the present sample (see 1.4.0.).

A negative correlation, $r = -.1752$, significant at $<.05$ level, between Neale Comprehension Quotients (NC) and Chronological Ages (CA) indicates a decrement of Comprehension ability with age, age being controlled in the NC quotients. There is a similar decrement of fluency of reading (NR) with age, $r = -.4119$ between NR and CA, significant at the $<.001$ level. These trends could only to a small degree be accounted for by the inclusion of 12 (out of 149) older subjects known to be underachieving.

The relationship between PoP quotients and Chronological Ages (CA) did not approach significance, suggesting that visuo-spatial ability, at least of the kind measured by the test, was evenly distributed throughout the age-range of the study sample.

A significant correlation ($r = +.3476$, $p<.001$) was found between the derived variable $\frac{NC}{NA}$ and Chronological Ages (CA), suggesting that the disparity between word recognition or mechanical reading ability (NA) and (higher) comprehension ability (NC) in the present sample increases with age. In the present sample, both Fluency (rate of reading) quotient (NR) and Accuracy quotient (NA) tended to decline significantly with age (CA): NA x CA, $r = .4063$, $p<.001$ and NR x CA, $r = .4119$, $p<.001$. It is unlikely that such a continuous relationship would be due to a distinct difference between the primary and secondary schoolchildren studied. A possible explanation may lie in the general lack of specific reading development to follow on from the initial instruction phase.

The relationships amongst the three Neale sub-test variables, for the present sample, may be observed by using the derived variables $\frac{NC}{NA}$ and $\frac{NR}{NA}$. A significant correlation ($r = -.2121$, $p < .01$) was found between NC and $\frac{NR}{NA}$, indicating that the higher the Comprehension ability, in the present sample, the lower the reading fluency relative to word recognition. Conversely, there was a significant and higher correlation between NR and $\frac{NC}{NA}$ ($r = -.3904$, $p < .001$), indicating that the greater the disparity between Comprehension and (lower) word recognition or mechanical accuracy, the slower the rate of reading.

A significant relationship was found between NA or reading accuracy and PoP visuo-spatial ability quotients in the present sample ($r = +.3887$, $p < .001$), and also between NC comprehension quotients and PoP quotients ($r = +.3837$, $p < .01$), and a less significant relationship ($r = +.2372$, $p < .01$) between reading rate (NR) and PoP quotients, indicating that:

(i) the higher the visuo-spatial ability, the higher the accuracy of reading.

(ii) the higher the visuo-spatial ability, the higher the comprehension of what is read.

(iii) the higher the visuo-spatial ability, the higher the fluency or rate of reading.

The relationship between GMPR (the rate component of the general modal preference measure) and NA (reading accuracy) did not approach significance ($r = +.0001$), nor did that between GMPR and Comprehension (NC) ($r = -.0669$) or between GMPR and reading rate (NR) (+.1334). The relationship between GMPR and the derived variable $\frac{NR}{NA}$ (r = +.1856) proved significant at the .05 level of confidence, higher distractibility as measured by GMPR tending to be correlated with fluent but relatively inaccurate reading. There was no significant relationship between GMPR and the 'specific reading difficulty' criterion variable $\frac{NC}{NA}$ (r = -.0417).

The relationship between the GMPC, general modal preference comprehension component, irrespective of modal origin, and NA (accuracy of reading quotients) was significant at the .01 level of confidence (r = +2576) to the extent that high accuracy quotients were accompanied by enhanced effect of interference on comprehension.

There was a low correlation (r = +.1309, n.s.) between GMPR and GMPC.

The relationship between the Auditory-Visual Modal Preference Rate (AVMPR) values, for the present sample, and NA was significant at the .01 level (r = -.2495), indicating that mechanical reading accuracy increased as the degree of auditory modal preference on the AVMPR scale. Good readers, in the word recognition sense, tended to be auditory-mode preferent. The relationship between AVMPR and NC (r = -.1218) did not approach significance. The relationship between AVMPR and NR (reading rate) (r = -.3420) proved significant at the .001 level of confidence, slow readers tending to be visual mode-preferent. Those subjects whose fluency was superior to their mechanical accuracy also tended to be auditory mode preferent on the AVMPR scale (r = -.2737, $p<.01$), whilst those subjects whose fluency was inferior to their mechanical accuracy tended to be visual-mode preferent on the AVMPR scale. There was also a significant correlation (r = +.2478, $p<.01$) between AVMPR and the derived $\frac{NC}{NA}$ variable, used in this study as a criterion for 'specific reading difficulty', whereby those subjects whose comprehension ability exceeded their word recognition ability (NA) tended to be visual mode preferent. Inversely, auditory preferent subjects tended to exhibit superior mechanical accuracy to comprehension.

The relationship between PoP quotients and AVMPR did not approach significance, nor did that between AVMPR and the subjects' reading (Accuracy) ages. The relationship between AVMPR and chronological ages of the subjects was significant at the .05 level of confidence ($r = +.1887$), indicating that the older the subject the greater tendency towards visual-mode preference on the AVMPR scale.

The relationship between the Comprehension component of the Auditory-Visual Modal Preference Scale (AVMPC) and reading accuracy quotients (NA) for the present sample ($r = -.2783$, $p < .01$) proved significant, the better readers in terms of accuracy of word recognition tending to be auditory-mode preferent on the AVMPC scale. AVMPC was not signficantly correlated with Comprehension (NC) quotients ($r = -.1021$), but was correlated with reading rate (NR) quotients ($r = -.4053$, $p < .001$), there being a tendency for visual mode preferents on the AVMPC scale to be slow readers. There was no significant correlation between AVMPC and PoP quotients ($r = -.0292$), nor between AVMPC and the chronolocial ages (CA) of the present sample. ($r = +.1450$). The significant correlation ($r = +.2535$, $p < .01$) between GMPC and AVMPC is presumably a function of the negative skew of the AVMPC distribution.

The relationship between AVMPR and AVMPC values is of importance in assessing the degree of internal consistency, and proved signficant at the .001 level, $r = +.3284$.

1.8.2. Summary of Results of Analysis.

In this section, the statistical hypotheses presented in section 1.1.4. will be tested by the application of the null hypothesis.

For Hypothesis H_{1a}, the null hypothesis, R = 0, was applied to the relationship between GMPC and $\frac{NC}{NA}$. The null hypothesis was rejected at the .001 level of confidence (r = +.3133).

For Hypothesis H_{1b}, the null hypothesis, R = 0, was applied to the relationship between GMPR and NR. The null hypothesis was accepted.

For Hypothesis $H_2 + H_3$, the null hypothesis, R = 0, was applied to the relationship between AVMPC and $\frac{NR}{NA}$. The null hypothesis was accepted.

For Hypothesis H_4, the null hypothesis, R = 0, was applied to the relationship between AVMPC and AVMPR. The null hypothesis was rejected at the .001 level of confidence (r = +.3284).

For Hypothesis H_5, the null hypothesis, R = 0, was applied to the relationship between AVMPC and PoP. The null hypothesis was accepted (r = -.0292, n.s.).

For Hypothesis H_6, the null hypothesis H_0 was applied to the differences between the means for those subjects who were subjected to the auditory-phonological interference condition first and the means for those who were subjected to the visuo-graphic interference condition first, in respect of the values for both AVMPR and AVMP measures. The null hypotheses were tested:-

H_{6R}	H_0	$AVMPR_1$	=	$AVMPR_2$
H_{6C}	H_0	$AVMPC_1$	=	$AVMPC_2$

by means of a t test, and the null hypothesis accepted in each case:

H_{6R} $AVMPR_1 = 104.5$, $AVMPR_2 = 102.8$, $t = -.536$ (n.s.).

H_{6C} $AVMPC_1 = 5.08$, $AVMPC_2 = 5.18$, $t = .531$ (n.s.).

For Hypothesis H_7, the null hypothesis, H_0, was applied to the differences between the mean scores obtained on the visual (M_V) and auditory (M_A) distractor passages, in respect of both the Rate and Comprehension measures. The null hypotheses were tested:-

H_{7R} H_0 $M_V = M_A$

H_{7C} H_0 $M_V = M_A$

by means of a t test, and the null hypothesis accepted in each case:-

H_{7R} $M_V = 66.28$, $N = 149$

$M_A = 71.23$ $N = 149$

Difference between means = 4.95

$t = -1.73$ (n.s.)

(The value of t required to reach significance at the .05 level is 1.980.)

H_{7C} $M_V = 1.61$, $N = 36$

$M_A = 1.37$, $N = 28$

Difference between means = 0.24

$t = 1.508$ (n.s.)

(The value of t required to reach significance at the .05 level is 2.000.)

1.9.0. Conclusions.

1.9.1. Modal Preference as an Attentional Style Variable.

The results of the investigation appear to establish the modal preference construct as an attentional style variable. Extraneous variables relevant to internal and external validity appear to have been reasonably controlled (see section 1.2.4 and hypotheses H_{6R}, H_{6C} above) with the possible exception of the reliability of the instruments used in the investigation. Initially the reliability of the passages used in the distraction conditions appeared to be established by the high inter-form reliability coefficients for the Neale Analysis of Reading Ability from which the passages were derived. The overall inter-form reliability of the Neale would not necessarily extend to the component graded passages when taken individually. As the passages, of assumed parallel difficulty, used in both distraction conditions were applied to each subject, it might be thought appropriate to apply the Pearson r correlation coefficient to indicate the reliability. The modality effect, however, would have confounded the (possible) difficulty effect. The values for Rate and Comprehension related to the two conditions (and passages) were accordingly treated as separate samples and the means compared by the t-test. Although the lack of any significant difference between the means suggested that the instruments were reliable, it would perhaps have been preferable to have exchanged the passages for half the subjects for the two conditions. This procedure might be considered in any replication of the experiment.

Some degree of construct validity appears to have been established:

(a) by the acceptance of the null hypothesis with regard to a possible relationship between AVMPC and PoP (the Problems of Position Test) and between AVMPR and PoP, where the Pearson r coefficients were almost zero. There appeared to be no relationship between preference for visuo-graphic processing in a bisensory task and visuo-graphic ability in a unisensory task, though the lack of relationship is strictly confined to the particular tasks described.

(b) by the rejection of the null hypothesis at the .001 level of confidence for the relationship between AVMPR and AVMPC ($r = +.3284$). However, if the correlation coefficient is viewed in terms of reduction of uncertainty (Burroughs, 1971) or common variance, the degree of reduction is 11%. Although the r is significant at the .001 level, it merely indicates the extent to which we can be sure that the AVMPR and AVMPC are measuring the same thing, and that extent is 11%. Both AVMPR and AVMPC appear to have the same pattern of relationships with other variables, see Table 4, a notable exception being with regard to the derived variable $\frac{NR}{NA}$, which will be considered later.

The possibility arises, however, that, whilst there is an 11% certainty that AVMPR and AVMPC are measuring the same phenomenon, there is a corresponding degree of uncertainty. It would appear that AVMPR is measuring the degree to which the subjects are <u>seeking</u> information according to modality classification, whereas AVMPC appears to be measuring the degree to which they are <u>obtaining</u> information according to modality classification. 17 of the 149 subjects exhibited different modality preferences on the AVMPR and AVMPC measures, further suggesting that two or more phenomena might be involved. If further consideration of the modal preference construct is merited, the technique of Factor Analysis might be applied to elicit the structures underlying the mass of test data.

Some difficulties arose with regard to the instruments of the enquiry. The prose passages used in the distraction conditions were selected as being at the same level of difficulty, and support for this assertion was afforded by the failure of the differences between the mean raw scores for both the AVMPR and AVMPC measures under the two distraction (and passage) conditions to reach significance as indicated by t-tests (p. 99). Even with passages of comparable difficulty, the difficulty arises of the relationship between passage difficulty and the level of word recognition skill that the individual subject brings to the task. The passages chosen were appropriate to the word-recognition-age or reading-age range 7.5 to 9.5 years. Whereas none of the subjects found the passages impossible to read in the word-recognition sense, it is very probable that a small percentage (almost 9%) of the subjects were well above the range of application of the passages. This would presumably tend to reduce the effect of the distractors, and would suggest that, in any replication, a battery of six graded passages be provided in each distraction condition; this would allow inferences to be made about developmental trends and, using the findings of Part 2, about the relationship between the modal preference construct and levels of linguistic complexity.

The discussion so far indicates that the results should be treated with caution, further work being necessary to establish (or otherwise) the reliability of the measures and the identity of the construct(s).

Variable	AVMPR	AVMPC	Variable	AVMPR	AVMPC
NA	-.2495	-.2783	PoP	+.0305	-.0461
NC	-.1218	-.1021	GMPR	+.0069	+.1421
NR	-.3420	-.4053	GMPC	+.2561	+.2535
$\frac{NR}{NA}$	-.2737	-.0324	RA	-.0912	-.1560
$\frac{NC}{NA}$	+.2478	+.3469	CA	+.1887	-.1450

Table 4. The Pattern of Relationships of AVMPR/AVMPC with other Variables in the present sample.

1.9.2. Modal Preference and Reading.

It was hypothesised (H_1) that if a reader, assuming that he was conforming to the three-stage model of reading, was predominantly attending to either of the modality-bound encoding stages, then he would tend to be underachieving in the sense that his capacity to comprehend in the auditory-linguistic mode would not tend to be supported by adequate and efficient word recognition ability in bisensory reading. This was supported by the findings, there being a significant relationship between GMPC and $\frac{NC}{NA}$ ($r = +.3133$, $p < .001$) whereby subjects who experienced strong interference effects on comprehension tended to be underachieving readers. Subjects who experience strong interference effects on comprehension also tended to be slow readers, as indicated by the relationship between NR and GMPC ($r = -.2419$, $p < .01$). It would appear, then, that those subjects who were predominantly attending to an encoding stage other than the semantic, i.e. one of the modality-bound encoding stages, were characteristically slow and underachieving readers, as would be predicted from LaBerge & Samuels (1974) model of automaticity in reading (section 1.0.4. q.v.).

The relationship between the degree of non-specific modal preference, as measured by the GMPR and GMPC instruments, and the three aspects of reading behaviour would suggest that, given that the subjects were adequate in unimodal communication situations such as those involving auditory-phonological processing only, there is some blocking or attenuation occurring in the peculiar bisensory or bimodal reading task that is making semantic encoding, as the last in a sequence of stages, very difficult. At first sight, the GMP scales would appear to be measuring something akin to the the 'impulsivity/reflectivity' of Kagan et al. (1963). If this were so, then one would expect a significant negative relationship between GMPR/GMPC and performance on the unimodal Problems of Position test; the relationships were not significant:

R: GMPR x PoP $r = -.0461$, n.s.,
R: GMPC x PoP $r = -.0292$, n.s..

It was predicted from the LaBerge & Samuels (1974) model of automaticity (assuming three stages were operant) that a reader who was predominantly attending to the visuo-graphic encoding stage would not only evince 'specific reading difficulty' but would exhibit depressed fluency of reading relative to mechanical accuracy or word recognition. This was predicted because attention would be to the FIRST, and nearest to 'reality', of the stages, and would involve close scrutiny of individual letters and small clusters of letters, which would be slow but relatively accurate. It was also predicted from the model that attention to the SECOND and auditory-phonological encoding stage would result not only in 'specific reading difficulty' but also in depressed mechanical accuracy, to the extent that visuo-graphic encoding was not automatised, and, relative to the depressed accuracy, a lesser depression of fluency or rate of reading aloud. These predictions were tested by the resolution of the two interference condition effects to one scale, the datum median (100 for AVMPR, 5 for AVMPC) indicates no interference effects, and exploring the relationship of the AVMPR and AVMPC scales to the derived variable $\frac{NR}{NA}$ which compared Neale Rate quotient with Neale Accuracy quotient for each subject. The predictions were not met with regard to the relationship between AVMPC, the effect of interference on Comprehension, where $r = -.0324$ (n.s.), but were met with regard to the relationship between AVMPR, the effect of interference on the Rate of reading, where $r = -.2737$, $p < .01$. The modality effect therefore only appears to apply to the depression of reading rate. It may be concluded that a reader attending to the visuo-graphic encoding stage will tend to be characteristically slow but relatively accurate in word recognition, subject to 'word recognition' not implying semantic encoding in any way, and also that a reader attending to the auditory-phonological encoding stage will tend to be less accurate but somewhat faster than the visuo-graphic stage reader.

$\frac{NC}{NA}$ and $\frac{NR}{NA}$ are, however, variables derived from comparisons of NA, NC and NR quotients and, division being used to preserve the age factor in the quotients, the error of measurement for component variables would be compounded when using the derived variables. This is a source of unreliability to be considered when interpreting the results, despite the low standard error, when compared with the unit of measurement, for each of the contributory variables.

A number of cognitive style variables have been suggested as being related to the learning, and particularly the reading, capabilities of children; some of these appear to suggest alternative interpretations of the results.

The GMP (GMPR and GMPC) or general modal preference effect may be interpreted as being consistent with the Constricted-Flexible Style categorisation of Santostefano, Rutledge & Randall (1965) who found that the capacity of children for "deploying attention in the face of contradictory, intrusive and distracting stimuli" was significantly related to reading ability. The Constricted-Flexible style presumably describes the manner in which an individual deals with a stimulus field containing a background of information which is intrusive or contradictory in terms of the central task. Santostefano's construct, whilst discriminating between good and poor readers in terms of the degree to which the latter are distracted by any intrusive stimuli, does not account for the differential effects of the visuo-graphic and auditory-phonological distractors in terms of rate, accuracy and comprehension of the prose texts used in this study. Santostefano et al. measured both the latency and 'potency' of recall under distractive conditions, and assumed that increased latency of recall and low success in recall were alternative indicators of the Constricted-Flexible style:

"It is assumed that S's who take significantly longer to complete or make more reading errors ..... cannot selectively withold their attention from the background and are governed by the constricted principle." (Santostefano et al. 1965, p 60.)

It would appear that the relationship between latency and success in Santostefano's study might be similar to that between the AVMPR and AVMPC rate and comprehension measures, already discussed as differentiating between <u>seeking</u> and <u>obtaining</u> information according to modality classification. Santostefano's Constricted-Flexible distinction cannot however, accommodate the specific modality effect in the present study, whereby those who attend to distraction material in the auditory modality tend to exhibit a different reading style from those who attend to distraction material in the visual modality (in terms of the relationships among the accuracy, rate and comprehension quotients).

Kagan (1965) found that reading errors were more numerous in children who were 'impulsive' on his test of 'impulsivity', whereas the good readers tended to be persistent or 'reflective' on his scale. The implication of Kagan's finding is that the personality trait of impulsiveness may be partly responsible for poor reading (and reasoning) ability. Whilst the highly significant negative correlations between the general modal preference variables, GMPR and GMPC, are quite compatible with Kagan's postulate, the specific modality effect cannot be accounted for, nor can the zero correlation with spatial ability or the low r with comprehension ability (NC):

AVMPR	AVMPC	NA	NC	NR	PoP
1.000	+.3284 $p<.001$	-.2495 $p<.01$	-.1218 n.s	-.3420 $p<.001$	+.0292 n.s.
	1.0000	-.2783 $p<.01$	-.1021 n.s	-.4053 $p<.001$	-.0292 n.s.

According to Kagan's postulate, a high negative correlation between GMPR/GMPC and PoP (spatial ability), and also with NC (comprehension), would be predicted; this was not so. It appears that the pattern of correlations between GMPR/GMPC and other variables cannot be adequately interpreted in terms of Kagan's Impulsivity-Reflectivity dimension of cognitive style.

Also relevant to the consideration of distraction effects is the cognitive style dimension of Field Dependence vs. Field Independence, a theoretical framework advanced by Witkin (1962) and others. According to this distinction, Field-Dependent children are unable to dissociate figure from ground (according to the well-known Gestalt principle), which would be an advantage in reading where the context or background of an idea is important to its meaning. In this study, the visual preferent children might be held to be Field-Dependent in that they are bound by the visual context. Similarly, those bound by the auditory-phonological context might be held to be Field-Dependent. Field-Dependence, contrary to Witkin's suggestion, would therefore seem to militate against effective comprehension. Again, Witkin's distinction cannot accommodate the specific modality effect observed in this study.

Another system for analysing cognitive style has been developed by Schroder, Driver & Streufert (1967) who see cognitive styles as involving (i) the number of dimensions or principles relevant to a topic, and (ii) the skill a person has in relating these dimensions to each other. If reading, viewed as a complex, three-stage process, produces too many dimensions for some children, according to Schroder the development of integration systems will be impaired. Schroder offers an alternative interpretation of the results insofar as it accommodates (though it does not account for) the zero correlation between PoP and visual preference in reading. Reading may offer so many dimensions to some children that they are unable to interrelate them.

Wallach (1962) advises caution with regard to generalising cognitive style variables to other than the specific contexts of their original application. When experiments are replicated, the results appear inconsistent. Wallach suggests the necessity of refinement of constructs through multidimensional rather than through unidimensional strategies of research, and cautions against applying constructs derived from unidimensional studies in their most general form. For this study, this would suggest the confinement of generalisation of the constructs to no more than the reading style and levels as defined by the passages and experimental conditions, however closely they were related to classroom practice, unless supported by replications, particularly of extended scope, and by the results of Factor Analysis involving the computation of other cognitive style variables.

In consideration of the above cognitive style distinctions, the specific modality effect, noted by others as relevant to reading performance, defied explanation.

Paivio (1971) suggested a dual coding model for pictorial and verbal memory, asserting that items which are both nameable and imageable, such as simple pictures and concrete nouns, are (or can be) encoded dually. Snodgrass & McClure (1975) suggested that subjects under instruction to 'image' are more likely to generate and store both pictorial and verbal codes to words, whereas subjects under neutral conditions (as in the present study) are more likely to simply store verbal codes. Snodgrass (1974) also found that subjects who were given neutral encoding instruction in a recognition memory experiment showed confusion between an old (previously named, but differently) and its corresponding new word. This result was interpreted as indicating that the subjects had encoded pictures dually and were thus confused as to the form of the item they had seen originally. Snodgrass & McClure (1975) suggested that dual coding was much more efficient than unicoding. These findings appear relevant to the results of the present study in that Snodgrass's subjects, in both the 1974 and 1975 studies, were students beyond the initial stages of apprentice reading and, as dual encoders, might be comparable with those subjects in the present study who exhibited no tendency to be distracted by either classification of distractor material, confining themselves to the printed prose texts which would admit of dual encoding. The modal preferents in the present study might not have been able to achieve the more efficient dual encoding, and hence would not achieve adequate comprehension.

Senf (1969) also found, in an audio-visual analogue of the dichotic listening paradigm, that, although subjects preferred to recall digit items in separate modality sets, adequate readers increasingly ordered items in audio-visual pairs with increasing age when induced to do so. Whereas Senf used directed recall, thus controlling the recall strategy, the present study examined the effects of free recall. Senf postulated that retarded readers store information to different modalities in distinctive forms so that it becomes less easily combined for recall, though it would be independently well remembered. Senf found that, contrary to what would be predicted from Broadbent's (1957) mechanical model of attention whereby a subject would be unable to switch attention from channel to channel if the stimulus presentation rate were increased, the effect of stimulus presentation rate on recall could be almost completely ameliorated by inducing different strategies. The effect of rate of stimulus presentation, Senf concluded, may only be a set effect. This interpretation is consistent with the present results where the rate of stimulus presentation was wholly, it was assumed, under the control of the individual subject, the rate and comprehension effects thereby being attributable to the individual's preferred set at that level and style of reading. As with the present study, Senf found no evidence of gross language (that is, oral language) dysfunctions in his retarded readers, suggesting that their difficulty was relatively specific to reading and, more particularly, to the 'reading aloud' stage of apprentice reading. It should be recognised, however, that Senf (1969) used digits for recall, presumably for the ease of experimentation as in the writer's previous study (Brown, 1975) where the modality set effect was first noted by the writer, and there remains the possibility that the modality set effect does not operate uniformly over such different task requirements. This would appear to be an even greater possibility than that whereby the modality set effect might operate differentially over the various stages of apprentice reading. Further, Senf does not state his criteria for assignment of subjects to the reading retardate group; in this study, the lag between comprehension quotient and accuracy quotient was the criterion, being assumed to be more pertinent to pedagogy than mere consideration of the word recognition or accuracy quotient or reading age alone.

The salience of the modality dimension of the set-effect prompts consideration of the relationship of coding processes to the cerebral hemispheres. In his discussion of visual imagery, Bower (1970) suggests that the verbal (which the writer interprets as 'auditory-phonological') and visual processing systems might be functionally discriminated along hemispheric lines. A verbal processing system, which is specialised for speech and abstract information, may be primarily a left hemisphere function, while a visual processing system, which is more adept at handling non-verbal spatial and concrete information, appears to be associated with the right hemisphere, according to Seamon (1974). The results of presentation of letters to right and left hemispheres, exploiting the contralateral connections of the visuocortical wiring in man, indicated that letter stimuli were responded to significantly faster when presented to the left hemishpere than to the right (Rizzolatti, Umilta and Berlucchi, 1971) whereas the reverse was so when the visual stimulus was a picture of a face (Geffen, Bradshaw & Wallace, 1971). Seamon quotes neurological observations in agreement with such findings, and further suggests that if information is temporally or spatially separated in memory at the time of input, retrieval requires a serial search regardless of whether the information has been coded in a verbal or imaginal form, whereas if the information is unitised or chunked, as it was in Seamon's study by relational imagery, retrieval may be described by a parallel (and presumably faster) retrieval process. The idea of separate processing systems as different modes of thought is also suggested from the study of cognitive development. Bruner (1966) suggests that the development of an imagery representational system precedes that of the language system, and Neisser (1962) has argued that early childhood experiences are frequently unrecallable because childhood memory schemata are incompatible with those of the adult.

The present study might be interpreted as an investigation into how the two systems act in conjunction and in disjunction in normal activities. Apprentice reading depends primarily, in the sense of temporal precedence, upon visual schemata, but primarily, in the qualitative sense, upon auditory-phonological schemata. Attention to visual encoding would, according to Seamon's findings, lead to both temporal and spatial separation in memory at the time of input, resulting in attenuation of the processing time, but ultimately in a fairly accurate translation to auditory-phonological codes provided that temporal press does not inhibit it. Attention to auditory-phonological encoding would tend to lead to spatial, but not temporal, separation at the time of input, resulting in lesser attenuation of processing time than that for visual encoding, but with a less accurate recall due to the haphazard formation of visual schemata. Thus visual-encoding preferent poor readers might be differentiated from auditory-phonological encoding poor readers in terms of the relationships of rate of reading aloud and accuracy of reading aloud viewed as the immediate retrieval of separately encoded or differentially encoded information. Good readers, on the other hand, would be characterised not by the duality of their encoding, which, when most effective, would result in good word recognition and fluency of reading aloud, but by relational imagery which subsumes but is not automatically consequent upon successful dual encoding. This interpretation would thus account for the difference between good reading in the word-recognition sense and good reading in the word-recognition plus comprehension sense, and for the differential effects of the distractors, according to modality, in the poor readers.

1.9.3. Towards a Remedial Procedure.

Commenting that the literature on the effects of remedial education is 'on the whole, fairly gloomy', Yule(1975) agrees with Miles(1974) that it is correct to argue that remediation may be separated from any understanding of aetiology. If those children who have 'specific reading difficulty' are characterised by modal preference in a task in which the required perception is of a peculiar three-stage sequence of processing levels, and if 'mature' reading involves the omission of one of those stages, the auditory-phonological encoding stage, it would seem reasonable to omit that stage for the 'apprentice' reader. Whether it is possible to omit that stage is another matter, to be discussed later. The omission of the auditory-phonological encoding stage would presumably benefit those readers who are visual-mode preferent on the AVMPC measure, enabling them to achieve semantic encoding by their preferred coding path: Readers with 'specific reading difficulty' tended to be visual-mode preferent, the relationship between $\frac{NC}{NA}$ and AVMPC being significant at the .001 level of confidence ($r = +.3469$). This possibility will be investigated in Part 3.

PART TWO

A STUDY OF LEVELS OF LINGUISTIC COMPLEXITY AND THEIR RELATIONSHIP TO READING DIFFICULTY.

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Part 2 A STUDY OF LEVELS OF LINGUISTIC COMPLEXITY AND THEIR RELATIONSHIP TO READING DIFFICULTY.

2.0.0 Introduction

Children in British schools are usually taught to read until 8 or perhaps 9 years of age, unless they are deemed 'remedial' and assigned to a special class for repetition of certain features of what was taught from 5 to 8. Thereafter, training in reading is largely incidental, the level of complexity of reading material being assumed to 'mesh' with progress through the higher forms of learning. This is to say that, after formal reading instruction has ceased,

(a) it is assumed that a fundamental skill has been mastered,

(b) it is accepted that elementary or basic reading strategies subsume all those required for increasingly complex reading matter from then onwards,

(c) it is taken for granted that the additional skills, when it is acknowledged that they may be required, for tackling more complex material, will accrue automatically.

Apart from 'remedial' teaching, then, secondary schooling appears, as far as reading is concerned at least, not to be concerned with 'learning to learn'.

This study focusses on the characteristice of the English language, particularly as they are presented to the 'apprentice' reader, and briefly traces the development of these characteristics, accompanied by an analysis which should be pertinent to the devising of a teaching paradigm for the remediation of certain reading difficulties, and should be relevant to the formulation of reading and vocabulary development policy in the upper primary and in the secondary school.

2.0.1. Development and Characteristics of the English Language.

English belongs to the Low-West-Teutonic branch of the Indo-European family of languages and consequently shares characteristics with all Teutonic languages; for example, the shifting of certain consonants according to Grimm's Law, the possession of a weak as well as a strong declension of the adjective, and a distinctive type of conjugation of the verb. It also shows the adoption of a strong stress accent on the first or root syllable of most words, but this is obscured in modern English by the abundance of Latinate words which behave differently.

English also has characteristics common to Low-West-Teutonic languages in particular, differentiating them from the North Teutonic or Scandinavian languages. These differentiating features mostly have to do with phonetic changes such as the gemination or doubling of consonants under certain conditions. English did not participate in the Second or High German Sound Shift ("open" - "offen"), belonging instead to the lowland dialects in the West Teutonic area.

The evolution of English has been unbroken over some 1500 years, but three main periods may be recognized within this time:

1. 450 - 1150 Old English, characterized by full inflections. the endings of the noun, adjective and verb being preserved relatively unimpaired.
2. 1150 - 1500 Middle English, characterised by reduction of the inflections.
3. 1500 - now. Modern English, characterised by the disappearance of a large part of the original inflectional system.

The progressive decay of the inflectional system is not the only development that marks the various stages of the evolution of the English language. In vocabulary, the Middle English period saw the loss of a significant proportion of the Old English word stock and saw the addition of thousands of words from French and Latin. The changes in grammar, 'reducing' English from a highly inflected or 'synthetic' language to a highly analytic one, have been shown to have been complete by 1500 (Fries, 1940). The Middle English period also saw the decline of the strong verb, nearly a third of which died out. New verbs were borrowed or formed from nouns and adjectives and were regularly conjugated as weak - even a few strong verbs were converted! - thus illustrating the principle of analogy, the tendency of language to follow certain patterns and adapt a less common form to a more familiar one.

<u>The influence of Norman-French upon English vocabulary</u>.

For a hundred years after the Norman Conquest, there was no increase in the number of French words adopted (Jesperson, 1928; Mossé, 1943). The adoption rate increases slightly in the latter half of the 12th. century, increasing rapidly in the 1200 - 1250 period, waxing to a climax at the end of the 14th. century, and then rapidly declining in the 15th. century, followed by a tapering-off. The introduction of French words into English follows closely the progressive adoption of English by the upper classes and then by the merchant class. During the period 1250 - 1400, there entered nearly 40% of all the words in the English language now and, of the slightly over 10,000 French words adopted during the Middle English period, about 75% are still in current use (Baugh, 1959). Hybridisation of the French roots occurred using the remaining English prefixes (be-, un-, over-, for-,) and suffixes (-hood, -ness, -ship). There was also consequent semantic differentiation of the hybrid words. Despite the above hybrid formation, there is a visible (in written language) decline in the Middle English period in the use of the old methods of word formation, in the combination of native elements into self-interpreting compounds. At the same time, there was continual borrowing from Latin, often to the point of affectation (as in the case of "Aureate Diction").

The Modern English Period may be held to date from about 1500 because a number of factors combined to produce accelerated change, the printing press, the rapid spread of popular education, the increase in travel and trade, and perhaps the growth of social consciousness. According to Baugh (1959), it is probable that not less than a third, and maybe as many as half, of the people could read. In this modern period, we see the development of social mobility and the growth in the awareness that there are standards of language. The printing press, the reading habit, and all forms of communication favoured the growth of ideas and stimulated the growth of vocabulary. At the same time, these same agencies of change, together with social consciousness, worked actively towards the notion of a standard, especially in grammar and usage.

In modern times, then, changes in grammar appear to have been slight, whilst changes in vocabulary have been very extensive. This appears to be the converse of what was true of the Middle English period, when the changes in grammar were revolutionary but, apart from the special effects of the Norman Conquest (and these took a long time to make themselves felt), the changes in vocabulary were not great.

By assimilation into the differentiating language of the new upper classes, the authority of Latin - particularly that of the time and class of Cicero - and also of Greek began to invade the vernacular and, in so doing, revealed the deficiencies of the vernacular. The borrowing from Classical language was so great at times that there was, for example, fierce opposition in the 16th. century to "inkhorn terms". Ben Jonson remarked in his "Discoveries" that "A man coins not a new word without some peril and less fruit; for if it happen to be received, the praise is but moderate; if refused, the scorn is assured."

A few of the words entering the language in the modern period maintained their Latin form ('climax', 'appendix' and 'delirium' for example), but most words underwent either abbreviation of inflectional ending or some other modification on entry. Examples of both forms of adaptation are:

	Latin	English
Abbreviation:	consultare	consult
	exclusionem	exclusion
Modification:	exterminatus	exterminate
	conspicuus	conspicuous
	externus	external.

The tendency observed by the present writer appears to be that the later the adoption of the classical word, the greater the likeli hood that the modification is regular in grammatical and semantic consistency. "Episcopal" and "disc"/"discus" are late borrowings, the early borrowings having the forms "bishop" and "dish"/"desk" respectively.

An important change, relevant to present-day orthography, in the development from Middle to Modern English is in the length of the vowels. The short vowels remained fairly stable, but not so the long vowels. In the 15th. century, all the long vowels came to be pronounced with a greater elevation of the tongue and closing of the mouth, whilst those that could not be raised without becoming consonantal became dipthongs. This Great Vowel Shift is responsible for the unorthodox use of the vowel symbols in English spelling, for the spelling of English had become fixed before the Shift and did not change when the quality of the long vowels changed. In other words, there is no longer a reasonably unequivocal phoneme-grapheme correspondence where there used to be, in this respect, and spelling does not accurately represent the present pronunciation.

In grammar, the loss of noun-, adjective- and pronoun-inflections is well known and well documented, and changes in syntax are also most noticeable, from the Middle to Modern English periods, one important development being the gradual refinement in the use of subordinate clauses, most marked by the use of 'who' as a relative. Parataxis, the loose association of clauses, in Middle English, gives way to Hypotaxis in Modern English, with more precise indications of the logical relationships and subordination which required a dramatic increase in the variety of words to relate clauses. The Parataxis - Hypotaxis trend is part of the third aspect of the development of the English language summarised in the following diagram:

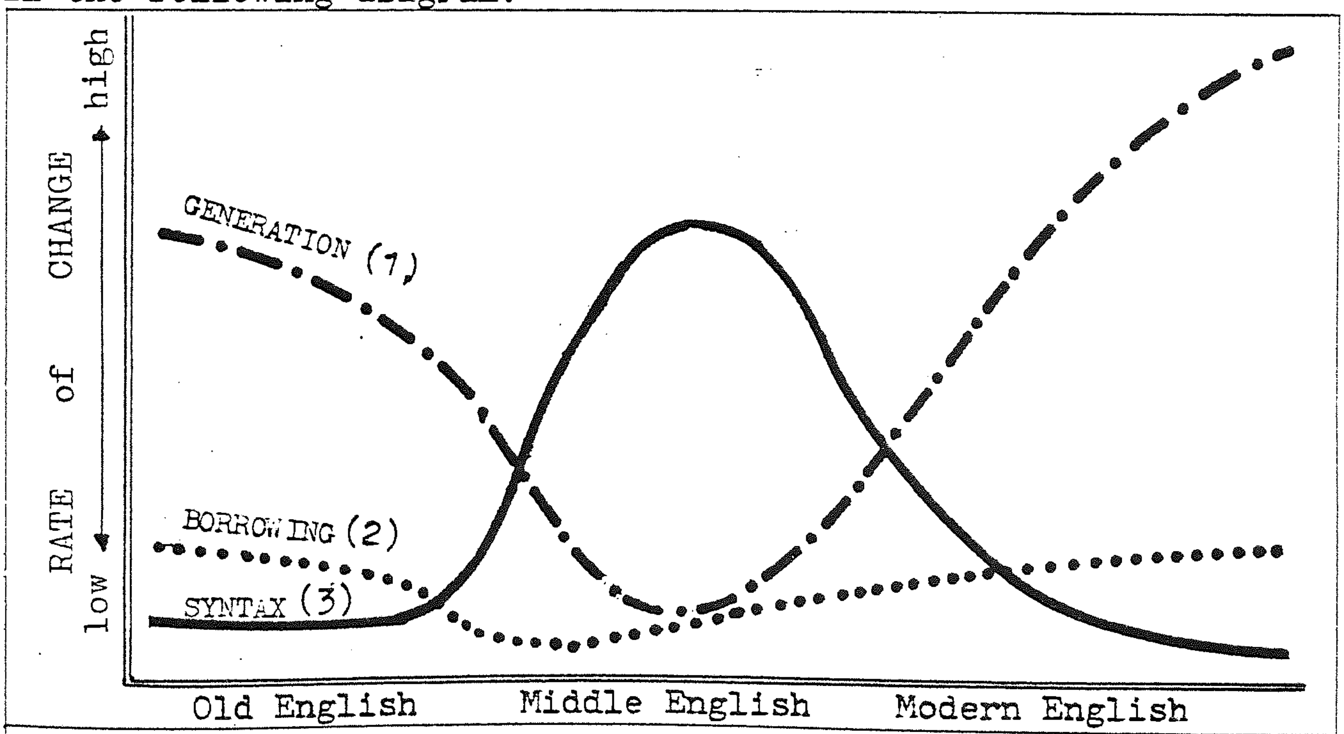


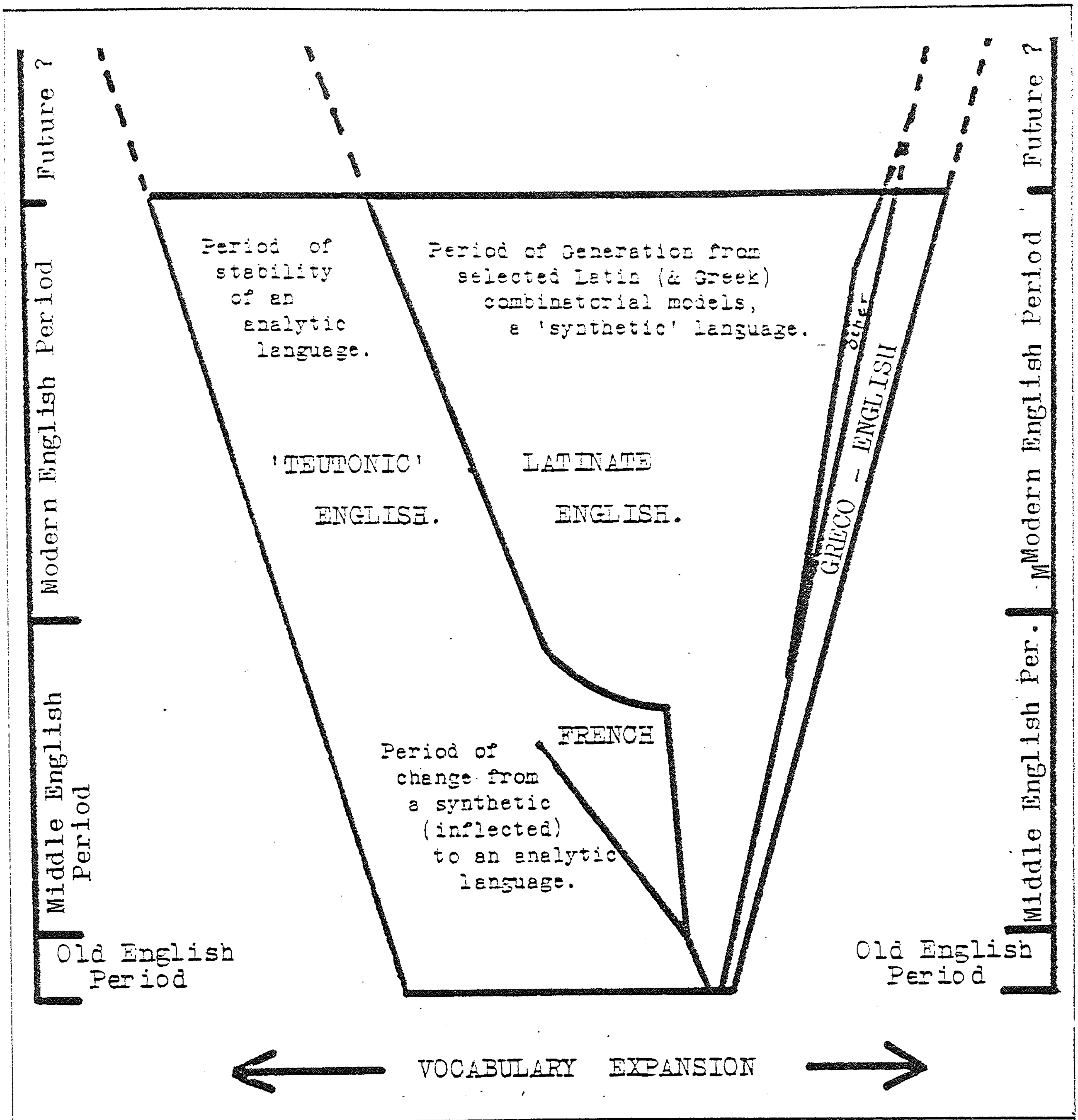
Figure 24. Diagram to show the estimated variation in rate of change of 3 aspects of the development of the English language.

The term "Generation" (aspect no. 1 in Figure 24) is here used to indicate the process whereby new words are formed by recombination of elements (roots, prefixes and suffixes) from the existing language.

We should neglect an essential element of the language if we ignored the numerous conventional features, other than those discussed above, that defy explanation in terms of logical classification but are nevertheless characteristic of the language at a given time and, like other conventions, are subject to change. The use of the double negative as an intensive is a good example, as is the rich variation in the use of prepositions. Many of these features, however, are more appropriate to a study of the spoken rather than the written language. There is currently much interest in the paralingual, non-verbal 'language' which would suggest that the features that have hitherto been dismissed as accidentals are not random or arbitrary but patterned behaviour, innate or learnt, from which may be induced a syntax.

The development of the English Language may be summarised at this point, mainly in terms of the vocabulary expansion and the clear influences of (1) Norman-French - itself a Teutonic variant of Old French - and also French, (2) Latin, both in direct borrowing and in subscription to Latin models of combination, and (3) Greek borrowing and models of combination or generation. A graphic representation of the expansion of English vocabulary from Old English to modern times is presented in Figure 25.

The Latin words which form so large a proportion of present-day English vocabulary originally entered the language through the medium of WRITING, in contrast to the Scandinavian, and to a large extent the French, influence, which was ORAL. This being so, we



<u>Figure 25.</u> Diagram to show the Expansion of English Vocabulary from Old to Modern English times.

can expect the entry of Latin words not only to be datable but also attributable to individual authorities, and indeed this is so: For example, we owe 'absurdity', 'acceptance' and hundreds more to Sir Thomas More. In contrast to the works of such as More (d. 1535), the translation of St. Matthew's Gospel by the Old-English-purist Cheke (c. 1560) seems to be far from modern English. Where the Authorised Version (1611) of the Bible reads 'lunatic', Cheke has 'mooned':-

Authorised Version 1611.	Cheke c.1560.
'lunatic'	'mooned'
'publican'	'toller'
'centurion'	'hundreder'
'prophet'	'foresayer'
'parable'	'byword'
'proselyte'	'freshman'
'crucified'	'crossed'
'Resurrection'	'gainrising'.

It is often assumed that the 'golden age' for classical verbal intrusions was the 18th. century, but Latin was **victorious long** before then!

The 18th. century is characterised by a feeling of need for permanence, stability and consolidation in England, the craving for permanence that prompted the new landowners to plant trees extensively and with such careful siting, even though the landscape would not be perfect until well after the decease of the planter. The intellectual qualities that parallel such thought are seen quite clearly in the 18th. century efforts to standardise, refine and FIX the language, tendencies found in other successful European states. Latin had been reduced to rule (or, at least, Ciceronian Latin had!), but English was found not to have grammar, or rather it was found that English grammar was uncodified, unsystematised and unsystematic: One learned to speak and write as one learned to walk, and in matters of grammatical usage there was great variation even among educated men. The spontaneous creativity of Shakespeare and his contemporaries, who ' verbed it with nouns and adjectives' became distasteful. The Rationalist spirit of the 18th. century revealed itself in the attempt to settle disputes logically, appealing to the analogy of the codified Latin. The English language being daily corrupted, the desire was to give it correction and refinement, and then fix it in a polished, rational and permanent form. The institutionalisation of this movement was to have been the establishment of an academy after the example of France - such was the intent of Swift's 'Proposal' (Swift, 1712). Advocacy of an Academy declined from then on, particularly after the publication of Dr. Johnson's Dictionary in 1755 - another attempt, influential but idiosyncratic, to fix the language by giving it certainty of diction and usage. What Dr. Johnson did for the vocabulary was attempted for the syntax by the grammarians of the 18th. century, who had three apparent aims:

1. to codify the principles of language and reduce it to rule,
2. to settle disputes and decide cases of divided usage,
3. to point out common (supposed) errors and thus correct and improve the language.

Not content to record the facts of the language as they presented themselves at that time, the grammarians, such as Lowth, pronounced judgment, and the considerations by which disputes were to be settled were Reason, Etymology and the Example of Latin and Greek. 'Reason' was commonly taken to mean 'consistency' or 'analogy' which appeals to "an instinct common at all times in matters of language, the instinct for regularity." (Baugh, 1959).

In the 19th. century, attention was diverted from the internal problems which beset the English language to the wide extension of the language across the world. Like the language itself, the British Empire was not the result of a consciously planned and aggressively executed programme, rather the product of circumstances, and often of chance.

Coincident with the growth of the Empire was the further growth of science and its application in the Industrial Revolution, again the product of circumstances and often of chance. The blossoming of an industrial, consumer-oriented, as opposed to leisure-oriented, society necessitated the introduction of numerous words from other languages; this easily-defined aspect of linguistic adaptation has been well documented but possibly of minor importance. Words can be thought of, when recorded in print, as an accurate measure of thought at a given time, the vocabulary having to keep pace with changes in knowledge and human purposes. Most of the words, however, that have come into use since 1800 have been derived from the same few sources or have been generated by the same few methods as those that have been long familiar. These principles are not new, in that what has been going on in the last 150 years could be paralleled from almost any period of the language. What is different is the rate of vocabulary expansion, or perhaps the accelerated change of rate, which is greater than that of any other period. The existence of a large Classical element in the language enables the new formations to seem quite congenial to the language.

Semantic change has also been well documented for the English language, the changes in the meanings of words often pursuing such well-marked tendencies as:-

1. Extension of meaning, or Generalisation,
2. Narrowing of meaning,
3. Degeneration,
4. Regeneration.

exemplified in:-

1. 'great' and 'lovely',
2. 'doctor' - The same word may acquire restricted meaning for ... often belonging to a special or class vocab-

ulary which does not preclude its different wider use.

3 overlaps with 1: 'smug' used to mean 'neat and precise' but has degenerated.

4. 'snob' and 'sham' were once slang.

Slang is a part of the language which should not be ignored, but its consideration is not relevant to this study because, functioning as a group differentiator, it appears first in the oral language, few slang expressions overcoming evanescence to appear in the written language, by which time, except when used to create atmosphere in novels, they would have regenerated.

Also largely outside the scope of written language, and therefore not relevant to this study, are the local and class dialects. Technical and occupational vocabularies, on the other hand, are relevant, informing the major part of literature published nowadays. The most dramatic changes have been in the growth of these technical and occupational vocabularies, involving the continual release of what is initially jargon to wider use, often accompanied by semantic generalisation. 'Chronic' has a narrow meaning for medical use, and a more vague, generalised meaning at large.

In present-day English, three broad types of language may be differentiated. That is to say that there are three broad contextual linguistic requirements: literary standard English, spoken standard, and vulgar speech, though it is not possible to draw rigid lines of demarcation between them. For example, formal occasions require the kind of English where the spoken standard approaches the written. The language being context-bound, the interaction of individual and context demands variation of vocabulary, semantics, syntax and grammar accordingly. In certain contexts, then, oral and written language may not be different in many important respects; conversely, where they are clearly differentiated, the contexts will be clearly different. It is here that linguistics merges imperceptibly into stylistics.

So far, it appears that not only are the spoken and written or printed versions of the English language usually differentiated in terms of function or purpose, but the sounds of the spoken language are now not very closely related to the orthography, the orthography having been almost immutably fixed well before the occurrence of certain critical sound shifts. Much attention has been given in the 20th. century to the possibility of regularising the spelling of the English language. There are also those who feel that the value of the old spelling is an asset not to be lightly relinquished (Craigie, 1944). Henry Bradley in his paper 'On the Relation of Spoken and Written Language' (1919) held that it was a mistake to think that the sole funtion of writing was to represent sounds, for, as we read, many words convey their meaning directly without the intermediate process of pronunciation, even 'mental pronunciation'. We know, of course, that many words are sounded alike, but are differentiated in writing. All reforms of English spelling seem to have suffered from the assumption that the sole function of writing was to represent sounds. This is probably because such reforms have been aimed at alleviating the problems that arise at the first or 'apprentice' stage of teaching and learning of writing and reading, where close correspondence between the spoken and written language is apparent ...... and contrived, being built into the design of reading primers according to the assumption that what is read should be read aloud. Such a reformed spelling, the I T A, the Initial Teaching Alphabet, was introduced to a number of English schools on trial, rather than on an expermental, basis, and has apparently been rejected by 'the trade'.

The presently constituted English language also has a number of distinctive linguistic strands, the importance of each of which, with regard to the proportion of vocabulary associated with each, is estimated in Figure 28, above. The two most significant strands appear to be the Teutonic and the Latinate. The corpus of Teutonic words appears to be stable and, because the corpus of Latinate and Greek words is growing rapidly in response to the demands of science and technology, is a declining proportion of the total vocabulary. The Teutonic vocabulary is characterised in writing by the shortness of its words, in numbers of letters, and by their functions; they particularly account for almost all of the 'function' words, as opposed to 'content' words, in the language (Gilliland, 1970). Where they do appear as 'content' words, they still tend to be short. On the other hand, the corpus of Latinate words appears to be ever-expanding, and is characterised by the length of the words and the tendency for them to be almost wholly 'content' words.

The distinction between 'function' and 'content' words is very widely used (Neisser, 1967; Francis, 1963, and Farnes, 1975, for example) but should not be pressed too far, in the present writer's opinion. 'Function' words are not supposed to have any specific referents of their own, whilst 'content' words are. The distinction holds fairly well for nouns, but when, for example, a 'function' words such as "with" is compared in certain contexts with appropriate verbs ('content' words) such as "coincides", the distinction becomes somewhat blurred. Further, it is difficult to educe a theory of language that would uphold the distinction.

The prose material selected or concocted for the 'apprentice' reader is graded carefully, largely according to the length of the words, and the progression in such literature appears to be from the short to the long, from the Teutonic to the Latinate. There would appear to be some connection between the language system to which words may be allocated and the length of the words, and also between the language system to which a word may be allocated and the reading level to which it may be assigned.

The word here is assumed to have some special significance, words being held to embody some commonly perceived boundary in the written language in particular. Little difficulty appears to be found by children in perceiving these boundaries, even when the words are difficult to read or reproduce. What constitutes a sentence, as we have seen earlier in this section, has undergone considerable adjustment in the course of the history of the English language. Children do appear to have more difficulties in the formation and punctuation of sentences, which the present writer would interpret as difficulties with the definition of sentence boundaries. Perhaps in the case of sentences, the linguistic ontogeny repeats the linguistic phylogeny!

The word itself, however, is capable of being segmented further, though the present writer would argue that the perception of within-word boundaries is not as universal a perception as that between words. Two methods of within-word segmentation appear to be available:

1. Syllabication, and 2. Morphemic.

The syllable is the result of phonetic or sound perception, and may be " A vocal sound or set of sounds uttered with a single effort of articulation" or "each of the elements of a spoken language comprising a sound of greater sonority (vowel or vowel-equivalent) with or without one or more sounds of less sonority (consonants or consonant equivalents)." (The Shorter Oxford English Dictionary.)

The morpheme may be thought of as "The smallest meaningful unit in the structure of words (a root word, a prefix, a suffix, or an inflectional ending." (Hingley, 1977.)

The relationship between the syllable and the morpheme as (possibly) perceived within-word boundaries would appear to be worthy of investigation, particularly with regard to the difficulties experienced by many 'apprentice' readers. If the purpose of reading is to merely reproduce, or in information processing terms to 'phonologically decode', the printed word in speech, then the syllabic boundaries would appear to be relevant. If the purpose of reading is to impose meaning on the displayed print, or in information processing terms to 'semantically encode', then morphemic boundaries would appear to be signficant. The question arises as to whether these boundaries in any way coincide. From what Bradley says (Bradley, 1919), there is no reason why they should, and the relationship, if any, will be investigated in this study.

2.0.2. Summary.

Modern English may not be considered as one language system but as a hybrid of at least two:

1. A basically Teutonic language with early intrusions from Norman French that have been, largely, successfully assimilated, and which characteristically tends to be:

i. analytic, i.e. tending towards dependence upon word order for the communication of syntactic or other relationships.

ii. widely used for oral and informal communication, perhaps where the status or role of either or both of the conversants is not being stressed.

iii. exploited in the written language for 'function' rather than for 'content' words. (Caution has already been advised with regard to these terms.)

iv. marked by a low syllable or morpheme count per word.

v. marked by a high degree of coincidence of morpheme boundaries with phoneme-cluster or syllabic boundaries. The coincidence of such boundaries within the word may be termed 'congruence' and is exemplified in Table 5.

vi. resistant to attempts, beyond the simplistic, at fixation of syntax by grammarians. This may well be because of the 'analytic' direction of the mutation of the Teutonic language system in England (section 2.0.1. q.v.).

vii. lexically static in that fresh concepts depend upon re-stringing existing words rather than recombining morphemic segments into new words.

viii. socially neutral in that, with the possible exceptions of slang, dialect and idiolect (not relevant to a consideration of the written language), it tends NOT to lend itself for use for exclusion or differentiation of occupational and other group vocabularies.

2. A basically Latinate language, with which may be included a lesser-used Greek language, which characteristically tends to be:

i. synthetic, or dependent upon the agglomeration of morphemes for the communication of semantic and some syntactic relationships.

ii. widely used for written, and moreso for printed, communication, particularly where the status or role of the writer is being stressed.

iii. exploited in the written or printed language for 'content' words rather than for 'function' words (subject to reservations already expressed).

iv. compounded, lexically, of morphemes to a large degree.

v. marked by a high degree of 'incongruence' or lack of coincidence of morphemic segmentation boundaries with syllabic or phoneme cluster segmentation boundaries within words.

vi. exceptionally amenable to attempts at fixation of syntax by grammarians. Both the entry to English of Latin particles and the overwhelming tendency to generate new words according to the Latinate agglomeration principles may be held to be a quite deliberate and controlled tendency rather than a capricious one.

vii. in a condition of lexical flux in that fresh concepts depend upon the perpetual recombination of existing elements or morphemic segments rather than upon the radical infusion of new elements into the lexicon.

viii. often socially dynamic, in that it lends itself for group, particularly occupational group, differentiation.

Etymology	Type of Combination	Morpheme Boundaries	Phoneme-Cluster (Syllabic) Boundaries	Grapheme-Cluster (Morpho-Grapheme) Boundaries	Congruence
Teutonic	Teutonic	for/bear/ing	for/bear/ing	for(e)/bear/ing	Yes
Teutonic	Teutonic	bind/sight	bind/sight	bind/sight	Yes
Teutonic	Teutonic	foot/path/s	foot/paths	foot/path/s	Yes (?)
Teutonic	Teutonic	water/cress	water/cress	water/cress	Yes
Norman-French	Teutonic	dis/taste/ful	dis/taste/ful	dis/taste/ful	Yes
Latin	Latinate	corp/or/at/ion	cor/por/a/tion	corp/or/at(e)/ion	No
Latin	Latinate	act/ion	ac/tion	act/ion	No
Latin	Latinate	com/bin/at/ion	com/bin/a/tion	com/bin(e)/at(e)/ion	No
Latin	Latinate	sup/pos/e	supp/ose OR su/ppose BUT NOT sup/pose	sup sub/pose	No

Table 5. Examples of Congruence/Incongruence of Morphemic, Syllabic and Grapheme-cluster Boundaries in terms of Etymological classification.

Examples of the difference between the Latinate and Teutonic systems in terms of morphemic, syllabic and grapheme-cluster (morphographemic) boundaries are presented in Table 5. Teutonic words such as 'hindsight' and 'footpaths' are considered to be congruent because the syllabic boundaries, between 'hind' and 'sight', 'foot' and 'paths', coincide with semantic or meaning boundaries. Such words may, in many cases, be regarded as compounded of semantically distinguishable particles that can be used independently, the morphemic boundaries always coinciding with the syllabic boundaries. In words formed according to Latinate principles, the morphemic segments (and the syllables) tend not to be able to stand independently as words, and also tend to exhibit incongruence between morphemic (or 'morphographemic', when written or printed) and syllabic boundaries. Thus 'corporation' (from Table 5) may be syllabified

'cor - por - a - tion'

whilst having the morphographemic boundaries

'corp - or - at(e) - ion',

where 'corp' indicates that a body is involved, 'or' indicates that an agent of action is making a body, 'at(e)' indicates that the action of making has stopped, and 'ion' indicates that one representation of all (possible?) cases of 'corporate' has been achieved. In this case, the individual syllables could be held to have little or no meaning, until the complete word has been synthesised, whereas the morphographemes, by definition, do have meaning individually, such meaning being presumably enhanced by the order of syntaxis.

The English language appears to be at least bisystemic, if not polysystemic, with regard to syntax, lexication or the mode of word generation from particles or smaller words, and the relationship between phonology and semantic. The relationship between the operation of these suggested systems and the actual perceptions of text and word difficulty by 'apprentice reader' children appears worthy of further investigation.

2.0.3 Levels of Linguistic Complexity and the Readability of Prose Materials.

Relevant to reading pedagogy, there are two kinds of measure that may be made of the readability of a text:

1. The characteristics of the language of the text, and
2. The individual reader's understanding of the text.

Only by studying the first of these can predictions be made as to the suitability of texts for classroom use without trying each text out on a sample of the children for whom it is intended, perhaps by use of the cloze procedure to predict whether the text is likely to be at 'frustration level', 'instruction level' or the 'independent level' according to the percentages of errors made in reading (Strang & Bracken, 1957).

In considering the linguistic characteristics that might affect the assignment of texts to levels of readability, various features have been put forward as contributing to reading difficulty, the main ones being:

The length of words.

The frequency of occurrence, or the rarity of words.

The length of sentences by number of words.

The complexity of sentences in terms of grammar or syntax.

The obscurity or otherwise of textual references.

The complexity of ideas contained in the text.

The 'human interest' of the subject matter.

It has, however, been repeatedly found (Gilliland, 1971) that two features, the length of words and the length of sentences, contribute most to a measure of readability (Davies, 1973). A readability measure, in turning attention from the reader to the material read, tries to indicate where a particular text lies on a scale of difficulty. However, the strength of the prediction made by an index of readability can only be tested by reference to norms obtained from the quantification of the difficulty that children, or adults for that matter, actually experience with the text OR by comparison of the saliences of relevant features of the text with those pertaining to other texts for which norms of difficulty are available. Such norms are available or may be computed from, the graded prose texts to be found in certain tests of reading ability.

Although there are other factors than stylistic ones (Interest, Format and Organisation, for example), attention has traditionally been focussed on stylistic variables of two classes or levels:

1. The word and syllable level.
2. The phrase - clause - sentence level.

These two levels, often in combination, have generated various formulae for the computation of indices of readability, examples of which are given in Table 6. What these measures have in common is the sentence length in terms of the number of words and the length of the words in terms of numbers of letters or syllables: "The largest groupings (of variables) involve sentence and word factors." (Gilliland, 1971.) A strong case has been made (Bormuth, 1966; Gilliland, 1971) for replacing the readability formulae by using the Cloze procedure, which is held to link the text with the individual reader and is also held to explore the relationship between words and sentences, links which other measures can only make by the addition of comprehension questions, usually graded according to a taxonomy such as that of Bloom (Bloom, 1956). The cloze procedure was devised by Taylor (1953) and involves systematically deleting or omitting words from a text. The reader is required to insert appropriate items with the help of the context.

Some Examples of Readability Formulae:

1. Farr-Jenkins-Patterson.

New Reading Ease Index = 1.599 nosw - 1.015sl - 31.517

(nosw = number of one-syllable words per 100 words;

sl = average sentence length).

2. Flesch.

R.E. (Reading Ease) = 206.835 - .846wl - 1.015sl

(wl = number of syllables per 100 words; sl = average number of words per sentence).

3. SMOG (McLaughlin, 1969).

Reading grade = 3 + P,

where P = number which is the nearest perfect square to the number of three-or-more syllable words in thirty sentences.

4. Gunning's FOG Index.

Reading grade level = .4 (average sentence length + percentage of words of 3 or more syllables, or poly syllables).

5. Powers, Sumner and Kearl.

X_c = 8.4335 + .0923sl + .0648(percent of monosyllables)

6. Dale and Chall.

$X_{c50} = .1579x_1 + .0496_{x2} + 3.6365$,

(X_{c50} = reading grade score of pupil who can answer correctly one half of the McCall Crabbs test questions on a passage: x_1 = percentage of words outside the Dale list of 3000 (Dale score); x_2 = average sentence length.

Table 6 . Some Examples of Readability Formulae.

Whilst Cloze may be thought to take more account of semantic and linguistic structures than do other readability measures, it also widens the possible interpretation because the word that was originally deleted need not necessarily be the same as the respondent's replacement for it. The replacement could, in some cases, be conceivably superior to the original. Further, the restriction of the replacement to a word-for-word basis could prevent the respondent from supplying a semantically and grammatically more appropriate phrase insertion. To meet such criticisms, Cloze might degenerate into a paraphrase or even a summary of the original.

Contextual aids tend to be used by readers who are at the 'independent' level of reading, where little difficulty is experienced with word recognition or meaning. 'Apprentice' readers vary greatly both in their ability to identify words and to derive meaning from context as is shown by various studies from Boston University, quoted by Burns (1967). For such readers, whilst context may clarify the meaning of a difficult word, it will usually be unable to do so without other identification. As vocabulary growth through context revelation is a very gradual one, this study concentrates on the level of word identification which may be held to precede it.

Bormuth (1966) does admit, after pressing the virtues of Cloze, that any advance in readability studies must await more careful description of the relevant linguistic variables: "Major advances in readability prediction will result from the development of more sophisticated variables with which to measure the attributes of prose style." (Bormuth, 1966, page 129.)

Another approach has been made to readability from general linguistic theory. Yngve (1960) hypothesised that, in the process of sentence recognition, a sentence constituent is submitted to memory, then each sub-constituent in turn, until the left-most terminal element (the first word of the constituent) is released. The other main constituent is kept in memory, together with the remaining sub-constituents of the first main constituent. These sub-constituents are then released, a word at a time, from left to right. Yngve then hypothesised that the memory load is the maximum number of constituents and sub-constituents that have to be remembered whilst processing the word which terminates the the largest string of left branches in the phrase 'tree'. Martin & Roberts (1967) and Perfetti (1969) found no support for Yngve's depth hypothesis in tests of sentence recall, but found that 'lexical density' appeared to be the important variable in recall, and that 'lexical density' appeared to be a measure of the semantic load of a sentence. Whilst Yngve held that the memorability of a sentence was a function of its grammatical or sybtactic complexity, Perfetti wishes to convert it to semantic complexity. Perfetti defines 'lexical density' as the number of lexical words in a sentence divided by the sum of the lexical words and the number of grammatical words in the sentence:-

$$\text{L.D.} = \frac{\text{number of lexical words in a sentence}}{\text{no. of lexical words + no. of grammat. words in sentence}}$$

<u>Lexical</u> words (following Lyons, 1968) were taken to include the open sets of nouns, adjectives, verbs and adverbs, whilst the remaining <u>grammatical</u> words included the closed sets of verb **auxiliaries** , articles, pronouns etc. The <u>lexical</u> or 'open' class of words, which give rise to Lexical Density, are closely parallel to 'content' words, as opposed to 'function' words, and presumably the same criticism would apply to the distinction (see section 2.0.1.). It has been shown (Aborn, Rubenstein & Sperling,

1959) that 'content' words are less predictable than 'function' words, and hence carry more <u>information</u>. If, as Perfetti argues, it is not sentence depth, in terms of the complexity of the underlying syntactic structures, that determines the memorability of sentences, but the semantic structures, why is attention again deflected to the word level rather than the morpheme (the smallest unit of meaning) level? Perfetti's 'Lexical Density' is held to be a measure of the semantic content load, yet it is dependent upon the (arbitrary) distinction between lexical and grammatical words. In a sentence containing 'men', is 'men' so different from 'others' or 'they' that it should be excluded from 'the closed set of verb auxiliaries, articles, pronouns etc.'? Pronoun and noun are somewhat arbitrarily differentiated in practice, and the 'boundary' has been fixed by grammarians. Ultimately, the criterion of differentiation would appear to the writer to be no more than an arbitrary point or small gap in a scale of frequency of occurrence of words, it being expected, from experience, that those words at the higher end of the frequency scale would be small words either in terms of graphemes or of phonemes according to whether one is focussing on the written or the oral language.

At first sight, derivational complexity, in terms of transformational grammar (Yngve, 1960), appears to provide a rationale for difficulty in sentence recall and, presumably, for difficulty in sentence processing. In terms of Yngve's 'mean depth' (the average number of left branches per word) variable, the following sentences have the same mean depth, $\bar{d} = 1.1$ (Yngve, 1960 q.v.).

1. The firemen hurried to the factory that was reported burning.
2. The museum is providing free public lectures on modern art.

The Perfetti Lexical Density of 1. is 0.5, and of 2., 0.7.

If we consider two further examples:

3. The inspector rejected the substandard component.
4. The man threw back the old ball

sentence 4 would appear to have more syntactic depth than 3:

3 (The inspector rejected the component)
(the component was substandard)

4 (The man threw the ball)
(the ball was old)
(he threw it back).

In terms of Perfetti's 'Lexical Density', sentence 3 would have L.D. = $\frac{4}{4 + 2}$ = 0.67, whilst sentence 5 would have a higher L.D = $\frac{5}{5 + 2}$ = 0.71, which appears to be a ridiculous state of affairs. Either way round, underlying syntactic structures or 'Lexical Density', we would not want to classify sentence 4 as more difficult to read or to memorise than sentence 3, either in general or for the 'apprentice' reader.

The problem, however, would appear to be, as Perfetti indicates in respect of sentences of comparable length in terms of the number of words, one of the semantic load content rather than of the underlying grammatical structures. It would appear to be connected with the composition of the words themselves, with the length of the words in terms of semantic load. Although Chomsky reasonably claims that highly specific mechanisms must be at work in language learning and in language processing, the definition of language by its syntactic structures, in turn determined by the innate properties of the human, cannot account for the obvious gross differences between sentences 3 and 4 above. Searle (1972) has criticised Chomsky for his lack of a semantic component, for Chomsky, in viewing language as a purely formal system, pays little attention to the fact that language is used for communicating meanings and intentions. Linguistic structure may be as much determined (or perhaps moreso) by the conditions it must satisfy as an effective means of communication of intentions as by its innate mental properties. The distinction between syntax and semantic cannot ultimately be upheld since the view of language as a purely formal system pays scant attention to the fact that language is used for communicating meanings. Linguistic structure may thus be determined as much by the conditions it must satisfy as an effective means of communication as by the innate properties (Searle, 1972). Perhaps there operates something akin to the Heisenberg 'principle of uncertainty' here: If you study the form, you miss the meaning; if you study the meaning, you miss the form.

One of the major stumbling blocks, in the present writer's opinion, to the emergence of a satisfactory wedding of syntax to semantic has been the focussing of attention on the relationship between the sentence and the word, so that grammatical structure tends to be only explained in terms of word units without consideration of or investigation into the very wide variability of what constitutes a word. Thus, whilst 'inspector' in sentence 3 above, and 'man' in sentence 4 above, would have to be deemed comparable in traditional syntax, as also would 'rejected' in sentence 3 and 'threw' in sentence 4, they can in no way be deemed comparable semantically. That the two are words is a function of the traditional spacing on the page or, in oral language, the perceived (but non-existent) time lapse between phoneme-clusters (themselves the result of perception) in the continuous speech flow.

Assuming the Eisenberg principle of uncertainty to prevail in respect of form and meaning, of syntax and semantic, a morpheme count, that would exclude consideration of grammatical structures, would reveal differences between sentences 3 and 4. Sentence 3 would have 13 or 14 morphemes, whereas sentence 4 would have only 6. It seems possible to differentiate between 'content' and 'function' words in terms of the morpheme density within words. The possibility must also arise of relating semantic density to semantic structures by studying the principles of segmentation of words, or the principles and regularities in the agglomeration of morphemes into words. It is not proposed to develop this line of argument in the present study.

From the preceding section, it was apparent that modern English might be conceived as embodying two linguistic systems, an agglomerative system predominantly characterised by regeneration from Latinate morphemes (though not necessarily Latin morphemes) and by lexical units that are, in themselves, semantically dense, <u>and</u> an analystic or 'strung' system characterised by low semantic density of words and, concomitantly, by 'low graphemic or phonemic density', in short, 'shortness'. The simultaneous evolution of the two systems appears to have given rise to certain problems with regard to the congruency of phoneme-cluster segmentation (or syllabification) with grapheme-cluster segmentation (in terms of 'morpho-graphemes' as suggested in the preceding section). For this reason, it would appear more profitable to study morpho-graphemic segmentation or boundaries as a readability variable rather than syllabification when we are dealing with the printed word.

However, because of the requirement of vocalisation of early or 'apprentice' reading acts, some note should be taken of the possible incidence of incongruence of the segment boundaries. From this it would appear that, where a printed or written word is perceived or is likely to be perceived by the 'apprentice' reader as semantically dense, then processing the written word by syllabification might be a disadvantage. Except for 'one-off' words like 'aeroplane' and 'GENTLEMEN' (or even 'PUBLIC CONVENIENCES'!), the degree of semantic density for the 'apprentice' reader would appear to be indicated by the length of the word in terms of the number of letters.

If, for the 'apprentice' reader, semantic density increases as the length of the word in letters, then presumably there must be some grouping or perhaps 'chunking' (Miller, 1956) of the letters to facilitate processing. It is widely accepted that there are limitations to the number of discrete items that can be processed after one presentation (Brener, 1940; Miller, 1951; Postman, 1964). Further, the number of discrete items that can be remembered is found to increase, on average, with age. Whereas college students were able to recall 7.3 letters on average when they were presented visually as discrete items, the limits on capacity for such discrete items for the 'apprentice' reader might well be Miller's 'magical number seven' minus three or four. The form or type of grouping of letters induced in the 'apprentice' reader to facilitate processing by 'chunks' is usually the syllabic, the clustering of phonemes in order to utter them with 'a single effort of articulation' (Shorter Oxford Dictionary). Considering the possibility of incongruence between morphemic (or morpho-graphemic) boundaries and syllabic or phoneme-cluster boundaries within the word, semantic processing would not be effected, for the 'apprentice' reader using the letter → sound → syllable processing path, until the whole word had been encoded phonologically, and identified by reference to phonological episodic memory (LaBerge & Samuels, 1974, model). It could be argued that, for long words where there is a high likelihood of incongruence, syllabic processing might be beyond the capacity of 'apprentice' readers, whereas clustering of letters according to semantic or morpho-graphemic principles might bring the processing of such words within the capacity of those readers.

2.0.4. Summary.

Of the linguistic features affecting the readability of prose materials, word-length and sentence-length have hitherto been found to be of greatest value in the prediction of reading difficulty both at the word-recognition/oral articulation level and at the comprehension level. Yngve's 'sentence depth' and Perfetti's 'lexical density' are briefly discussed as possible lines of enquiry in relating word and sentence factors. Approaches that emphasize the syntactic component of sentences are rejected in favour of those approaches which emphasize the semantic component. The semantic approach also appears more useful in the study of linguistic complexity and its (likely) effect on the 'apprentice' reader because it is relevant at the word and word-segment level. The writer argues that attention to the relationship between meaning and syllabification of phoneme-cluster segmentation together with the assumption of a unitary rationale for the definition of word and intra-word boundaries, both in speech flow and in the written language, militates against the emergence of a satisfactory account of the roles of both stylistic and semantic factors and their inter-relationships in reading, and hence against the emergence of a theoretically satisfactory predictor of reading difficulty or even a satisfactory procedure for the improvement of reading performance in the context of pedagogy.

As Bormuth points out: "the most important advances should come through the identification of better linguistic variables," though " the wholesale introduction of new variables can have limited value unless some method is used to integrate each new linguistic variable in a general body of readability theory." (Bormuth, 1966, p. 130).

2.1.0. Aims of the Investigation.

The preceding sections in Part 2 have suggested lines of investigation of the assumptions made by teachers, pedagogues and others underlying the notion of (i) the development of reading competence in children and (ii), conversely, the assignment of prose material to successive levels of difficulty for the individual child or for the (intuited) developmental level of the child, group, class or age-group.

From earlier discussion, it is apparent that any investigation of the influence of factors likely to contribute to reading difficulty must ultimately be reconciled with some statistically-derived norm. In this study, the appropriate norm would be the age-norm or statistical-mean age (a) at which a prose passage is read accurately in the mechanical or oral/articulatory sense, and (b) at which a passage is understood, as evinced by correct response to comprehension questions.

Because of the wide application of standardised reading tests and the consequent availability of reliable norms, it is proposed to study the operation of the linguistic variables already discussed in the graded prose passages of such a test, the 'popular' Neale Analysis of Reading Ability (Neale, 1966), using other widely used tests for comparison. Also for comparison, the operation of the linguistic variables will be investigated with regard to the Queensway reading scheme, which is the "outcome of several years' work based on current research into the teaching of reading", the vocabulary being "drawn entirely from words found to be in common use by children of Primary School age, or universally understood by them." (Brearley & Neilson, 1964).

For further comparison, it is proposed to analyse the errors actually made by respondents to a large number of applications of the Neale Analysis of Reading Ability; the analysis is in terms of the linguistic variables already discussed.

Finally, it is proposed to formulate a readability index in terms of the suggested linguistic variables so that it yields the most accurate predictions for the population sampled during the standardisation of the Neale prose-reading tests.

2.1.1. Research Hypotheses.

In order to study the value of the 'new' variables in assigning prose materials to grade or developmental levels, or in assessing the probability of reading difficulty arising, the following hypotheses are postulated:-

H_1 If the Comprehension Reading Age Norms for graded prose materials are increased, then the incidence of Latinate words will be increased also.

H_2 If the Comprehension Reading Age Norms for graded prose materials are increased, then the average number of morphographemes per word will be increased also.

H_3 If the Comprehension Reading Age Norms for graded prose materials are increased, then the incidence of incongruence between syllabic (or phoneme-cluster) segmentation and morphographemic segmentation of words will increase also.

The three hypotheses, above, may also be tested with respect to the errors actually made by 'apprentice' readers in reading the graded passages of a prose reading test. Any word in the passages that gives rise to incidence of error in word recognition may be termed a '<u>baulk</u>' word so that the degree of 'baulk' will reflect the incidence of errors made in reading that word.

The three parallel hypotheses may be coded H_{1B}, H_{2B} and H_{3B}.

H_{1B} If a word is a 'baulk' word, then it will tend to be Latinat

H_{2B} If a word is a 'baulk' word, then it will tend to be long in terms of the number of morphographemes.

H_{3B} If a word is a 'baulk' word, then it will tend to show incongruence between syllabic and morpho-graphemic segmentatio

2.1.2. Operational Hypotheses.

The research hypotheses may be operationalised thus:-

H_1 There will be direct relationship between the age norms for the successful completion of the comprehension questions related to the successive passages of the Neale Analysis of Reading Ability, Forms A, B and C, and the incidence of Latinate words, as ascertained by reference to the Shorter Oxford Dictionary, in each passage.

H_2 There will be a direct relationship between the age norms for the successful completion of the comprehension questions related to the successive passages of the Neale Analysis of Reading Ability, Forms A, B and C, and the number of morphographemes per 100 words computed by dividing the number of morpho-graphemes in each passages by the number of words in that passage and then multiplying by 100.

H_3 There will be a direct relationship between the age norms for the successful completion of comprehension questions related to the successive passages of the Neale Analysis of Reading Ability, Forms A, B and C, and the number of words in each passage that exhibit incongruence of syllabic and morphographemic segmentation.

The three above hypotheses may also be applied to the age-norm levels provided for the Queensway Reading scheme; the Queensway age-norms may thus be substituted for the Neale age-norms.

H_{1B} There will be a relationship between the incidence of errors made by children in response to the application of Form A of The Neale Analysis of Reasing Ability and the classification of errors as occurring in Latinate as opposed to Teutonic words as ascertained by reference to the Shorter Oxford English Dictionary.

H_{2B} There will be a direct relationship between the incidence of errors made by children in response to the application of Form A of The Neale Analysis of Reading Ability and the counts of morpho-graphemes in the words ('baulk' words) in which the errors occurred.

H_{3B} There will be a relationship between the incidence of errors made by children in response to the application of Form A of The Neale Analysis of Reading Ability and the classification of such 'baulk' words as congruent/incongruent with respect to syllabic and morpho-graphemic segmentation.

2.1.3. Statistical Hypotheses.

For each of the hypotheses H_1, H_2, H_3, H_{1B}, H_{2B} and H_{3B}, the statistical hypothesis may be tested:-

For hypothesis H_n:

$$R \text{ variable } 1/\text{variable } 2 = 0$$

2.2.0. Design of the Study.

The three forms of the Neale Analysis of Reading Ability offer 18 prose passages, each of which can be related, upon successful completion, to age norms for both comprehension and for mechanical reading performance. It is proposed to perform an analysis of these passages in terms of the stated variables and also in terms of the traditional readability variables. The results of investigating the relationships between each variable and the comprehension age norms for the graded prose passages may then be entered into a straightforward correlation matrix, using the Pearson r product-moment correlation coefficient for the continuous dependant variables and the point biserial (r_{pb}) coefficient where the dependant variables are dichotomous (i.e. congruence and origin). The point-biserial correlation coefficient is a variant of the Pearson product-moment coefficient which, unlike the biserial correlation coefficient (r_b), can be compared with the Pearson r (Downie & Heath, 1970). The correlation matrix design is also appropriate for testing the parallel hypotheses in respect of the errors made in responding to the Neale reading test.

2.3.0. The Prose Passages for Analysis.

The prose passages for analysis comprised the six graded passages of each of the three parallel forms of the Neale Analysis of Reading Ability (Neale, 1966), 18 passages in all, and may be found in Appendix 1. Each form of the test consisted of six passages graded "with regard to word difficulty, sentence structure complexity as reflected in answers to comprehension questions, children's preferences for theme and optimum length of test for each age", (Neale, 1966, p 11). The final selection of vocabulary for the tests was guided partly by reference to the word lists of Thorndike & Lorge (1944), Rinsland (1945). Vernon (1949) and Dale & Chall (1948). Each passage was accompanied by eight comprehension questions (except for the first in each form, where there were only four) for oral presentation and oral response. The passages were in narrative form, with length and complexity of sentence structure controlled and graded.

The evolution of the Neale test established a close correspondence (r = .97) among the three forms, using a good cross-section of English schoolchildren; the mechanical accuracy scores were also highly correlated with scores achieved on the Schonell Graded Reading Vocabulary Test (r = .95), (Schonell, 1950).

The sample for standardisation of the test was controlled with reference to size, area, social background, age and sex. Over 2000 children were used to establish the norms. The results of factor analysis revealed that all age groups produced similar factor patterns:-

1. A large general factor accounting for the high correlations,
2. Small group factors which can be interpreted as distinct aspects of reading related to:
   a. mechanical aspects of reading,
   b. the understanding of words and ideas,
   c. the rate or fluency of mechanical reading.

For the purposes of this study the age norms for the successful completion of each of the six graded passages, for all three alternative forms, are set out in Table 7.

For comparison, with regard to word recognition, the Schonell Graded Reading Vocabulary Test (Schonell, 1950) was also analysed. The Schonell is a 100-item word recognition test whereby the correct pronunciation, according to the Oxford Dictionary, is the scoring criterion, the score being then converted, according to

Passage number	Age Norms	
	Comprehension	Mechanical Accuracy
1	6.9	7.2
2	8.5	8.4
3	9.6	9.2
4	11.2	10.3
5	12.3	11.5
6	13.0	13.0

Table 7. Age Norms for the successful completion of the graded passages in the Neale Analysis of Reading Ability (Neale, 1966).

the table of norms, into a Reading age by dividing the number of words correctly read by 10 and adding (the basal) 5 years. It is thus possible to obtain a notional age norm for, say, each group of ten words for comparison with the results of an analysis in terms of the variables used in the study:-

Number of words correctly read	Reading Age norms
0	5 yrs.
10	6
20	7
30	8
40	9
50	10
60	11
70	12
80	13
90	14
100	15

Table 8. Schonell Graded Reading Test, Scoring and Age Norms.

Of the proprietary reading schemes available on the British market, the Queensway Reading scheme appears to be the most carefully controlled in terms of both vocabulary and sentence length. The vocabulary control results from the authors' involvement in research conducted at the Birmingham Institute of Education into the vocabulary used by young children (Burroughs, 1957). The control of sentence length is based on findings such as those of the Winnetka research report (Morphett & Washbourne, 1940). The scheme comprises 26 books allocated to six progressive levels:-

1.1a.1b.1c.1d:2.2a.2b.2c.2d:3.3a.3b.3c.3d:4.4a.4b.4c.4d:5.5a.5b: and 6.6a.6b.

These levels may be allocated to approximate reading age norms, for both comprehension and mechanical reading ability, as follows:

Grade of Book	Reading Age Norm
1	6.0
2	6.3
3	6.6
4	6.9
5	7.2
6	7.5

Table 9. Reading age norms for book grade levels of the Queensway Reading.

The Queensway Reading thus spans the infant school period only, rendering it of limited use for comparison. It is included, however, because of the availability of age norm comparisons in the teacher's manual.

2.3.1. Calculation of Values for Variables used in the Study.

The calculation of the (optimum) comprehension and word recognition or accuracy age norms for each of the Neale passages was obtained by comparing the no-error scores with the age norm equivalents in the table of norms provided in the test manual (Neale, 1966).

The percentage of Latinate words also included some few words of Greek derivation, assumed to follow similar principles of agglomeration, and was obtained by consulting the Shorter Oxford Dictionary.

The percentage of incongruous words was obtained by application of the principle explicated in section 2.0.3. and illustrated in Table 5. Any difficulties of assignment were resolved by submission to a small panel comprising one teacher of English and two others interested in linguistics. Only two such referrals were made, arising from possible alternative syllabication alternatives, which perhaps suggests that the procedure may be regarded as reasonably reliable.

The number of Morpho-Graphemes per 100 words was obtained by applying the principle of morpheme segmentation (section 2.0.3.), resolving any difficulties in discussion with the advisory panel.

The calculation of Perfetti's 'Lexical Density' was obtained by applying the formula:

$$\text{L.D.} = \frac{\text{Number of Lexical Words in Sentence}}{\text{No. Lexical + No. Grammatical Wds. in sentence.}}$$

and finding the average L.D. for the sentences in each passage. Difficulties arose, and were predicted, because Perfetti's formula was employed in consideration of sentences each with the same number of words (Perfetti, 1969), so a modification of the formula was introduced to control for sentence length (and, according to Perfetti's thesis, for 'semantic load'): The L.D. for each passage was multiplied by the average sentence length, a procedure justified by the control of sentence length built into the test passages.

The number of Syllables per 100 words was obtained by counting the syllables in each passage and dividing by the number of words multiplied by 100. The numbers of Monosyllables and Polysyllables per 100 words were obtained in a similar manner, Polysyllables being defined as words with three or more syllables.

2.4.0. Results.

In this section, the results will be presented together with the analysis of results by computation of the r correlation coefficients and their associated levels of significance (from Burroughs, 1971).

2.4.1. Incidence of Occurrence of Latinate Words.

The incidence of the occurence of Latinate words was expressed as a percentage of the number of different words (of ALL aords) used in each of the Neale passages, and the percentage was found to increase as the grade of the passage in each of the alternative test forms. The mean percentage was 18.61, and the covariance with thepassage level (in terms of age norms) was 24.26. The results are set out in Table 10.

A Pearson r correlation coefficient of +.9336 ($p < .001$) was obtained between the Comprehension Age Norms and the percentages of Latinate words in the 18 passages, and an r of +.9368 ($p < .001$) between the Mechanical Accuracy Age Norms and the percentages of Latinate words.

The results of analysis of the Schonell Graded Reading Test in terms of the percentages of Latinate words at the progressive reading age (word recognition not comprehension) levels also exhibited an increase in the proportion of Latinate words with Reading Age level. The results may be found in Table 11. The relationship between 'Latinicity' and reading age levels for the Schonell Reading ($r = +.9364$) was significant at the .01 level.

The mean sentence length for each passage was obtained by dividing the total number of words in the passage by the number of sentences.

Passage number/ form.	Compre- hension Age	Mechan- ical Reading Age	Number of Latinate Words	Number of Different Words	Percentage Latinate Words
A1	6.9	7.2	0	24	0
A2	8.5	8.4	3	36	8.3
A3	9.6	9.2	14	58	24.1
A4	11.2	10.3	14	68	20.6
A5	12.3	11.5	31	102	30.4
A6	13.0	13.0	39	105	37.1
B1	6.9	7.2	0	26	0
B2	8.5	8.4	0	41	0
B3	9.6	9.2	8	60	13.3
B4	11.2	10.3	16	81	19.8
B5	12.3	11.5	25	98	25.5
B6	13.0	13.0	45	115	39.1
C1	6.9	7.2	0	26	0
C2	8.5	8.4	4	38	10.5
C3	9.6	9.2	15	61	24.6
C4	11.2	10.3	18	78	23.1
C5	12.3	11.5	24	96	25.0
C6	13.0	13.0	40	119	33.6

Table 10. The results of the analysis of 18 passages of the Neale Analysis of Reading Ability in terms of percent. of Latinate words.

For further comparison, the Schonell Graded Spelling Test was analysed in terms of the percentages of Latinate words at the progressive age-norm levels; the results are presented in Table 12. The relationship between Spelling levels and 'Latinicity' was also signficant at the .01 level (r = +.9385), and was therefore similar to that between Reading age levels and 'Latinicity'. The age norms for Spelling, however, appeared to lag behind those for Reading by approximately two years when compared at the same level of 'Latinicity'.

Reading Age	Percentage of Latinate Words	Percentage of Teutonic Words
6.0	0	100
7.0	0	100
8.0	0	100
9.0	50	50
10.0	70	30
11.0	80	20
12.0	80	20
13.0	80	20
14.0	100	0
15.0	100	0

Table 11. The percentages of Latinate words at the age norm levels of the Schonell Graded Reading Test.

Spelling Age	Percentage of Latinate Words	Percentage of Teutonic Words
6.0	0	100
7.0	0	100
8.0	0	100
9.0	0	100
10.0	10	90
11.0	60	40
12.0	80	20
13.0	90	10
14.0	100	0
15.0	100	0

Table 12. The percentages of Latinate words at the age norm levels of the Schonell Graded Reading Test.

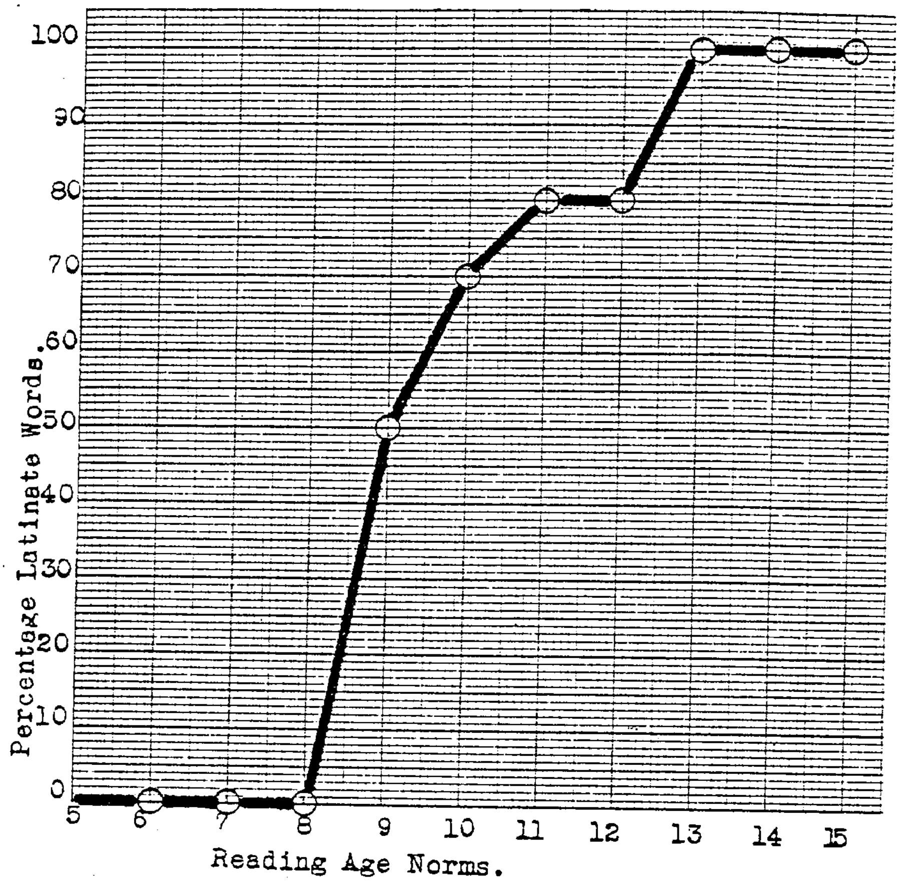


Figure 26. Graph to show the relationship between Reading age norm levels and percentages of Latinate words in the Schonell Graded Reading Test.

The results of the analysis of the Queensway Reading Scheme, presented in Table 13, also suggested that 'latinicity' increased through the age-norm levels of the books of the scheme, $r = +.8306$, $p = < .05$. If the words of Norman-French were added, the relationship was even more significant, $r = +.8616$, $p < .02$. The detailed analysis of the Queensway Reading scheme may be found in Appendix 6.

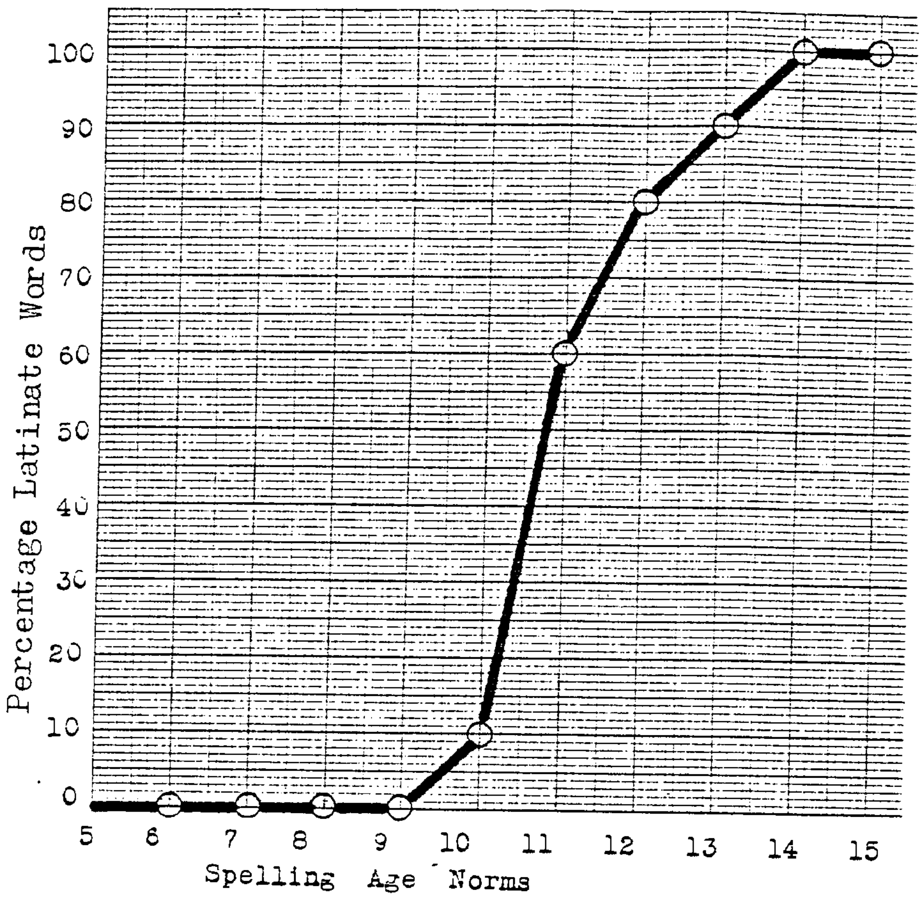


Figure 27. Graph to show the relationship between Spelling age norm levels and percentages of Latinate words in the Schonell Graded Spelling Test.

Approximate Comprehension and Mechanical Accuracy Age	Percentage of Latinate words	Percentage of Teutonic words
6.0	3.2	96.8
6.3	1.5	98.5
6.6	6.2	93.8
6.9	5.9	94.1
7.2	6.6	93.4
7.5	11.3	88.7

Table 13. The percentages of Latinate and Teutonic words at the reading age norm levels of the Queensway Reading scheme.

2.4.2. Semantic Density.

The number of morpho-graphemes per 100 words may here be termed 'semantic density'. The results of the analysis of the 18 Neale passages in terms of 'semantic density' are presented in Table 14.

Passage number	Comprehension age norm levels	Mechanical Accuracy age norm levels	Morpho-graphemes per 100 ww.
A1	6.9	7.2	100
2	8.5	8.4	133
3	9.6	9.2	139
4	11.2	10.3	151
5	12.3	11.5	172
6	13.0	13.0	170
B1	6.9	7.2	108
2	8.5	8.4	120
3	9.6	9.2	139
4	11.2	10.3	161
5	12.3	11.5	153
6	13.0	13.0	166
C1	6.9	7.2	108
2	8.5	8.4	120
3	9.6	9.2	140
4	11.2	10.3	145
5	12.3	11.5	164
6	13.0	13.0	177

Table 14. Results of the analysis of 18 passages of the Neale Analysis of Reading Ability in terms of Semantic Density or Morpho-graphemes per 100 words.

A significant relationship ($r = +.9692$, $p < .001$) was found between 'semantic density' and comprehension age norm levels of passages of the Neale test. A similar relationship ($r = +.9490$, $p < .001$) was also found between 'semantic density' and mechanical accuracy age norm levels for the same passages.

An analysis of the Queensway Reading scheme in terms of the 'semantic density' or morphographeme count was made by finding the number of different words in each of the six levels of the scheme and dividing that number into the morpho-grapheme count for those words, then multiplying the resultant by 100 to give the number of morphographemes per 100 words. The last computation controlled the variation in the numbers of different words as the texts increased in length. The results of the analysis are set out in Table 15.

Level	Reading Age Norms in years.	Number of different words	Number of morpho-graphemes	Semantic Density, MGs/100 ww.
1	6.0	88	95	108
2	6.3	133	148	111
3	6.6	229	285	124
4	6.9	412	491	119
5	7.2	581	701	121
6	7.5	816	1103	135

Table 15. Results of the analysis of the numbers of different words in the 6 levels of the Queensway Reading scheme in terms of 'Semantic Density'.

The 'semantic density' tended to increase through the levels of the Queensway: The relationship between Reading Age norm levels and 'semantic density' (r = +.8846) was significant at the .01 level.

2.4.3. Incongruence of Syllabic and Morpho-Graphemic Segmentation.

The results of the computation of the incidence of incongruence of syllabic or phoneme-cluster and morpho-graphemic segmentation in the 18 passages of the Neale Analysis of Reading Ability are presented in Table 16:

Passage Number	Reading Age Level Norms	Comprehension Age Level Norms	Incidence of Incongruence (%)
A1	7.2	6.9	0
2	8.4	8.5	2.8
3	9.2	9.6	3.4
4	10.3	11.2	2.9
5	11.5	12.3	4.9
6	13.0	13.0	13.3
B1	7.2	6.9	0
2	8.4	8.5	2.4
3	9.2	9.6	5.0
4	10.3	11.2	9.9
5	11.5	12.3	10.2
6	13.0	13.0	17.4
C1	7.2	6.9	0
2	8.4	8.5	2.6
3	9.2	9.6	6.6
4	10.3	11.2	5.1
5	11.5	12.3	10.4
6	13.0	13.0	12.6

Table 16. Results of the Analysis of the Neale Analysis of Reading Ability in terms of Reading Age Norms, Comprehension Age Norms and Incongruence of Syllabic and Morpho-Graphemic Segmentation.

The relationship between the comprehension age level norms and the incidence of incongruence ($r = +.8664$) was found to be significant at the .001 level of confidence. A similar relationship was found between mechanical reading age level norms and the incidence of incongruence ($r = +.9087$, $p < .001$). The incidence of incongruence appeared to increase directly as the age norm of the level of the reading passage, both for comprehension and for mechanical reading.

A similar analysis was conducted with regard to the corpus of different words at each of the six levels of the Queensway Reading scheme, the results of which are presented in Table 17.

Level	Reading Age Norms in years.	Number of different words.	Number of incongruent words.	Incidence (%) of Incongruence
1	6.0	88	0	0
2	6.3	133	2	1.5
3	6.6	229	3	1.3
4	6.9	412	5	1.2
5	7.2	581	13	2.2
6	7.5	816	37	4.5

Table 17. Results of analysis of the Queensway Reading in terms of incongruence of syllabic and morpho-graphemic segmentation.

For the Queensway Reading, the incidence of incongruence tended to increase as the reading age norm; the relationship ($r = +.8678$) was significant at the .01 level.

2.4.4. Traditional Readability Indices.

An analysis was made of the 18 graded passages of the 3 forms of the Neale Analysis of Reading Ability in terms of the variables traditionally used in the formulation of readability indices:

the number of words per sentence,

the number of syllables per 100 words,

the number of monosyllables per 100 words,

the number of polysyllables (3 or more) per 100 words,

and also in terms of Perfetti's 'Lexical Density', and 'Lexical Density' controlled for sentence length (section 2.0.3. q.v.). The results of the analyses are presented in Table 18.

The relationships between the values for these variables and the age norm levels (comprehension and mechanical accuracy) for successful completion of the Neale passages were explored by means of the Pearson r correlation coefficient. Most of the relationships,

Passage Number	Reading Age Norms	Compre. Age Norms	Words per Sentence (Sentence Length)	Syllables per 100 Words.	Polysyllables (≥3) per 100 Words	Monosyllables per 100 Words	'Lexical Density' (Perfetti)	'Lexical Density' X Sent. Length
A1	7.2	6.9	6.50	112	0	88.46	.538	5.57
2	8.4	8.5	8.17	120	0	75.51	.551	6.66
3	9.2	9.6	8.22	135	6.76	60.81	.676	3.95
4	10.3	11.2	11.38	149	12.09	64.84	.538	9.76
5	11.5	12.3	13.11	170	17.80	50.85	.526	11.83
6	13.0	13.0	17.38	174	23.02	55.40	.511	16.64
B1	7.2	6.9	6.50	108	0	92.31	.577	4.77
2	8.4	8.5	7.00	118	2.04	79.60	.510	6.73
3	9.2	9.6	10.29	133	4.17	68.06	.347	7.34
4	10.3	11.2	9.20	159	15.22	59.78	.598	6.19
5	11.5	12.3	13.11	160	11.86	53.39	.377	9.54
6	13.0	13.0	13.90	181	25.18	49.64	.583	9.95
C1	7.2	6.9	6.50	115	0	80.77	.462	7.58
2	8.4	8.5	8.17	133	2.04	71.43	.551	6.66
3	9.2	9.6	8.00	158	8.33	51.17	.611	5.09
4	10.3	11.2	9.10	134	13.19	59.34	.549	7.46
5	11.5	12.3	14.75	177	17.80	57.63	.542	12.45
6	13.0	13.0	17.38	181	23.02	51.80	.553	14.00

Table 18. Results of Analysis of 18 passages of the Neale Analysis of Reading Ability in terms of Traditional Readability Variables.

Reading Age Level Norms	Words per Sentence	Syllables per 100 Words	Monosyllables per 100 Words	Polysyllables (≥3) per 100 ww.	Percentage of Latinate Words	Percentage of Incongruent ww.	Lexical Density (Perfetti)	Lexical Density x Sent. Length	Morphograph's per 100 Words	Compre. Age Level Norms
1.0000	.9426 p<.001	.9391 p<.001	-.8632 p<.001	.9691 p<.001	.9368 p<.001	.9087 p<.001	-.0184 n.s.	.8117 p<.001	.9490 p<.001	.9827 p < .001
	1.0000	.8839 p<.001	-.7285 p<.001	.1187 n.s.	.8369 p<.001	.8229 p<.001	-.1528 n.s.	.9247 p<.001	.8785 p<.001	.9020 p < .001
		1.0000	-.9057 p<.001	.2174 n.s.	.9255 p<.001	.8893 p<.001	.0755 n.s.	.7352 p<.001	.9349 p<.001	.9350 p < .001
			1.0000	-.8386 p<.001	-.9414 p<.001	-.7896 p<.001	-.0840 n.s.	-.5373 p<.02	-.8989 p<.001	-.8983 p < .001
				1.0000	.9267 p<.001	,8934 p<.001	.1238 n.s.	.7708 p<.001	.9287 p<.001	.9512 p < .001
					1.0000	.8527 p<.001	.1588 n.s.	.6529 p<.01	.9211 p<.001	.9336 p < .001
						1.0000	.0170 n.s.	.6487 p<.01	.8291 p<.001	.8664 p < .001
							1.0000	-.2535 n.s.	.0481 n.s.	-.2554 n.s.
								1.0000	.7302 p<.001	.7578 p < .001
									1.0000	.9692 p < .001

Table 19. Correlation Matrix of Readability Variables applied to Neale Analysis of Reading Ability, Forms A, B & C, 18 passages.

which are presented in Table 19, were found to be signficant at the .001 level of confidence, with the predicted exception of Perfetti's 'Lexical Density' when uncontrolled for sentence length.

The correlation coefficients, with levels of significance, for all variables used in the study of the prose passages from the Neale Analysis of Reading Ability, are presented in Table 19.

2.4.5. Analysis of Mechanical Accuracy Errors made by children in response to Form A of the Neale Analysis of Reading Ability.

An analysis of the results of 460 applications of Form A of the Neale test was made with regard to the incidence of difficulty experienced by the testees with each word. Lists of 'baulk' words were compiled for each passage and the incidence of refusal or misreading of each word was recorded. The incidence of 'baulk' was then computed as a function of the maximum possible errors for that particular passage. The number of possible errors for a particular passage was obtained by multiplying the number of testees who attempted that passage by the number of different words in that passage, as set out in Table 20.

Passage number	Number of different words	Number of testees	Maximum possible errors (= 100%)
1	24	41	984
2	36	76	2736
3	58	76	4408
4	68	74	5032
5	102	109	11118
6	105	84	8820

Table 20. Maximum possible error count for 6 passages of Form A of Neale Analysis of Reading Ability.

The 'Latinicity', 'semantic density', and congruence/incongruence of each 'baulk' word were determined, the results being presented in Appendix 7. Having controlled for the range of vocabulary (number of different words) and the number of responses (testees) for each passage, it was then possible to explore the relationships between the incidence of 'baulk' or error and each of the following word-level variables:

number of letters in the word,
number of syllables in the word,
number of morpho-graphemes in the word,
derivation ('Latinicity' or not) of the word,
congruence/incongruence of segmentation types,

by the computation of coefficients (point biserial for the last two, being dichotomous variables). The relationships, with levels of significance, are presented in Table 21.

At level 1, the earliest level of primer reading, the only variable to achieve significance was the length of words in terms of the numbers of letters; the number of letters was most significant at level 2 ($r = +6938$) but syllabication and morpho-grapheme count also reached significance at the .001 level. 'Latinicity' was significant ($p < .001$) from the third level upwards, as was 'incongruence' which achieved the highest correlation coefficients at levels 5 and 6 ($r = +.7019$, $p < .001$ and $r = +.5557$, $p < .001$, respectively).

2.5.0. Summary of Results.

In this section, each of the hypotheses listed in section 2.1.1. is examined by applying the null hypothesis to the relationship.

H_1 The null hypothesis was applied to the relationship between the Comprehension Reading Age norms for the Neale test and the incidence of Latinate words. An r of +.9336 enabled the null

Passage Number	Number of Different Words	r and p	Number of Letters in Word	Number of Syllables in Word	Number of Morphographemes in Word	Latinate Derivation of Word	Incongruence of MG and Syll. Segmentation
1	28	r	.7437	.3512	(all 1)	(all T)	.2936
		p	.001	n.s.	n.s.	n.s.	n.s.
2	36	r	.6938	.6299	.6427	.4689	.3820
		p	.001	.001	.001	.01	.02
3	58	r	.4616	.4202	.6203	.5686	.6204
		p	.001	.01	.001	.001	.001
4	68	r	.5117	.4697	.5728	.5492	.5093
		p	.001	.001	.001	.001	.001
5	102	r	.6249	.4843	.4516	.5177	.7019
		p	.001	.001	.001	.001	.001
6	105	r	.4902	.4997	.4715	.4767	.5557
		p	.001	.001	.001	.001	.001

Table 21. Correlation Coefficients of Relationships between Error Count and Word-Level Variables in the Neale Analysis of Reading Ability, Form A, with levels of Significance.

hypothesis to be rejected at the .001 level of confidence. This was supported by an r of +.9368 between 'Latinicity' and the age norm levels for mechanical accuracy in the Neale passages, also significant at the .001 level. Further support for the acceptance of the H_1 hypothesis was evinced by the significance of the relationship between reading age norm levels and 'Latinicity' in respect of the Queensway Reading ($r = +.8306$, $p < .05$), the Schonell Graded Reading Test ($r = +.9385$, $p < .01$) and also, incidentally, the Schonell

Graded Spelling Test (related to spelling rather than reading age norm levels) where r = +.9385, $p < .01$).

H_{1B} The relationship between the incidence of errors or 'baulk' in the responses of 460 children to the Neale test and the 'Latinicity' of the 'baulk' words varied according to the level of the individual passage in the test (Table 21, q.v.) and was taken to support the rejection of the null hypothesis at the .001 level of confidence.

H_2 The null hypothesis was applied to the relationship between the Comprehension age norm levels of the Neale test and the 'semantic density' or morpho-grapheme count per 100 words. An r of +.9692 enabled the null hypothesis to be rejected at the .001 level of confidence. This was supported by an r of +.9490 between mechanical accuracy of reading norm levels and 'Latinicity', also significant at the .001 level.
Further support for the acceptance of the H_2 hypothesis was evinced by the significance of the relationship between reading age norm levels and 'semantic density' in respect of the Queensway Reading (r = +8846, $p < .01$).

H_{2B} The relationship between the incidence of errors or 'baulk' in the responses of 460 children to the Neale test and the 'Latinicity' of the 'baulk' words varied according to the passage level (Table 21, q.v.) and was taken to support the rejection of the null hypothesis at the .001 level of confidence.

H_3 The null hypothesis was applied to the relationship between the Comprehension age norm levels of the Neale test and the incidence of incongruence between syllabic (phoneme-cluster) and morpho-graphemic segmentation in the words of the test. An r of +.8664 enabled the null hypothesis to be rejected at the .001 level of confidence. This was supported by an r of +.9087 between norm levels for mechanical accuracy of reading and 'incongruence', also significant at the .001 level. Further support for the acceptance of the H_3 hypothesis was evinced by the significance of the relationship between reading age norm levels and 'incongruence' in respect of the Queensway Reading ($r = +8678$, $p < .01$).

H_{3B} The relationship between the incidence of errors or 'baulk' in the responses of 460 children to the Neale test and the 'incongruence' varied according to the passage level (Table 21, q.v.) and was taken to support the rejection of the null hypothesis at the .001 level of confidence.

In summary, the results were taken to suggest acceptance of the hypotheses relating 'Latinicity', 'semantic density' and the 'incongruence of syllabic/morpho-graphemic segmentation' to levels of linguistic complexity as determined (a) by textual analysis, and (b) by the nature of the responses actually made by children in the application of the Neale reading test.

2.5.1. Discussion of Results.

The results of the various analyses were interpreted as supporting the acceptance of the three hypotheses, thereby establishing the predictive value of the three factors ('Latinicity', 'semantic density' and 'incongruence of syllabic/morpho-graphemic segmentation') in assigning prose materials to levels of difficulty at the 'apprentice' reading level.

The relationship between 'semantic density' and 'Latinicity' was of high significance ($r = +.9211$, $p < .001$), indicating the extent to which longer words in terms of the number of morpho-graphemes tend to be of Latinate (or to a small extent Greek) derivation or mode of agglomeration. The incidence of 'incongruence' is also significantly related to both the 'semantic density' ($r = +.8291$, $p < .001$) and to 'Latinicity' ($r = +.8527$, $p < .001$), indicating the tendency for incongruent words to be of high semantic density and of Latinate derivation or construction. Although syllable count is related significantly to the 'semantic density' or morpho-grapheme count, this must, in view of the high significance of the 'incongruence' factor, be interpreted more as a function of the length of the word on the page.

The Neale Analysis of Reading Ability is a standardised instrument of proven test-retest reliability and internal consistency. The high level of agreement between:

(i) the results of analysis of the texts of the three alternative forms of the Neale test,

(ii) the results of the analysis of the Neale texts and the results of the analysis of errors in 460 actual responses to the Neale test,

(iii) the results of analysis of the Neale texts and of analysis of the Kingsway controlled-vocabulary reading scheme,

suggest that:

(a) the test procedures are reasonably reliable, so that the results may be regarded as having some degree of internal validity.

(b) because of the high correlations between the hypothesised gradients of difficulty and the gradients of difficulty in the various controlled texts, some degree of concurrent validity may be imputed for the test procedures.

The factors proposed by Campbell & Stanley (1963) as affecting the external validity of the results were also held to have been controlled. It was suggested that the results may be generalised to textual material designed for the stage of reading, either with respect to reading for comprehension or to mechanical reading, that is broadly termed 'apprentice' reading and covers the reading 'age' range 6 years to 13 years.

High correlations do not in themselves give grounds for the inference of causal relationships: There is a highly significant relationship between syllabification and 'semantic density', for example, though there is no necessary causal relationship between them. Further, the results suggest, because of the relationships with other variables relevant to readability or linguistic complexity, that neither syllabification nor 'semantic density' may be dismissed as of 'spurious' as opposed to 'true' correlation (in the sense of Zeisel, 1957, chapter 9) with comprehension age or mechanical reading age norms. The degree to which, with respect to (a) the length of words in the Neale passages, and (b) the words which actually caused readers to 'baulk', syllabification and 'semantic density' or morpho-graphemic agglomeration could be held to be describing the same phenomenon is indicated by high correlations, all significant at <.001 level, between 'incongruence' and the incidence of 'baulk' at all but the lowest age norm levels of the Neale test. It is suggested that both syllabification and 'semantic density' are 'true' correlates of reading level and reading difficulty at the 'apprentice' stage of reading.

It would then appear that syllabification and morpho-graphemic agglomeration are alternative approaches to the derivation of meaning <u>from</u>, or to the imposition of meaning <u>on</u>, the sequence of printed words on the page. The high significance of the relationship between 'incongruence' and reading difficulty would thus appear to be due to the operation of two systems of 'segmentation of reality'. Though these two systems would, in the case of the printed or written English language, be associated with each of the two sense modalities, auditory and visual, it is assumed that the morphemes now evident in the language must be continuants, in the main, of morphemes imposed on phonemes prior to the advent of of written language, and, consequently, are not entirely modality bound.

The results suggest, then, that there are two cognitive sub-systems, sometimes integrated or congruent and sometimes disparate or incongruent at the level of word perception, which may operate at the 'apprentice' reading level. The cognitive sub-system which involves syllabification appears, ironically, to be most useful in the ascription of meaning to words at the very earliest level where the shortness of the predominantly Teutonic words renders them easy to remember by sight. This cognitive subsystem appears to be decreasingly appropriate for the ascription of meaning as words become longer, Latinate and of greater 'semantic density'. At this 'higher' level of reading, it would appear that a cognitive subsystem that allows the meaningful segmentation of longer words is more appropriate as a learning strategy for the 'apprentice' reader.

The results of this study suggest the possibility of an approach to readability of textual materials and to reading difficulty whereby 'surface features' imposed on printed and/or phonological symbols can be related to a semantic 'deep structure'. This is the converse of the Chomsky approach to linguistics which appears to divorce syntax from semantics. The grammatical approach to readability, exemplified by Perfetti's index of lexical density, appeared to be less relevant to the prediction of reading difficulty and to the ascription of readability levels (a) as evinced by the lower significance, compared with syllabication and morphographeme count, of its relationship to comprehension age norms and to mechanical reading age norms, and (b) because of the inability of the L.D. index to accommodate the semantic (and perhaps grammatical or syntactic) density of individual words in its emphasis upon the sentence.

Traditionally, indices of readability of prose materials have ascribed texts to grades for the use of the 'apprentice' reader, according to his/her proficiency, on the basis of the criteria of syllabification complexity and sentence length in terms of words. This would be in keeping with the 'set' of 'apprentice' reading instruction in schools, which involves syllabification necessary to reading aloud. If the semantic-linked cognitive subsystem may also operate in reading at the 'apprentice' reading stage, it should be possible for an alternative index of readability to be computed which is based on morpho-graphemic segmentation rather than syllabification. It would be reasonable to expect such an index to give results with prose materials such as those of the Neale test that were as significantly related to the comprehension age norm levels and the mechanical reading age norm levels of the passages as the result of the applications of the 'traditional' readability indices or formulae.

The justification of a readability formula or index appears to the present writer to be a matter of which procedure can be expected to yield the most accurate prediction for the population. From the study, the inclusion of morphographeme count or 'semantic density' and the incidence of 'incongruent words' would appear to be justified, the latter on the assumption that there may arise a clash of the two cognitive subsystems which would render processing of longer words more difficult for some 'apprentice' readers than even their length would suggest. Further, an index of readability should be reasonably simple in application, though some require quite sophisticated computation based on the esoteric mathematics of factor weightings. By assuming or guessing the factor weightings in a quite simplistic manner, the present writer took the mean morphographeme count for the different words used in each of the graded passages of the Neale test and added the proportion of these different words that exhibited incongruence of syllabic and morphographemic segmentation. The resultant was termed the SLI or 'semantic load index'. Values for SLI and for the fiver perhaps most popular 'traditional' readability indices, listed and explained in Table 6, for the 18 graded Neale passages were compared with the comprehension age norm levels and the mechanical-reading age norm levels for those passages by means of the Pearson r product moment correlation coefficient, the results of which are presented in Table 22a, the key for which is presented in Table 22b. All the relationships between comprehension/mechanical-reading age norm levels and the various readability indices computed for the 18 graded passages of the Neale test were significant at the .001

level of confidence (df = 16). The computed values are presented in Table 22b.

The results suggested that, for the range of prose materials analysed, the author's 'semantic load index' was superior to all but the Farr-Jenkins-Patterson in predicting the level of difficulty of the prose passages. The SLI may, consequent upon upon its competitiveness with 'traditional' indices which use syllable counts, possibly be considered superior in that it has a semantic component. The results were also taken to suggest the possibility of further investigation of the 'new' variables in the ascription of levels of difficulty to a wider range of prose materials, even though the variables operate at the word or intra-word level.

	FJP	Flesch	FOG	PSK	SMOG	SLI
Comprehension age norm levels	+.9839	-.9405	+.9571	+.9550	+.9420	+.9756
Mechanical reading age norm levels.	+.9723	-.9492	+.9788	+.9599	+.9529	+.9661

Table 22a. Table of correlations between readability indices and comprehension/mechanical reading age norm levels for the graded passages of the Neale reading test.

The study afforded some consideration of the change in the characteristics of the printed or written language in relation to the 'grapholinguistic' development of the 'apprentice' reader and to the modulation of societal and pedagogic expectation, through the agency of the teacher, with age. The reading tests studied, supported by the analysis of a reading scheme with carefully controlled vocabulary, were held to reflect this modulation of expectation. The gradient in 'apprentice' reading is accordingly one not only of longer and longer words, but of words with increasing semantic, and (therefore) of increasing intra-lexical and inter-lexical syntactic, complexity, achieved in English by increasing dependence upon words of

Pass. No.	FJP	Flesch	FOG	PSK	SMOG	SLI	Read. Age Norms	Compre. Age Norms
A1	0	105	2.6	10.5	0	1.000	7.2	6.9
2	19.35	104	3.3	11.6	0	1.358	8.4	8.5
3	32.09	84	10.0	12.1	4	1.424	9.2	9.6
4	51.27	69	16.6	13.3	7	1.539	10.3	11.2
5	51.12	50	23.0	13.5	8	1.769	11.5	12.3
6	73.96	42	30.0	15.0	11	1.833	13.0	13.0
B1	0.26	109	2.6	10.6	0	1.080	7.2	6.9
2	23.74	100	4.8	12.7	2	1.224	8.4	8.5
3	36.39	84	8.3	12.6	4	1.440	9.2	9.6
4	47.09	63	18.9	12.8	7	1.709	10.3	11.2
5	55.91	58	17.1	13.7	7	1.632	11.5	12.3
6	64.71	40	30.7	14.2	10	1.834	13.0	13.0
C1	4.54	103	2.6	10.4	3	1.080	7.2	6.9
2	16.15	86	5.3	11.5	4	1.226	8.4	8.5
3	22.72	65	11.5	11.7	4	1.466	9.2	9.6
4	45.59	84	16.8	12.8	6	1.501	10.3	11.2
5	62.24	42	23.7	14.2	9	1.744	11.5	12.3
6	65.97	36	30.0	14.7	11	1.896	13.0	13.0

<u>Key:</u> For details of computation, see Table 6, page 128.

- FJP Farr-Jenkins-Patterson.
- Flesch Flesch Reading Ease.
- FOG Gunning's FOG Index.
- PSK Powers, Sumner and Kearl.
- SMOG McLaughlin's SMOG Reading Grade.
- SLI The author's 'Semantic Load' Index.

Table 22b. <u>Readability Indices and Reading Age Level Norms Computed for 18 Passages of the Neale Analysis of Reading Ability.</u>

Latinate derivation and of agglomeration/segmentation according to Latinate principles. It would appear, from the present writer's long experience in education, that formal instruction in reading ends precisely at the critical stage in the change from shorter Teutonic words, of low 'semantic density' and high frequency, in primer stories at least, to Latinate (and to a lesser extent, Greek, Norman-French and French) words with a high degree of agglomeration of morphographemic segments, with a high incidence of incongruence between syllabification and morphographemic segmentation, and also featuring quite different segment-bonding principles from those used in words of Teutonic origin. At present, reading development appears only to be conceived in terms of the Language Experience approach which, lacking theoretical underpinning, seems to operate at the level of accidental progression from symbol to semantic.

PART THREE

DEVELOPMENT OF A TREATMENT PROCEDURE FOR SPECIFIC READING DIFFICULTY.

PART THREE: THE DEVELOPMENT OF A TREATMENT PROCEDURE FOR SPECIFIC READING DIFFICULTY.

3.0.0. Development of a Treatment Procedure for 'Specific Reading Difficulty'.

In this study, the development of a procedure for the treatment of 'specific reading difficulty' will be attempted, drawing upon the findings of part 1 and 2. The assessment of the efficacy of the treatment will be ascertained by comparison with traditional methods of treatment.

3.0.1. Aims of the Investigation.

In Part 1, it was suggested that 'modal preference' as measured by comparison of the effects of auditory-phonological and visuo-graphic interference was related to 'specific reading difficulty' in two ways:

1. There was a significant relationship between SRD ('specific reading difficulty') and the salience of the interference effect on comprehension ($r = +.3133$, $p < .001$), suggesting that children who were modal-preferent, irrespective of the particular mode, tended to have great difficulty in deriving meaning from their reading.
2. There was a significant relationship ($r = +.3469$, $p < .001$) between SRD and the modality effect of interference on comprehension whereby visual-mode preferent children (who were distracted by visuo-graphic rather than auditory-phonological material) tended to have a greater degree of 'specific reading difficulty'.

It was further suggested that 'specific reading difficulty' was a phenomenon, not of general language disability or of deficit in visuo-spatial ability, but of the requirements or set of 'apprentice' reading. (1), above, may be interpreted in terms of the ability to switch attention, on an information processing model where phonological encoding is preced by visuo-graphic encoding, rapidly between the phonological and visuo-graphic processing levels. (2), above, may be interpreted in terms of the degree to which modal channel preference cuts across (1). In the case of the deaf person, the channelling would presumably be absolute for all input; the relationship, however, was only explored with regard to reading when conceived as a bisensory activity involving phonological encoding as mediational in the imposition of meaning on the printed symbols.

Goodman (1967) argues that, for the higher levels of reading, the semantic load is so high that it would be impossible not only to cope with the overwhelming input without sampling but to achieve efficient processing unless phonological mediation were omitted. The LaBerge & Samuels (1974) model of automaticity in reading, initially a three-level model, would therefore appear to be more relevant to the earlist stages of 'apprentice' reading where the stage of phonological encoding is not only ingredient but, apparently, mandatory. Both the 'look-and-say' and the 'phonic' approaches to primary reading instruction can be accommodated on the LaBerge & Samuels three-stage model, the difference being merely the level of grapheme clustering at which the shift to phonological encoding takes place. These different levels would entail differential demands on the graphic and phonological 'episodic' (LaBerge & Samuels) memories.

If, as Goodman says, the difference between the lower and higher levels of reading lies in the exclusion of mediational phonological encoding, whereby a return to phonological mediation only occurs for the mature reader when there is a semantic 'mismatch', it seems to follow that those children who are unable to readily switch from the visuo-graphic to the phonological encoding stages would not only have difficulty, as was found in Part 1, in imposing meaning on print, but would not be likely to reach the 'higher' level of reading described by Goodman because of the three-stage requirements or set of 'apprentice' reading.

In Part 2, it was suggested that the higher levels of reading could be described in terms of the higher semantic density of the words, which were found to be predominantly Latinate in construction. It would further appear that such long words might, unless segmented, or capable of being segmented, in a meaningful way, place greater demands on what LaBerge & Samuels term 'phonological episodic memory'. In Part 2, it was suggested that phoneme-cluster segmentation of long words (or syllabification), which may be considered to be an extension of the set of early reading instruction, might preclude the meaningful segmentation of longer words by morpho-graphemic segmentation. The suggestion was supported by the relationship between the incidence of 'baulk' and 'incongruence' (significant at the .001 level) with regard to the errors made by 460 children in response to application of the Neale prose reading test.

From Part 1 it was predicted that children who were of high distractibility in three-stage reading were likely to exhibit 'specific reading difficulty', and that children who were visual-mode preferent in three-stage reading were more likely to exhibit SRD than those who were auditory-mode preferent. Given that the general modal preference or distractibility is a significant factor in SRD, it would follow that a unimodal rather than a bi-modal approach to reading would be indicated for those children whose difficulty, according to the LaBerge & Samuels model of automaticity in reading, would be in oscillating attention between the visuo-graphic and the auditory-phonological stages of processing in 'apprentice' reading. To be 'reading', however, unimodal reading can only be in terms of graphic input which is then encoded semantically. Given that the goal of mature reading is the imposition of meaning on the words of the text, it may thus be hypothesised that:

H_A If two groups of 'specific reading difficulty' children are subjected to unimodal (whereby graphic input is encoded semantically without mediational phonological encoding) reading instruction, and bimodal (with mediational phonological encoding) reading instruction, respectively, superior semantic encoding will be achieved by the unimodal reading group.

It was also suggested in Part 1 that children who exhibited visuo-graphic processing preference tended to have greater 'specific reading difficulty' than those who exhibited auditory-phonological processing preference. A second hypothesis may thus be appended to the first:-

H_B If two groups of SRD children, one group exhibiting visuo-graphic processing preference and one group exhibiting auditory-phonological processing preference, are subjected to unimodal reading instruction, the visuo-graphic preferent readers would exhibit superior semantic encoding.

It would also follow, and this is suggested by the results of Part 1, that, because phonological encoding is mediational in 'normal' reading at the 'apprentice' reading level (though not necessarily so at higher levels, according to Goodman), auditory-phonological processing preferents would be superior to visuo-graphic processing preferents in 'normal' bimodal reading. A further hypothesis may thus be generated:-

H_C If two groups of SRD children, one group exhibiting visuo-graphic processing preference and the other group exhibiting auditory-phonological processing preference, are subjected to 'normal' or bimodal reading instruction, the auditory-phonological preferent readers will exhibit superior semantic encoding.

In order to discuss the validity of the findings of the enquiry, it is also necessary to compare the effects of reading instruction, whether unimodal or bimodal, with the effects of no instruction at all. A compound hypothesis may thus be generated:-

H_D If SRD children are subjected to reading instruction (either unimodal or bimodal), they will exhibit superior semantic encoding ability to that of SRD children who are subjected to no reading instruction or to a placebo instruction.

With regard to the vocabulary to be used in the instructional régimes and in the tests of comprehension or semantic encoding, it is proposed to draw upon the findings of Part 2 in compiling a list of words predicted to offer great difficulty to SRD children. The testing of the comprehension or understanding of these words would be held to subsume word recognition; it is therefore not proposed to test word recognition as such.

3.0.2. Operational Hypotheses.

The research hypotheses may be restated as operational hypotheses as follows:-

H_A That SRD subjects subjected to a unimodal reading instruction regime will achieve significantly superior scores on an associated comprehension test than SRD subjects subjected to a bimodal reading instruction regime based on the same vocabulary and subjected to the same associated comprehension test.

H_B That SRD subjects classified as visuo-graphic processing preferent on the AVMPC (Auditory-Visual Modal Preference Comprehension) measure derived from Part 1 will achieve significantly superior scores than SRD subjects classified as auditory-phonological processing preferent on the AVMPC measure in a comprehension test associated with and following a unimodal (visual) reading instruction regime.

H_C That SRD subjects classified as auditory-phonological processing preferent on the AVMPC measure will achieve significantly superior scores than SRD subjects classified as visuo-graphic processing preferent on the AVMPC measure in a comprehension test associated with and following a bimodal reading instruction régime.

H_D That SRD subjects subjected to unimodal or bimodal reading instruction will achieve significantly superior scores than SRD subjcted to a placebo or no reading instruction on the comprehension test associated with the two instructional regimes.

3.0.3. Statistical Hypotheses.

In this section, planned comparisons are formulated according to the recommendations of Burroughs (1971, Section 29). The proposed method of analysis of results is by a One-Way Analysis of Variance so that a planned comparison 'can be substantiated with slightly smaller differences among the means than will suffice to substantiate the general hypothesis' (Burroughs, 1971, p 236). The means to be compared may be coded thus:

M_1 mean comprehension score for unimodal reading group.
M_2 mean comprehension score for bimodal reading group.
M_3 mean comprehension score for placebo group.
M_4 mean comprehension score for no-treatment group.

After computing the F ratio for all method groups, the planned comparisons

$$M_1 > M_2 > M_3 \;.\; M_4$$

may be made by three
may be made by three separate F tests (or t tests, because, for a one-way Anova, $t^2 = F$), in testing hypotheses H_A and H_D, for the following independent hypotheses:-

$H_{A.D}$

Method	M_1	M_2	M_3	M_4
Hypothesis (i)	1	-1	0	0
(ii)	1	1	-1	-1
(iii)	0	0	1	-1

the variances being pooled for hypothesis (ii). Initially, the values for F would be for a two-tailed test; subsequently for a one-tailed test, the directions of the comparisons being predicted by the hypotheses. The following null hypotheses may thus be tested:-

(i) $H_0 \quad M_1 = M_2$

(ii) $H_0 \quad M_{(1+2)} = M_{(3+4)}$.

(iii) $H_0 \quad M_3 = M_4$

Hypotheses H_B and H_C are from two independent sets, and would be tested separately by F or t tests, the values for F or t being for a one-tailed test as the directions of the comparisons are predicted:-

H_B for method group 1 only:-

M_{1v}	M_{1a}
1	-1

(where v = visual preferent, and a = auditory preferent)

Thus the null hypothesis may be tested:

(iv) $M_{1v} = M_{1a}$

H_C for method group 2 only:-

$$\begin{array}{cc} M_{2v} & M_{2a} \\ -1 & 1 \end{array}$$

Thus the null hypothesis may be tested:

$$(v) \quad M_{2v} = M_{2a}$$

Determination of the significance of the above comparisons would be made by consulting appropriate tables according to the degrees of freedom, and would be followed, where appropriate by a computation of a correlation coefficient r for each comparison, using the formula:

$$r = \frac{F - 1}{n_1 + n_2 + F - 1}$$ (Burroughs, 1971).

3.1.0. Variables to be Controlled and Measured in the Study.

3.1.1. Variables to be Controlled in the Study.

This section will consider the proposed control of variables affecting consideration of internal and external validity.

Control for Internal Validity.

Campbell & Stanley (1963) postulate 8 classes of extraneous variables whose effects, if not controlled, become confounded with the effect of the independant variable. These are listed, with the proposed methods of control:

1. History. The instructional regime for each subject was of short duration, 1 session per day for seven days. Choice of the instruction period was by consultation with the subject.
2. Maturation should likewise be controlled by the relative brevity of the period of the instruction regime.
3. Instrumentation was controlled by the construction of a simple right/wrong test allowing no shift in standards.

3. Testing. The interaction effect between pre-testing and post-testing was controlled by the inclusion of a post-test-only condition.
4. Instrumentation was controlled by the construction of a simpl right/wrong test allowing no shift in standards.
5. Regression. The Solomon Four-Group design considers only the post-test scores in consideration of the effects of pre-testing. Any consideration of gains would entail consideratio of regression to the mean.
6. Selection Bias was avoided by the use of a sample selection criterion followed by random allocation to groups.
7. Experimental Mortality was difficult to control in advance, but proved easy to control in the individual treatment conditions.
8. Selection-Maturation Interaction. Both of the component variables were not operant.

Control for External Validity.

Campbell & Stanley (1963) postulate 4 classes of extraneous variable which may operate on the experimental treatments and which would inhibit generalisation:-

1. Interaction between testing and the Experimental Variable was controlled by the inclusion of a post-test only comparison group, so the the pre-tested and non-pre-tested interaction variance could be compared with the Error variance by the computation of an F ratio.
2. Interaction between Selection of the Experimental Variable was controlled by the stipulation of criteria for the definition of the population and by variation of the sources of the sample.

3. Reactive Effects of the Experimental Arrangements.
   The 'Hawthorne' effect was controlled in this experimental design by:
   (a) the inclusion of a placebo group in addition to the non-treatment group so that comparison could be made by means of an F test, and
   (b) the assignment at random to each of two teachers for each treatment condition so that comparisons could be made between the mean scores for the two teachers by means of an F ratio between the interaction variance and the error variance.
4. Multiple Treatment Interactions were not relevant to this design.

3.1.2. Control of the Vocabulary to be used in the Reading Instruction Regimes M_1 and M_2.

In part 2, it was suggested that useful predictions of difficulty in the comprehension and in the recognition of words, even when they were context-bound in prose passages, could be made by considering three inter-related factors:-

1. the semantic density or the number of morphemes in a words,
2. the incidence of incongruence of morpho-grapheme boundaries with syllabic boundaries,
3. the mode of agglomeration of morpheme particles, the dominant mode of generation of words for modern English being the Latinate mode.

The corpus of words for the reading instruction regime was selected according to these findings so thast they would be of predictably high degree of difficulty for the subjects. This imposed a constraint upon the range of the 'specific reading difficulty' population from which the sample might be drawn, the prediction of difficulty being a function of the level of comprehension and word recognition already achieved by the reader. This point is considered further in discussing the sampling procedure.

The procedure for the selection of the corpus of vocabulary was as follows:-

(a) A typical school dictionary was rapidly scanned by the investigator and a somewhat arbitrary list of frequently occurring 'dominant' morphemes (those usually occurring in the root position) was prepared. The dictionary chosen was the Kingsway Dictionary, (Stoloff, 1960), compiled especially for children of 8 to 15 years and based on research into children's reading and conversational vocabulary supported by the advice of a panel of teachers. The dictionary contained nearly 10,000 words. The initial list of 'dominant' morphemes, 28 in number, is presented in Table 23.

Dominant Morphemes.

1.	cess	15.	press
2.	cis	16.	punct
3.	dict	17.	mob/mot/mov
4.	duct	18.	port
5.	fer	19.	rad
6.	fac/fec/fic etc.	20.	rupt
7.	fin	21.	script
8.	flex, flect	22.	spect
9.	fus	23.	struct
10.	gress	24.	tact
11.	ject	25.	terr
12.	junct	26.	tract
13.	miss	27.	vers
14.	plic/ply	28.	vis

Table 23 . List of Dominant Morphemes, extracted from the Kingsway Dictionary (Stoloff, 1960).

(b) From the list, at random, 10 'dominant' morphemes were selected, from which would be generated a large number of words by prefixing and suffixing other morphemes and combinations of morphemes. The selected 'dominant' morphemes were:

duct   press   terr   fer   struct

vers   ject   tact   vis   fac/fec/fic.

On further consideration, the 'make' morpheme, 'fac' was omitted for two reasons: (i) the wide variation in form - there are at

TABLE 24. A List of words generated from Nine Dominant Morphemes by combination with Prefix and Suffix Morphemes.

duct	difference	compress	structure	obverse
ductile	differentiate	compression	obstruction	extraterrestrial
ductility	defer	compressible	obstructor	versatile
introduction	deference	compressibility	instruct	verse
deduction	project	depress	instructor	version
reduction	object	depression	instruction	inverse
inductive	abject	depressive	instructional	inversion
product	inject	depressible	restructure	reverse
productive	eject	depressibility	restructurable	reversion
production	reject	depressor	restructurability	reversible
conduct	interject	depressant	superstructure	reversibility
conductor	subject	suppress	substructure	revers
conduction	objection	suppressor	destruction	extraversion
superconductor	injection	suppressive	destructive	transverse
deductible	objector	suppression	destructible	subversive
prefer	objective	repress	constructor	subversion
preferent	objectivity	repression	constructive	diverse
preference	injector	repressive	constructible	diversion
preferable	rejection	irrepressible	reconstruct	introversion
offer	rejector	express	reconstruction	converse
afferent	trajectory	expression	reconstructible	conversion
afference	interjection	expressive	preconstruction	adverse
infer	subjective	expressible	tact	adversary
inferent	subjection	impress	intact	visual
efferent	dejection	impressive	tactile	visor
refer	adjective	impression	contact	vision
referent	conjecture	impressionable	contactible	visible
transfer	conjectural	oppress	terrace	visibility
transference	projector	oppressor	terrain	advisor
interfere	projection	oppression	terrier	advise
suffer	projectile	oppressible	territory	devise
sufference	press	oppressive	territorial	divisor
differ	pressure	obstruct	terrestrial	subdivision
different	divisive	obstructive	subterranean	divisible
supervise	supervision	television	revise	revision
televisor	provision			

least eight variants, and (ii) the generative capacity of this particular morpheme when compounded with other 'dominant' morphemes, would both increase the instructional load disproportionately. The revised list of nine morphemes, then, was chosen as basal.
A list of prefix morphemes appropriate to the 'dominant' morphemes was then prepared:-

abs, ad, con, de, di, ex, extra, in, inter, intro,
pre, pro, re, sub, super, tele, trans;

and then a list of appropriate suffixes:-

ion, ive, ile, or, ate, al, u, ity;

and also of their compound forms:-

ual, uate, ible, ation, ator, uation, uator,
ibility etc. The list of generated words is presented in Table 24.

The list of words in Table 24 represents the optimum teaching load for the period of experimental instruction, with the exception of nine reserved words, discussed below in (c). The characteristics of the words in the list, in terms of the findings of Part 2, were as follows in Table 25:

	Number	Percentage
Latinate words	178	100
Congruent words	73	41
Incongruent words	105	59
Total words	178	100
Morphemes	535	
Morphemes per 100 ww.	300.6	

Table 25. Characteristics of words used in reading instruction régimes in terms of findings of Part 2.

(c) From the list of generated words, nine words were abstracted, one for each of the 'dominant' morphemes, and were reserved, that is, not taught, as the components of the comprehension test. These words are labelled (u) (untaught) on the test score sheet.

3.1.3. Control of Time allocation for the realisation of the instructional regimes.

Equal units of instruction or teaching time were allocated to the M_1 (unimodal) and M_2 (bimodal) groups. A pilot regime suggested that an appropriate allocation be:-

Seven lessons, each of 50 minutes duration, one per day, over nine days, commencing on a Monday and omitting Saturday and Sunday.

This allowed subjects to be treated within the framework of the normal school timetable. The short length of the overall instructional period was to reduce the risk of experimental mortality. A similar allocation was also made for the Placebo instruction group (M_3), and all groups were subjected to the same pre-test/post-test interval, as indicated by the schedule presented in Table 26.

Group	Days													
	F	S	Su	M	Tu	W	Th	F	S	Su	M	Tu	W	Th	F
M_1	p	-	-	x	x	x	x	x	-	-	x	x	-	-	P
M_2	p	-	-	x	x	x	x	x	-	-	x	x	-	-	P
M_3	p	-	-	x	x	x	x	x	-	-	x	x	-	-	P
M_4	p	-	-	-	-	-	-	-	-	-	-	-	-	-	P

Table 26. Schedule of PreTest (p), PostTest (P) and Treatments (x).

3.1.4. Reading Instruction Régimes used in the Study.

3.1.41. M_1, the Unimodal Reading Instruction Régime.

The unimodal (visual) reading instruction regime was developed from the writer's previous work, and may be considered under two headings, (i) the procedure itself, and (ii) the suppression of mediational phonological encoding.

(i) The Teaching Procedure. Each of the nine 'dominant' morphemes was taught to the subject by a procedure which parallels Bruner's 'course of cognitive growth' (Bruner, 1964). For example, in teaching the morpheme 'ject', the action of throwing was first presented to the subject in a variety of contexts or applications, the teacher then impoasing a generalisation of the throwing action, in physical terms, which was copied by the subject. This may be considered to correspond to Bruner's 'enactive representation'. A graphic representation was then derived from and imposed on, or associated with, the generalised action: This may be considered to correspond to Bruner's 'iconic representation'. The association was then 'overlearnt', the criterion being the unhesitant drawing of the 'icon' by the subject when presented with the generalised action, and conversely. The third stage was the association of the 'icon' with the morpheme, an arbitrary association facilitated by the small number of graphemes (or letters) in the morpheme, which would not throw too great a strain on immediate memory. This stage may be considered to correspond to (albeit a rudimentary form of) Bruner's 'symbolic representation'. It was assumed that the small number of graphemes present in the morpheme, or more strictly 'morpho-grapheme', being well within the short-term-memory capacity of most children, would lower the probability of letter reversal in reproducing the morpho-grapheme.

thus preparing the subject for adequate 'chunking' when ultimately presented with poly-morpho-graphemic words. The coding paths for the three stages, with the directions of central control of processing, are represented in Figure 28.

(i) 'incidents' (I) ⟵ 'throwing' action generalised (AG) ⟵ semantic control

(ii) (I) ⟵ (AG) ⟵ 'icon' ⟵ semantic control

(iii) (I) ⟵ (AG) ⟵ 'icon' ⟵ morpheme ⟵ semantic control

Figure 28. Coding paths for the three progressive stages of unimodal (visual) reading instruction régime.

Brief descriptions of the 'icons' and generalised actions for the nine 'dominant' morphemes are presented in Figure 29.

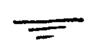
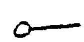
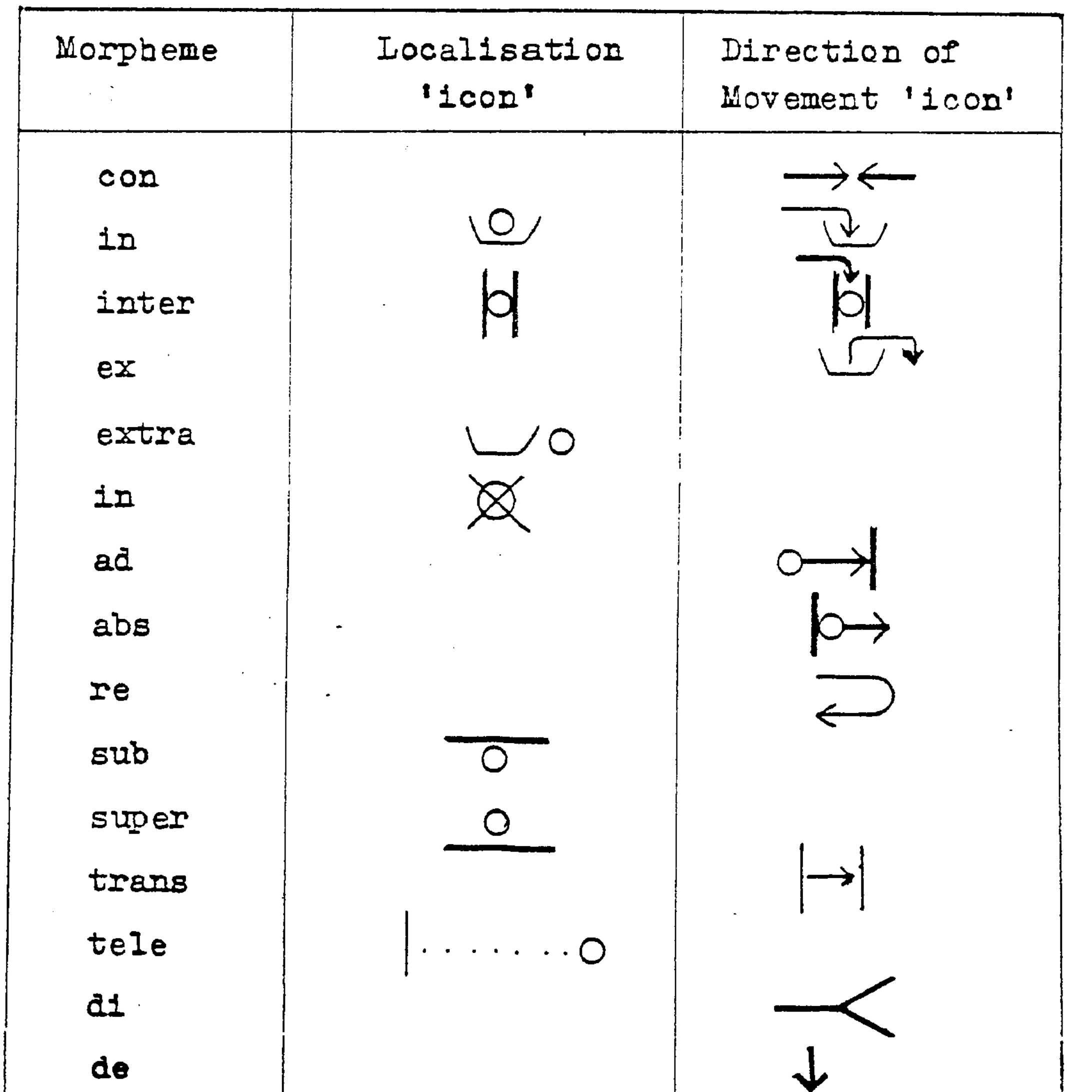
'Dominant' morpheme.	Generalised action	'icon'
ject	derived from the arm action in throw ing an object, e.g. a ball.	
fer	derived from a case, bag etc. used for bringing things by hand.	
terr	derived from the land surface and the underlying strata, deminstrated.	
vis	derived from the eyes with hand held horizontally above in an active seeing position.	
struct	derived from building with Lego bricks and other materials.	
duct	derived from a leading action performed on a pet and representing the lead and collar.	
tact	derived from a fist with one finger extended to touch something.	
press	derived from the complete hand pressing on a surface.	
vers	derived from proceeding forward and then turning.	

Figure 29. Generalised actions and 'icons' associated with 'dominant' morphemes or morphographemes.

Each prefix morpho-grapheme was taught by a similar approach, according to the three 'Bruner' stages of representation. From a pilot study, it was realised that a distinction had to be made, for some prefixed morpho-graphemes, between movement and location, thus the single morpho-grapheme 'in' might entail <u>movement into</u> in some contexts and <u>location inside</u> in others. For other morpho-graphemes, this problem did not arise, 'ex' usually indicating movement out of, and 'extra' indicating location outside something. Further, there appeared to be be no reason to differentiate these morphographemes from the 'dominant' ones on some grammatical (i.e. prepositional) classification. They were all amenable to the



<u>Figure 30</u>. 'Icons' associated with prefix morphemes.

'icon' treatment; thus, for example, the action of bringing together could be rendered by a symbolic bringing together of the fingers with the hands held out from the body, then embodied in an 'icon' $\rightarrow \leftarrow$, which was the associated with the morphographeme 'con'. A list of 'icons' associated with prefix morphemes or morpho-graphemes is presented in Figure 30, with classification into <u>location</u> and <u>movement</u> as appropriate.

At this stage, after presenting one or two prefix morphographemes, combination could be attempted with any or all of the nine 'dominant' morphemes, irrespective of the existence of words in the language with such combinations, but, of course, constrained by semantic considerations. It would be inappropriate to use 'con' with 'terr', for example. Combination at this stage would be more of a semantic game than a lesson in reading. All recognition and associative learning here entailed the use of a multitude of sketches and drawings by the instructor and the subject, using plastic drawing sheets and 'Lumocolor' pens.

In the trials, the suffix morpho-graphemes presented more difficulty to the teacher because, presumably, they involved relationships in time rather than in space. 'ive' indicated that an action had been completed on previous occasions and would continue to be in the future, as in the lexemes 'constructive' and 'destructive'. In this circumstance, the teacher would repeat the enaction of the the 'construct' and 'destruct' combinations of actions and then draw attention to the agent, already defined by the 'or' suffix, as being 'destructive'. It should be appreciated that the communication process, being non-phonological, is impossible to describe adequately: Perhaps research into nonverbal communication is not yet advanced sufficiently! A list of the suffix morpho-graphemes is presented, with a cryptic verbal description of the semantic 'sign-posting', in Figure 31.

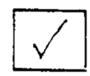
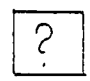
	Morpheme	Attempted Verbal Description	Pseudo-'icon'
1.	'or'	the means by which an action can be accomplished, if a machine or tool:	
		if the agent of an action:	
2.	'ion'	the picture of an action 'in the head', reduced to an ellipse around the posited combination of morphemes:	
3.	'ate'	the action is completed.	
4.	'ent'	the action is continuing now.	
5.	'ile'	the action can be accomplished, if one wishes.	
6.	'ive'	the action has been successfully accomplished in the past and will be continued, significantly.	
7.	'al'	similar to 5.	
8.	'ite'	similar to 3.	
9.	'er'	similar to 1.	
10.	'y'	as 2 when combined with 'ite'	
11.	'u'	increases the value or significance; a 'morphomorpheme' of 'ive'.	

Figure 31. 'Icons' associated with suffix morphemes.

In summary, the reading instruction method proceeds from enactive representation of experience to iconic representation and thence to grapheme-symbolic representation of experience, the suffix morphemes being apparently important for the final, semantic ordering of the experience.

Suppression of Auditory-Phonological Encoding.

Although the restriction of the range of the population in terms of reading, following the findings of Part 2, rendered it highly probable that subjects would find the morpho-graphemes initially meaningless, it was expected that the subjects would attempt an auditory-phonological encoding strategy involving phonological episodic memory. A mere instruction to eschew vocalisation would not be presumed to eradicate years of pedagogical induction of 'phonics'. In trials, a sorting exercise was devised, subsequently improved and tested, which aimed at the inhibiting of vocalisation of the morphemes. The sorting procedure was as follows:-

1. Three sorting exercises were devised, the sorting targets being, respectively and in sequence, (i) prefix morpho-graphemes, (ii) suffix morpho-graphemes, and (iii) 'dominant' morpho-graphemes in medial position. Cards with words or pseudo-words containing the appropriate target morphemes were sorted and placed under the target morphemes. The order of execution of the three sortings was based on the general finding that children have least difficulty in recognising the opening graphemes of a 'difficult' or long word, followed by the final graphemes, then followed by the (most difficult) medial graphemes. This was supported by the results of tachistoscopic exposure of letter strings (Miller, 1958), where the same order of difficulty in memorising was observed. The gradient of task difficulty, overall, was thus from the easiest to the most difficult.

2. Each sorting test comprised 9 target morpheme cards and 36 cards with polymorphemes for sorting into the nine categories. Examples of the sorting cards and target cards, actual size, are presented in Figure 32, overleaf.

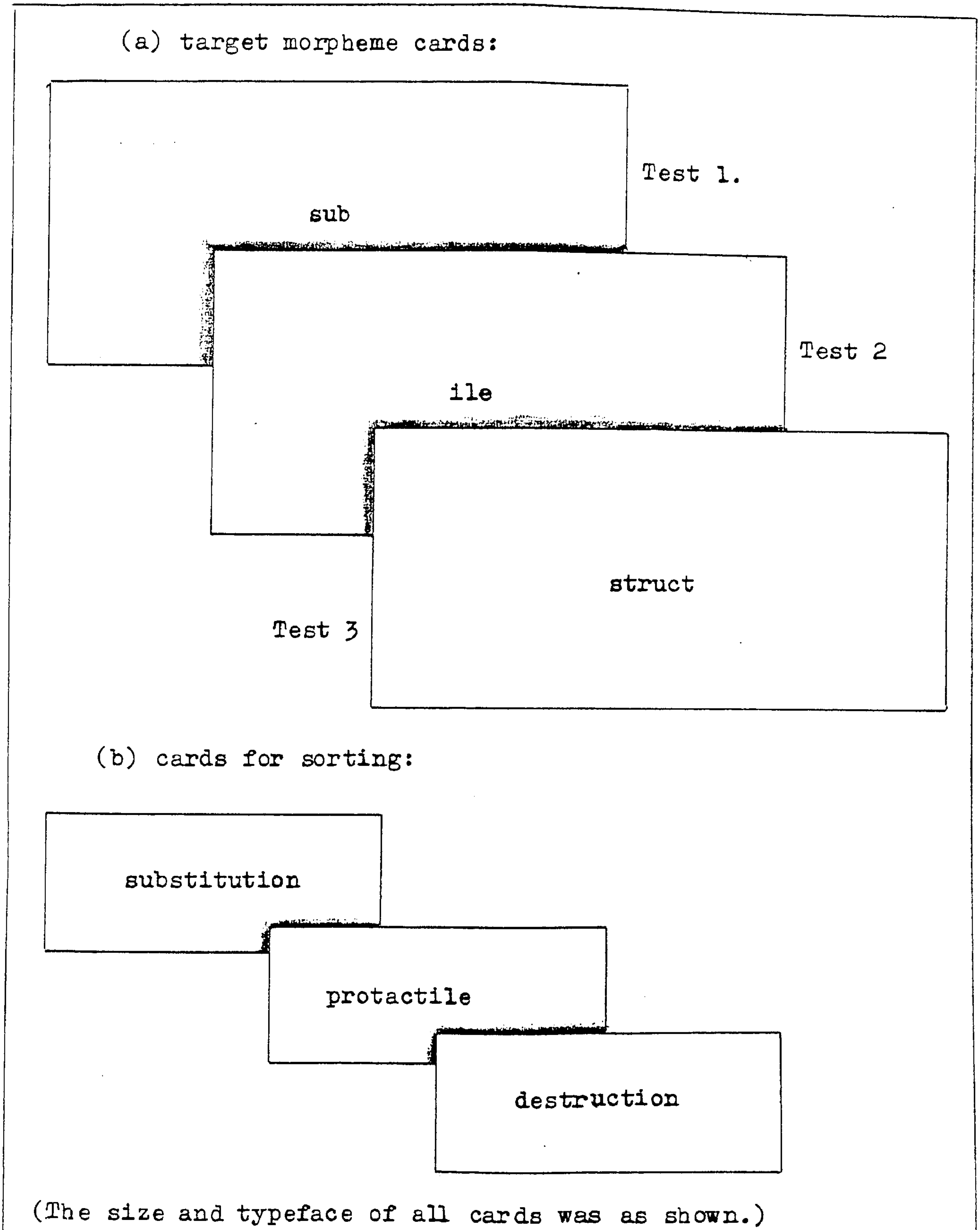
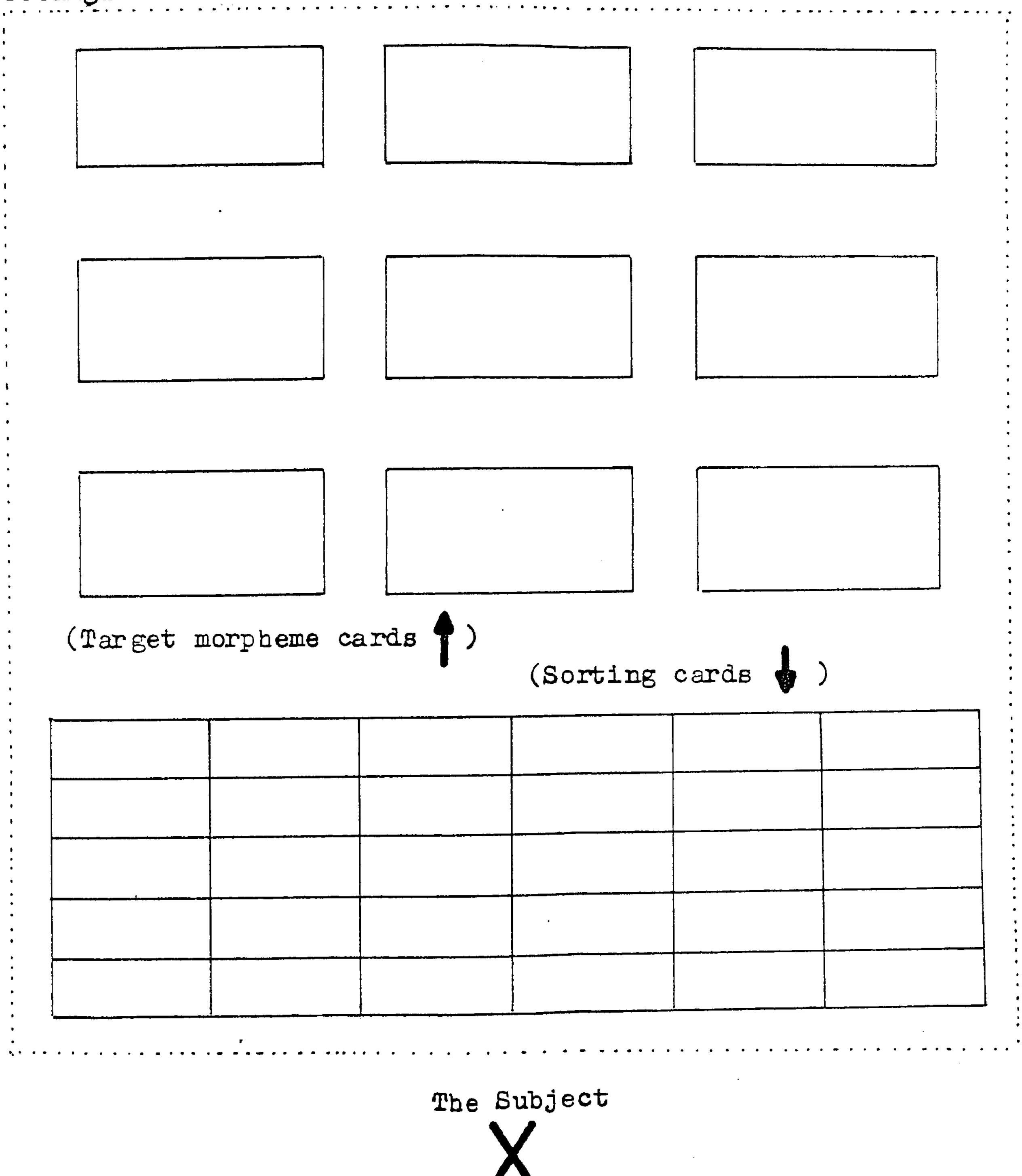


Figure 32. Examples of target- and sorting-cards for the exercise designed to inhibit phonological encoding.

3. The target morpheme cards for each 'test' were shuffled and placed on a table, face upwards and 'tacked' down. The 36 cards for sorting were shuffled and 30 of them dealt into a 6 by 5 rectangle thus:-



The subject was required to sort the cards, placing them just under the targets, using any sorting strategy. Any error in sort sorting was corrected by an invigilator who merely returned the card to the sorting array. Each sorting exercise was timed by means of a stopwatch, and the subject was encouraged to 'beat the clock', that is, to improve upon previous sorting times, if appropriate. The exercise was conducted in silence and the aim was to achieve the fastest sorting time possible.

4. The three sorting tests were always given in the same order, and preceded each M_1 lesson. The sorting test also functioned as placebo instruction for the M_3 condition.

5. The times for each application of the set of three exercises were recorded and graphed for the encouragement of the subject.

6. The rationale of the test was made clear to the subject, and discussion of times and strategies was encouraged. On the first application of the exercise the procedure was explained using the terms 'beginnings', 'endings' and 'middles', and the procedure was demonstrated to the subject.

In the development of the sorting exercises, discussion of the aims and strategies with the 'guinea-pigs' resulted in:

(i) random changes in the numbers of sorting opportunities for each target morpheme, by dealing 30 from 36, in addition to random changes in the positions of both the target and the sorting cards, thus preventing the subjects from memorising quantity as well as location as cues rather than the morphographemes themselves.

(ii) the conclusion that, as trials continued and sorting times decreased, times of below 2 minutes, approximately, could only be achieved by total inhibition of vocalisation, the motor requirements of the test rendering it unlikely that any subject would achieve a time of under 50 seconds on any 'test' anyway.

As a check on the subjective opinions of the trial subjects on the inhibition of vocalisation, a minor experiment was later conducted with 6 subjects who were subjected to the sorting 'tests' each under two conditions (i) in silence, with the instructional set to avoid vocalisation, and (i) under instructions to say the particles or morphemes during the sorting. The subjects were children aged 9 to 10, with 'reading ages' of 9 to 11. The two condition (i) and (ii) were presented with a two week interval, and half (i.e. 3) of the subjects were given the 'tests' in the order (ii) then (i) in order to control for the practice effect. The 'tests' were otherwise conducted as already described. Five applications of the 'tests' were given, and the times for each of the 3 sortings on the fifth application were averaged. The means for the 6 subjects under the non-vocalised condition and the vocalised condition were compared by means of a t test for paired observations, which enabled a null hypothesis of no difference between the means to be rejected at the .05 level of confidence (for a two-tailed test). A comparison of the means of the scores for application (i), irrespective of instructional

condition ▷	Non-vocalisation				Vocalisation				Order of pres.
sorting time/secs ▷	pre fix	suf fix	mid	Total ÷ 3	pre fix	suf fix	mid	Total ÷ 3	
subject									
1	191	196	298	228	223	218	346	262	NV-V
2	94	131	194	140	98	128	206	144	NV-V
3	125	121	164	137	133	124	196	151	NV-V
4	76	73	96	82	94	83	128	102	V-NV
5	71	88	103	87	102	116	158	125	V-NV
6	103	101	118	107	138	146	278	187	V-NV

Non-vocalisation group mean = 130.2 secs.
Vocalisation group mean = 161.8 secs.

$t = -2.893$, df = 5, mean deviation = 31.67, s.d. = 26.82.
Significant at .05 level of confidence.

First presentation mean = 153.2 secs.
Second presentation mean = 138.8 secs.

$F = .188$, df = 11, not significant.

Table 27. Results of application of sorting 'test' under conditions of vocalisation and non-vocalisation.

set, and for application (ii) was made by means of an F-test, and did not justify rejection of the null hypothesis. It was therefore concluded that, although the order of doing the tests had some effect, that effect was not statistically significant, and also that the results suggested that vocalisation tended to extend the time in which the 'test' could be accomplished by each subject, to a significant degree. The results of this minor experiment are presented in Table 27.

3.1.42. M_2, the Bimodal Reading Instruction Régime.

The bimodal reading instruction regime was basically what the Bullock Report (D.E.S., 1975) terms 'Phonics 2'. The same corpus of words was used for this regime as for M_1, and the rationale of the lessons was explained to the subjects as the building up of vocabulary to help them to read better. Each word was presented by writing it on the plastic-coated writing sheet, as used in the M_1 regime, pronounced by the teacher, using the syllabification approach, and repeated by the subject. The meaning of the word was discussed and illustrated, e.g. 'construction' was illustrated by building with Lego bricks. Each word was looked up in the Kingsway Dictionary by the subject, and the 'meaning' read out and associated with the oral expression of the word. Spelling patterns were emphasized, the final 'le' and long/short vowels associated with single and double consonants, for example.

The teaching method for this regime was based on Stage III of 'ALPHA to OMEGA: The A-Z of teaching reading, writing and spelling' (Hornsby & Shear, 1975), which appears to be the only method book to consider the teaching of reading polysyllabic words of Latinate derivation. An example of the approach, relevant to a number of words in the corpus, may be found in Figure 33.

Figure 33. Example of model of the teaching approach for M_2 reading instruction regime, from Hornsby & Shear (1975), page 200.

3.1.43. M_3, the Placebo Reading Instruction Regime.

The placebo reading instruction regime consisted of the application of the worting tests', devised to inhibit auditory-phonological encoding and to encourage segmentation of words and pseudo-words according to grapheme clustering. The application of the 'tests' was as described in 3.1.41. and was followed by no teaching régime.

3.1.5. Variables to be measured in the study.

It was proposed to measure one variable, comprehension, in the study, on the assumption that the goal of reading is semantic encoding of information input.

Halliday & Bierwisch (1970) distinguish three purposes of written or printed language, communication between questioner and responder, expression of ideational content, and a textual function. The latter two are regarded as interdependent (Peel, 1975). It was proposed to adopt a question and answer approach compatible with both reading instruction regimes, whereby an oral question, supported by visual display if necessary, demanded a recognition response which might occasion, but did not necessarily entail, the phonological decoding of the response. It was accordingly decided to allow the testee to respond by pointing out a word from amongst a number of others, irrespective of their perception as grapheme clusters or syllables. It is held that the procedure fulfils Halliday's three purposes.

Da Silva (1969, 1972) viewed the ideational content of a text predominantly in terms of the constraint that it imposes upon single word meanings or lexical-concept terms. The emphasis, in the comprehension test, upon single words was also supported by Bierwisch (1970) who makes the point that a semantic theory must " systematically represent the meaning of single words (or, more generally, of the lexical elements, which include also lexicalised phrases like idioms, isolated compounds etc.)".

Peel(1975) also distinguishes four components, semantic, psycholinguistic, logical and ontological, which form the overall setting in which comprehension takes place. It might be argued that, to some extent, the psycholinguistic element is fixed by the different natures of the two instructional régimes. The assertion by the subject of what Piaget (Piaget & Inhelder, 1964) calls the 'pertinence relation' between the words-cum-deminstration and the appropriate word culled from confusibles would appear to be an adequate criterion for inference of a semantic connection. Piaget (op. cit.) and others have demonstrated that something like the 'pertinence relationship' precedes the (logical) classification relation, according to the age or maturity of the testee. With the

<u>Question 3</u>

Oral, with visual example using empty shell cases.

"A device for throwing these out of a rifle after they have been fired?"

	Response choices:	Correct response:
3	expression adjective rejectible ejector extraction constructible injector suppressor injection dejected extractor expressor	<u>ejector</u>

<u>Figure 34</u>. Example (1) of comprehension test question.

Question 7.

Oral, with visual example. Untaught word.

"If you knock this house down*, it can be put together again." (* Demonstration using Lego house.)

	Response choices:	Correct response:
7	reconstructible	
	contactible	
	indifferent	
	irreversible	
	reconstruction	Reconstructible.
	contact	
	destructible	
	conversion	
	recompression	
	distraction	
	substructure	
	constructible	

Figure 35. Example (2) of comprehension test question.

inclusion of semantically possible combinations of morphemes amongst the confusible words, it might be held that the subject must also utilize some notion of logical class inclusion, particularly with regard to the relationships between suffix morpheme combinations and 'dominant' morphemes. It could be further argued that, particularly where suffix morphemes, such as '-ive', '-u-', '-ile' and '-ible' to exemplify a few of the simpler, are concerned, choice of the correct word in such circumstances might indicate what Peel (1971) terms 'sensitivity in the respondent to the nature of stability and change' or 'ontological awareness', to the extent allowable by the constraint of consideration of single, polymorphographemic words.

Examples of the comprehension questions and of the mode of response are given in Figures 34 and 35. The full test is presented in Appendix 9. One third of the 'target' words in the comprehension test were 'untaught' (represented by ⓤ in the test), i.e. not used in the instruction regimes, and therefore required 'semantic inference'. Two-thirds of the words used in the comprehension test were taken at random from the corpus of words used in the reading instruction regimes, two for each 'dominant' morpheme. There were thus 27 words in the comprehension test, 3 representing each 'dominant' morpheme.

3.2.0. The Design of the Experiment.

For planned comparisons to be made of the effects of the three teaching methods, the M_1 unimodal, the M_2 bimodal, and the M_3 placebo regime, and also of M_4 no instruction, it was proposed to use an analysis of variance design. The Solomon (1949) Four Group design offered the possibility of controlling variables which might jeopardise internal validity and also offered some possibility of controlling variables which might threaten external validity. Further, the design could be extended (Campbell & Stanley, 1963; Burroughs, 1971) to accommodate the four 'method' groups:-

M_1	unimodal (visual) reading instruction,
M_2	bimodal (normal) reading instruction,
M_3	placebo reading instruction,
M_4	no reading instruction.

The design, set out in Figure 36, incorporated allocations to pre-test and non-pre-test groups, the test being the comprehension measure.

R	O_1	M_1	O_2
R	O_3	M_2	O_4
R	O_5	M_3	O_6
R	O_7	M_4	O_8
R		M_1	O_9
R		M_2	O_{10}
R		M_3	O_{11}
R		M_4	012

where R indicated random allocation,
O indicates the observation variable or test.

M indicates the treatment variable.

Figure 36. The design of the experiment.

So far, the Solomon design appeared appropriate for testing the hypotheses presented in section 3.0.3. using anoVa.

(i) $H_0 \quad M_1 = M_2$

(ii) $H_0 \quad M_{(1+2)} = M_{(2+3)}$

(iii) $H_0 \quad M_3 = M_4$

where M represents the mean for the treatment group. The design required some modification, however, to test the null hypotheses:

(iv) $H_0 \quad M_{1v} = M_{1a}$

(v) $H_0 \quad M_{2a} = M_{2v}$

This was effected by equalising the instruction method groups in terms of auditory preferents and visual preferents, according to the scale derived from Part 1, the AVMPC scale. Thus two further analyses of variance could be made, and would be structured thus:

Modality Preference of Subjects, for comparisons (iii) & (iv)	Reading Instruction Treatment Groups			
	M_1 unimodal	M_2 bimodal	M_3 placebo	M_4 no treatment
Visual	a b c d e	a b c d e	a b c d e	a b c d e
Auditory	f g h i	f g h i	f g h i	f g h i

The partitioning of the degrees of freedom would thus be:-

1. For comparisons (i), (ii) and (iii):

Source of variance	degrees of freedom	
Between methods	3	
Comparison (i)		1
Comparison (ii)		1
Comparison (iii)		1
Within	32	
Total (N-1)	35	

2. For comparison (iv) within M_1:

Source of variance	degrees of freedom
Between modalities	1
Within modality	7
Total (N-1)	8

3. For comparison (v) within M_2:

Source of variance	degrees of freedom
Between modalities	1
Within modality	7
Total (N-1)	8

Further analyses of variance would be used to investigate
(a) the interaction of pretesting and the experimental variable;
(b) the interaction of teacher with the experimental variable.
Two further partitions of the degrees of freedom were thus possible:-

(a) pre-test/post-test interaction:

source of variance	d.f.
between methods	3
between pre-test/non p.t.	1
method x test interaction	3
error	28
total (N - 1)	35

(b) teacher/method interaction, for M_1 and M_2 only:

source of variance	d.f.
between methods	1
between teachers	1
method/teacher interaction	1
error	14
total (N - 1)	15

3.3.0. <u>Subjects</u>.

3.3.1. <u>Population</u>.

The population studied was that of children 'suffering' from 'specific reading difficulty' (SRD). In Part 1, SRD was defined in terms of the lag between word recognition ability, measured in relation to standardised norms by the Neale Accuracy Quotient, and comprehension ability, similarly measured and expressed as a Neale Comprehension Quotient, the degree of lag being expressed as NC ÷ NA or $\frac{NC}{NA}$. A 'serious' or problematic lag was arbitrarily defined as $\frac{NC}{NA} > 110$, thus defining the population from which the sample was drawn.

Because of the restricted range of the Neale test, from 6 to 13 years in terms of age norms, a lag of $\frac{NC}{NA} > 110$ was deemed to provide a level of word recognition low enough to predict that such subjects would find great difficulty with the corpus of polymorphographemic words.

3.3.2. The Sample.

The sample was drawn from the population, as defined above, in two ways:

(i) by initial consultation with teachers in one primary and two secondary schools, resulting in testing suspect SRD children by means of the Neale test for conformity to the population criterion;

(ii) by contacting parents of children referred to a research agency for diagnosis, but not treatment, of reading difficulties, again followed by a test of conformity to the population criterion.

No attempt was made to describe the sample in terms of social class background, family circumstances, attitude to school, or physiology.

The sampling procedure might be held to be selective of those children who not only have SRD but also evince it to teachers and/ or parents, and perhaps have themselves some perception of their difficulty. It may be argued, however, that it is in this way that the discrepancy between oral receptive language (and its comprehension) and lower ability in written receptive language (and its comprehension) does, in fact, manifest itself.

From the findings of Part 1, the subjects were described in terms of visuo-graphic/auditory-phonological processing preference for the purpose of making comparisons (iii) and (iv) (3.0.3. q.v.).

A summary of the characteristics of the sample is presented in

Table 28.

Description of the sample.

Description		No. of ss	%
Sample size		36	100
Boys		27	75
Girls		9	25
Chronological Age	10 years	5	14
	11 years	6	17
	12 years	9	25
	13 years	8	22
	14 years	6	17
	15 years	2	6
Auditory preferent on AVMP scale		16	44
Visual ditto.		20	56
Reading Age (Word recognition)			
	8 years	1	3
	9 years	15	42
	10 years	13	36
	11 years	7	19
Comprehension Age	10 years	2	6
	11 years	9	25
	12 years	23	64
	13 years	2	6
Neale Comprehension Quotient: Neale Accuracy Quotient			
	110-119	21	58
	120-129	13	36
	130+	2	6

Table 28. Description of sample.

3.4.0. Administration of the Experiment.

3.4.1. Randomisation of Allocation to Instructional Régimes.

As the treatments were individually applied, the subjects were allocated to treatment conditions as they were selected. The equalisation of treatment groups in terms of visuo-graphic/auditory-phonological processing preference effectively doubled the number of groups for random allocation of subjects. A sampling frame was set up, using an overflow technique so that the randomness of the allocation was not affected by the processing-modality classification. The sampling procedure is presented in Table 29, the numbers indicating the order of selection of the subjects as conforming to the population criterion.

Direction of allocation ⟶

Order of Allocation ↑

30 t2		33 t2		34		35	
21 t2	28 t2	23 t2	31 t2	26	32	29	36
p14 t1	p22 t2	p17 t1	p24 t2	p19	p25	p20	p27
8 t1	12 t1	9 t1	15 t1	16	11	13	18
p1 t1	p3 t1	p2 t1	p6 t1	p4	p7	p5	p10
Visual Pref.	Audit. Pref.	Visual Pref.	Audit. Pref.	Visual Pref.	Audit. Pref.	Visual Pref.	Audit. Pref.
Method 1 Unimodal		Method 2 Bimodal		Method 3 Placebo		Method 4 No treat.	

t1 = allocation to teacher 1,
t2 = allocation to teacher 2.

p = allocation to pretest.

Table 29. Sampling frame, showing order of allocation to all groups, basic to analyses of main and interaction effects.

In addition, Table 29 shows the procedure by which the subjects were randomly allocated to teacher and pre-test groups, this being necessary for analysis of the effects of interaction between these variables and the main variables of the study.

3.4.2. Application of the Reading Instruction Régimes.

The reading instruction scedules were operated over the course of one year. Each treatment was conducted individually in a room with no distractions. An unlimited supply of sketching and writing area was provided by means of A2 size washable writing sheets, and 'Lumocolour' pens were provided in various colours. Those subjects derived from schools were treated within their schools, and those derived from the research agency were treated in the writer's home. No distinction in method or supportive materials was made. Each schedule was strictly adhered to; that no schedule was broken was due to careful planning, prior consultation, and sheer luck. The writer was mindful of the problem of possible communication between testees in the school situation, which may jeopardise internal validity, but this did not appear to arise in practice partly because both the secondary schools were split-site schools, and because of the small numbers of subjects from any one school. The subjects were therefore well-dispersed by geography and age-banding.

The pre-test (where appropriate) and the post-test applications of the comprehension test were conducted according to the schedule laid down in section 3.1.3. The individual subjects' scores were recorded on a duplicated score sheet, a copy of which is presented in Appendix 9.

3.5.0. Results of the Experiment.

The total scores for each subject for the pre-test, where appropriate, and the post-test, were obtained by summing the correct responses observed by the administrator of the test. The pre-test scores for each method group are presented in Table 30, below.

Method Group	M_1	M_2	M_3	M_4
Scores:	3	3	4	4
	4	4	6	5
	5	6	4	5
	4	4	4	3
Totals:	16	17	18	17
Means:	4	4.25	4.5	4.25

Table 30. Pre-test scores for 4 method groups on the Comprehension test, with mean scores.

Method Groups:	M_1	M_2	M_3	M_4
Scores:	21	9	5	3
	15	14	7	2
	18	8	4	7
	22	6	4	6
	18	9	2	3
	16	14	5	6
	12	11	3	3
	11	13	7	3
	15	9	5	7
Totals:	148	93	42	40
Means:	16.44	10.33	4.67	4.44

Table 31. Post-test scores, with means, for four method groups on the Comprehension test.

The results of the application of the Comprehension post-test, for all method groups, are presented, with means, in Table 31.

Method Groups:	M_1	M_2	M_3	M_4
Scores for PreTest ss:	21	9	5	3
	18	8	4	7
	16	14	5	6
	11	13	7	3
Totals:	66	44	21	19
Means:	16.5	11.0	5.25	4.75
Scores for No-PreTest ss:	15	14	7	2
	22	6	4	6
	18	9	2	3
	12	11	3	3
	15	9	5	7
Totals:	82	49	21	21
Means:	16.4	9.8	4.2	4.2

Table 32. Post-test results for pre-tested and non-pretested groups on Comprehension.

Little difference was observed between the means of the pre-test scores for all method groups. In contrast, there were greater differences between the means of the post-test scores for all method groups (Table 31), the mean score on the comprehension test for the M_1 bimodal (visual) regime being 16.44, for the bimodal or normal regime 10.33, for the placebo group 4.67, and for the no-treatment group 4.44. The post-test comprehension scores for the pre-tested and non-pretested groups were differentiated, and are presented in Table 32.

Within the M_1 unimodal (visual) method group, the scores for the visual and auditory preferents were differentiated, and are presented in Table 33. The mean comprehension scores were 18.80 and 13.50 repectively.

Method Group 1 (Unimodal) only:		
Preference:	Visual	Auditory
Scores:	21	16
	15	12
	18	11
	22	15
	18	
Totals:	94	54
Means:	18.80	13.50

<u>Table 33</u>. Comprehension test scores and means for Auditory and Visual preferents in Method Group M_1.

Within the bimodal or normal group M_2, the scores for visual and auditory preferents were also differentiated, and are presented with their respective means for the Comprehension test in Table 34. The mean comprehension score for the visual preferents was 9.20, and that for the auditory preferents, 11.75.

Method Group 2 (Bimodal) only:		
Preference:	Visual	Auditory
Scores:	9	14
	14	11
	8	13
	6	9
	9	
Totals:	46	47
Means	9.20	11.75

Table 34. Comprehension test scores and means for Auditory and Visual preferents in Method group M_2

The mean comprehension scores for the auditory/visual and unimodal/bimodal dimensions may be presented thus:

	Aud. Pref.	Vis. Pref.
Unimodal	13.50	18.80
Bimodal	11.75	9.20

Comparison was made of the pre-test scores (of those who were pre-tested) and post-test comprehension scores: The gains were computed for each method group, and are presented in Table 35.

Method Group	M_1	M_2	M_3	M_4
Scores:	18	6	1	-1
	7	4	0	2
	12	8	-1	1
	11	9	3	0
Totals:	48	27	3	2
Means:	12	6.75	.75	.5

Table 35. Pre-test/Post-test gains and mean gains for 4 method groups on the comprehension test.

The mean gain for the unimodal (visual) method group M_1 was 12.0, that for the bimodal group M_2 was 6.75, that for the placebo group M_3 was .75, and the mean comprehension gain for the non-treatment group was .5.

Teacher - Method Interaction:				
	Teacher 1		Teacher 2	
Method Group	M_1	M_2	M_1	M_2
Scores:	21	9	22	6
	15	14	18	9
	18	8	11	13
	16	14	15	9
	12	11		
Totals:	82	56	66	37
Means:	16.4	11.2	16.5	9.25

Table 36. Comprehension test scores and means for Teacher groups 1 and 2.

The scores for those subjects taught by Teacher 1 and for those taught by Teacher 2 were differentiated, and are presented with the mean scores in Table 36. The scores and means were also differentiated by method group. The mean scores for Teacher 1 on method groups M_1 and M_2 were 16.4 and 11.2 respectively; and for Teacher 2, 16.5 and 9.25 respectively.

Out of the 27 words in the comprehension test, 9 were untaught (labelled u on the test sheet). The results of the presentation of the u component of the comprehension test, with mean scores, are presented in Table 37. These post-test u scores ranged from 0 to 6. The mean u score for the M_1 unimodal regime was 4.1, for the M_2 bimodal regime 1.6, for the M_3 placebo regime 1.0, and for the M_4 no-treatment group 0.9 . In Table 37, the u scores for the auditory and visual preferents are separated, though there is little difference between the means within each regime.

Method Groups		M_1	M_2	M_3	M_4
Scores:	Vis.Pref.	5	2	1	1
		6	0	2	2
		4	3	0	1
		3	1	2	1
		3	2	0	0
	Aud.Pref.	3	1	1	1
		6	2	0	1
		5	1	3	0
		2	2	0	1
Totals:		37	14	9	8
Mean Vis. Pref.		4.2	1.6	1.0	1.0
Mean Aud. Pref.		4.0	1.5	1.0	0.75
Group Means:		4.1	1.6	1.0	0.9

Table 37. Comprehension Test scores and means for Untaught Words, u.

3.5.1. Analysis of Results.

The Four Method Groups:

A. Post-Test Scores.

Analysis of variance was applied to the mean post-test scores for each of the four reading instruction method groups according to the partition of degress of freedom already given. The sums of squares were computed between methods, within methods, and the variances determined as functions of their respective degrees of freedom: The results of the anova are presented in Table 38:

Source of variance	d.f.	s.s.	Variance
Between methods	3	871	290
Within methods	32	228	7
Total (N - 1)	35	1099	

Table 38. Results of analysis of variance for 4 method groups.

The F-ratio, between 'Between' and 'Within', was computed and found to be 41 which, on consulting a proprietary F Table, was found to be significant at the .01 level. As planned comparisons had been made, however, there was strictly no necessity to compute F for a two-tailed test. An anova (analysis of variance) was therefore applied to each of the comparisons (i), (ii) and (iii) (see section 3.2.0.) which, because the direction was specified, could be interpreted in terms of the values for a one-tailed test. The comparisons are reiterated below:

Means......	M_1	M_2	M_3	M_4
Comparison (i)	1	-1	0	0
(ii)	1	1	-1	-1
(iii)	0	0	1	-1

The anova, above, was accordingly extended to accommodate the comparisons and the appropriate sums of squares computed; and is presented in Table 39.

Source of Variance	d.f.	ss	Variance
Between methods	3	871	290
Comparison (i)	1	168	168
Comparison (ii)	1	703	703
Comparison (iii)	1	0	0
Within	32	228	7
Totals	35	1099	

Table 39. Results of analysis of variance for comparisons (i), (ii) and (iii).

For comparison (i), between the means of groups M_1 and M_2, the resultant F ratio was $^{168}/_{7}$ or 24, indicating a difference between the means ($M_1 = 16.44$, $M_2 = 10.33$) significant at the .001 point. Thus the mean score on the comprehension test for the Unimodal (visual) Instruction Group was significantly superior to the means score for the Bimodal (normal) Instruction Group.

For comparison (ii), between the mean score of the combined treatment groups (M_1 and M_2), 13.39, and the mean score of the combined non-treatment groups (M_3 and M_4), 4.56, the resultant F ratio was $^{703}/_{7}$ or 99, indicating a difference between the means significant at the .001 point. Thus the mean score on the comprehension test for the combined treatment groups was significantly superior to the mean score for the combined non-treatment groups.

For comparison (iii), between the mean score for the placebo group (M_3), 4.67, and the non-treatment group (M_4), 4.4, the resultant F ratio was $^{0}/_{7}$ (the 0 value being to two significant figures) or 0, indicating an insignificant difference between the means. Thus there was no significant difference between the mean score on the comprehension test for the placebo group and the mean score for the non-treatment group.

B. <u>Pre-Test - Post-Test Gains</u>.

As in A, analysis of variance was applied to the mean pre-test/post-test gains for each of the four reading instruction groups according to the partition of degrees of freedom already given. The sums of squares were computed between methods, within methods, and the variances determined as functions of their respective degrees of freedom, the results being presented in Table 40.

Source of Variance	d.f.	s.s.	Variance
Between methods	3	361	120
Comparison (i)	1	55	55
Comparison (ii)	1	306	306
Comparison (iii)	1	0	0
Within methods	12	91	7.6
Totals:	15	452	

Table 40. Results of analysis of variance of Pre-Test/Post-Test Gains.

For comparison (i), between the means of groups M_1 and M_2, the resultant F ratio was $^{55}/_{12.83}$ or 4.3, indicating a difference between the means (M_1 = 12.0, M_2 = 6.75) significant at the .05 point. Thus the mean pre-test/post-gain on the comprehension test for the Unimodal (visual) Instruction group was significantly superior to the mean pre-test/post-test gain for the Bimodal (normal) Instruction group.

For comparison (ii), between the means of the $M_1 + M_2$ and $M_2 + M_3$ combined groups (treatment vs. non-treatment), the resultant F ratio was $^{306}/_{10.43}$ or 29.3, indicating a difference between the means significant at the .001 point. Thus the mean pre-test/post-test gain on the comprehension test for the combined treatment groups was significantly superior to that for the combined non-treatment groups.

For comparison (iii) between the means of groups M_3 and M_4, the resultant F ratio was $^{.13}/_{2.33}$ or 0. There was thus no significant between the mean pre-test/post-test gain for the placebo group and that for the no-treatment group.

C. Post-Test Scores for Untaught Words.

As in A and B, analysis of variance was applied to the mean post-test scores for untaught words (labelled ⓤ on the score sheet) according to the partition of degrees of freedom already given. The sums of squares were computed between methods, within methods, and the variances determined as functions of their respective degrees of freedom, the results being presented in Table 41.

Source of Variance	d.f.	s.s.	Variance
Between methods	3	126	42
Comparison (i)	1	30	30
Comparison (ii)	1	32	32
Comparison (iii)	1	(.1)	0
Within methods	32	35	1.1
Totals:	35	161	

Table 41. Results of analysis of variance of post-test scores for untaught words.

For comparison (i), between the means of groups M_1 and M_2, the resultant F ratio was $^{30}/_{1.3}$ or 22 indicating a difference between the means (M_1 = 4.11, M_2 = 1.56) significant at the .001 point. Thus the mean untaught word score on the comprehension test for the Unimodal (visual) Instruction Group was significantly superior to that for the Bimodal (normal) Instruction group.

For comparison (ii), between the means of the combined treatment groups (M_1+M_2 = 2.83) and that of the combined no-treatment groups (M_3+ M_4 = 0.94), the resultant F ratio was $^{48}/_{1.9}$ or 25 indicating a difference between the means significant at the .001 point. Thus the mean untaught word score on the comprehension test for the treatment groups was significantly superior to that for the no-treatment groups.

For comparison (iii), between the mean untaught word score for the placebo group (M_3 = 1.0) and the no-treatment group (M_4 = 0.9), the resultant F ratio was $^{.1}/_{.7}$ or 0.2 indicating an insignificant difference between the means. Thus there was no no significant difference between the mean untaught word score on the comprehension test for the placebo group and that for the no-treatment group.

The Modality Classification.

A. Post-Test Scores.

Analysis of variance was applied to the mean post-test comprehension scores for the auditory-preferent/visual-preferent modality classification within the treatment groups according to the partition of degrees of freedom already given. The sums of squares were computed between classes, within classes, and the variances determined as functions of the respective degrees of freedom.

For comparison (iv), within the M_1 Unimodal (visual) Instruction group and between the mean score for the visual-preferent group (18.80) and that for the auditory-preferent group (13.50), the resultant F ratio was $^{62}/_{6.86}$ or 9, indicating a significant difference between the means at the .01 point. Thus the mean post-test score for visual-preferents was significantly superior to that for auditory-preferents within the Unimodal (visual) Instruction method group, M_1.

Source of Variance	d.f.	s.s.	Variance
Between Modalities	1	62	62
Within Modalities	7	48	6.86
Totals:	8	110	

Table 42. Results of analysis of variance of Post-Test Comprehension scores within Unimodal Method group M_1.

For comparison (v), within the M_2 Bimodal (normal) Instruction group and between the mean score for the visual-preferent group (9.20) and that for the auditory-preferent group (11.75), the resultant F ratio was $^{14}/_{7.14}$ or 2, which did not approach significance at the .05 point. Thus there was no significant difference between the mean scores for auditory-preferents and visual-preferents with the M_2 Bimodal (normal) Instruction group.

Source of Variance	d.f.	s.s.	Variance
Between Modalities	1	62	62
Within Modalities	7	48	6.86
Totals:	8	110	

Table 43. Results of analysis of variance of Post-Test Comprehension scores within Bimodal Method group M_2.

B. Pre-Test/Post-Test Gains.

As in A, analysis of variance was applied to the mean pre-test/post- test comprehension gains for the auditory-preferent/visual-preferent classification within treatment groups.

For comparison (iv), within the M_1 Unimodal (visual) Instruction group and between the mean gain for the visual-preferent group (15.0) and that for the auditory-preferent group (9.0), the resultant F ratio was $^{36}/_{13}$ or 2.8, indicating no significant difference between the means.

Source of Variance	d.f.	s.s.	Variance
Between modalities	1	36	36
Within modalities	2	26	13
Totals:	3	61	

Table 44. Results of analysis of variance of pre-test/post-test gains within Unimodal Method group M_1.

For comparison (v), within the M_2 Bimodal (normal) instruction group and between the mean gain for the auditory-preferent group (8.5) and that for the visual-preferent group (5.0), the resultant F ratio was $^{13}/_{1}$ or 13, indicating a difference between the means significant at the .05 point.

Source of Variance	d.f.	s.s.	Variance
Between modalities	1	13	13
Within modalities	2	2	1
Totals	3	15	

Table 45. Results of analysis of variance of pre-test/post-test gains within Bimodal Method group M_2.

C. Post-Test Scores for Untaught Words.

As in A and B, analysis of variance was applied to the mean post-test scores for untaught words (labelled u on the score sheet) according to the partition of degrees of freedom already given.

For comparison (iv), within the M_1 Unimodal (visual) Instruction group and between the mean score for the visual-preferent group (4.20) and that for the auditory-preferent group (4.00), the resultant F ratio was $^{.1}/_{2.8}$ or .04, indicating no significant difference between the means.

Source of Variance	d.f.	s.s.	Variance
Between modalities	1	0.1	0.1
Within modalities	7	16.8	2.4
Totals	8	16.9	

Table 46. Results of analysis of variance for modalitiy classes within Method group M_1, untaught word scores.

For comparison (v), within the M_2 Bimodal (normal) Instruction group and between the mean score for the auditory-preferent group (1.6), the resultant F ratio was $^{.92}/_{.89}$ or 1.03, indicating no significant difference between the means.

Source of Variance	d.f.	s.s.	Variance
Between modalities	1	0.92	0.92
Within modalities	7	6.20	0.89
Totals	8	7.12	

Table 47. Results of analysis of variance for modality classes within Method group M_2, untaught word scores.

A summary of the results of analysis of variance applied to total comprehension-test scores, pre-test/post-test gains, and untaught-word scores is presented in Table 48.

Effects of Interaction Variables.

The effects of two interaction variables, Teacher and Pre-Testing may be investigated by means of a Two-Way Analysis of Variance, whereby, in a random effects model, the appropriate numerator for the F ratio would be the interaction term and the denominator the error term (Burroughs, 1971, chap. 28).

For the interaction of the teacher method, the appropriate sums of squares were computed and the variance derived according to the partition of degrees of freedom, using (a) the Post-Test scores and summary data for all ss on the Comprehension Test, and (b) the Pre-Test - Post-Test gains on the Comprehension Test for Pre-Tested ss. The results of both computations are presented in Tables 49 and 50.

	Post-Test scores on Comprehension Test.					Pre-Test/Post-Test Gains on Comprehension Test.					Post-Test scores - Untaught words only.				
	Mean	Diff betw. Means	d.f.	F	p	Mean	Diff. betw. Means	d.f.	F	p	Mean	Diff. betw. Means	d.f.	F	p
Comparison (i)															
Unimodal Reading Method group M_1	16.44	6.11	17	24	.001	12.0	5.25	7	4.3	.05	4.11	2.55	17	22	.001
Bimodal Reading Method group M_2	10.33					6.75					1.56				
Comparison (ii)															
Uni- + Bimodal RM groups M_1+M_2	13.39	8.83	35	99	.001	9.38	8.62	15	29.3	.001	2.50	1.38	35	25	.001
Placebo + Non-treatment groups M_3 + M_4	4.56					.62					1.12				
Comparison (iii)															
Placebo Reading Method group M_3	4.67	0.23	17	0	n.s.	.75	.25	7	0	n.s.	1.00	0.10	17	0.2	n.s.
Non-treatment RM group M_4	4.44					.50					0.90				
Comparison (iv)															
Visual-Preferent class in group M_1	18.80	5.30	8	9	.01	15.0	6.0	3	2.8	n.s.	4.20	0.20	8	0.1	n.s.
Auditory-Pref'nt class in group M_1	13.50					9.0					1.50				
Comparison (v)															
Auditory-Pref'nt class in group M_2	11.75	2.55	8	2	n.s	8.5	3.5	3	13	.05	1.60	0.10	8	1	n.s.
Visual-Preferent class in group M_2	9.20					5.0					1.50				

Table 48 Summary of Means, F Ratios and Significance resulting from Analysis of Variance of Post-Test and Gain scores on the Comprehension Test.

Source of Variance	ss	d.f.	Variance
Between methods	174	1	174
Between teachers	5	1	5
Method X Teacher Interaction	3	1	3
Error	164	14	11.7
Totals:	364	17	

Table 49. Analysis of interaction variance for Teachers using postTest Comprehension scores for all (taught) ss.

Source of Variance	ss	d.f.	Variance
Between methods	55	1	55
Between teachers	5	1	5
Method X Teacher Interaction	35	1	35
Error	37	4	9.25
Totals	132	7	

Table 50. Analysis of Teacher/Method interaction variance using preTest-postTest gains on Comprehension Test, N = 8.

The interaction variance F was computed for both sets of data using the interaction term as the numerator and the error term as the denominator, giving:

(a) interaction F = $3 \div 11.7 = 0.26$, postTest scores only.

(b) interaction F = $35 \div 9.25 = 3.78$, preTest - postTest gains only.

neither F ratio approaching (.05) significance for d.f. 1,14 and 1,4 respectively. A summary of results of analysis of interaction variance is presented in Table 52, below.

For the interaction of preTesting and method, the appropriate sums of squares were computed and the variance derived according to the partition of degrees of freedom, comparing the means of the preTested and non-preTested ss groups. The results are tabulated below:

Source of Variance	SS	d.f.	Variance
Between methods	895	3	298
Between preTested, non-preTested groups	4	1	4
Method x Testing Interaction	3	3	1
Error	124	28	4.43
Totals	1026	35	

Table 51. Analysis of preTest/method interaction variance using postTest Comprehension scores.

The interaction variance F = 1 ÷ 4.43 = .226 which, for 3,28 degrees of freedom, was found to be insignificant.

The results of analyses of interaction variance are presented in the following table which includes summary data:

Interaction Variables (with Methods)	Diff. betw. Means	F Ratio	p (sig.)	d.f.
<u>Teachers</u> (postTest Comprehension mean score for Teacher 1 = 13.9, N=10 Teacher 2 = 12.9, N=8)	1.0	0.26	n.s.	1,14
<u>Teachers</u> (preT - postT Comprehension mean gains for Teacher 1 = 9.83, N=6 Teacher 2 = 8.00, N=2)	1.83	3.78	n.s.	1,4
<u>preTesting</u> (postTest Comprehension mean score for preTested ss = 9.37 N=16 non preT. ss = 8.65 N=20	0.72	0.226	n.s.	3,28

<u>Table 52</u>. Summary of results of analyses of interaction variance.

3.5.2. Supplementary Data and Analysis.

At this stage in the investigation, the possibility arose that the lack of significance of the F ratios for comparisons (iv) and (v) might be due to the very small sample sizes and the corresponding increase in probability in making Type I or II errors (Burroughs, 1970). The sample size for comparisons (iv) and (v) was determined by the 'cost' (Burroughs, 1970, p 58) of obtaining a sufficient number of subjects, and also by the sampling procedure. The analysis of results for comparisons (iv) and (v) therefore suggested the advisability of further data collection.

Since the collection of the original data, treatment of children with reading difficulties (including a number of the original subjects) by the use of the Unimodal method had proceeded on a weekly-lesson basis. A waiting-list had also been established, and this offered the possibility of further data collection. For moral reasons, however, such additional data collection had to be confined to that for comparison (iv), between auditory- and visual-preferents within the M_1 Unimodal (visual) Instruction Regime. There was a further constraint upon the number of subjects that could be investigated in that longer-term treatment had to be offered to those participating.

Consultation suggested that a systematic element be introduced, in view of the smallness of the supplementary sample, to reduce the error variance, and also suggested that matching the auditory and visual groups according to intelligence would be appropriate. Unlike the original sample, the 'waiting-list' children had been, or were about to be, subjected to the WISC, the Wechsler Intelligence Scale for Children (Wechsler, 1949), a reliable, standardised instrument. Thus a small supplementary sample of children, referred for underachievement in reading, was available for testing in respect of intelligence and of 'modal preference', and consequently for experimental treatment according to the M_1 Unimodal teaching regime administered under the same conditions as previously. Rather than employ a non-parametric statistic such as the Wilcoxon Matched Pairs, it was decided to retain Analysis of Variance, comparing the auditory and visual groups by means of an F ratio, as being a more stringent test.

In practice, very close matching proved unattainable. This was not only because of the limited availability of subjects, because of the additional requirement to match, albeit approximately, by age as well as by intelligence. Wechsler (1949) renounces the concept of Mental Age, the WISC I.Q. being a deviation quotient which indicates the amount by which a subject deviates above or below the average performance of individuals of his own age. Matching children with similar quotients but with disparate ages was therefore inappropriate. Further, as was found in the original sample, there was a low proportion of auditory-preferents. Only six auditory-preferent underachievers were ultimately available for matching with visual-preferents according to age and intelligence. Such were the constraints on the collection of further data, advertisement for subjects not being possible because of the obligation of the investigator to provide continuing treatment.

From a list of 38 children and adolescents awaiting diagnosis and/or treatment, 28 were available for tuition during the school summer holidays and the period immediately following.

Of the 28, 19 had previously been subjected to the WISC, the Neale Analysis of Reading Ability, the 'modal preference' measure and other diagnostic or descriptive tests. The remaining 9 children were also tested, the results for the 28 possible subjects being presented in the following table:

Subject code	Age	WISC Quotient	Aud/Vis
a	6.16	122	v
b	7.58	96	v
c	8.67	88	v
d	8.67	91	a
e	8.72	102	v
f	9.25	119	v
g	9.33	117	a
h	9.58	130	v
i	10.00	108	v
j	10.08	151	v
k	10.67	109	v
l	10.67	102	v
m	10.92	112	a
n	10.92	121	v
o	11.17	152	v
p	11.25	125	a
q	11.58	104	v
r	12.08	131	a
s	12.08	108	v
t	12.50	130	v
u	13.67	98	v
v	14.17	133	v
w	14.33	109	a
x	14.50	89	v
y	14.50	122	v
z	14.67	113	v
aa	16.08	104	v
bb	19.92	140	v

Table 53. Intelligence Test results, ages and modal preferences for 28 possible ss.

From the above list, the six auditory-preferent subjects were (approximately) paired with six visual-preferent subjects according to intelligence and chronological age. 12 subjects were thus subjected to the M_1 Unimodal teaching regime followed by the comprehension test as described in section 3.1.41. The matched pairs are described in Table 54.

Pair No.	Subject code	m/f	Age	I.Q.	Aud/Vis
1	d	m	8.92	88	a
	c	m	8.67	91	v
2	g	m	9.33	117	a
	f	m	9.25	119	v
3	m	f	10.92	112	a
	k	m	10.67	109	v
4	p	m	11.25	125	a
	n	m	10.92	121	v
5	r	m	12.08	131	a
	t	m	12.50	130	v
6	w	m	14.33	109	a
	z	f	14.67	113	v

Table 54 Details of matched pairs to be used in supplementary investigation.

Comprehensive data for the matched pairs, including the results of application of the Neale Analysis of Reading Ability, may be found in Appendix 10.

3.5.21. Results of Supplementary Investigation.

The total score for each subject on the comprehension post-test was obtained by summing the correct responses observed by the administrator of the test. The untaught-word score for each subject on the comprehension post-test was obtained by summing the correct u item responses, as previously. The results are presented in Table 55.

3.5.22. Analysis of Supplementary Results.

Analysis of variance was applied to the mean post-test scores, separately for total and untaught-word scores, for the auditory- and visual-preferent groups according to the partition of degrees of freedom. The sums of squares were computed between groups,

Pair No.	Aud/Vis	Total Score (/27)	u Score (/9)
1	a v	12 12	0 1
2	a v	13 18	1 3
3	a v	16 18	2 3
4	a v	14 22	2 6
5	a v	15 20	1 3
6	a v	17 20	2 4

Table 55. Supplementary post-test scores, total and u, on comprehension test.

within groups and the variances determined as functions of the respective degrees of freedom, the results of the AoV being presented in Tables 56 and 57.

Source of Variance	d.f.	s.s.	Variance
Between a/v groups	1	44	44
Within a/v groups	10	78	7.8
Totals:	11	122	

Table 56. Result of AoV of total comprehension scores for comparison (iv), supplementary matched-pairs data.

Source of Variance	d.f.	s.s.	Variance
Between a/v groups	1	12.01	12.01
Within a/v groups	10	16.67	1.67
Totals:	11	28.68	

Table 57. Result of AoV of u comprehension scores for comparison (iv), supplementary matched-pairs data.

3.5.23. Effects of Interaction Variables.

As matching according to both age and intelligence quotient had been somewhat approximate, the systematic variation of age and intelligence might be held to be imperfect. Analysis of variance was therefore applied to the effects of intelligence, age, intelligence/modal preference interaction, and age/modal preference interaction, the results of the analyses being presented in Table 58.

Source of Variance	d.f.	s.s.	Variance
Between a/v classes	1	44	44
Between high/low I.Q.	1	4	4
Between high/low age	1	15	15
I.Q./a v interaction	1	28	28
Age /a v interaction	1	4	4
Residual error	6	27	4.5
Totals:	11	122	

Table 58. Results of AoV of supplementary post-test scores for interaction effects.

For the total comprehension scores, the F-ratio between 'Between' and 'Within' was $^{44}/_{7.8}$ or 5.64 which, for d.f. 1 and 10, was found to be significant at the .05 level (.025 point for one-tailed test). For the u or untaught-word comprehension scores, the F-ratio between 'Between' and 'Within' was $^{12.01}/_{1.67}$ or 7.19 which, for d.f. 1 and 10, was found to be significant at the .05 level (.025 point for one-tailed test). The results are summarised in Table 59.

	Post-test scores on the Comprehension Test					Post-test u scores on the Comprehension Test				
Comparison (iv)	Mean	Diff. betw. Means	df	F	p	Mean	Diff. betw. Means	df	F	p
Visual-pref class in M_1	18.3	3.8	11	5.64	.025	3.33	2.0	11	7.19	.025
Auditory-pref class in M_1	14.5					1.33				

Table 59. Summary of Means, F Ratios and Significance resulting from AoV of post-test (total and u) scores on comprehension test for matched pairs.

The main effect was then tested against the two interaction effects by computing the F ratios:

F (a/v ÷ I.Q./a/v interaction) = $^{44}/_{28}$ = 1.57 n.s.
(did not approach significance for 1 x 1 d.f.)

F (a/v ÷ Age/a/v interaction) = $^{44}/_{4}$ = 11 n.s.
(did not approach significance for 1 x 1 d.f.)

and the other effects against the error:

F (I.Q. ÷ error) (d.f. 1,6) = $^{4}/_{4.5}$ = 0.89 n.s.

F (Age ÷ error) (d.f. 1,6) = $^{15}/_{4.5}$ = 3.3 n.s.

In such a mixed effects model, Burroughs (1971) recommends pooling the error in order to be conservative:

$$\frac{\text{Interaction ss} + \text{Error ss}}{\text{Interaction d.f.} + \text{Error d.f.}}$$

so that this can then be used for all those effects which would ordinarily have been tested against the interaction term. The pooled error now being $^{59}/_{8}$ or 7.4, an F table may be constructed to show the ratio of each effect variance to the error variance:

Effect	Variance	F	p
Aud/Vis class	44	5.94	.05
Intelligence	4	0.54	n.s.
Age	15	2.02	n.s.
F value for p< .05 for 1,8 d.f. = 5.32			

Table 60. F ratios for Auditory-Visual class/ Intelligence/Age against pooled Error, supplementary data.

The only significant effect (p<.05) was therefore that of modal preference.

3.5.3. Reliability of the Comprehension Test.

The comprehension test, being a specially-devised test, was not of proven reliability. As there were no parallel forms of the test and there was no opportunity to retest the subjects, a single-testing reliability approach by means of the Kuder-Richardson Formula No. 20 (Burroughs, 1971) was suggested, yielding a coefficient of internal consistency. The size of such a coefficient is dependent upon differences between the samples studied and also upon the homogeneity of the samples. However, it was considered that, by considering the post-test comprehension test scores of all subjects (including the supplementary data), the sample would sufficiently lack homogeneity to allow some conclusion regarding the reliability of the test instrument to be drawn.

The Kuder - Richardson formula was evolved on the basis of making all possible split-halves to a test and finding the mean of all the consequent reliability correlations (Burroughs, 1971), and reads:

$$\text{rel.} = \frac{n}{n-1} \times \frac{s^2 - \Sigma pq}{s^2}$$

where n = number of items in test,
s = variance of total test scores,
p = proportion of sample passing each item,
q = 1 - p

The formula was used for both the complete test scores and also for the untaught-word scores which might be considered as a sub-test. The results were:-

$$\text{rel. (full test)} = \frac{27}{27 - 1} \times \frac{25.979 - 5.796}{25.979}$$

$$= 1.038 \times .777$$

$$= .8068$$

$$\text{rel. (untaught words)} = \frac{27}{27-1} \times \frac{4.043 - 1.484}{4.043}$$
$$= 1.038 \times .6329$$
$$= .6570$$

The results were interpreted as suggesting that the comprehension test was reasonably reliable with regard to internal consistency.

3.5.4. Summary.

In this section, Hypotheses A to D (from 3.0.0.) will be considered in relation to the foregoing analyses of variance.

For comparison (i), or Hypothesis H_A, it was hypothesised that SRD ('specific reading difficulty') children subjected to a unimodal (visual) reading instruction regime would achieve significantly better scores on a related comprehension test than SRD childrem subjected to a bimodal (normal) reading instruction regime based on the same vocabulary. Analysis of variance (AoV) yielded the following F ratios, for given d.f.:

Post-test scores	$F = 24$	p .001	d.f. 1,17.
Pre/Post gains	$F = 4.3$	p .05	d.f. 1,7.
Untaught words	$F = 22$	p .001	d.f. 1,17.

enabling the null hypothesis, of no difference between the means, to be rejected, and hypothesis H_A accordingly accepted. The supplementary data for the M_1 also suggested a significantly superior mean score, but the temptation to combine the original an supplementary data was resisted because of the matching procedure.

For comparison (ii), or Hypothesis H_D, it was hypothesised that SRD children subjected to both unimodal and bimodal instruction regimes would achieve significantly better scores on a related comprehension test than SRD children subjected to placebo or no reading instruction. AoV yielded the following F ratios, for given d.f.:

Post-test scores	F = 99	p .001	d.f. 1,35
Pre/Post gains	F = 29	p .001	d.f. 1,15
Untaught words	F = 25	p .001	d.f. 1,35

enabling the null hypothesis, of no difference between the means, to be rejected in favour of hypothesis H_D.

For comparison (iii), it was hypothesised that there would be no significant difference between the mean scores for the placebo treatment and the no-treatment groups. AoV yielded the following F ratios, for given d.f.:

Post-test scores	F = 17	p n.s.	d.f. 1,17
Pre/Post gains	F = 0	n.s.	d.f. 1, 7
Untaught words	F = 0.2	n.s.	d.f. 1,17

enabling the null hypothesis, of no difference between the means, to be accepted.

For comparison (iv), or hypothesis H_B, it was hypothesised that those SRD children classified as 'visual mode preferent' according to the AVMPC measure derived from Part 1 would achieve significantly better scores on a related comprehension test than those classed as 'auditory mode preferent', when subjected to a unimodal (visual) reading instruction regime. AoV yielded the following F ratios, for given d.f.:

Post-test scores	F = 9	p .01	d.f. 1,8
Pre/Post gains	F = 2.8	n.s.	d.f. 1,3
Untaught words	F = 0.1	n.s.	d.f. 1,8

and also the F ratios from the analysis of the supplementary matched-pairs data:

Post-test scores	F = 5.64	p .025	d.f. 1,11
Untaught words	F = 7.19	p .025	d.f. 1,11

enabling the null hypothesis, of no significant difference between the means, to be rejected in favour of hypothesis H_B.

For comparison (v), of hypothesis H_C, it was hypothesised that, subjected to a bimodal (normal) reading instruction regime, those classified as 'auditory mode preferent' would achieve significantly better scores on a related comprehension test than those classified as 'visual mode preferent'. AoV yielded F ratios that failed to reach significance, thereby enabling the null hypothesis, of no significant difference between the means, to be accepted. Unlike comparison (iv), it was not possible, for ethical reasons, to obtain supplementary data to boost sample size.

The results are summarised in Table 61.

	Post-Test scores on Comprehension Test.					Pre-Test/Post-Test Gains on Comprehension Test.					Post-Test scores - Untaught words only.				
Comparison	Mean	Diff. betw. Means	d.f.	F	P	Mean	Diff. betw. Means	d.f.	F	P	Mean	Diff. betw. Means	d.f.	F	P
Comparison (i)															
Unimodal Reading Method Group M_1	16.44	6.11	17	99	.001	12.0	5.25	7	4.3	.05	4.11	2.55	17	22	.001
Bimodal Reading Method group M_2	10.33					6.75					1.56				
Comparison (ii)															
Uni- + Bimodal RM groups M_1+M_2	13.39	8.83	35	99	.001	9.38	8.62	15	29.3	.001	2.50	1.38	35	25	.001
Placebo Non-treatment groups M_3+M_4	4.56					.62					1.12				
Comparison (iii)															
Placebo Reading Method group M_3	4.67	0.23	17	0	n.s.	.75	.25	7	0	n.s.	1.00	0.10	17	0.2	n.s.
Non-treatment RM group M_4	4.44					.50					0.90				
Comparison (iv)															
Visual-Preferent Class in group M_1	18.80	5.30	8	9	.01	15.0	6.0	3	2.8	n.s	4.20	0.20	8	0.1	n.s.
Auditory-Pref'ent class in group M_1	13.5					9.0					1.50				
Supplementary data Comparison (iv)															
Visual-Preferent class in group M_1	18.3	3.8	11	5.7	.025						3.33	2.0	11	7.2	.025
Auditory-Pref'ent class in group M_1	14.5										1.33				
Comparison (v)															
Auditory-Pref'ent class in group M_2	11.75	2.55	8	2	n.s.	8.5	3.5	3	13	.05	1.60	0.10	8	1	n.s.
Visual-Pref'ent class in group M_2	9.20					5.0					1.50				

Table 61. Summary of Means, F Ratios and Significance resulting from Analysis of Variance of post-test and gain scores on the Comprehension test, including supplementary data.

3.6.0. Discussion of Results.

3.6.1. Comparison of Reading Instruction Methods.

The results of the comparison of the means for the M_1 unimodal (visual) and M_2 bimodal (normal) reading instruction regimes appear to demonstrate the significance of the general modal preference factor, GMPC, derived from Part 1, for 'specific reading difficulty'. The differences between the means were significant both for the comprehension test post-test scores, and for the pre-test/post-test gains, suggesting that the unimodal reading method was significantly superior to the bimodal reading method, the difference between the means (post-test scores) of 6.11 being significant at the .001 point. Alternatively, the outcome of the experiment may be expressed as a correlation coefficient, where $r = \frac{F - 1}{n_1 + n_2 + F - 1} = .7490$, or as a reduction in uncertainty by 56%. Such a reduction in uncertainty does not necessarily justify imputing educational signficance. There appeared, however, to be no significant threats to both internal and external validity. The lack of significant interaction between pre-tested and non-pretested results and the high coefficient of reliability or internal consistency of the specially-devised comprehension test ($r_{rel.}$ = .8068 as measured by the Kuder-Richardson formula), and also the rather elaborate random-sampling procedure, all suggested that factors relating to the internal validity of the results had been reasonably controlled. Regarding the external validity of the results, the interactive effects of the experimental arrangements were held to have been controlled by the inclusion of a placebo group whose results were not significantly superior to those of the non-treatment group, and the possible interaction between testing and the experimental variables was held to be controlled by the inclusion of non-pretested subjects, evenly distributed. Interaction between selection and the experimental variables was a distinct possibility, however, the compilation of the corpus of words and the apposition of morphemically-related words in the teaching regimes could be held to favour the M_2 Bimodal (normal) group, and might even be held to account for the slight, but statistically insignificant superiority of the placebo group over the non-treatment group. The high significance of the difference between the M_1 and M_2 means, in favour of the M_1 group effectively rules out such interaction as a threat to external validity.

It would appear, then, that for SRD ('specific reading difficulty') subjects, a unimodal reading instruction regime is significantly superior to a bimodal regime based on 'Phonics 2'. The predictive validity is restricted, however, by the constraints imposed by (a) the population criterion, the population having a chronological age range of 10 to 15 years, word recognition age range 8 to 11 years, comprehension age range 10 to 13 years, and also exhibiting a discrepancy between (Neale) comprehension quotient and reading accuracy (word recognition) quotient whereby $\frac{NC}{NA} > 110$; and also by (b) the vocabulary criterion, the words chosen for the reading instruction regimes being Latinate, poly-morphographemic and tending to exhibit incongruency of syllabic/ morpho-graphemic segmentation.

The results of the experiment also support the suggestion, made in Part 1, the reading process does not necessitate auditory-phonological encoding as mediational between visuo-graphic en-coding and semantic coding. Whilst Goodman (1967) argued that a fluent and advanced reader could only achieve a sufficiently rapid rate of information input by (a) eschewing phonological encoding, and (b) sampling, the results of this experiment suggest that for SRD subjects, who are at the 'apprentice' level of reading, it is not only possible to eschew mediational phonological encoding, but actually beneficial to do so when one considers the purpose of reading to be the imposition of meaning on the printed display. Both the 'Look-and-Say' and 'Phonic' reading methods depend upon mediational phonological encoding, though the levels at which the shift from visuo-graphic to phonological encoding takes place would be different (the LaBerge & Samuels model, Figs. 6 and 8 q.v.).

The results may also be interpreted as supporting the view of Senf (1969) that poor readers have difficulty in switching rapidly from one modality, or 'modality-bound encoding path in an activity or task where bimodal processing is required' (the writer's interpretation), to another, whatever the level of shift is required. If this is so, it would be appropriate to limit the number of processing paths in a bimodal task such as 'apprentice' reading to one path only for those who find such switching difficult.

Whilst the superiority of the unimodal over the bimodal, for the SRD subjects, appears to be established, the results also indicate, as one would expect, that some tuition in reading, of whatever kind, is better than none, the difference between the mean comprehension scores for the combined treatment (M_1 and M_2) and non-treatment (M_3 and M_4) groups of 8.83 was significant at the .001 point (F = 99) whilst the difference between the means of the placebo and non-treatment groups was negligible.

3.6.2. Specific Modal Preference.

In the M_1 unimodal instruction regime, modal preference (in terms of the AVMPC construct derived from Part 1) appeared to be a significant factor in performance on the comprehension test, the difference between the means for the visuo-graphic and auditory-phonological processing preferents of 5.30 being significant at the .01 point ($F = 9.0$). The VMP (visual-mode preferent) subjects were significantly superior to the AMP (auditory-mode preferent) subjects on the unimodal (visual) reading method. The F-ratio of 9.0 may be transformed into a correlation coefficient (Burroughs, 1971) of .6860 (where $r = \frac{F - 1}{n_1 + n_2 + F - 1}$) between modal preference and comprehension test score for the unimodal regime. Alternatively, it may be said that there is a notable reduction in uncertainty, by using the modality classification, of 47% (or $r^2 \times 100$) with regard to the comprehension test score, which indicates the tendency for VMP subjects to 'do better' than AMP subjects on the M_1 regime. The supplementary investigation, using matched pairs (on age and intelligence) may be regarded as further confirmation of this trend.

The results of the supplementary investigation suggest some further degree of predictive validity for the modal preference construct derived from Part 1, and, in addition to that suggested in Part 1 by the low correlation between AVMP and spatial ability (as measured by PoP), some discriminant validation of the construct in that the modal preference effect was still found to be significant when intelligence and age were controlled by matching. The significance of the mean-difference, between AMP and VMP, for post-test scores with respect to both the original and supplementary data, and the significance of the post-test untaught-word mean-difference, were offset by the non-significance of mean-differences for the pre-test/post-test gains and for the untaught-words on the original data. Such results suggest the amelioration of the sample size in any replication.

For the bimodal (M_2) instruction regime, the only mean-difference between AMP and VMP to reach significance was that for pre-test/post-test gains (p .05). The small sample size for comparison of AMP and VMP within M_2 suggested the need for supplementary data. Unfortunately, this was not possible for ethical reasons already discussed (3.5.2. q.v.). In the absence of such data, it may be suggested that the modal preference effect operated differentially in the unimodal and bimodal treatment conditions, but not necessarily in opposite ways. A possible explanation of the difference may be that the bimodal regime, assumed to be based closely on 'normal' 'apprentice-reading' pedagogy, tended to stress phonological encoding at the mediational stage and, at the same time, requiring some degree of necessary visuo-graphic processing at the prior stage. On the LaBerge & Samuels (1974) model of reading automaticity, it must be possible for an apprentice reader to predominantly attend to the second or auditory-phonological stage of processing without necessarily having achieved full automaticity in the prior visuo-graphic stage of encoding. In such a case, semantic coding would be inadequate because of the direction of attention elsewhere and also because of the omission of the use of what LaBerge & Samuels term 'visual episodic memory' associated with the primary visuo-graphic processing stage. It is thus conceivable that the M_2 bimodal regime test results would not adequately discriminate between AMP and VMP subjects.

Willows (1974) interprets LaBerge & Samuels' model as requiring, assuming that multiple independent routes for word recognition exist, that the onset of a stimulus word would initiate processing along all paths automatically and simultaneously. Willows demonstrates that there is more than one mode of processing words and, in an experiment where the effectiveness of visual-matching as a processing strategy was controlled by masking, found that recognition was dependent upon the time available for response and that the response-strategy that was successful at longer delays involved syllables and phonemes. Whilst Willows was studying fluent undergraduate readers, in contrast to the underachieving apprentice readers of this study, she nevertheless found that the subjects chose a visual-matching strategy for short delays and a syllable or phoneme processing strategy for longer delays in enforced response time. Even when delays were randomised, Willows suggests that interaction between delay interval and stimulus word type (visually-matched or syllable/phoneme processed) could equally well have been generated by a selectable (but uncompleted) verbal coding process as by an automatic one. The results of the present study suggest support for Willows contention that all processing paths are not necessarily activated as LaBerge and Samuels hypothesise. The findings of Part 1 suggested that good readers varied their processing strategy, perhaps according to the time required or allowed for processing individual words or word clusters, whereas poor readers seemed to prefer to retain one strategy, either a visual or a phoneme/syllable auditory strategy but not both, with indifferent success. It would appear, from the apparent success of the M_1 unimodal regime, that a visual-matching strategy could be a suitable alternative method of processing where the phoneme/ syllable strategy has failed, as in the apparent case of the VMP children (with SRD), but this approach does not account for the difference between the mean score for the AMP children in M_1 (13.5 and 14.5 for original and supplementary data) and that for AMP children in M_2 (11.75) which was significant at the .05 point ($t = 1.9365$ for d.f. 13). The results of the present investigation suggest that, whereas Willows' mature readers could choose the strategy (visual-matching versus syllable/phoneme processing) accord to the nature of the word recognition task, the SRD subjects in the present study appeared to exercise little choice of strategy, even when failing.

The failure of the SRD children to vary their processing strategy could not, it is suggested, be accounted for by the complexity of the task, for, the corpus of difficult words in the teaching regimes and the content and format of the comprehension test were kept constant across the treatment conditions, there being significant differences between the means not only in respect of the post-test scores but also of the pre-test/ post-test gains. Further, intelligence, being controlled in the supplementary investigation, could not be held to account for the difference between VMP and AMP children subjected to unimodal teaching.

Whilst the results appear to be consistent with the perceptual modality concept as expounded by Wepman (1968), Lerner (1971) and others, whereby it is held that:

> "Children appear to have one optimal perceptual modality for learning. While some children learn most efficiently through their ears or by listening (auditory modality), others learn best through their eyes (visual modality),

> and a few children seem to learn best by touch (tactile modality, or even by muscle feeling (kinesthetic modality).
>
> (Lerner, 1971, p. 118.),

the results may only be generalised to SRD children, non-SRD children being predicted, according to the findings of Part 1, to have no limitation of pathway to learning. Thus the perceptual modality concept would only apply to <u>some</u> or <u>many</u> children, not to <u>all</u>. Further, the SRD children appeared to have no great difficulties with non-reading tasks associated with either of the modalities under discussion.

The comprehension test involved the presentation of information, often simultaneously, in more than one modality, including the auditory-phonological so that it might be suggested that difficulty with cross-modal matching or integration could not, without some refinement at least, be held to account for the SRD children's greater apparent success following the unimodal teaching. Such refinement would need to accommodate the peculiar nature of the apparent requirements of early pedagogy, which, it is suggested, are not (in the case of phonological mediational encoding) strictly necessary to the derivation of meaning from the printed text.

It would appear that the unimodal approach allows a greater degree of generalisability 'new' words, in terms of deriving meaning from them, than does the bimodal approach. A possible explanation for this may lie in the differential demands that the morpho-graphemic and the phoneme-cluster (syllable) make upon memory, whether STM or LTM, in that the graphemes may be held as 'chunks' according to some semantic-syntagmatic principle, whereas syllables would presumably not necessarily have such a facility and would require processing as whole words, unless, as would be suggested by the findings of Part 2 with regard to the errors made in reading, the individual syllables also functioned elsewhere as complete words. It is no original conclusion that meaning aids processing and retention!

The modality effect may also be interpreted in terms of the cortical lateralisation of information processing. Bahrick & Boucher (1968) have demonstrated that object drawings may be verbally (the writer prefers 'phonologically') or visually coded in memory independently, and Seamon (1974) suggests that retrieval processes and cerebral laterality effects may be related to coding strategies. Whilst theorists (Bower, 1970; Bruner, 1966; Paivio, 1969) have tended, in viewing verbal (the writer prefers 'phonological') and visual codes as different representational systems, and distinguished as separate modes of thought, little neurological evidence is yet forthcoming. It would seem possible, however, to describe the course of 'apprentice' reading in terms of a shift in emphasis from the visual mode of representation, for the processing of letters according to significant features and/or according to model-matching, to the auditory-phonological, for the recoding of complete words from 'phonological episodic memory' in reading aloud to the teacher, and then back to the visual representation for rapid 'mature' reading. This appears to be supported by the findings of Part 1, in which the importance of visuo-graphic <u>ability</u>, as measured by the Problems of Position test, declined with the increasing word recognition age, $r = -.3680$, $p<.001$, for a population that had not reached the 'mature' reading stage. One is reminded of Vigotsky's (1934) suggestion that the oral and the written language should be regarded as two separate systems, hence the writer's insistence that 'phonological' is not synonymous with 'verbal', nor 'verbal' with 'oral' for that matter.

Assuming that what was measured by the specially-devised comprehension test could be termed 'comprehension' or 'semantic encoding', the results of the study suggest, and this is subject to the findings of replication and further studies, that children who would have the greatest difficulty in imposing meanings on words (and increasingly so as the length of the words increased) could achieve a significant improvement in semantic processing and in word-recognition (as subsumed by semantic encoding) by omitting the phonological encoding stage; these were the VMP children. Further, the AMP children, characterised by a preference for unimodal auditory encoding, also showed a significant improvement in performance in semantic encoding and (subsumed) word-recognition by omitting the auditory-phonological encoding stage. This, coupled with the findings of Part 2 with regard to the increase in the incidence of incongruence between syllabic and morphographemic segmentation with level of linguistic complexity or difficulty ($r = +.9087$, $p<.001$), suggests support for the view that the English language is polysystemic, and also for the view that phonological rules may have no necessary connection with semantics or the meaning systems in language, a view perhaps implied by Searle (1972).

4.0.0. Conclusions.

The findings of the three parts of this study suggest the importance of studying 'apprentice' reading behaviour in relation to the demands of a variable task, the attentional style of the 'apprentice' reader appearing to be related to the 'polysystemicity' of the English language itself. It is thus suggested that 'specific reading difficulty' should be considered as language specific in that one would would expect different patterns of difficulty for different languages, and should also be considered as sensitive to gradient of difficulty in reading pedagogy and perhaps pedagogy in general.

In Part 1, the differences between the processing strategies that children expected to use whe

material appeared to be of crucial importance to their subsequent progress in reading. The polarisation of these strategies according to modality, as opposed to the non-polarising of the strategies, may be regarded as possibly synonymous with the 'constricted - flexible' cognitive style variable which describes the manner in which an individual deals with a stimulus field of information which is intrusive or contradictory in terms of the central task. Whilst Santostefano et al. (1965) found that the constricted - flexible style variable was the only one, of three studied, that correlated significantly with achievement in reading, the constricted - flexible principle or dimension has, in such studies, been described in terms of difficulty in "limiting attention to elements of the stimulus field defined as critical and relevant" (Santostefano et al. 1965). Such studies seemed to imply that the underachieving readers were in some way erroneous in the direction of their attention, suggesting a deficit-rectification approach. Assuming the perceptual modality concept (Wepman, 1968; Lerner, 1971, and others) such an approach would be to improve performance in modality of deficit so that it can become a productive pathway for learning. As there appeared to be no evidence for deficit of perceptual modality in other areas of learning, an alternative was suggested whereby teaching was directed to the preferred processing modality in reading, a possibility also suggested by Wepman (1964). Wepman, in noting a third alternative combination approach advises that indiscriminate multisensory approaches to teaching should be used with caution, suggesting the independent training of the modalities. The results of the present study appear to support this suggestion.

The findings of Part 1 may be regarded as not embodying the perceptual deficit value judgment, suggesting the usefulness of an approach whereby the very inflexibility of choice of processing path might be used to inform the teaching of reading to such children. Given the inflexibility of approach, in terms of modality-bound processing paths or encoding strategies, by the SRD or underachieving reader, the actual choice of path appeared to be related to the degree of underachievement in reading under the prevalent reading method(s), whereby the visuo-graphic processing preferents 'suffered' a greater degree of SRD or 'specific reading difficulty', according to the criterion used in the study, than auditory-phonological processing preferents.

In contrast, the visuo-graphic processing preferents appeared to benefit more from the unimodal (visual) instruction régime than did the AMP children. This result reinforced the suggestion, above, that reading instruction should perhaps take account of the attentional style of the 'apprentice' reader. Whilst such an approach was consistent with the (perhaps widely accepted) 'individual differences' approach to pedagogy, the implications for the practice of reading instruction were radical, involving the diversion of attention in teaching from the phonetic and phonological aspects of word recognition to the semantic ordering of information input by emphasis upon visuo-graphic processing for children who find bisensory reading difficult. There are obvious implications for the teaching of 'meaningful reading' to the deaf and partially-deaf, whose choice of processing path is restricted by physiological considerations. The view that perception is a learned skill (Lerner, 1971 and others) implies that the teaching process can have a direct impact on the child's perceptual skills. The findings of the present study suggest, however, that the possible impact is modified in the interaction.

It was suggested in Part 1 that the inflexibility in the choice of coding path might be more a feature of central nervous system control (as postulated by Treisman) than peripheral (as postulated by Broadbent). The deaf, as far as being in control of the imposition of meaning upon auditory language (particularly in the absence of lip-cues and facial expression) is concerned, lack peripheral control, and consequently central control ...... and also have great difficulty in 'apprentice' reading as a bisensory activity. It appeared to the writer that, in this respect, the SRD children had similar difficulties to those of deaf children, a not unusual conclusion amongst researchers. Hier (1978), in comparing cortical tomographs of retardate and normal readers, found deficiency in the volume of that part of the brain given over to phonological processing in the retardates. Tentative results of recording evoked potentials before and after the M_1 unimodal treatment condition, by computing the average of 18 samplings of potentials from the display of 18 slides of words from the corpus of taught words, suggest that processing attempted in the (assumed) speech or phonological processing area was transferred to the (assumed) graphic processing area in the contralateral hemisphere. This suggests another orientation for research, perhaps exploring the role of visual-matching and critical feature-to-phoneme/ syllable encoding in early reading, suggesting a method for exploring the relationship between semantic and phonology, questions about which having been raised by the present study.

Whilst the neuropsychological approach does much to explain the occurrence of 'specific reading difficulty' and to predict it (Newton, 1975), however, the writer concludes that the information-processing approach offers the greatest scope for further research into the amelioration of reading difficulty, particularly the model of LaBerge & Samuels (1974) extended to include unimodal reading as (a) a selectable path, as suggested by Spoehr (1978), or (b) as an autonomic path, as suggested by the findings of the present study.

There appear to be even wider implications of the study for pedagogy. The diversion of attention from the phonological aspect of the English language to the semantic aspect was considered in this study only in the context of underachievement in reading. The construction of the comprehension test in Part 3 raises questions about what Bruner calls 'the course of cognitive growth' (Bruner, 1964). The learning of the semantic code here required the mediation of an 'icon' associated with the 'generalised action'. The mental activity required for this, and for the subsequent combination of the 'generalised actions' or 'morphemes' may presumably be termed 'conceptualisation': "Primary experience is chopped up into percepts, and these are assembled into concepts and things" (Munn, 1973). The possibility arises that not only may undue emphasis upon phonological aspects of language inhibit the imposition of meaning on print by some children, but also that it may tend to prevent the 'graded' teaching and acquisition of concept formation. This aspect appears to be worthy of further investigation.

Further, there appear to be implications of the apparent success of the unimodal (visual) treatment, with respect to performance on the 'cognitive growth' comprehension test, for linguistics. It may be argued (Searle, 1972, seems to imply this) that concentration on the importance of the phonological aspects of language, as Chomsky appears to do, actually precludes consideration of the functions of language, thus suggesting redirection of attention to consideration of the semantic component. For Chomsky, the semantic component appears to be 'tacked on' as a necessary afterthought, whilst for Searle, the semantic would appear to direct the 'assembly' (Munn, 1973), stringing or syntax of those representations of (differentiated and generalised) experiences that relfect man's 'intentionality' (Searle, 1972), whether those representations be phonetic, visual (a reminder of the opening sentence of the study is apt: "Of the numerous purposes of reading, perhaps the oldest is a mnemonic one." p 7) or associated with any other modality. It is here that implications merge into speculation.

4.0.1. Final Word.

The initial motivation for this study was the possibility of helping children who were frustrated by lack of adequate processing of the printed word and by their own failure to respond to traditional remedial treatment. A secondary motivation developed from the endeavour to inter-relate the various academic disciplines relevant to reading.

Shortcomings of the study may be to some extent held to be a function of the complexity of the task, requiring new measures of unproven reliability, the number of disciplines involved, and the limitation upon enquiry of the heavy cost of unsponsored research (a constraint well-recognised by Burroughs, 1971).

Since the completion of the field-work, the emergent principles have been more extensively applied to the treatment of reading, writing and spelling difficulties in 'normal' and deaf children, with most encouraging and consistent results.

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A P P E N D I C E S

Name APPENDIX 1. Neale Analysis of Reading Ability, Forms A,B,C. School

Sex Age Date of Birth I.Q.

Family M F Examiner Date

INITIAL INTERVIEW

Appearance

Hearing Eyesight

Interests

Pertinent Emotional Difficulties

Attitude to Reading. Likes "a little" "a lot" "not really"

Attitude to School. Likes "a little" "a lot" "not really"

QUALITATIVE ASSESSMENT

PERSONAL CHARACTERISTICS

Needs encouragement to begin reading

Refuses to try unknown words

Repeats words or phrases habitually

Reads in a quiet loud
mumbled hurried voice

WORD RECOGNITION

Guesses at unknown words

Reverses words

Uses contextual clues

Spells out words

Sounds out letter combinations
but cannot synthesize

Does not know letters

Does not know sounds

GENERAL READING HABITS

Reads word by word

Ignores punctuation

Enunciation. Poor Average Good

Holds reading close to face

Uses finger as pointer

Loses place frequently

Head movements. Marked Slight

TEST SUMMARY

Passage	Words read	Time in secs.	Errors	Accuracy score	Compre-hension
1	26		=		
2	75		=		
3	149		=		
4	240		=		
5	358		=		
6	497		=		
Totals		•			

Reading Ages

• Words per min. $= \frac{\text{Words}}{\text{Time}} \times \frac{60}{1} = - \times \frac{60}{1}$

Choice of Story

Comments or Recommendations

1 KITTEN (26)	Mis*	Sub	Ref	Add	Oms	Rev
A						
black						
cat						
came						
to						
my						
house.						
She						
put						
her						
kitten						
by						
the						
door.						
Then						

Questions 1. What came to the little boy's/girl's house
2. Where did the black cat leave her kitten?

1 continued	Mis	Sub	Ref	Add	Oms	Rev
she						
went						
away.						
Now						
I						
have						
her						
baby						
for						
a						
pet.						

Errors ....

Time ....

Comprehension ....

26

3. What did the black cat do then?
4. What did the little boy/girl do with the kitten?

Passage 1. 1. A (black) cat. A kitten
2. By the door
3. She went away
4. Kept him (for a pet)

2 TOM (49)	Mis	Sub	Ref	Add	Oms	Rev
Tom						
stopped						
on						
his way						
to school.						
The milkman's						
horse had						
wandered						
in the fog.						
The horse						
and cart						
blocked						
the centre						
of the road.						
Traffic						
was coming.						
There was						

Questions 1. Where was Tom going?
2. What did he see on the way?
3. What had happened to the horse?
4. What kind of day was it?
Or What was the weather like?

2 continued	Mis	Sub	Ref	Add	Oms	Rev
no						
time						
to call						
the milkman.						
Quickly						
Tom						
led						
the horse						
to safety						
just as the						
frightened						
milkman						
returned.						

Errors ....

Time ....

Comprehension ....

5. Why was it dangerous for the horse and cart to stay there? (
6. Why didn't Tom call the milkman?
7. What did Tom do?
8. How did the milkman feel as he came running back?

Passage 2. 1. To school
2. Horse and cart (blocking the road)
3. It had wandered (strayed into middle of the road)
4. Foggy
5. Traffic (a car) was coming
6. There was no time
7. He led the horse to safety (the side of the road)
8. Afraid. Frightened. Worried

APPENDIX 1 continued.

3 CIRCUS (74)	Mis	Sub	Ref	Add	Oms	Rev
The lions'						
final						
act was						
in progress.						
Jack stood						
waiting to						
clear the ring.						
Tonight the						
thunder						
outside the						
circus tent						
had made the						
lions restless.						
Suddenly Tess,						
the lion trainer,						
stumbled.						
Her whip fell.						
The youngest						
lion sprang						
towards her.						
Swiftly						

3 continued	Mis	Sub	Ref	Add	Oms	Rev
Jack leaped						
inside the cage,						
cracking the						
whip with						
great skill.						
His prompt						
action						
enabled						
Tess to regain						
control quickly.						
During						
that brief						
adventure,						
however, Jack						
had decided						
upon his						
future work.						

Errors

Time

Comprehension

Questions

1. Where did this story take place? Or Where was all this happening?
2. Were the lions near the beginning, near the middle or near the end of their act?
3. What was Jack waiting to do?
4. Why were the lions restless?
5. What happened to Tess?
6. What did Jack do?
7. Who finished the act?
8. What did Jack decide after this adventure?

* *Mispronunciations, Substitutions, Refusals, Additions, Omissions, Reversals*

Passage 3.
1. Circus, Tent. Big top
2. End
3. Clear the ring. To take the lions away
4. Thunder had frightened them. Because of the thunder
5. She stumbled. Lost her whip. A lion jumped at her
6. Cracked the whip. Saved Tess. Controlled the lions
7. Tess
8. That he would be a lion tamer. On his future work . . . (explanation required)

4 DRAGON (91)

4 DRAGON (91)	Mis	Sub	Ref	Add	Oms	Rev
The fearful						
roaring of the						
dragon guided						
the Knight to						
the monster's						
territory. As the						
intruder crossed						
the dreaded						
marshes, the						
dragon charged						
furiously,						
whipping its						
enormous tail						
around the legs						
of the Knight's						
steed. Horse and						
rider collapsed.						
The Knight now						
realised that he						
must attack when						
the creature						
was off guard.						

4 continued	Mis	Sub	Ref	Add	Oms	Rev
He crouched						
as though						
wounded.						
The monster,						
accustomed to						
speedy victory,						
prepared to seize						
its prey. Then						
the Knight struck						
powerfully						
beneath the						
beast's out-						
stretched wing.						
A despairing						
groan told the						
villagers that						
they would be						
troubled no more.						

Errors

Time

Comprehension

Questions

1. How did the Knight know exactly where to find the dragon?
   or What guided the Knight to the dragon?
2. What kind of land did the Knight have to cross over?
3. How did the dragon knock the Knight down?
4. What did the Knight realise would be a good moment to attack the dragon?
5. What did the Knight pretend?
6. Why did the dragon think that its very first blow could kill the Knight?
7. What part of the dragon's body did the Knight strike?
8. Why would the villagers be pleased at the defeat of the dragon?

Passage 4. 1. The roaring of the dragon
2. Marshland
3. By whipping its tail around the horse's legs
4. When the dragon was off-guard (wasn't looking)
5. That he was wounded. Hurt. Dead
6. He was used to quick victories. He was very powerful
7. Under the wing
8. Because they would not be troubled again (by the dragon)

5 SUBM

The strick
submarin
lay at a d
of approx
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ssage 5. 1
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APPENDIX 1 continued.

5 SUBMARINE (118)	Mis	Sub	Ref	Add	Oms	Rev
The stricken						
submarine						
lay at a depth						
of approximately						
one hundred and						
twenty feet.						
Although it was						
common						
knowledge that						
the treacherous						
currents of the						
area would						
make rescue						
operations						
difficult, the						
crew remained						
disciplined and						
confident. Mean-						
while, outside						
their prison,						
a diver with						
technical						
equipment for						
their release						
was in peril.						
His life-line						
had become						
entangled						
around a						
projection on						
an adjacent						

5 continued	Mis	Sub	Ref	Add	Oms	Rev
wreckage.						
Experience						
warned him						
against his						
first impulse						
to dislodge the						
line by force.						
Patiently						
he turned						
and twisted.						
At last his						
calmness and						
persistence						
were rewarded.						
Triumphantly he						
detached the						
final loop from						
the obstruction.						
Then fatigued						
but undaunted by						
this unpleasant						
accident,						
he proceeded						
to provide an						
escape exit for						
the submarine's						
captives.						

Errors

Time

Comprehension

Que

1. What did the diver have to do in this story?
2. To what depth did he have to go?
3. What made rescue work difficult in this area? Or What was this part of the sea noted for?
4. How did the crew feel? Add Were they hopeful or had they given up hope?
5. What happened to the diver?
6. What did the diver's experience warn him not to do?
7. How did the diver behave in his danger? Or What qualities did the diver show in his danger?
8. What did the diver do as soon as he was free?

Passage 5.

1. To rescue the men in the submarine
2. 120 feet, 150, 100 (approximately)
3. Treacherous currents
4. Hopeful. Confident. Calm
5. His life-line was caught (entangled) on the wreckage
6. Not to jerk the line free by force. Not to use force
7. He kept calm. Was patient. Showed persistence
8. Rescued the people in the submarine. Carried on with the rescue work

6 EVEREST (139)	Mis	Sub	Ref	Add	Oms	Rev
Realising the						
necessity for						
conserving						
the strength of						
the team, the						
leader decided						
to pitch an						
intermediate						
camp. The						
initial						
enthusiasm and						
anticipation						
of attaining						
the final camp						
had been						
subdued						
by the recent						
mishap						
in which one						
member had						
fallen into a						
crevasse.						
Although the						
rescue had been						
accomplished						
magnificently,						
it was obvious						
that the						
incident						
had hampered						
the original						
programme. The						
men accepted						
the leader's						
decision						
with relief.						
The tedious						

6 continued	Mis	Sub	Ref	Add	Oms	Rev
crawl to the						
plateau against						
incessant winds						
of varying						
violence had						
challenged						
their endurance						
to the limit.						
Every step at						
this height						
required						
will power.						
Immediately						
ahead lay an						
unforeseen rise						
from which,						
by great						
misfortune, all						
the tracks of the						
advance party						
had disappeared.						
Rest was						
essential if						
the men were to						
withstand the						
arduous						
conditions in						
the concluding						
stages of the						
assault						
upon this						
unconquered						
peak.						
Errors						
Tone						
Comprehension						

Questions

1. What did the leader realise his men needed?
2. What did the leader decide to do?
3. How did the men feel about the leader's decision to stop climbing? Were they pleased or annoyed?
4. What incident had hindered their progress?
5. What had made them slacken their pace of climbing to a crawl?
   Or What made them go so very slowly?
6. What lay just ahead of them?
7. What piece of bad luck had the team noticed?
8. Why would it be very exciting to reach the peak?

SUPPLEMENTARY DIAGNOSTIC TEST 1.

What are the names and sounds of these letters?

a	c	o	e		
t	r	k	h	l	
p	d	b	g	q	y
m	w	n	r	u	v

s	z	x	i	j				
A	H	K	F	E	L	I	T	X
C	G	O	Q	P	R	D	B	J
M	N	U	V	Y	W	S	Z	

SUPPLEMENTARY DIAGNOSTIC TEST 2.

Auditory discrimination through simple spelling.

1.	tap	man	rat
2.	beg	red	pet
3.	tin	lip	ink
4.	told	bolt	cold
5.	but	mug	hutch
6.	show	star	sport
7.	every	bridge	chicken
8.	girl	grid	grumble

SUPPLEMENTARY DIAGNOSTIC TEST 3.

Blending and recognition of syllables.

1.	c-old	d-ear	l-ock	t-ask
2.	m-ouse	l-augh	s-ight	b-urnt

Name

Sex

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INDIVIDUAL RECORD SHEET — FORM B

Name

School

Sex

Age

Date of Birth

I.Q.

Family M F

Examiner

Date

INITIAL INTERVIEW

Appearance

Hearing

Eyesight

Interests

Pertinent Emotional Difficulties

Attitude to Reading. Likes "a little" "a lot" "not really"

Attitude to School. Likes "a little" "a lot" "not really"

QUALITATIVE ASSESSMENT

PERSONAL CHARACTERISTICS

Needs encouragement to begin reading

Refuses to try unknown words

Repeats words or phrases habitually

Reads in a quiet loud mumbled hurried voice

WORD RECOGNITION

Guesses at unknown words

Reverses words

Uses contextual clues

Spells out words

Sounds out letter combinations but cannot synthesize

Does not know letters

Does not know sounds

GENERAL READING HABITS

Reads word by word

Ignores punctuation

Enunciation. Poor Average Good

Holds reading close to face

Uses finger as pointer

Loses place frequently

Head movements. Marked Slight

TEST SUMMARY

Passage	Words read	Time in secs.	Errors	Accuracy score	Comprehension
1	26				
2	75				
3	147				
4	239				
5	357				
6	496				
Totals 1340		•			

Reading Ages

• Words per min. $= \frac{\text{Words}}{\text{Time}} \times \frac{60}{1} = \quad \times \frac{60}{1}$

Choice of Story

Comments or Recommendations

1 PAM'S BOX (26)	Mis*	Sub	Ref	Add	Oms	Rev
Father						
gave						
Pam						
a						
big						
box.						
Pam						
put						
it						
on						
the						
table.						
She						
looked						
in						

Questions
1. Who gave Pam the box?
2. Where did Pam put the box?

1 continued	Mis	Sub	Ref	Add	Oms	Rev
the						
box						
for						
a						
doll.						
Then						
out						
jumped						
a						
white						
rabbit.						

Errors ....

Time ....

Comprehension ....

3. What did she think would be in the box?
4. What was the surprise?

Passage 1.
1. Father
2. On the table
3. A doll
4. A (white) rabbit

2 WOODMAN (49)	Mis	Sub	Ref	Add	Oms	Rev
John						
and Ann						
were fishing.						
Suddenly						
they						
heard						
a splash.						
A woodman						
had fallen						
into the						
lake.						
He could						
not swim,						
for he was						
hurt. The						
children						
tried						

Questions
1. What were John and Ann doing at the lake?
2. What noise did they hear?
3. What had happened?
4. Why could the man not swim ashore?

2 continued	Mis	Sub	Ref	Add	Oms	Rev
to pull						
him ashore.						
He was						
too heavy.						
Then John						
held the						
man's						
head						
above						
water						
and Ann						
ran for						
help.						

Errors ....

Time ....

Comprehension ....

5. What did the children try to do?
6. Why were they unable to pull him ashore?
7. How did John help the man?
8. How did Ann help?

Passage 2.
1. Fishing
2. A splash
3. A woodman had fallen into the lake
4. He was hurt
5. To pull him out
6. He was too heavy
7. He held the man's head above water
8. She ran for help

APPENDIX 1 continued.

3 PUPPET (72)	Mis	Sub	Ref	Add	Oms	Rev
The Swiss						
puppet						
watched						
the children						
arranging						
the puppet						
theatre. He						
felt useless.						
He was not						
often						
chosen						
to act						
because he wore						
unusual						
clothes. Now the						
children were						
discussing their						
new play. "We						
need a brave						
person for						
the mountain						

3 continued	Mis	Sub	Ref	Add	Oms	Rev
rescue,"						
explained						
a boy. Each						
puppet tried						
to appear like						
the required						
hero.						
Then cheers						
greeted						
the boy's						
choice. On						
to the stage						
was raised						
the shy						
but happy						
Swiss						
puppet.						

Errors ....

Time ....

Comprehension ....

Questions

1. What was the Swiss puppet watching in the beginning of the story?
2. Why did he feel useless?
3. Why was the Swiss puppet not chosen very often for the plays?
4. What kind of hero did the boy want for the new play?
5. What kind of work would the hero have to do in the play?
6. What did all the puppets hope?
7. How do you know that everyone was pleased with the hero that was chosen?
8. How did the Swiss puppet feel when he was chosen?

Passage 3.
1. The children (fixing) arranging the theatre
2. He was not chosen often for the plays
3. Because he had unusual (different) clothes
4. Someone brave
5. Rescue someone on a mountain
6. Each puppet hoped to be chosen as the hero
7. They cheered
8. Happy. Shy. Pleased

4 EXPLORING (92)	Mis	Sub	Ref	Add	Oms	Rev
It was midnight.						
A mournful						
wailing sound						
echoed through						
the deserted						
castle. The						
girls ceased						
exploring						
abruptly.						
"Ghosts!"						
whispered one						
girl. "Nonsense!"						
replied the other,						
but nevertheless						
she proceeded						
cautiously in						
the direction of						
the mysterious						
noise. Gathering						
courage, and						
with mounting						
curiosity, the						

4 continued	Mis	Sub	Ref	Add	Oms	Rev
girls approached						
the old kitchen.						
Then scarcely						
daring to breathe,						
they swung open						
the door. Their						
torches searched						
the darkness and						
immediately their						
excitement turned						
to pity. Before						
them, almost						
exhausted, lay						
the farmer's dog.						
He had been						
imprisoned while						
hunting for rats						
by a gust of wind.						

Errors

Time

Comprehension

Questions
1. At what time did the girls go to the castle?
2. What were the girls doing at the castle?
3. What made them stop exploring?
4. Why did they go cautiously in the direction of the noise?
5. From where was the noise coming?
6. What did they discover?
7. What had the dog been doing there?
8. Why did the girls feel sorry for him?

Passage 4.
1. Midnight
2. Exploring
3. A noise
4. They were afraid. They thought it was a ghost
5. The old kitchen
6. A dog
7. He had been hunting for rats
8. He was exhausted. He had been trapped a long time

APPENDIX 1 continued.

5 ARABS (118)	Mis	Sub	Ref	Add	Oms	Rev
After a brief						
encounter						
with the Turks,						
Lawrence and						
his Arab force						
made a mock						
retreat. Although						
out-numbered,						
Lawrence						
guessed that						
surprise tactics						
might retrieve						
the campaign.						
Accordingly, as						
his followers						
withdrew,						
they concealed						
themselves in						
the rocky						
crevices						
of a narrow						
gorge						
leading to the						
city. Meanwhile						
the women,						
acquainted with						
the circumstances,						
prepared to						
defend the city						
gates. The						
success of						

5 continued	Mis	Sub	Ref	Add	Oms	Rev
Lawrence's						
plan depended						
on whether						
the Turks						
would assume						
that the Arab						
retreat						
was genuine.						
There was an						
interval						
of terrible						
tension. Then						
the unsuspecting						
Turks stormed						
in hot pursuit						
into the pass.						
At once,						
concentrated						
rifle fire swept						
their column.						
The troops						
fell into a						
panic, for						
the confined						
space permitted						
no counter						
attack.						

Errors

Time

Comprehension

Questions
1. Which two armies were taking part in this battle ?
2. Which army was Lawrence leading ?
3. Which side had the greater numbers ?
4. What did Lawrence tell his men to do ?
5. What did Lawrence hope that the Turks would think ?
6. What part were the women taking in the battle ?
7. Why did the Turks pursue the Arab force into the pass ?
8. Why were the Turks unable to fight back successfully ?

Passage 5.
1. The Turks and the Arabs
2. The Arab army
3. The Turkish army
4. To pretend to retreat. To retreat. To hide behind the rocks in the pass
5. That the retreat was real
6. They were defending the city gates
7. They thought they had won the battle. They thought they could get into the city
8. Because there wasn't enough room in the pass. Because they were taken by surprise. Because they were in a panic

6 VOLCANO

6 VOLCANO	Mis	Sub	Ref	Add	Oms	Rev
Fascinated by						
the prospect						
of recording						
the spectacle of						
a long-dormant						
volcano						
smouldering						
again, the two						
scientists						
approached the						
crater's edge.						
Intent on their						
photography,						
they ignored						
an ominous						
rumbling. In						
reproof, the						
subterranean						
cauldron						
suddenly exploded						
violently,						
ejecting a						
great quantity						
of rocks.						
Fortunately						
these fell on						
to the opposite						
slopes. Greatly						
alarmed by this						
premature						
eruption, the						
men hastily						
began the descent.						
Instantly a						
gigantic						
avalanche						
of fiery						

6 continued	Mis	Sub	Ref	Add	Oms	Rev
boulders						
hurtled						
around them.						
Aware that						
their apparatus						
hindered						
progress, they						
abandoned all						
equipment						
except their						
precious						
cameras. Then						
came an anxious						
moment. As one						
man was evading						
a flying fragment,						
he was struck						
off-balance						
by a rebounding						
boulder. A						
lengthy halt						
would have been						
disastrous. It						
was, therefore,						
with immense						
relief that						
they discovered						
his injuries to						
be superficial						
and resumed						
the fantastic						
scramble to the						
safety zone.						

Errors

Time

Comprehension

Questions

1. What were the scientists doing on the volcano?
2. Why was this volcano so interesting?
3. What warning should the men have noted?
4. Whereabouts were the men when the volcano exploded?
5. How did they escape from the first explosion?
6. What did they do to speed up their descent?
7. What kind of material was ejected by the volcano?
8. Were the man's injuries serious or slight?

Passage

6.
1. Taking photographs
2. It had been dormant (quiet) a long time
3. Rumbling. The noise
4. Near the crater (top)
5. The rocks fell on to the opposite slopes
6. Threw away their equipment (things)
7. Rocks. Boulders
8. Slight

INDIVIDUAL RECORD SHEET — FORM C

Name | School
Sex | Age | Date of Birth | I.Q.
Family M F | Examiner | Date

INITIAL INTERVIEW

Appearance

Hearing | Eyesight

Interests

Pertinent Emotional Difficulties

Attitude to Reading. Likes "a little" "a lot" "not really"

Attitude to School. Likes "a little" "a lot" "not really"

QUALITATIVE ASSESSMENT

PERSONAL CHARACTERISTICS

Needs encouragement to begin reading

Refuses to try unknown words

Repeats words or phrases habitually

Reads in a quiet loud mumbled hurried voice

WORD RECOGNITION

Guesses at unknown words

Reverses words

Uses contextual clues

Spells out words

Sounds out letter combinations but cannot synthesize

Does not know letters

Does not know sounds

GENERAL READING HABITS

Reads word by word

Ignores punctuation

Enunciation. Poor Average Good

Holds reading close to face

Uses finger as pointer

Loses place frequently

Head movements. Marked Slight

TEST SUMMARY

Passage	Words read	Time in secs.	Errors	Accuracy score	Comprehension
1	26				
2	75				
3	147				
4	238				
5	356				
6	495				
Totals					

Reading Ages

• Words per min. $\frac{\text{Words}}{\text{Time}} \cdot \frac{60}{1} = \quad \cdot \frac{60}{1}$

Choice of Story

Comments or Recommendations

1 ROBIN (26)	Mis*	Sub	Ret	Add	Oms	Rev
A						
robin						
hopped						
up						
to						
my						
window.						
I						
gave						
her						
some						
bread.						
She						
made						
a						

1 continued	Mis	Sub	Ret	Add	Oms	Rev
nest						
in						
my						
garden.						
Now						
I						
look						
after						
her						
little						
birds.						

Errors

Time

Comprehension

Questions
1. Where was the little boy girl standing when the robin hopped up to him her?
2. What did the little boy girl give the robin?
3. What did the robin do in the garden?
4. How does the little boy girl help the robin now?

Passage 1.
1. By the window
2. Bread
3. Built a nest
4. Looks after (feeds) the baby birds

2 PARCEL (49)	Mis	Sub	Ret	Add	Oms	Rev
A surprise						
parcel						
for Jane						
and Peter						
arrived						
on Saturday.						
Peter						
looked at						
the strange						
stamps.						
Jane undid						
the string.						
Then they						
shouted						
with delight.						
Uncle						
had sent						

2 continued	Mis	Sub	Ret	Add	Oms	Rev
some						
skates						
for Jane						
and an						
electric						
train						
for Peter						
They were						
what the						
children						
had wanted						
for a long						
time.						

Errors

Time

Comprehension

Questions
1. On what day did the parcel arrive?
2. How do you know that Jane and Peter were not expecting the parcel?
3. Who undid the string?
4. How do you know that the parcel came from another country?
5. Who had sent the parcel?
6. What was in the parcel for Jane?
7. What was in the parcel for Peter?
8. Why were the children so pleased to receive these presents?

Passage 2.
1. Saturday
2. It was a surprise parcel
3. Jane
4. It had strange stamps
5. Their Uncle
6. Skates
7. An electric train
8. They had wanted these things for a long

APPENDIX 1 continued.

3 ALI (72)	Mis	Sub	Ref	Add	Oms	Rev
As Ali						
sheltered in						
a ruined						
temple,						
his shoulder						
knocked						
against						
a secret						
spring.						
Instantly he						
was thrown into						
an underground						
room. In the						
darkness the						
walls appeared						
to be decorated						
with precious						
jewels.						
Ali rested						
awhile. He						
remembered						

Questions 1. Why did Ali go into the temple?
2. How did he find the secret spring?
3. What happened when he touched the spring?
4. What did he see there?

3 continued	Mis	Sub	Ref	Add	Oms	Rev
that desert						
travellers						
often imagined						
queer things.						
Later he						
explored						
the place						
for means of						
escape. To his						
amazement the						
treasure did						
not vanish. He						
had discovered						
a buried						
palace						
of former						
times.						

Errors
Time
Comprehension

5. Why did Ali not rush to look at the jewels?
6. After he had rested, what did Ali try to find?
7. Why was he so surprised?
8. How had the jewels come to be there?

Passage 3. 1. To shelter
2. His shoulder bumped (knocked) against it
3. He fell into an underground room (cellar)
4. Precious jewels
5. He did not think that they were real. He thought his eyes were playing tricks on him. He thought he was imagining things
6. A way (out) to escape
7. To find that the jewels were real
8. They belonged to a buried palace of long ago

4 SPORTS DAY (91)	Mis	Sub	Ref	Add	Oms	Rev
Susan hurried to the starting position for the relay race. Last year her team had been disqualified for not transferring the baton properly. Now they were determined to avenge their defeat. But what was this? Susan inspected one shoe. The sole had broken loose in the obstacle event. Her heart sank. The track was						

4 continued	Mis	Sub	Ref	Add	Oms	Rev
unsuitable for running barefoot. Her plight, however, had been observed. "Try mine," insisted Philip, a reserve runner, unfastening his shoes. Luckily they fitted, and later, Philip shared the honours when his school was awarded the athletic shield						

Errors
Time
Comprehension

Questions
1. In what kind of race was Susan's team competing?
2. Why was her team so keen to win?
3. Why had they been disqualified last year?
4. What did Susan suddenly discover?
5. In what race had the sole of her shoe broken loose?
6. Why was there no time to fetch another pair of shoes?
7. How did Philip help Susan?
8. How was Philip rewarded for his kind act?

Passage 4.
1. R
2. T ay race. Team race
3. F y had been disqualified last year
4. T not passing the stick (baton) properly
t the sole of one shoe had torn loose
5. T broken loose)
6. T obstacle race
7. H race was about to begin
8. H lent her his shoes
shared the honours at the prize-giving

5 THE

Among
the fox
no riva
for cun
Suspic
of man
its only
enemy
when
perfor
extrao
feats,
alight
the ba
sheep
its sce
trail.
Paren
share
respe
of cu
Thro
hunt
expe
they
an u
kno
of th
surr
whi
its a

APPENDIX 1 continued.

5 THE FOX (118)	Mis	Sub	Ref	Add	Oms	Rev
Among animals						
the fox has						
no rival						
for cunning.						
Suspicious						
of man, who is						
its only natural						
enemy, it will,						
when pursued,						
perform						
extraordinary						
feats, even						
alighting on						
the backs of						
sheep to divert						
its scent						
trail.						
Parent foxes						
share the						
responsibilities						
of cub-rearing.						
Through their						
hunting						
expeditions						
they acquire						
an uncanny						
knowledge						
of their						
surroundings,						
which they use						
in an emergency.						

Questions
1. Who is the chief enemy of the fox?
2. Why does a hunted fox sometimes jump on to the back of a sheep?
3. Who provides the food for the cubs?
4. How do foxes know the best hiding places in their surroundings?

5 continued	Mis	Sub	Ref	Add	Oms	Rev
This is well						
illustrated by						
the story of						
a hunted fox						
which led its						
pursuers to						
a neglected						
mine-shaft						
enclosed by a						
circular hedge.						
Swiftly it						
mounted the						
barrier. The						
hounds followed,						
only to be						
drowned in the						
accumulated						
water fifty						
feet below. The						
fox, however,						
apparently on						
familiar						
territory,						
skirted						
the hedge						
and subsequently						
escaped.						

Errors

Time

Comprehension

5. To where did the fox in this story lead the hounds?
6. Was the mine working or had it been closed down?
7. How did the fox avoid falling into the water?
8. Why were the hounds unable to see the danger?

Passage 5.
1. Man
2. To divert (break) its scent trail
3. Both parents
4. From their hunting expeditions. Knowledge of the area
5. To a mine-shaft. A neglected mine-shaft. An old mine
6. It had been closed down
7. He skirted the hedge. Went round the hedge
8. Because the hedge enclosed the mine-shaft. Because the hedge was in the way. Because they were intent on the fox

6 MIGRATION (139)	Mis	Sub	Ref	Add	Oms	Rev
Each April, at the						
re-appearance						
of the cuckoo in						
its familiar						
haunts, bird-						
watchers must						
marvel at the						
accurate						
flights with						
which birds span						
the distances						
between their						
seasonal						
abodes. What						
causes these						
regular						
journeys? The						
theory						
that rigorous						
winters compel						
birds to migrate						
is insufficient,						
for many migrate						
in summer.						
Likewise,						
it cannot						
be argued that						
the fledglings						
imitate the older						
generation,						
for the offspring						
generally migrate						
alone. The best						
explanation						
suggests that						
migration is an						
inborn custom,						

6 continued	Mis	Sub	Ref	Add	Oms	Rev
probably						
originating						
in some ancient						
era when the						
flights were						
necessary						
for survival.						
Most species						
favour						
particular						
routes. Thus,						
on one occasion						
when some storks						
from east						
Germany						
were captured						
and released						
among storks in						
west Germany,						
they did not						
accompany						
their relatives						
along the west-						
ern migration						
route. Instead,						
with unerring						
instinct, they						
re-discovered						
the traditional						
south-easterly						
path of their						
eastern						
ancestors.						

Errors

Time

Comprehension

Questions.

1. In which month can bird watchers hope to see the cuckoo re-appear from its winter home?
2. Why do bird watchers think that birds are such remarkable creatures?
3. Why is it wrong to say that cold weather makes all the birds migrate (fly away)?
4. Do the young birds learn the migration routes from their parents?
5. Is migration an old or recent custom?
6. In what country was an experiment done with storks?
7. What route did the eastern storks usually take when migrating?
8. In which direction did the eastern storks fly when they were taken to the west?

Passage 6.

1. April
2. Migration. The distances birds fly. Regular journeys of the birds
3. Many birds migrate in summer. Many birds stay in winter
4. No. (They generally fly or migrate alone)
5. Ancient. Old
6. Germany
7. South-easterly. Easterly
8. South-easterly. Easterly. Same way

APPENDIX 2. Reliability Data for Neale Analysis of Reading Ability (Neale, 1966, pp 13-14).

Accuracy.

No.	Age Group	Forms	Mean	S.D.	Correlation
83	7 year	A B	24.02 23.42	18.56 18.24	.97
74	8 year	A B	34.77 32.12	22.72 22.30	.97
116	9 year	A B	51.74 52.52	26.94 25.36	.98
108	10-11+ year	A B	64.96 64.72	26.30 26.85	.96
Group Results 100	7-11 years	A B	47.80 48.50	30.40 30.89	.98
100	7-11 years	A C	43.90 43.20	28.80 29.04	.98

Comprehension.

No.	Age Group	Forms	Mean	S.D.	Correlation
83	7 year	A B	8.79 10.12	7.33 8.51	.93
74	8 year	A B	13.59 15.35	8.82 10.51	.93
116	9 year	A B	19.60 21.97	10.29 10.11	.98
108	10-11+ year	A B	25.07 26.04	10.29 11.18	.92
Group Results 100	7-11 years	A B	17.75 19.00	11.77 12.26	.97
100	7-11 years	A C	16.60 17.05	11.07 10.88	.96

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APPENDIX 4. Values for all variables used in Part 1.

	m f	NA	NC	NR	NR/NA	NC/NA	POP	AVMPR	AVMPC	MPR	MPC	CA	RA
1	f	128	111	119	93	87	109	98	5	- 2	0	7.92	10.40
2	f	102	95	103	101	93	98	77	5	-23	0	7.92	8.08
3	f	121	146	98	81	121	116	95	4	- 5	1	8.00	9.66
4	f	96	94	107	111	98	96	78	5	-22	0	8.00	7.88
5	f	98	86	102	104	88	109	54	5	-46	0	8.00	7.84
6	f	95	90	90	94	94	105	125	5	25	0	8.08	7.69
7	f	90	83	95	106	92	91	88	5	-12	0	8.08	7.27
8	f	146	143	117	80	98	138	87	5	-13	0	8.17	11.93
9	f	120	106	130	108	88	81	38	5	-62	0	8.30	10.00
10	f	95	89	106	112	94	91	72	5	-28	0	8.42	8.00
11	m	121	127	116	96	105	128	111	5	11	0	8.58	10.38
12	f	81	84	81	100	137	106	126	6	26	1	8.58	6.95
13	m	83	82	114	137	98	76	33	4	-67	1	8.67	7.20
14	f	91	100	89	98	110	96	109	5	9	0	8.67	7.89
15	m	96	100	93	97	104	97	116	7	18	2	8.67	8.32
16	f	125	134	107	86	107	91	76	3	-24	2	8.67	10.84
17	m	85	83	103	121	97	102	114	5	14	0	8.75	7.44
18	m	103	124	103	100	120	91	88	5	-12	0	8.75	9.01
19	m	101	93	122	121	92	88	72	5	28	0	8.75	8.84
20	m	91	99	96	105	109	114	121	7	21	2	8.75	7.96
21	f	118	127	97	82	108	89	89	4	-11	1	8.75	10.32
22	m	98	109	90	92	111	91	130	5	30	0	8.75	8.57
23	m	80	74	111	139	92	78	109	2	9	3	8.75	7.00
24	f	75	71	80	107	95	78	106	4	6	1	8.75	6.56
25	m	104	115	114	110	111	108	84	4	-16	1	8.75	9.10
26	f	89	86	87	98	97	106	35	3	- 5	2	8.75	7.79
27	f	87	84	87	99	98	108	99	3	- 1	2	8.75	7.52
28	m	88	80	91	92	91	98	108	3	8	2	8.83	7.77
29	m	99	87	96	92	88	75	110	5	10	0	8.83	8.74
30	f	112	136	140	125	121	89	96	6	- 4	1	8.83	9.89
31	f	104	100	121	116	96	105	129	5	23	0	8.92	9.28
32	m	81	81	87	107	100	87	108	5	8	0	9.08	7.35
33	m	73	73	85	110	100	101	112	3	12	0	9.17	5.98
34	f	111	124	142	128	112	103	78	5	-22	0	9.1.	10.18
35	m	93	100	89	94	105	102	118	7	18	2	9.25	8.79
36	f	77	73	95	98	95	84	128	5	28	0	9.25	7.12
37	f	98	95	85	97	108	51	103	6	3	1	9.25	8.14
38	m	76	73	109	145	96	81	93	4	7	1	9.25	7.03
39	f	75	71	75	100	95	90	112	4	12	1	9.33	6.25
40	m	119	131	139	117	110	113	94	5	- 6	0	9.33	11.10
41	f	99	93	96	96	94	90	105	5	5	0	9.33	9.24
42	f	87	92	87	100	106	88	134	7	34	2	9.33	9.12
43	m	100	97	139	139	97	94	131	4	31	1	9.33	9.33
44	m	127	119	138	109	94	93	142	3	42	2	9.42	11.96
45	f	97	89	107	110	92	104	136	4	38	1	9.42	9.14
46	m	96	95	87	101	110	94	129	7	29	2	9.42	8.10
47	f	74	72	73	99	97	84	115	5	15	0	9.42	6.23
48	m	91	71	99	109	78	71	83	5	-17	0	9.50	8.64
49	f	98	90	88	90	92	106	96	5	- 4	0	9.50	8.33
50	m	103	110	87	84	107	115	78	5	-24	0	9.50	9.78
51	f	74	71	87	118	96	100	104	5	4	0	9.50	7.03
52	m	95	114	117	123	120	95	95	8	- 5	1	9.58	9.10
53	m	108	126	111	103	117	108	103	5	3	0	9.58	10.35
54	m	96	90	111	86	94	97	109	5	9	0	9.58	9.17
55	m	104	103	93	89	99	108	86	5	-14	0	9.58	9.96
56	f	88	85	80	91	106	97	112	8	12	3	9.58	8.43
57	m	72	88	74	103	122	71	129	9	28	3	10.00	7.20
58	m	89	99	81	92	111	108	126	6	26	1	10.08	8.37
59	m	102	118	89	87	116	88	107	5	7	0	10.08	10.29
60	f	98	94	103	105	96	103	115	3	18	2	10.08	9.88
61	f	109	108	121	111	99	121	132	5	32	0	10.17	11.09
62	f	94	98	89	95	104	85	104	5	4	0	10.17	9.53
63	f	93	103	99	106	111	89	84	5	-16	0	10.25	9.53
64	m	86	108	78	91	126	94	123	6	29	1	10.25	8.81
65	m	96	94	106	110	98	102	126	4	26	1	10.25	9.84
66	m	91	98	85	93	108	96	89	5	-11	0	10.58	9.63
67	m	103	121	92	89	117	96	131	5	31	0	10.58	10.90
68	m	75	94	68	91	125	116	120	8	26	3	10.58	7.93
69	m	70	79	67	96	113	91	128	5	28	0	10.58	7.41
70	m	68	73	73	107	107	82	98	6	- 2	1	10.67	7.26
71	m	105	116	122	116	110	110	84	4	-16	1	10.67	11.20
72	m	65	82	57	87	126	82	131	7	31	2	10.67	8.93
73	m	81	101	75	92	125	103	113	8	13	1	10.75	8.71
74	m	65	58	71	109	89	103	111	5	11	0	10.75	8.99
75	f	109	105	121	111	96	89	134	5	34	0	10.75	11.72
76	m	67	68	71	106	101	100	91	5	- 9	0	10.75	7.20
77	m	81	84	79	87	104	91	99	5	- 1	0	10.83	8.77
78	f	61	74	86	141	121	98	86	5	-14	0	10.83	8.81
79	f	100	85	95	95	85	105	91	5	- 9	0	10.92	10.92
80	f	66	61	65	98	92	70	98	5	- 2	0	10.92	7.21
81	f	107	107	119	111	100	118	76	6	-24	1	10.92	11.68
82	f	81	101	87	107	125	116	94	4	- 6	1	10.95	8.97
83	m	94	105	82	87	112	112	96	6	- 4	1	11.00	10.34
84	f	79	67	114	144	85	108	34	5	-66	0	11.00	8.69
85	m	91	89	78	86	99	110	109	5	9	0	11.00	10.01
86	f	92	84	91	99	91	89	106	5	6	0	11.00	10.12
87	f	76	80	74	97	105	94	128	7	28	2	11.00	8.36
88	m	84	91	90	107	108	78	80	5	-20	0	11.00	9.34
89	m	98	107	80	81	109	94	112	5	12	0	11.00	10.78
90	m	94	112	79	84	119	97	108	6	8	1	11.08	10.41
91	m	70	69	70	100	99	98	127	5	27	0	11.08	7.78
92	m	77	77	73	95	100	79	100	5	0	0	11.08	8.53
93	f	71	73	75	105	103	97	103	5	3	0	11.17	7.93
94	f	103	100	79	72	97	86	76	4	-24	1	11.17	11.50
95	f	81	83	77	95	102	80	138	6	38	1	11.17	9.05
96m	m	110	107	89	81	97	103	107	3	7	0	11.17	12.29
97	m	58	60	49	84	103	91	129	8	29	3	11.17	8.48
98	m	97	113	83	86	116	114	108	5	8	0	11.25	10.31
99	f	83	101	88	106	122	96	106	5	6	0	11.25	9.34
100	m	87	100	78	90	115	103	111	5	11	0	11.25	9.73

APPENDIX 4 continued.

	m f	NA	NC	NR	NR/NA	NC/NA	POP	AVMPR	AVMPC	MPR	MPC	CA	RA
101	m	102	110	118	114	108	106	85	4	-15	1	11.25	11.48
102	f	113	104	113	100	92	89	50	5	-50	0	11.25	12.71
103	f	97	84	84	96	96	104	88	5	-12	0	11.25	11.59
104	m	88	98	82	95	112	112	121	6	21	1	11.33	9.74
105	f	103	92	115	112	89	103	118	5	18	0	11.33	11.67
106	f	99	96	83	93	109	96	110	6	10	1	11.33	10.16
107	f	107	105	114	107	98	100	101	5	1	0	11.42	12.22
108	f	98	102	88	92	104	106	122	5	22	0	11.42	11.19
109	m	91	107	90	99	118	109	102	5	2	0	11.42	10.39
110	f	84	91	86	102	108	79	123	4	29	1	11.42	9.59
111	f	63	59	71	113	94	99	95	5	- 5	0	11.50	7.24
112	m	102	95	113	111	93	106	112	5	12	0	11.50	12.88
113	m	79	94	71	90	119	93	125	5	25	0	11.58	9.15
114	f	107	104	112	105	97	108	109	5	9	0	11.58	12.39
115	m	89	77	66	97	113	86	108	5	6	0	11.58	7.97
116	m	99	100	112	113	101	91	101	5	1	0	11.66	11.54
117	m	80	63	57	93	105	98	134	7	34	2	11.67	7.00
118	m	87	72	58	94	107	86	109	7	9	2	11.67	7.82
119	m	76	106	83	109	139	99	86	3	-14	2	11.67	8.87
120	m	83	122	73	95	147	91	122	6	22	1	11.67	9.75
121	m	89	99	103	116	111	108	78	5	-21	0	11.75	10.46
122	f	73	77	77	105	105	98	131	5	31	0	11.75	9.59
123	m	106	102	103	97	98	108	136	5	36	0	11.92	12.63
124	f	69	93	101	113	104	-	91	3	- 9	2	12.08	10.75
125	f	101	112	91	90	111	-	94	5	- 6	0	12.08	12.20
126	f	66	91	91	107	94	-	102	5	2	0	12.17	10.47
127	m	108	123	97	90	114	-	96	5	- 4	0	12.17	13.00
128	m	102	95	108	106	93	-	84	5	-16	0	12.25	12.49
129	m	88	91	82	93	103	-	137	6	37	1	12.25	10.78
130	f	112	108	114	102	98	-	112	5	12	0	12.25	13.00
131	f	109	112	118	109	104	-	78	4	-22	1	12.25	13.00
132	m	83	101	76	92	122	-	94	7	- 8	2	12.33	10.23
133	f	76	84	76	100	111	-	109	6	9	1	12.33	9.37
134	m	94	102	91	97	108	-	119	5	19	0	12.58	11.82
135	m	91	114	112	123	102	-	84	4	-16	1	12.58	11.45
136	m	72	78	93	129	108	-	91	3	- 9	2	12.58	9.06
137	f	81	98	89	110	121	-	87	4	-13	1	12.66	10.25
138	m	70	81	67	96	116	-	126	6	26	1	13.08	9.16
139	f	82	86	75	91	105	-	113	6	13	1	13.08	10.72
140	m	66	94	59	89	142	-	134	7	34	2	13.17	8.69
141	m	58	61	68	117	105	-	76	5	-24	0	13.17	7.84
142	f	69	84	59	87	124	-	129	7	29	2	13.33	9.06
143	m	61	92	55	90	151	-	133	8	33	3	13.58	8.23
144	m	101	122	69	67	121	-	96	5	- 4	0	13.67	12.56
145	m	76	86	67	89	113	-	101	6	1	1	14.50	11.02
146	m	56	60	64	114	101	-	113	4	13	1	14.59	8.16
147	m	63	82	57	90	131	-	117	5	17	0	14.59	9.19
148	f	96	93	123	131	97	-	131	5	31	0	15.08	12.49
149	m	64	86	61	95	134	-	127	5	27	0	15.33	9.81

APPENDIX 5. Statistics computed in the treatment of variables in Part 1.

KEY:-

Variables x and y.

$\bar{x}$ = mean of x, $\bar{y}$ = mean of y,

S_x = standard deviation of x by n-1 method, S_y = standard deviation of y by n-1 method,

$S_{\bar{x}}$ = standard error of the mean by n-1 method, $S_{\bar{y}}$ = standard error of the mean by n-1 method,

S_{xy} = covariance of x and y by n-1 method,

r = correlation coefficient of x and y,

p = significance of correlation coefficient,

n = number in sample.

Var x	Var y	$\bar{x}$	$\bar{y}$	n	S_x	S_y	$S_{\bar{x}}$	$S_{\bar{y}}$	S_{xy}	r	p
NR	MPR	91.68	17.40	149	19.82	12.93	1.62	1.06	34.18	.1334	-
NR	MPC	91.68	.66	149	19.82	.87	1.62	.07	- 4.16	-.2419	.01
NR	RA	91.68	9.42	149	19.82	1.81	1.62	.15	15.74	.4382	.001
NR	CA	91.68	10.59	149	19.82	1.62	1.62	.13	-13.23	-.4119	.001
NR/NA	NC/NA	101.58	105.77	149	13.98	12.80	1.15	1.05	-44.65	-.2497	.01
NR/NA	POP	101.78	96.92	123	13.87	12.67	1.25	1.14	-16.90	-.0961	-
NR/NA	AVMPR	101.58	104.61	149	13.98	21.23	1.14	1.74	-31.20	-.2737	.01
NR/NA	AVMPC	101.58	5.13	149	13.98	1.09	1.14	.09	- 4.91	-.0324	-
NR/NA	MPR	101.58	17.40	149	13.98	12.93	1.14	1.06	33.54	.1856	.05
NR/NA	MPC	101.58	.66	149	13.98	.87	1.14	.07	- .57	-.0467	-
NR/NA	RA	101.58	9.42	149	13.98	1.81	1.14	.15	- 3.87	-.1527	-
NR/NA	CA	101.58	10.59	149	13.98	1.62	1.14	.13	- 2.54	-.1122	-
NC/NA	POP	104.30	96.92	123	11.92	12.68	1.08	1.14	10.16	.0672	-
NC/NA	AVMPR	105.77	104.61	149	12.80	21.22	1.05	1.74	67.31	.2478	.01
NC/NA	AVMPC	105.77	5.13	149	12.80	1.09	1.05	.09	4.82	.3469	.001
NC/NA	MPR	105.77	17.40	149	12.80	12.93	1.05	1.06	- 6.90	-.0417	-
NC/NA	MPC	105.77	.66	149	12.80	.87	1.05	.07	3.47	.3133	.001
NC/NA	RA	105.77	9.42	149	12.80	1.81	1.05	.15	- .52	-.0226	-
NC/NA	CA	105.77	10.59	149	12.80	1.62	1.05	.13	7.21	.3476	.001
POP	AVMPR	96.92	102.54	123	12.68	23.44	1.14	2.11	9.05	.0305	-
POP	AVMPC	96.92	5.11	123	12.68	1.06	1.14	.10	- .39	-.0292	-
POP	MPR	96.92	17.57	123	12.68	13.38	1.14	1.21	- 7.83	-.0461	-
POP	MPC	96.92	.63	123	12.68	.86	1.14	.08	- 1.12	-.1025	-
POP	RA	96.92	9.14	123	12.68	1.65	1.14	.15	7.71	.3680	.001
POP	CA	96.92	10.06	123	12.68	1.17	1.14	.11	- .12	-.0080	-

APPENDIX 5 continued.

Var x	Var y	$\bar{x}$	$\bar{y}$	n	S_x	S_y	$S_{\bar{x}}$	$S_{\bar{y}}$	S_{xy}	r	p
NA	NC	89.97	94.54	149	16.51	17.79	1.35	1.46	238.13	.8109	.001
NA	NR	89.97	91.68	149	16.51	19.82	1.35	1.62	251.87	.7700	.001
NA	NR/NA	89.97	101.58	149	16.51	13.98	1.35	1.14	- 20.72	-.0898	-
NA	NC/NA	89.97	105.77	149	16.51	12.80	1.35	1.05	- 57.76	-.2735	.01
NA	POP	91.48	96.92	123	16.11	12.68	1.45	1.14	79.40	.3887	.001
NA	AVMPR	89.97	104.61	149	16.51	21.23	1.35	1.74	- 87.43	-.2495	.01
NA	AVMPC	89.97	5.13	149	16.51	1.09	1.35	.09	- 4.99	-.2783	.01
NA	MPR	89.97	17.40	149	16.51	12.93	1.35	1.06	.02	.0001	-
NA	MPC	89.97	.66	149	16.51	.87	1.35	.07	- 3.67	-.2567	.01
NA	RA	89.97	9.42	149	16.51	1.81	1.35	.15	18.95	.6350	.001
NA	CA	89.97	10.59	149	16.51	1.62	1.35	.13	- 10.87	-.4063	.001
NC	NR	94.54	91.68	149	17.79	19.82	1.46	1.62	186.85	.5300	.001
NC	NR/NA	94.54	101.58	149	17.79	13.98	1.46	1.14	- 52.74	-.2121	.01
NC	NC/NA	94.54	105.77	149	17.79	12.80	1.46	1.05	69.82	.3067	.001
NC	POP	94.85	96.92	123	18.20	12.68	1.64	1.14	88.55	.3837	.001
NC	AVMPR	94.54	104.61	149	17.79	21.23	1.46	1.74	- 46.01	-.1218	-
NC	MPR	94.54	17.40	149	17.79	12.93	1.46	1.06	- 15.38	-.0669	-
NC	MPC	94.54	.66	149	17.79	.87	1.46	.07	- 1.24	-.0802	-
NC	AVMPC	94.54	5.13	149	17.79	1.09	1.46	.09	- 1.99	-.1029	-
NC	RA	94.54	9.42	149	17.79	1.81	1.46	.15	20.36	.6315	.001
NC	CA	94.54	10.59	149	17.79	1.62	1.46	.13	- 5.05	-.1752	.05
NR	NR/NA	91.68	101.58	149	19.82	13.98	1.62	1.14	148.68	.5368	.001
NR	NC/NA	91.68	105.77	149	19.82	12.80	1.62	1.05	- 99.00	-.3904	.001
NR	POP	93.46	96.92	123	19.20	12.68	1.73	1.14	57.73	.2372	.01
NR	AVMPR	91.68	104.61	149	19.82	21.23	1.62	1.74	-143.86	-.3420	.001
NR	AVMPC	91.68	5.13	149	19.82	1.09	1.62	.09	- 8.72	-.4053	.001
AVMPR	AVMPC	104.61	5.13	149	21.23	1.09	1.74	.09	7.57	.3284	.001
AVMPR	MPR	104.61	17.40	149	21.23	12.93	1.74	1.06	1.89	.0069	-
AVMPR	MPC	104.61	.66	149	21.23	.87	1.74	.07	4.71	.2561	.01
AVMPR	RA	104.61	9.42	149	21.23	1.81	1.74	.15	- 3.51	-.0912	-
AVMPR	CA	104.61	10.59	149	21.23	1.62	1.74	.13	6.49	.1887	.05
AVMPC	MPC	5.13	.66	149	1.08	.87	.09	.07	.24	.2535	.01
AVMPC	MPR	5.13	17.40	149	1.09	12.93	.09	1.06	1.20	.1421	-
AVMPC	RA	5.13	9.42	149	1.09	1.81	.09	.15	- .31	-.1560	-
AVMPC	CA	5.13	10.59	149	1.09	1.62	.09	.13	.26	.1450	-
MPR	MPC	17.40	.66	149	12.93	.87	1.06	.07	1.47	.1309	-
MPR	RA	17.40	9.42	149	12.93	1.81	1.06	.15	- .98	-.0417	-
MPR	CA	17.40	10.59	149	12.93	1.62	1.06	.13	- .54	-.0257	-
MPC	RA	.66	9.42	149	.87	1.81	.07	.15	- .40	-.2540	.01
MPC	CA	.66	10.59	149	.87	1.62	.07	.13	.02	.0109	-
RA	CA	9.42	10.59	149	1.81	1.62	.15	.13	1.19	.4480	-

KEY TO VARIABLES:

AVMPR	Auditory-Visual Modal Preference (Rate)
AVMPC	Auditory-Visual Modal Preference (Compre)
MPR	General Modal Preference (Rate)
MPC	General Modal Preference (Comprehension)
PoP	Problems of Position Test
NC/NA	Neale Compre. Quotient divided by Neale Accuracy Quotient.
NR/NA	Neale Rate Quotient divided by Neale Accuracy Quotient.
CA	Chronological Age
RA	Reading Age (Accuracy)
NA	Neale Accuracy Quotient
NR	Neale Rate Quotient
NC	Neale Compre. Quotient

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APPENDIX 7. Values for all variables computed in the study of errors or 'baulk by respondents (N-460) to Form A of the Neale Analysis of Reading Ability.

Key: SY - number of syllables in word. MG - morphographeme count.
BK - number of words or 'baulk' NL - number of letters in word.
%E - percentage total errors. IC - incongruence 0; congruence 1.
OR - origin of word; T Teutonic, L Latinate.

Passage number 1.
N - 41.

Word	MG	OR	BK	SY	NL	IC	%E
black	1	T	41	1	5	-	20.5
came	1	T	34	1	4	-	17.0
my	1	T	3	1	2	-	1.5
house	1	T	9	1	5	-	4.5
put	1	T	8	1	3	-	4.0
kitten	1	T	16	2	6	1	8.0
then	1	T	3	1	4	-	1.5
went	1	T	9	1	4	-	4.5
away	1	T	16	2	4	1	8.0
now	1	T	11	1	3	-	5.5
her	1	T	15	1	3	-	7.5
baby	1	T	24	2	4	0	12.0
pet	1	T	11	1	3	-	5.5

Passage number 2.
N - 76.

returned	3	L	61	2	8	1	7.28
frightened	3	T	56	2	10	0	6.68
stopped	2	T	51	1	7	1	6.09
milkman	2	T	19	2	7	1	2.27
wandered	2	T	71	2	8	1	8.47
blocked	2	T	66	1	7	1	7.88
traffic	2	L	49	2	7	0	5.85
coming	2	T	18	2	6	1	2.15
quickly	2	T	36	2	7	1	4.30
safety	2	T	68	2	6	1	8.11
way	1	T	4	1	3	-	.48
school	1	T	6	1	6	-	.72
horse	1	T	48	1	5	-	5.73
fog	1	T	21	1	3	-	2.41
cart	1	T	34	1	4	-	4.06
centre	1	L	76	2	6	0	9.07
road	1	T	24	1	4	-	2.86
there	1	T	19	1	5	-	2.27
time	1	T	16	1	4	-	1.91
call	1	T	28	1	4	-	3.34
led	1	T	31	1	3	-	3.70
just	1	T	36	1	4	-	4.30

Passage number 3.
N - 76.

word	MG	OR	BK	SY	NL	IC	%E
enabled	3	L	71	3	7	0	11.47
adventure	3	L	11	3	9	0	1.78
decided	3	L	28	3	7	0	4.52
lions'	2	L	8	2	5	1	1.29
progress	2	L	31	2	8	1	5.01
waiting	2	T	4	2	7	0	.65
tonight	2	T	4	2	7	1	.65
restless	2	T	9	2	8	1	1.45
suddenly	2	T	18	3	8	1	2.91
trainer	2	L	54	2	7	0	8.72
stumbled	2	T	29	2	8	1	4.68
youngest	2	T	24	2	8	1	3.88
towards	2	T	8	2	7	1	1.29
swiftly	2	T	21	2	7	1	3.39
least	2	T	16	1	6	0	2.58
inside	2	T	15	2	6	1	2.42
cracking	2	T	51	2	8	1	8.24
prompt	2	L	76	1	6	0	12.28
action	2	L	44	2	6	0	7.11
regain	2	L	16	2	6	1	2.58
during	2	T	14	2	6	1	2.26
future	2	L	29	2	6	0	4.68
control	2	L	38	2	7	1	6.14

Passage number 4.
N - 74

outstretched	3	T	24	2	12	1	3.20
despairing	3	NF	68	3	10	0	9.06
villagers	3	NF	8	3	9	1	1.07
territory	3	L	41	3	9	0	5.47
intruder	3	L	19	3	8	1	2.53
curiously	3	L	21	4	9	1	2.80
enormous	3	L	24	3	8	1	3.20
collapsed	3	L	38	2	9	0	5.07
realised	3	L	47	3	8	0	6.27
crouched	2	T	31	1	8	1	4.13
wounded	2	T	68	2	7	1	9.07
speedy	2	T	16	2	6	1	2.13
beneath	2	T	3	2	7	1	.40
troubled	2	T	12	2	8	1	1.60
roaring	2	T	14	2	7	1	1.87
guided	2	NF	25	2	6	1	3.33
monsters	2	T	28	2	7	1	3.73
dreaded	2	T	30	2	7	1	4.00
marshes	2	T	11	2	7	1	1.47
charged	2	T	28	1	7	0	3.73
whipping	2	T	13	2	8	1	1.73
rider	2	T	4	2	5	0	.53
creature	2	L	5	2	8	0	.67

APPENDIX 7 continued.

Passage number 5 continued.

word	MG	OR	BK	SY	NL	IC	%E
off-guard	2	T	16	2	8	1	2.13
accustomed	3	L	74	3	10	0	9.86
victory	3	L	6	3	7	0	.80
prepared	3	L	51	2	8	1	6.80
powerfully	3	T	4	4	10	1	.53

Passage number 5.
N - 109.

approximately	4	L	26	5	13	0	2.40
operations	4	L	15	4	10	0	1.39
discipline	4	L	64	3	11	0	5.91
experience	4	L	21	4	10	0	1.94
persistence	4	L	65	3	11	0	6.01
triumphantly	4	L	45	4	12	0	4.16
submarine	3	L	5	3	9	1	.46
treacherous	3	NF	21	3	11	1	1.94
currents	3	L	16	2	8	0	1.48
remained	3	L	11	2	8	1	1.02
confident	3	L	25	3	9	0	2.31
technical	3	G	64	3	9	0	5.91
equipment	3	L	10	3	9	1	.92
entangled	3	NF	32	3	9	0	2.96
projection	3	L	52	3	10	0	4.81
adjacent	3	L	109	3	8	0	10.07
patiently	3	L	25	3	9	0	2.31
rewarded	3	NF	4	3	8	1	.37
detached	3	L	21	2	8	1	1.94
obstruction	3	L	20	3	11	0	1.85
undaunted	3	NF	45	3	9	0	4.16
unpleasant	3	L	15	3	10	1	1.39
accident	3	L	12	3	8	0	1.11
proceeded	3	L	15	3	9	1	1.39
captives	3	L	35	2	8	0	3.23
stricken	2	T	29	2	8	1	2.68
depth	2	T	5	1	5	1	.46
although	2	T	15	2	8	1	1.39
common	2	L	4	2	6	1	.37
knowledge	2	T	13	2	9	1	1.20
meanwhile	2	T	0	2	9	1	.00
outside	2	T	0	2	7	1	.00
diver	2	T	4	2	5	1	.37
release	2	L	16	2	7	1	1.48
lifeline	2	T	0	2	8	1	.00
become	2	T	0	2	6	1	.00
wreckage	2	T	11	2	8	1	1.01
warned	2	T	14	1	6	1	1.29
impulse	2	L	15	2	7	1	1.39
dislodge	2	T/NF	29	2	8	1	2.68
turned	2	T	5	1	6	1	.46
twisted	2	T	0	2	7	1	.00
calmness	2	L	24	2	8	1	2.22
final	2	L	4	2	5	1	.37
fatigued	2	NF	98	2	8	0	9.06
provide	2	L	9	2	7	1	.83
escape	2	L	5	2	6	1	.46
exit	2	L	0	2	4	1	.00

Passage number 6. N - 84.

word	MG	OR	BK	SY	NL	IC	%E
conditions	4	L	34	3	10	0	2.76
necessity	4	L	70	4	9	0	5.67
anticipation	4	L	84	5	12	0	6.81
accomplished	4	L	17	3	12	1	1.38
magnificently	4	L	44	5	13	0	3.57
endurance	4	L	8	3	9	1	.65
immediately	4	L	0	5	11	1	.00
disappeared	4	L	0	3	11	1	.00
required	3	L	0	2	8	1	.00
realising	3	L	21	4	9	0	1.70
conserving	3	L	12	3	10	1	.97
intermediate	3	L	81	5	12	0	6.56
initial	3	L	85	3	7	0	6,89
enthusiasm	3	G	59	5	10	0	4.78
attaining	3	L	18	3	9	1	1.46
subdued	3	L	12	2	7	1	.97
obvious	3	L	31	3	7	1	2.51
incident	3	L	22	3	8	1	1.78
original	3	L	12	4	8	1	.97
accepted	3	L	24	3	8	1	1.94
decision	3	L	11	3	8	0	.89
tedious	3	L	55	3	7	0	4.46
incessant	3	L	69	3	9	1	5.59
violence	3	L	9	3	8	1	.73
misfortune	3	L	0	3	10	1	.00
advance	3	L	15	2	7	1	1.22
essential	3	L	54	3	9	0	4.38
concluding	3	L	5	3	10	1	.41
unconquered	3	NF	42	3	11	1	3.40
unforeseen	3	T	8	3	10	1	.65
required	3	L	0	2	8	1	.00
decided	3	L	0	3	7	1	.00
tedious	2	L	52	3	7	0	4.46
plateau	2	F	74	2	7	1	5.97
arduous	2	L	69	3	7	0	5.59
varying	2	L	13	3	7	1	1.05
challenged	2	NF	32	2	10	1	2.59
height	2	T	5	1	6	1	.40
will-power	2	L	6	3	8	1	.47
leader	2	T	3	2	6	1	.23
recent	2	L	15	2	6	0	1.22
mishap	2	T	26	2	6	0	2.11
crevasse	2	F	64	2	8	1	5.19
ahead	2	T	0	2	5	1	.00
limit	2	L	0	2	5	1	.00
assault	2	NF	16	2	7	1	1.30
strength	2	T	0	1	8	1	.00
member	2	L	0	2	6	0	.00
withstand	2	T	0	2	9	1	.00
programme	2	F/L	0	2	9	1	.00
ahead	2	T	0	2	5	1	.00
final	2	L	0	2	5	1	.00
although	2	T	2	2	8	1	.10
rescue	1	L	0	2	6	1	.00
fallen	2	T	0	2	6	1	.00
upon	2	T	0	2	4	1	.00
into	2	T	0	2	3	1	.00

APPENDIX 8. The Sorting 'Test' used in Part 3 to inhibit Auditory-phonological encoding.

Sorting Test A, Initial Positions.

Target Particles.

sur ob ab con de sub com ex in

Sorting Words and Pseudo-words.

surplacement	surmountable	obligation	obstruction	obflation
ablation	abstructory	abstraction	contraction	constipation
consumation	detergent	deterrence	deflation	substitution
subtraction	subprotean	compulsion	compensatory	compression
extrusion	exitatory	examples	surprising	inoperable
incarceration	injection	objectionable	contracting	intact

Sorting Test B, Terminal Positions.

Target Particles.

ible ent or ion ean ence ory ure ile

Sorting Words and Pseudo-words.

protactible	reversible	distractible	different	complacent
insurgent	reflector	superconductor	projector	consumption
confusion	subjection	crutacean	subterranean	protean
fumitory	transistory	trajectory	photogravure	sinecure
procure	projectile	prehensile	percentile	eminence
reference	omnipresence	distractor	discernible	expectoration

Sorting Test C, Medial Positions.

Target Particles.

terr struct tact press vis vers fer duct

Sorting Words and Pseudo-words.

proterrafer	instruction	transpressation	abstructile	nonterrapan
interstructors	preversile	conversion	perductine	surductire
survisure	invisible	pervisine	revisional	impression
suppressor	trajectory	jodfertol	induction	extraterrestrial
subpressible	substructure	contactibility	perversatile	projecture
transterritorial	interpressured	intactate	interductors	conferential

APPENDIX 9. Comprehension Test used in Part 3 of the study.

1

- constructor
- expression
- conductor
- substructure
- instructor
- subversion
- conduction
- inductive
- constructive
- destructible
- expressor
- conjecture

2

- construction
- conduction
- inference
- trajectory
- compressor
- terrestrial
- deference
- constructive
- conference
- suffering
- reversible
- compressant

3

- expression
- adjective
- rejectible
- ejector
- extraction
- constructible
- injector
- suppresor
- injection
- dejected
- extractor
- expressor

4

- suppression
- reduction
- suppressor
- contact
- divisive
- irreversible
- repression
- depressant
- reconstruction
- restructured
- substructure
- depression

5

- terrain
- extraversion
- reversible
- televisor
- converse
- territorial
- eduction
- contactible
- subject
- territory
- subjection
- trajectory

6

- inverse
- contact
- conversion
- inconstructible
- destructive
- restrutured
- construct
- reverse
- subdivisible
- indestructible
- divisible
- intact

APPENDIX 9 continued.

7
- reconstructible
- contactible
- indifferent
- irreversible
- reconstruction
- contact
- destructible
- conversion
- recompression
- distraction
- substructure
- constructible

8
- division
- reconstruction
- revisible
- substructure
- conversion
- provision
- preferent
- visible
- projector
- projection
- preconstruct
- conference

9
- reduction
- intact
- advisor
- converse
- contact
- traverse
- conduct
- constructive
- structure
- supervise
- obverse
- construct

10
- extraversion
- conversion
- ejective
- subjection
- expression
- provision
- territorial
- extraterrestrial
- expressive
- terrain
- invisible
- subterranean

11
- ejector
- instructor
- projector
- invisible
- substructure
- subject
- construction
- structurure
- visible
- subject
- provision
- visor

12
- converse
- afferent
- subjection
- instruction
- conversation
- differentiate
- versatile
- interference
- conference
- interfere
- differentiation
- contact

APPENDIX 9 continued.

13

divisible
different
instructive
construct
diverse
revise
afferent
destructive
conference
difference
reversible
ejection

14

supervisor
inversion
expressible
extraterrestrial
construction
subversion
expression
adversary
advisor
extraversion
eduction
efference

15

dejected
substructure
compressible
subjection
suffer
subversion
trajectory
subject
dejection
supressor
reject
destructive

16

constructible
subject
compressible
projectile
provision
ejectible
subterranean
expressive
repression
revise
referent
compression

17

trajectory
construction
interfere
superstructure
reference
conductor
introduction
interjection
transference
conduction
afferent
reversal

18

reconstruct
reversal
constructive
depressive
reconstruction
destructive
subjective
intact
terrain
depression
dejection
extraversion

APPENDIX 9 continued.

19

ejector
eductive
conductor
express
subjective
transfer
product
ejectible
production
transferable
reversal
expression

20

pressure
reversible
intact
compressible
converse
irreversible
compressor
subjection
incompressible
rejectible
subjective
compressor

21

construction
compressible
interjection
projector
restructure
reconstruction
interference
afferent
conference
pressure
conjecture
construction

22

constructive
expression
construction
conversion
territory
constructor
instructor
reconstruct
compressor
transference
conjecture
constructive

23

reject
interject
transfer
projection
reversion
revise
provision
object
reconstruct
division
repression
objective

24

transverse
trajectory
reconstruct
reversal
diversion
restructure
transduction
destructive
reverse
revision
transferable
reversible

APPENDIX 9 continued.

25

contact
conversion
transferable
intact
projectile
construct
tactile
invisible
incompressible
invisibility
construction
indestructible

26

injector
depressive
subterranean
territorial
instructor
destructive
substructure
reconstruction
interfere
terrier
interference
terrain

27

provision
conversation
introduction
inversion
instruction
afferent
conduction
reconstruction
adduction
interfer
preconstruction
introversion

APPENDIX 9 cont:

COMPREHENSION TEST.

1. A thing through which something can pass to get from one place to another
Conductor.

2. A meeting where people bring their ideas together.
Conference.

3. A device for throwing these * out of a rifle after they have been fired (* Show shell case).
Ejector.

4. If I'm angry but i don't want to show it, I push my anger back so it won't show.
Repression.

5. This is the land owned by the indians (Show picture).
Territory.

6. This tube of sweets is complete; it hasn't been touched (Show Spangles).
Intact.

7. If you knock this house down *, it can be put together again (* Show model of house). u
Reconstructible.

8. There's going to be a shortage of sugar in the shops at Christmas, so I'm looking ahead and getting a good stock in.
Provision.

9. I've brought these two blocks together * so that they just touch (Show blocks placed together).
Contact.

10. A Martian comes from outside our earth.
Extraterrestrial.

11. Choose the word for this * (* Show visor on crash helmet). u
Visor.

12. They've turned towards each other and now they are speaking to each other.
Conversation.

13. This one is large, this one is small; this one is coloured, this one is not * (* Show two different blocks).
Different.

14. The idea of a person who turns his thoughts to people and things outside himself. u
Extraversion.

15. To throw a man under the rule of a king.
Subject.

16. You can push this * together a bit to make it go in (Press piece of foam)
Compressible.

APPENDIX 9 cont:

Comprehension Test cintinued.

17. Here x is a picture of a man taking things from a lorry and carrying them across to a van (x Show picture).
Transference. (u)

18. The vandals knocked a shed down just two days after it had been put up. These vandals are ......what?
Destructive.

19. What kind of movement is required to draw this out of the tube x (Show bung in tube).
Eductive. (u)

20. You cannot push this together to get it in x. (Sow hard bung slightly bigger than tube.)
Incompressible. (u)

21. The idea of throwing odd thoughts togetherin your mind.
Conjecture. (u)

22. This x is the man who built it (Show house and man).
Constructor.

23. To look back at what you did yesterday.
Revise.

24. The stripes on these x trousers are the wrong way; they're going across rather than down (Show picture).
Transverse.

25. Close your eyes: You can touch this x . Open your eyes and find the word. (Place object on hand, and stress underlined words.)
Tactile. (u)

26. This dog x is bred small to dig rabbits out of the ground. (Show picture).
Terrier. (u)

27. This is a small chapter inside a book to lead you into the beginning of the story.
Introduction.

(u) indicates that these words have not been taught.

APPENDIX 10. Supplementary data for Part 3, including statistics computed for Kuder-Richardson Formula.

Comprehension Test Score Sheet															
Matched Pair Number	1		2		3		4		5		6				
Auditory/ Visual Preferent	A	V	A	V	A	V	A	V	A	V	A	V	Total	p	q	pq
1 Conductor	✓	✓	✓	✓	✓	0	✓	✓	✓	✓	✓	✓	11	·083	·917	·076
2 Conference	✓	0	✓	✓	0	✓	0	✓	0	✓	✓	✓	8	·333	·667	·222
3 Ejector	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	11	·083	·917	·076
4 [illegible]ion	0	✓	0	✓	✓	✓	✓	✓	✓	✓	✓	0	9	·250	·750	·187
5 [illegible]	0	✓	✓	0	✓	✓	0	✓	✓	0	0	✓	7	·417	·583	·243
6 Intact	✓	0	0	✓	✓	0	✓	✓	✓	✓	✓	✓	9	·250	·750	·187
7 Reconstructible (u)	0	0	✓	✓	0	0	0	✓	0	✓	0	✓	5	·583	·417	·243
8 Provision	0	✓	✓	✓	✓	✓	✓	✓	✓	✓	0	✓	11	·083	·917	·076
9 Contact	✓	0	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	11	·083	·917	·076
10 Extraterrestrial	0	0	0	✓	0	✓	✓	✓	✓	0	✓	✓	7	·417	·583	·243
11 Visor (u)	0	0	0	0	0	✓	✓	✓	✓	✓	✓	✓	7	·417	·583	·243
12 Conversation	0	✓	0	✓	✓	✓	✓	0	0	✓	✓	✓	8	·333	·667	·222
13 [illegible]	0	✓	0	✓	✓	✓	0	✓	✓	✓	✓	✓	9	·250	·750	·187
14 [illegible]version (u)	0	0	0	0	0	0	0	✓	0	0	0	✓	2	·833	·167	·139
15 Subject	✓	0	✓	✓	✓	✓	0	✓	✓	✓	✓	✓	10	·167	·833	·139
16 Compressible	0	✓	✓	0	0	✓	✓	✓	0	✓	✓	✓	8	·833	·667	·222
17 [illegible] (u)	0	0	0	0	✓	0	0	✓	0	0	0	0	2	·833	·167	·139
18 Destructive	✓	✓	✓	✓	✓	✓	0	✓	✓	✓	0	✓	10	·167	·833	·139
19 [illegible] (u)	0	0	0	0	0	0	0	✓	0	0	0	0	1	·917	·083	·076
20 Incompressible (u)	0	✓	0	0	0	✓	0	0	0	0	0	0	2	·833	·167	·139
21 Conjecture (u)	0	0	0	✓	0	0	0	0	0	0	✓	0	2	·833	·167	·139
22 Constructor	✓	✓	✓	✓	✓	0	✓	✓	✓	✓	✓	✓	11	·083	·917	·076
23 Revise	✓	✓	0	0	✓	✓	✓	✓	✓	✓	✓	✓	10	·167	·833	·139
24 Transverse	✓	0	✓	✓	✓	✓	✓	0	0	✓	✓	✓	9	·250	·750	·187
25 Tactile (u)	0	0	0	✓	✓	0	✓	✓	0	✓	0	0	5	·417	·583	·243
26 [illegible] (u)	0	0	0	0	0	✓	0	0	0	0	0	✓	2	·833	·167	·139
27 Intr[illegible]uction	✓	0	✓	✓	0	✓	0	✓	✓	✓	✓	✓	9	·250	·750	·187
																2.884
Total non-(u)	12	11	12	15	14	15	12	16	14	17	15	16				1.500
Total (u)	0	1	1	3	2	3	2	6	1	3	2	4				4.384
Total	12	12	13	18	16	18	14	22	15	20	17	20				