An Investigation of a Structuring Model for the Acquisition of Semantic Structures by Young Children.

Lionel John Chapman

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SUMMARY

AN INVESTIGATION OF A STRUCTURING MODEL FOR THE ACQUISITION OF SEMANTIC STRUCTURES BY YOUNG CHILDREN

This study, which was motivated by pedagogical needs, examined the development of semantic structures in children aged 6 to 11 years.

A series of experiments used the judgement of nearness of meaning of terms, and free recall of word associations, as the tasks.

It was hypothesised that, because of the length of the developmental processes in children, different stages would be observed in the judgement of meaning tasks and also that the associated strength between related pairs of words would increasingly facilitate the children's performances. Further, it was hypothesised that this developmental pattern could be traced by an investigation of the storage of meaning relationships.

In the first two experiments, investigations were carried out into children's ability to retrieve the logical organisation of three semantic fields by using Miller's (1969) method for judging meaning relationships. Cluster analysis was employed to arrange the data and the results showed that the children's Hierarchical Cluster Schemes (HCS) became more stable with age and these gradually approximated models of the semantic fields. Three stages were discerned in both these experiments in the characteristic progression of the hierarchy. Opposite or compli-

mentary terms were paired as closest in meaning initially, and these were then merged or joined by another term. The final strong clusters of the oldest group resembled the semantic field models.

The third experiment, using free recall of meaning associations, employed two lists each containing six pairs of words selected according to linguistic categories and controlled for associated strength. The results of a free recall task using this experimental material demonstrated that age, linguistic category and associative strengths were significant variables. Relative high associative strengths enhanced recall whereas when the associated strength was low, words did not occur in adjacent positions in recall.

The general conclusion from this research is that children's ability to judge closeness of meaning relationships increases with age and this ability is also associated with their appreciation of the structure of semantic fields. The HCS's obtained from the subject's 'judgement' performances contained an initial pairing of terms definable by logical - linguistic categories. Other similarly defined linguistic pairs become increasingly secure in long term memory with age. This security in long term memory is also related to associated strength of the verbal material.

The research demonstrated a possible structuring model for the learning of the meaning of related words during the acquisition of semantic fields.

To my wife
Mary

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1.0 INTRODUCTION

To begin with an almost hackneyed phrase, 'research begets research', and this work is no exception as it arises directly from the main findings of the author's M.Sc. thesis which was presented in 1970.

1.1. PEDAGOGIC PURPOSES

The aim then, as now, was 'to examine the possibility of improving pedagogical procedures designed to promote language skill by utilising recent developments in psychology and linguistics.' In the previous study it was argued that many of the findings and important developments in what has become known as psycholinguistics required bringing together and surveying to discover whether they have important implications for classroom practice. There is still a great need for this type of data to guide those whose work it is to prepare, for instance, programmes for initial training and in-service education of teachers as well as for direct guidance for the practitioner in the classroom and elsewhere. Indeed, there appears to be very little work carried out at the present time which is devoted to examining the results of pure research in terms of its possible applications let alone into its effectiveness when it is applied.

During the five years that have elapsed since the previous work was reported, the development of language skills, always recognised as a pre-requisite in education, has received a new direction from research into adult functional reading and the needs of industry and commerce.

An instance first from the traditional teaching of reading in schools, illustrating the application of the intentions behind this work, can be found in a recent collection of papers entitled, 'Language and Learning to Read: What the Teacher should know about Language.' (Hodges and Rudorf, (Eds.) 1972). In one of the articles, Constance McCullogh suggests that the teacher's present goal,

> 'is the development of a new way of looking at the teaching of reading by being aware of these new findings, of their relationships to each other, and of the bearing these relationships have upon reading comprehension.'

In this work language skills are directly applied to the development of reading skills and in particular to the higher order skills of comprehension. The new findings mentioned include the work of Chomsky (1965) on transformational grammar, Whorf's (1964) study of the nature of English, Guildford's(1958) model of the structure of the intellect and Fries (1951) on the structure of English. And here, it is most important to recognise that there has been a considerable change of emphasis in the study of reading in the last decade. Nowadays the focus of attention is no longer on the skills required by children beginning to read but on reading as a developmental process which continues virtually throughout life. As I. A. Richards (Department of Ed. and Science, 1975) has it,

> 'We are all of us learning to read all of the time.'

It is not without interest that in the United States of

America, the United States Office of Education recently requested the Educational Testing Service 'to describe and measure the reading activities and skills of American adults as they function in the course of an ordinary day.' The findings of the initial survey (Murphey, R.T., 1973) showed that the average American reported spending some ninety minutes a day in reading. The national survey listed the following reading content as the most important:

a) price, weight and size information while shopping.
b) street and traffic signs while travelling and commuting.
c) the main news in the newspaper.
d) writing on packages and labels while shopping.
e) manuals and written instructions at work.
f) other forms, invoices and accounting statements at work.
g) tests, examinations and written assignments in school.
h) letters, memos and notes at work.
i) order forms to fill out or look at at work.
j) the local news in the newspapers.
k) other school papers and notes of any kind at school.
l) bills and statements received in the mail.

Several hundred reading tasks have been analysed for their correspondence with these reading activities and a selection of those have been further developed and administered to adults in the New York area. The attempt to define the skills and measure adult functional reading has not yielded simple answers but progress is being made.

In Canada too another type of analysis of language skills has been undertaken by the Department of Manpower and Immigration, and here the direction of the research is even more closely allied to this present work as it is concerned with communication skills. In reporting the work, Smith A. De.W (1974) stated that the aim of his paper was 'to examine the communication skills used in the performance of occupational work and to briefly comment on the implication of these skills in so far as they affect reading strategies and standards.' Here those communication skills, including reading, writing, talking and listening, that are required for adult education and training, are the main research aims. (A note in passing: it is unusual, perhaps unique, to hear of this type of research being undertaken outside a University Department of Education). It is interesting to see from some of the preliminary findings how different skills and occupations require a variety of language skills and different levels of subskills.

This type of survey and skill research is in its infancy but is already showing a new emphasis on those language skills in adult life. This is an area, much neglected at the present time; as witness the plight and numbers of adult illiterates. The size of this problem is very large indeed. In Birmingham alone, a conservative estimate puts the number of 24,000 and this is increasing annually. (Ben-Tovim M. and Kedney R.J., 1974).

These examples of the applied purposes of this present research reveal that a continuum is being discussed. There are problems too when the other end of that continuum is examined. In a piece of published research, (Chapman, 1973, see copy in Appendix 1), the author shows that,

that, despite the entry qualifications in terms of 'O' and 'A' level G.C.E. results, students entering a College of Education in the West Midlands might not have the requisite reading comprehension skills that were assumed by the lecturers who had designed their courses. A decline over the years in the ability of the men students was also shown and the need for further detailed research, for the effects of the overestimate of the level of students' skills by the staff was 'unrest' in the form of complaints about the uneveness and severity of work loads. The findings of this research were reported as being 'sufficiently disturbing to justify some pressure for a more extensive investigation of reading standards.' (Merritt, J. 1973).

As this section of the thesis was being written, the Report of the Committee of Enquiry appointed by the Secretary of State for Education and Science, 'A Language for Life,' the so-called Bullock Report, was published. (Department of Ed. & Science 1975). Many of the Report's three hundred and thirty-three recommendations presume that knowledge of language acquisition and its relation to learning is there to be studied and that teachers should acquire this knowledge as part of their preparation for teaching. Paragraph 1.11 of the Report (page 8) strongly emphasises this when it states,

> 'If a teacher is to control the growth of competence (ie. the language competence of his pupils) he must be able to examine the verbal interaction of a class or group in terms of an explicit understanding of the operation of language.'

And,

> '.... in the course of the Report we emphasise that if standards of achievement are to be improved all teachers will have to be helped to acquire a deeper understanding of language in education.'

Furthermore, certain sections of this authoritative document also deal with specific areas of the author's previous research (Chapman, 1970). Syntactical structures, for example, are discussed in relation to reading. In paragraph 6.34 (page 92) the Report, discussing learning to read, points out that 'Word recognition is also made easier by the ability to anticipate syntactic sequence.' And, 'A number of studies show that a printed text is easier to read the more closely its structures are related to those used by the reader in normal speech.' The acquisition of structures, their complexity and order of progression then are of the utmost importance. If the information being gathered by research is noted by authors of reading primers and schemes, then the task of the child who is faced with learning to read is made that much easier. In the same way, instructional material for the older student can be so structured to take language processes into account.

Apart from using new knowledge and perspectives in the production of learning materials, there is that other particular area mentioned briefly earlier where the details of the research has applicability. This is the examination of specific verbal skills employed by the child when first learning to read and later when,as a student,he is confronted with complex texts in reading to learn. In discussing these aspects, the Report mentions the work of

Goodman (1970), who emphasises the student's response to meaning.

> 'The purpose of reading', he claims, 'is the reconstruction of meaning. Meaning is not in the print, but it is the meaning the author begins with when he writes. Somehow the reader strives to reconstruct this meaning as he reads.'

Goodman has concerned himself with an analysis of the miscues made by children in their oral reading. The analysis has been presented by Goodman (1973) in taxonomic form showing in detail how the child brings his language skills, including such effects as the predictability provided by a well known syntactical form, to help decode the meaning carried by the print. As well as these syntactic cues there are the semantic cues themselves which are related to the meaning structures the child has acquired and can reconstruct. The author's earlier research dealt, in the main, with syntactical elements although semantic effects were clearly demonstrated. The present work is engaged in a study of semantic structures and their acquisition.

These then are the broad areas of purpose that motivate and indeed justify this study and an indication of the direction it will take.

Summary.

1. An attempt has been made to show very briefly that the vast complex of modern society relies heavily on communication, at the heart of which is language.
2. Those who serve the improvement of these communication skills wherever they appear on the continuum should achieve better results if their knowledge of language is better

informed by research findings.

3. In particular, the study of syntactical structures undertaken in the author's previous work is to be complemented by a study of the development of semantic structures.

1.2 LANGUAGE AND MEANING

> 'The habit of responding to context (reading is being discussed) in order to detect significant nuances of meaning, is not one that can be acquired quite simply in the early stages ...., it develops over a life-time....'
> (Department of Ed. and Science, 1975, para 6.35 page 92).

If, as has been estimated the most common 500 words in English share between them some 14,050 meanings, then the supporting psychological mechanisms developing during the acquisition of language skills may well be very intricate indeed. But first what is understood by the term meaning?

This question has been discussed by philosophers and thinkers from Platonic and Aristotelean times onward, (for a useful summary see Hörmann (1970, page 148 et seq.)). It is in this century however, that significant developments have taken place. In a now classic work, 'The Meaning of Meaning', Ogden and Richards (1936 edition) put forward a dualistic dynamic approach that words (the traditional units of meaning) as such have no meanings; 'they get their meanings by the way they are used by individuals. Language', they say, 'is a means, not of symbolising references, but for the promotion of purposes'. (page 16). They propose a triangular relationship as in Figure 1.

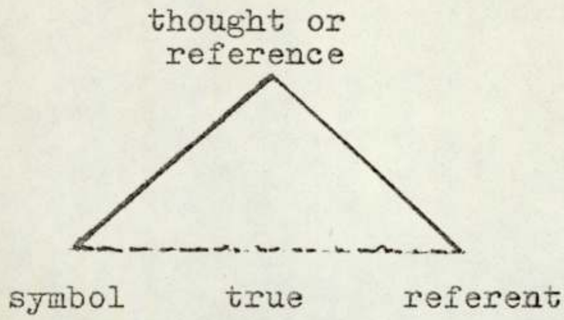


Figure 1

Schema of the relationship between symbol, reference and object. Based on Ogden and Richards (1952 edition)

Their work, termed by some mentalistic, spans the changes from an older view of meaning as connection with images or engrams, to a newer one. In this, the process occurring in the language-user, is a third constituent in the meaning relationship. In the work, the cause-effect (or stimulus-response) relationship is portrayed. In a more recent study, Rommetveit (1968, page 11) recounts Morris' (1938) definition of a language as a set of signs linked together by syntactic, semantic and pragmatic rules. This formulation of Morris was based partly on the proposals of Ogden and Richards and partly on those of an earlier writer Pierce (1878) who appears, even at this point in time, to be using the cause and effect relationship in his thinking. To understand the meaning of a sentence all one had to do, he writes, was to observe what habits it evokes. It can be seen then that meaning as such is no longer conceived by some as the dictionary definition of an isolated word, but embedded and observable in communication events, which can be described as messages. As meaning is contained in messages, then it must be susceptible to the rules that govern their transmission and reception.

The area is very complex indeed and accounts of it are numerous, and as Creelman (1966) found, 'there is no concensus concerning the concept of meaning.' This being so a series of selections must take place so that further discussion may proceed and the specific area of meaning relationships being researched teased from the umbrella term, language. Recalling the notion of messages mentioned above, some thoughts put forward by Rommetveit (1968) are accepted as providing a frame of reference for the study at the macro-level. His thesis is to place the study of language processes in a framework of semiotics, 'a general science of signs'. These ideas are put forward in his book, 'Words, Meanings and Messages', in which he surveys much of the recent work on this topic. As will be seen later, this way of entering and approaching the weighty questions involved in language study is particularly apposite to the data collected, and helps to give it further context.

Rommetveit (p.11) quotes Morris' three rules defining a language as mentioned earlier as:

> Syntactic rules which prescribe in which ways signs may be combined into compounds;
>
> Semantic rules required in order to establish correspondences between sign and sign compounds on the one hand and significances on the other;
>
> Pragmatic rules are brought to our attention when one focuses upon signs and sign compounds as a means to an end.

It has been observed elsewhere (Anglin 1971) that the word is 'the container of meaning' and that interword relations are as important as its reference. The difficulty of the word per se as a unit is resolved when the dynamic aspect, revived by thinking of a particular word meaning being activated as the word enters into specific cases of message transmission.

> 'Decoding', says Rommetveit (1968 p.107) referring to messages, 'will involve interrelated afferent and efferent mechanisms at different levels of a hierarchical structure. Only the superordinate level of semantic attribution appears to be attended to in ordinary settings of message transmission, but lower order operations may acquire saliency under specific experimental conditions.'

Put another way, the semantic element conveyed is the purpose of transmitting a message in everyday communication. This should not be lost sight of, as experimental conditions may involve only 'lower order' mechanisms. However, if as Rommetviet has it, the system is hierarchical then the higher order processes will be built up from and subsume that of the lower strata.

So far the first selection made from language processes at the macro level is that best described by the more neutral term semantics. A second selection decision is now required, that is to put on one side areas which are labelled variously affective, attitudinal or emotive. This is not to say that they are, in any way, less important, but to do them justice they require full studies of their own. A useful model for the discussion illustrating the components in message transmission is provided by Rommetveit (p.110). The model, see Figure 2, shows the interrelatedness of the three areas always present in messages; without them 'no autonomous word meaning can emerge'.

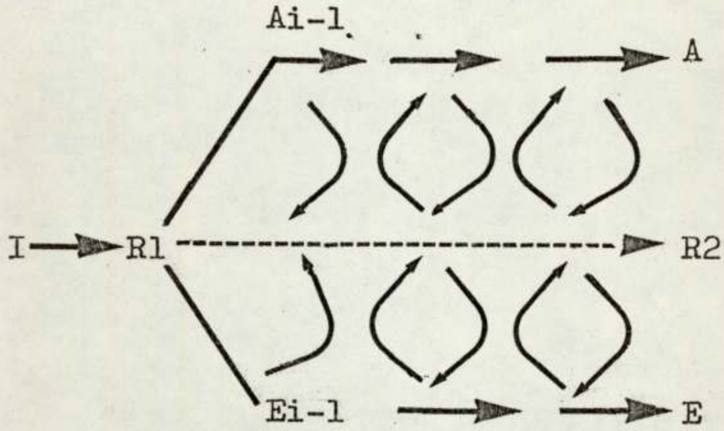


Figure 2
The word as a three component temporal pattern where I = Input (word form); R1 = act of reference, choice of specific semantic correlate; R2 = process of representation (sustained); A = association process; and E = Emotive process. (Model after Rommetviet p.110)

In the model the sustaining of the representation of input over time is shown as central and is considered feasible under conditions of associative and affective feedback. 'Operationally', says Rommetviet, 'the assumed components may possibly be partly assessed by such procedures as requests for definitions (R2), word association tests (A), and semantic differential scalings (E).' Thus if the emotive component (E) is left aside, it is possible to concentrate on the other two, the Reference or Denotative element and that of Association.

Much work has been done over the years and much written on the acquisition of word references in works like Roger Brown's 'Words and Things', and important studies concerned with concept formation and development as exemplified by the work of Piaget and Vygotsky. From these writings two different paradigms for establishing word reference can be traced. First, there is the 'coupling of the word form to some prelinguistically established analyzer,' and secondly, the intra-linguistically derived reference. Rommetviet summing this development says,

> 'from the very beginning, (words are) encountered in complex intralinguistic networks and that objects are always encountered in complex event structures. Appropriate acts of reference and cognitive representation may therefore be said to develop by a process of decontextualisation.'

However, it is with the third of Rommetviet's components, Association, that the main interest lies. Summarising the research into word association responses, he points out the problems of drawing inferences from observed stimulus-response patterns to associative structures. He catalogues the various areas of study such as,

> 'investigation of meaningfulness and learnability of verbal material, in research on paired associate learning and verbal concept attainment, in measures of similarity between words with respect to associative structures and in explanation of so-called syntagmatic and paradigmatic aspects of linguistic competence.'

He further distinguishes between association responses tapping the sphere of reference of the stimulus word and associations proper. Secondly, he points out that 'a request for an associative response may also contribute to the internal state generating that response.' There are, he suggests, those linkages which appear to originate in 'intra-linguistic semantic networks' and those arising from 'contiguities of cognitive elements to which classical laws of association seem to apply.' This makes up what he calls the 'associative state' which is defined as 'an induced state of evocating a temporary reordering of an internal vocabulary in terms of relative availability'.

For the purposes of this study, semantic relationships have been reduced to the inspection of an internal vocabulary which, according to Rommetviet's definition, can be alerted in such a way that its contents can be re-ordered according to the demands being made. This dynamic model of an internal vocabulary is examined at greater depth and its acquisition and development becomes the main concern of the thesis.

Summary.

1. Sketching the route taken by this subsection, it was soon clear that the extent of the topic and the blanket nature of the term Language must necessarily force a process of ruthless selection. This was achieved by first accepting Rommetviet's semiotic perspective such that language is a vehicle for communication which consists of

three interrelated components, the syntactical, the semantic and the pragmatic.

2. From these three, the semantic area is chosen as of particular interest and its interrelationship with the syntactic provides a link with the findings of the final experiment in the author's previous study.

3. Following a very brief review of studies of semantics, Rommetviet's definition of the dynamic nature of the associative state, 'a temporary reordering of an internal vocabulary', is selected for investigation, leaving aside the emotive and reference components.

1.3 RESUMÉ OF EXPERIMENT 3 FINDINGS (M.Sc.)

In order to provide continuity with the previous work, some comments are appropriate at this stage.

The final experiment reported in the author's M.Sc. thesis confirmed a developmental trend in the acquisition of syntactical structure and, at the same time, discovered an interaction effect between specific syntactical structures and different levels of vocabulary. Two publications (Chapman, 75a.b. copies in Appendix 1) report these findings, the latter taking the discussion of the results a little further and aligning them with other work in language acquisition.

In the final experiment, two sets of syntactical structures of differing complexity were presented to one hundred and forty-two children aged 4½ to 7½ years. The structures were strictly controlled for length and levels of vocabulary. This study provided further evidence that the control of syntax is still developing in the First (or Infant) School. In addition, the different levels of vocabulary used had marked effects on repetition performance, when interaction effects were observed between chronological age, STM capacity, syntactical structure and vocabulary. It was clear from the results of the study that the different levels of word familiarity (or frequency of occurrence) used had a considerable effect and, as the levels chosen were all from the relatively familiar (the first 2,000 words in the Burrough's (1957) count), then this factor is demonstrably a sensitive one. Howes (1957) showed that there is a relationship between intelligibility and frequency of occurrence of English words. Extrapolating his findings it could be said that although the structures presented were out of continuous context, nonetheless they were intelligible or meaningful in themselves. Conversely, the immediate recall or repetition of the sentences was enhanced by the more familiar words making the complex structures meaningful to the children.

The total meaning of a sentence is given partly by the value of the words and partly by their organisation governed by the rules of syntax. However, the interaction results in the study show that the conveyance of meaning is not a simple additive process as is often assumed but an intricate interaction between the two components, syntax and semantics. Certain words in the syntactical structures are seen to be more sensitive than others as for instance in the 'Because' structure. When 'cos' was counted as correct that structure's position in the graph came into line with the others. (See Figure 2 in the article, Appendix B). Some of the discussion from that article is rehearsed next for it is germane to the argument and provides a linkage with the experiments to be reported later.

The character of some structures is determined by a key word such as 'because' in that structure. Here in this instance, 'Because's' conjunctive properties linked two statements as causative, the word 'Because' and its positioning constraining what is to follow. During language development children have to appreciate that the use of a particular word carries with it not only that word's lexical meaning but also implications for syntax when it is used in a particular position in a specific structure. Thus, although 'so' was in the same position in the eight-word sentence frame, it was slightly more complex structurally than 'because' as the identical word 'so' can be used in similar ways and yet have different meanings. (For instance, 'so' can be used as a conjunction, as an adverb, as an interjection, an adjective and so on!) Hence some words will require additional features to be learned in acquisition and mastery is delayed a little. Anglin (1970) touches on this aspect in his study on the growth of word meaning when he confirms a generalisation hypothesis. His concern is with the progression from concrete to abstract as the child's vocabulary matures. Extrapolating his results a little, it may be that although children already have a word in their vocabulary, further features, linguistic markers, defining the detail of its exact usage, are yet to be added. The accretion of these markers may be reflected in the distinction between 'more frequently' and 'less frequently' occurring words.

When words occur frequently in children's usage this may indicate that most of the word's markers have already been added or that that word required very few markers in the first place. It may be, however, that frequency is a variable in its own right. Foss (1969), working with college students, investigated this possibility by using reaction time (RT) to push a button in response to a previously specified phoneme as an index of local sentence processing difficulty. He found that RT was longer after low frequency words as compared with high frequency controls. He attributed his results 'to the additional difficulty of lexical look-up in the case of low-frequency items.' However, his finding that low frequency and RT had a low correlation, led him to reject the idea that word frequency per se was a process variable. He suggested instead that 'some structural variable involved in lexical organisation affected the lexical search process.' Cairns and Foss (1971) referring to this reported another experiment which controlled grammatical class. It was found that only low frequency adjectives produced longer RT's. No effect of word frequency for nouns or verbs was observed. In their discussion, one hypothesis which was consistent with the data, is called by them the incomplete entry hypothesis. This states that 'a low frequency word is likely to be stored in the subject's internalized lexicon with some information about it missing.' The missing information may be semantic, syntactic, phonological or any combination of the three. These findings of Cairns and Foss match the present author's previous results quite well apart from word frequency effects with young subjects. Furthermore, the incomplete entry hypothesis takes the discussion of the internalised dictionary a stage further in its description.

Summary.

1. The author's earlier findings of syntactical structure and vocabulary interaction has led to an examination of semantic features.

2. It was noted that Cairns and Foss working with adults abandoned word frequency as an independent variable.

3. A closer investigation of the so-called internalised dictionary was begun.

1.4. THE 'TIP OF THE TONGUE' PHENOMENON.

The notion of an 'internalized lexicon' or the mental equivalent of a dictionary has been proposed by many authors and among them the proposals of Katz and Fodor (1963) are often referred to in psycholinguistic discussions. In essence the model supposes that our memory for words and their definitions is organised into the functional equivalent of a dictionary. An interesting use of this construct was made a few years ago by Brown and McNeill (1966) in their experiments with the 'Tip of the Tongue' phenomena. Here the state in which one cannot quite recall a word but can recall words of similar form and meaning was investigated. It was found that several hundred such states could be precipitated by reading to subjects the definitions of English words of low frequency and asking them to recall the words. Since the work by Brown and McNeill is pertinent to this study it is quoted fairly fully. They demonstrated that,

> 'while in the Tip of the Tongue (TOT) state, and before recall occurred, subjects had knowledge of some of the letters in the missing word, the number of syllables in it, and the location of the primary stress. The nearer S (the subject) was to recall the more accurate the information he possessed. The recall of parts of words and attributes of words is termed 'generic recall'. The interpretation offered for generic recall involves the assumption that users of a language possess the mental equivalent of a dictionary. The features that figure in generic recall may be entered in the dictionary sooner than other features and so, perhaps, are wired into a more elaborate association network. These more easily retrieved features of low frequency words may be the features to which we chiefly attend in word perception. The features favoured by attention, especially the beginnings and endings of words, appear to carry more information than the features that are not favoured, in particular the middle of words.'

The word being sought is termed the 'target word' and it was interesting to hear that Brown and McNeill used SM words (similar in meaning to the target word) provided by their subjects as a baseline for their data, against which 'to evaluate the accuracy of the explicit guesses and of the SS words (similar in sound to the target word). The SM words are produced 'under the spell of the positive TOT state' but judged by subjects to resemble the target in meaning rather than sound. (It is this ability of the subjects to judge similarity in the meaning in the TOT state that is of additional interest (see section 3.0.))

During the process of attempting to retrieve the target word the subject appears to engage two types of function. There are (a) the physical features such as sound, number of syllables, first, last and middle letters and (b) the area of meaning association. Brown and McNeill liken their model of the process to a card sorting device. The real dictionary however, where entries are alphabetically listed on pages bound in place, is at once too simple and too inflexible, but 'keysort cards', file cards punched for various features of the words entered, are a better analogy. It is possible to retrieve from such a deck of cards any subset punched for a common feature by putting a needle through the proper hole. It is hypothesised that in the brain a speedier equivalent for retrieval is at work. The example given by Brown and McNeill to illustrate the process is of a target word 'sextant'. The definition given to the subjects for this word was 'a navigation instrument used in measuring angular distances, especially the altitude of sun, moon and stars at sea'. The SM words provided by nine (of the fifty-six) subjects in a TOT state included astrolabe, compass, dividers, and protractor. The SS words were secant, sextet, and sexton. The authors point out that the difficulty in the experiment was that the subject started with a definition rather than a word and so the subject had to, as it were, enter the dictionary backwards. This would be quite impossible with a book form model. It is not impossible however, with 'keysort' cards, 'providing (it is) supposed that the cards are punched for some set of semantic features.

Perhaps these are akin to the semantic markers that Katz and Fodor (1963) postulate in their account of the comprehension of sentences' (Brown and McNeill 1966, page 333). The first response to the definition must be semantically based but does not therefore account for the appearance of such SS words as sextet and sexton. In the author's model of the process a distinction is made between SM and SS words occurring in the first retrieval. This accounts for the recall of the details of SS words and is followed by a suggestion that each word is not entered in memory just once on a single card, but on several, of which some might be incomplete and one or more complete.

> 'The several cards would be punched', suggest Brown and McNeill, 'for different semantic markers and perhaps for different associations so that the entry recovered would vary with the rule of retrieval. ..... The difference between features commonly recalled, such as the first and last letters, and features that are recalled with difficulty or perhaps only recognised, can be rendered in another way. The more accessible features are entered on more cards or else the cards on which they appear are punched for more markers, in effect, they are wired into a more extended associative net'.

Finally Brown and McNeill point out that,

> 'the amounts of detail needed to specify a word uniquely must increase with the total number of words known, the number from which only one is to be distinguished'. (page 337)

This study, as well as demonstrating the psychological reality of the phenomenon's existence, gives some points of detail of the organisation of the suggested internalised dictionary. These are,

1. Generic features may enter the dictionary sooner and be part of (2).
2. The associative network is said to be elaborate.
3. The number of features to specify a word uniquely must increase with the total number of words known.
4. The experimental task required subjects to judge resemblances in meaning.

In the example given for SM words retrieved by the subjects, Brown and McNeill give astrolabe, compass, dividers and protractor for sextant. The words have meaning associations with the target word, but, in the internalised dictionary, are traditional word associations sufficient to explain the organisation?

In an article concerned with this problem, Miller (1969) puts forward six distinct hypotheses for the organisation of what he calls lexical memory. These were,

1. a sequential frequency hypothesis,
2. a shared-name hypothesis,
3. an image hypothesis,
4. a branching hypothesis,
5. a semantic marker hypothesis and
6. a predicate hypothesis.

Miller suggests that each has its virtues and that they are not mutually exclusive. However, he also points out that the predicate hypothesis is the only one to account for the part-whole association. eg. A leg has a foot, a foot has a toe. After examining each in turn, he suggests tentatively that 'some combination of the semantic marker and predicate hypothesis is required to account for our linguistic abilities'. A semantic marker system then must be supplemented by rules for combining markers in grammatical phrases. 'The 'is a' and 'has a' relations discussed (earlier in the paper) may be simply two such rules, in which case we probably should call them together the grammatical function hypothesis, where predication would be only one of several functions for which we know the rules'(p.235).

SUMMARY 1.

The central position of communication skills in modern society was acknowledged and factors governing their improvement by educative processes related to language skills, was outlined. As a complement to the earlier study of syntax, semantics was to be the main concern of this thesis.

After adopting a semiotic perspective a process of ruthless selection from the many facets of language followed, and Rommetveit's 'associative state' chosen for detailed examination.

It was noted that word frequency was abandoned by some researchers as a variable in its own right and an examination of the organisation of the so-called internalised vocabulary begun.

Pertinent features of the proposed internal dictionary were selected from the work of Brown and McNeill (1966) and Miller's (1969) grammatical function hypothesis was examined.

2.0. THE STRUCTURE AND ACQUISITION OF SEMANTIC RELATIONSHIPS.

How then might the storage of semantic relationships be organised? The experimental work of Brown and McNeill suggests a theoretical model and a way by which 'judgment of meaning' can be a route to study the underlying psychological mechanisms. They have provided experimental evidence about the structure of the so-called 'mental dictionary' from which inferences may be drawn and tested by tracing developmental patterns.

As their subjects searched for a target word, two processes were noted. Words of similar meaning were produced in response to the definition during the first retrieval as well as words of similar sound. This suggests that storage must be both semantic and acoustic requiring 'cards to be punched' recording both the meaning and the word's physical attributes of sound and shape. It may be that the meaning attribute is more favoured in some way and it will be interesting to see how 'the elaborate associative network' is built up to account for this, and how the generic features enter the dictionary. Furthermore, it is suggested that the number of features increase as the number of words increase. This again can be examined in a developmental study of this kind as it attempts to trace the acquisition of these features.

2.1. KATZ AND FODOR'S SEMANTIC THEORY.

The theoretical model referred to by Brown and McNeill is contained in a paper by Katz and Fodor (1963) entitled 'The Structure of a Semantic Theory'. It is this latter theory that must now be examined to trace the detail required.

Katz and Fodor claim, in the first place, that semantics takes over the explanation of the speaker's ability to produce and understand new sentences at the point 'where grammar leaves off'. They posit two components for their semantic theory:

1. a Dictionary of that language, not provided by the grammar and giving every sense that a lexical item can bear in any sentence.

2. rules, (termed projection rules), for applying the information in the dictionary.

These two components must account for the following:

a. they must mark each semantic ambiguity that a speaker can detect;
b. they must explain the source of the speaker's intuitions of anomaly when a sentence evokes them; and
c. they must suitably relate sentences that speakers know to be paraphrases of each other. (page 410)

The Dictionary component is said to have two parts:

1. a grammatical section which provides the part-of-speech classification of the lexical item, and
2. a semantic section which represents each of the distinct senses of the lexical item in its occurrences as a given part-of-speech.

Thus,

> 'the grammatical section classifies the syntactic roles which the lexical item can play in sentences, while the semantic portion supplies one sense of the lexical item as the terminal element of each complete distinct descending path through the tree which represent the entry'.

The sense terminating each path through the tree can in turn be analysed into two parts:

a. a sense characterization (which appears mandatorily), and

b. a sequence of one or more synonyms (which appear optionally).' (page 410).

An example of a dictionary entry for the word 'bachelor' is given by Katz and Fodor, thus;

bachelor - noun

1. a young knight serving under the standard of another knight.
2. one who possesses the first or lowest academic degree.
3. a man who has never married.
4. a young fur seal when without a mate during the breeding time.

Figure 3.
Dictionary entry; after Katz and Fodor, (page 411).

This traditional dictionary description is, however, not adequate for a semantic theory, which requires entries as follows:

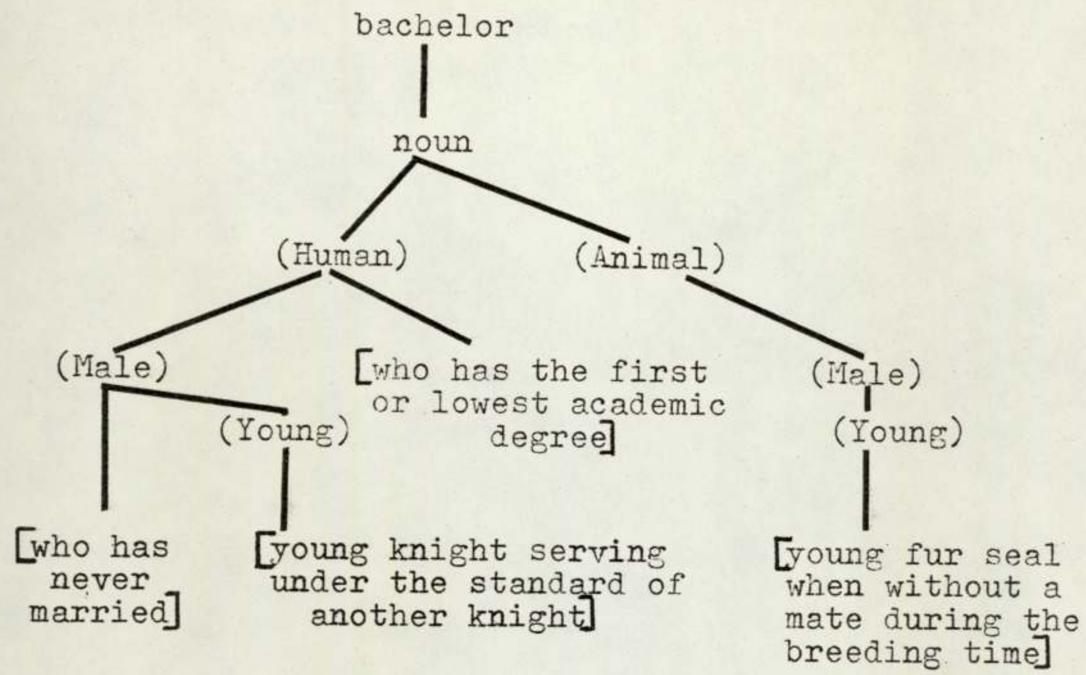


Figure 4.
Semantic structure IN and BETWEEN Dictionary entries. After figure 5, Katz and Fodor (page 415).

> 'The unenclosed elements are Grammatical markers (here, noun), the elements enclosed in round brackets are termed Semantic markers, and the expression enclosed in square brackets are called Distinguishers. The semantic markers allow the decomposition of the meaning of one sense of a lexical item into the 'atomic' concepts, and thus exhibits the semantic structure IN a dictionary entry and the semantic relations BETWEEN dictionary entries'. (page 412).

(ie. the semantic relations among the various senses of a lexical item and among the various senses of different lexical items are represented by formal relations between markers and distinguishers. Later Katz and Fodor put this another way when they say,

> 'The semantic markers assigned to a lexical item in a dictionary entry are intended to reflect whatever systematic relations hold between that item and the rest of the vocabulary of the language. On the other hand the distinguishers assigned to a lexical item are intended to reflect what is idiosyncratic about its meaning. So, if the distinction between the markers (Male) and (Female) were removed, not only would every pair of sex-antonyms be represented as synonymous but the indefinitely many other semantic relations involving the distinction would also be incorrectly represented by the theory. In contrast, eliminating the distinguisher (young fur seal ...) would merely prevent the theory from representing one sense of bachelor.' (page 412 et seq.)

As mentioned earlier, there is a second component to Katz and Fodor's semantic theory, this is the Projection Rule component. If we regard the theory as having input and output, then the input is a sentence and its grammatical description and the output is a semantic interpretation of each sentence given as input.

There is, in the first place, the output of (I) which is an Instruction which together with the Dictionary, comprises the dictionary component. '(I) chooses as relevant to the semantic interpretation of a sentence in a given derivation only those paths from the dictionary entries for each of the lexical items in the sentence which are compatible with the lower-level syntactic structure of the sentence on that derivation. The output of the dictionary component is thus a mapping of a finite nonnull set of paths onto each m; (lexical item) for each d; (syntactic derivation). This output is the input to the projection rules.' (page 20).

The projection rules now convert its input into a semantic interpretation by an amalgamation process. The set of paths dominated by a grammatical marker are combined so that 'a set of readings are assigned to the concatenation of lexical items under that marker by associating the results of the amalgamation with the marker until it reaches the highest marker 'Sentence' and

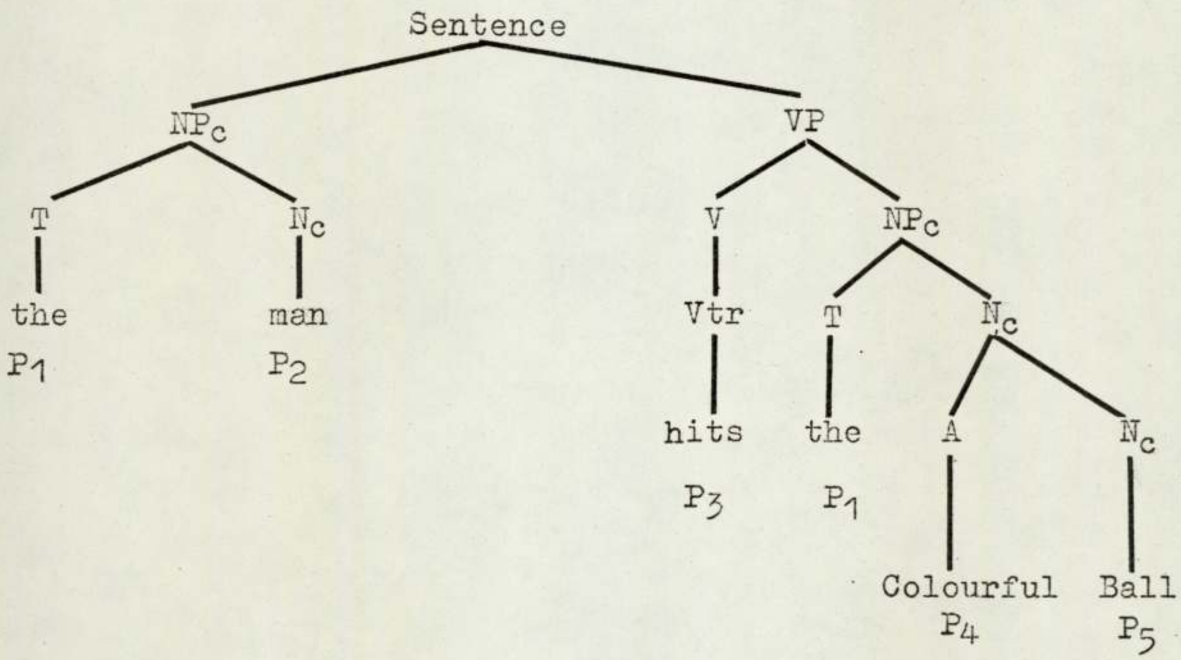


Figure 5. Projection Rules.

This figure combines diagrams 8 and 9 of Katz and Fodor (pages 420 and 421).

associates this with a semantic interpretation. The way in which the rules attached to the component function are illustrated in examples on pages 421-429 but are not recorded here as this detail is not required for the argument.

Summary.

1. This then is the semantic model and in particular the Dictionary component that categorises features in a hierarchical structure.

2. The features proposed are grammatical class, semantic markers and distinguishers.

2.2 SEMANTIC ORGANISATION IN LONG TERM MEMORY (LTM).

A tentative model for the structure of LTM based on these ideas of Katz and Fodor (1963), and of the linguists Chomsky (1965), Lyons (1963), and Porzig (1950), is suggested by Kintsch (1970). This model looks at the intricacies involved in terms of memory processes. His formulation differs from some others for he leaves aside the traditional network of association, like those proposed by Rommetviet (1968) for he argues, 'in order to achieve even a mild degree of realism the resulting network of associations would be extremely complicated, and it is hard to see how the redundancy that exists in this network can represent all relevant linguistic relationships' Instead of the association network model Kintsch proposes a marker theory of memory by which each word is encoded in memory as a list of markers. 'A marker', however, 'at least in the case of semantic markers .... is in general another word.' (page 352). This at first sight appears to be an association network. However, by distinguishing different types of marker, Kintsch shows that the model he proposes is not an associative network but that it 'contains different kinds of relationships of which associative relations are one'. His model proposes three basic classes of markers S, I and P which are complex symbols, so that when a word is encoded, S is a list of semantic-syntactic markers, I is a list of sensory features or image-markers, and P stands for phonetic feature. These proposals are useful as they assume the type of semantic theory already outlined and also bring the study to investigate types of semantic relationship other than the traditional association. Further, Kintsch's chief concern is to probe the 'S' feature, the semantic-syntactic leaving aside the I and P symbols. Meaning relationships he suggests, 'are embodied in the list S of semantic-syntactic markers'. Again, the notion of the word not having meaning in itself (c.f. Rommetviet) is posited; the word only has the meaning as given by its context.

The next step proposed is the introduction of the concept of semantic field, which have been developed by linguists interested in structural semantics. Quoting Trier (1934), Kintsch suggests that the meaning of a word is defined within a field. 'The meaning of a word is known only if it is contrasted with the meaning of a related or opposed term'. This concept of semantic field is basic to the model for it provides a definition of meaning 'without recourse to some substratum of meaning' as a list of pointers to other terms. The model (which will be called here K) has the advantage of distinguishing between reference and meaning. This point was also made by Rommetviet (1968, page 134 et seq.) who found it very difficult in experimental work to separate the two types of association.

Kintsch distinguishes two kinds of semantic field and here the terminology is such as to cause confusion. The first set of words are those of the same form class, ie. paradigmatic, and the term lexical field is used for this. Such a field is given by antonymy, and examples of non-gradable antonymy such as Male, Female, as well as gradable antonymy, e.g. Good, Bad are instanced. Fields where there are two or more terms are called Contrasts, eg. with colour names, Violet, Blue, Green, Yellow, Orange, Red. There are also temporal orderings in the contrast field such as Morning, Noon, Afternoon, Evening, Night.

Words which belong to such sets are given a marker F(X). 'Good' will have the marker F(Good-Bad); 'Orange' will have the marker F(colour between Yellow and Red). F(X) is defined thus, 'In general an F marker contain the information which is necessary to specify the relative position of a word within a Semantic field'. (page 355)

Another type of lexical field involves hierarchical or sequential organisation such as class inclusion and the part-of relationship.

An example of the hierarchical structure can be represented by a tree diagram of country names.

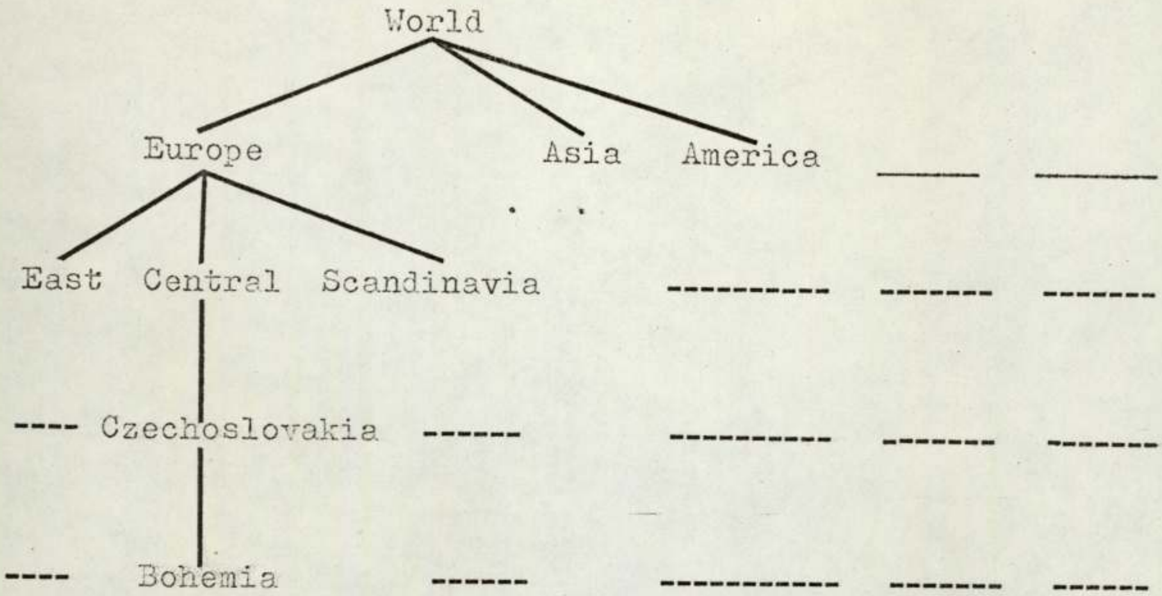


Figure 6.
Hierarchical structure of country names (after Kintsch (1970, page 355))

Each country is said to have two class markers, one that specifies its superordinate category $C\uparrow(X)$ and one that specifies its direct subordinate $C\downarrow(X_1 \ldots X_R)$. Thus in the diagram Czechoslovakia would be marked $C\uparrow$(Central Europe) and $C\downarrow$(Bohemia). Further examples of hierarchies are discussed by Kintsch who shows also that the proposed marker system can provide 'a simple, and relatively compact description of logical, semantic and syntactic information because of the way in which redundancy rules can be employed within such a system'. (page 357). An example from the set of antonyms is given so that F(X) is itself a 'word' of the system which has its own set of markers $Y_1, Y_2 \ldots Y_R$. The convention that whenever F(X) appears as a marker, it is automatically extended to include all the general characteristics of the antonym set. This is given by the rewrite rule,

$$F(X) \rightarrow (Y_1, Y_2, \ldots\ldots Y_R, F(X)),$$

thus making for economic storage space. In the case of colour names for instance, all relevant information of a general nature is stored only once (eg. syntactical markers) and then extended by the above rewrite rules. After further examples of the application of redundancy rules, which include transformational rules, Kintsch moves from the paradigmatic to the syntagmatic relationship. (The former, as stated, were called lexical fields, the latter are termed associative fields). Again caution is needed with the terminology, for associative fields here refer to the association of say certain verbs and adjectives with certain nouns. eg. Hand with Hold or Grasp. Bite implies Tooth; Lick implies Tongue. It should be noted however, that these are mainly association rules and great detail will be necessary, for example, whisper tenderly can be used but not walk tenderly. This requires the storage of many different associative relations and a final class of markers, the syntactic markers, are mentioned but are not dealt with at the moment.

Summary.

Kintsch's model for Long Term storage of semantic detail has been sketched. It relies on a hierarchical system such that markers are attached to words in terms of the organisation of their semantic fields.

2.3. KINTSCH'S EXPERIMENTS AND DATA ANALYSIS

As well as providing a model of the organisation of the

Long Term storage of semantic information, Kintsch points to methods of analysing experimental data. First, Kintsch attempts to test his model's validity by looking at the structure of semantic relations recovered from the recall data in Miller's (1967) work. These experiments used a card sorting technique where subjects were asked to judge similarity between words presented to them on cards by putting those of similar meaning in piles. By counting the number of times word X was put in the same pile as word Y, a basic measure of frequency was obtained.

Having achieved this similarity measure, Johnson's (1967) clustering computer programme was used to extract clusters to determine any structure that might be present. The programme locates the items that are most similar and merges them into a cluster, then the whole table is re-computed, the merged items being treated as only one item. This procedure is then repeated until all items are clustered. Obviously the first clusters have the greatest intercluster similarity and this decreases as the clustering proceeds. Kintsch observes that Miller's sorting procedure appears to be a very promising experimental technique.

Kintsch, however, reanalyses the data to discover whether it supports his model. He explains that, 'according to the model semantic markers play a crucial role in the retrieval process; given that a word has been recalled, its marker will determine what word will be recalled next. Thus output order in recall should reflect semantic relationships.

That it does', he continues, 'is well known. The clustering of related items in the subject's recall has been intensively investigated (eg. Bousfield, 1953).'

. .

Kintsch used two sixteen-word lists in his own experiments, one consisted of four nouns from four conceptual categories. The other was composed of sixteen unrelated low-frequency nouns. Other controls were built into the experiment and the subjects' recall was in writing. Three trials were given with each list and the 42-48 subjects were run singly. Adjacency measures were calculated on the basis of the order in which the words were recalled and the analysis done twice according to the two different methods described by Johnson (see Section 3.1.). The results were quite encouraging as 'output order in recall did reflect semantic structure, at least in the sense that items belonging to the same category clustered together'. It was also shown that the organisation increased with the number of trials. On the third trial the clusters had higher similarity values and there were fewer clusters, which means more items were merged at each level. Kintsch does not make extravagant claims for his model but believes his experiments and their analysis do give it support.

Summary.

After re-analysing the results of Miller's (1967) card sorting experiments, Kintsch puts forward evidence to support his model of the semantic organisation of human Long Term memory from a series of his own recall experiments.

2.4. SEMANTIC DEVELOPMENT

Given a model of the memory facility just described, it seems reasonable to discuss the following statements:

1. that the store of semantic relations is gradually accumulated by the child during language acquisition.

2. this being so, it is further suggested that some entries will be acquired early and some late. This may depend on such factors as their frequency of occurrence and the growing demands of the child's over-riding need to make sense of the world - 'his effort after meaning'.

Some work has been published recently that bears on these aspects but there is little of substance as yet. In one article, Macnamara et al (1972) investigated the simplest hypothesis for 'the structure of the English lexicon'. The hypotheses being tested were:

1. that several meanings of a single word are stored and recalled for use in a fixed order,
2. that persons agree in that order,
3. that for each person the order remains constant over time,
4. that the order observed in subjects agrees with that available from semantic frequency counts,
5. that the order in which adults recall meanings is the order in which they learned them.

The authors claim that their data support their hypotheses but 'only insofar as they relate to the first meaning recalled'. After pointing out the importance of context they suggest that the data

> 'throws some light on the acquisition of vocabulary and they (the data) indicate that at the age of five, all the essential features of adult lexical structure are already present. The body of information is however much more limited in the child'. (page 141).

Another study, Schaeffer et al (1971) looking at the way in which the semantic elements grow in semantic memory, found however, that children learn superordinate elements much later than subordinate ones. Using semantic oddity problems (ie. choosing the odd one from a selection) they found that first graders (6 yrs.) understood very little about the superordinate elements animate and inanimate, that fifth graders (10 yrs.) understand them better and ninth graders (14 yrs.) understand them perfectly. Further, they found in contrast that first graders (6 yrs.) understood the subordinate elements fairly well and the fifth and ninth graders perfectly.

Clark's (1972) work is of direct interest as she suggests that, as a child acquires language, he 'gradually adds meaning components or features to the lexical entry for each word until its meaning coincides with the adult one'. Clark also uses the traditional linguistic notion of semantic field (Lyons, 1968, page 428) for her study asking first whether the child is 'aware that a word is a member of a particular semantic field before he has learnt the full meaning of that word', and secondly, 'whether there is an order of acquisition for words within a particular semantic field'. Clark hypothesised that 'children set up semantic fields automatically as they learn something of the meaning of related words'. She investigated this in an experiment where children aged four and five and-a-half years were asked to respond to the experimenter's word with its opposite. The pairs of words used were dimensional and spatio-temporal terms. (eg. Big-Small; dimensional: In-Out, First-Last; spatio-temporal). The results showed '(a) a distinct developmental order of acquisition among the pairs based on their relative complexity of meaning, and (b) substitutions as opposites, of semantically simpler, better-known words for lesser-known words.' Clark claims that both results were compatible with the hypothesis.

Summary.

1. Macnamara et al (1972) suggests that all the essential features of the adult lexicon are present by five years, but that all the information is not there.

2. Schaeffer et al (1971) found that superordinate features were slow to be acquired.

3. Clark (1972) found a distinct order of acquisition based on complexity and structure of the semantic field, together with a word frequency effect.

SUMMARY 2.

The hierarchical structure of the dictionary component of the Katz and Fodor (1963) model was explored and in particular the category features, grammatical, semantic and distinguishers, were noted. It was seen further that Kintsch's (1970) proposed model of LTM also revealed a hierarchical structure requiring items to be tagged by markers and organised in semantic fields. These suggestions were supported by a small amount of experimental evidence which also pointed to a methodology and a procedure for data analysis.

Some of the research into the acquisition of semantic structure was examined and support found for a developmental pattern of the gradual addition of semantic markers delineating semantic fields.

3.0. METHODOLOGY AND DATA ANALYSIS.

The type of experimental work envisaged in this study requires a method that will enable structural patterns, if any, to be discerned from judgments of semantic nearness or relatedness. At once there are difficulties to be overcome and a need for experimental safeguards. Two important factors are that, in the search for structural behaviour caution must be taken not to impose a structure on data that has none, and secondly, working with child subjects requires the utmost care in ensuring that the experimenter's instructions are not misinterpreted. In the study then, two guidelines will always be observed. Firstly, during data collection the instructions to the children and the procedure will be strictly controlled, and during data analysis, the results will be subjected to checking to guarantee structure is not imposed.

3.1. METHODOLOGY

After warning that the model he has put forward is deficient in many ways, Kintsch shows nonetheless how the structure of semantic relations can be recovered from recall data. It is suggested by Kintsch from his (K) model that 'the similarity between two words is determined by the number of shared semantic markers. Thus judgment of similarity reflects marker overlap. If the similarity relations among a whole set of items are evaluated, they should be related to the underlying semantic structures. In particular, if the items form a class or part-of hierarchy, such relations should be apparent in the similarity judgments'. (page 363). There is some affinity here with the Brown and McNeill formulation of a card file system (based mostly on the Katz and Fodor theory) and Kintsch's which seems to subsume these and add other features. However, one area of concurrence is in the 'judgment of similarity' which occurs in both proposals. In the TOT state, for instance, Brown and McNeill's subjects gave words 'judged to be similar in meaning' to the target word, as though they were closely related. This happened, it should be noted, as part of the TOT behaviour and not following the direct requests for similarity by the experimenters. In Kintsch's work, the storage relationships being tapped are also in terms of 'similarity judgments'. In the former it is understandable that the subjects should give words 'similar in meaning' for they were trying to match a traditional dictionary type definition to a particular word, in the latter the ascertainment of similarity is indirect; the subjects reveal semantic relationships in LTM during the process of recall.

If as has been suggested, meaning lies not in the isolated word itself but in its relationship with other words, and if these relationships can be tapped by techniques using 'judgment of similarity', then something of the organisation of the underlying structure should be revealed. Further, the way in which this system is acquired may yield this information although there may be fundamental problems and differences, eg. 'first-in' items may not be the 'most favoured' in adult performance.

Summary.

It was noted that 'judgment of similarity' occurred in the experiments with adult subjects and might also be a realistic expectation with child subjects.

3.1.1. CARD SORTING TECHNIQUES

An early published account of the use of card sorting as a method for studies of this nature was in a contribution by Miller (1967) to a volume on communication, where the technique was compared with other methods psychologists have used to study what linguists call 'the subjective lexicon'. In a later more detailed account entitled 'A Psychological Method to Investigate Verbal Concepts' Miller (1969) gives an account of a sorting experiment and examines the theory of sorting that supports the method. Clark (1968) also used the method successfully in his study into the way in which prepositions are used and what they mean. The instructions to his experimental subjects, however, called for 'related' words rather than words similar in meaning.

In order to perform the task of grouping together nouns as semantically similar, Miller points out that the native speaker 'must deliberately ignore some of their distinguishing features'. In analysing these sortings the investigator hopes to discover which conceptual features have been ignored and thus which features are not.

The method of sorting obviously 'imposes certain constraints in the frequencies of paired occurrences that can be obtained' and it is assumed that each subject creates a collection of subsets such that each element belongs to one and only one subset. Miller goes on to say that 'the decision to interpret the resulting data matrix as a similarity matrix is equivalent to assuming that it is appropriate to represent the relations among the items as distances.' Clarification on this point is given by quoting Fillenbourm and Rapoport's (1971, page 9) understanding when they state,

'Proximity data include almost any measure of similarity, substitutability, concurrence and association between every two stimulus objects or sets of stimulus objects (words, persons, groups etc.) under study. In Psychological experiments, proximity measures have been obtained traditionally by asking subjects which of two pairs of stimulus objects are more similar (or dissimilar), by asking them to rate each pair of stimulus objects according to the strength of similarity between its elements, or by rank-ordering some or all pairs of stimulus objects with respect to similarity, dissimilarity, substitutability, occurrence etc.....'

The mathematical implications of the method are next explored in Miller's (1969) paper, and in particular it is shown that the triangular inequality holds for sorting data generally. Johnson (1967, page 245) defines triangle inequality thus:

$$d(x,z) \leq d(x,y) + d(y,z)$$

that is, to satisfy the triangle inequality requirement, the distance between two stimulus objects x and z must be equal to or less than the distance between x and another stimulus object y added to the distance of that object (y) and z. So in Figure 7 d_2 (the distance between x and z) $d_1 + d_3$.

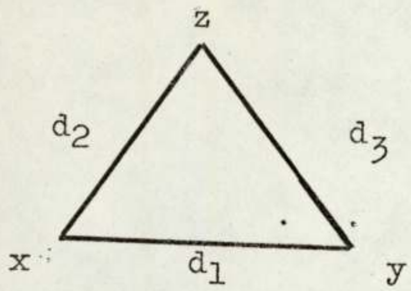


Figure 4. Illustration of triangle inequality.

In the memory paradigm then, it is assumed that the items are sorted according to some system of features, but no claim is made that the analysis reveals all the conceptual features that are characteristic of any item. Miller suggests that for sorting nouns as semantically similar, three types of organisation of these features are possible, paradigmatic, linear, and hierarchical. In the paradigmatic organisation, the set of lexical items all have value for every feature, and the example given for this type of organisation is Kinship terms. In the linear organisation (eg. Baby, Child, Adolescent, Adult), although sorting might not be the method of choice for estimating distances between the terms, they are often included in larger vocabularies, and for longer series than the example, the linear constraints become progressively stronger.

It is on the hierarchical organisation, however, that Miller concentrates his attention. He points out that an organisation based on class inclusion is a pervasive feature of the lexicon and that, in such a system not every item has a value for every feature. The classification of living things are given by Miller as an example. He points out (page 176 et seq.) that,

'those living things that are classified as animals may then be further classified as vertebrates. Plants have no value for the vertebrate feature; the results of applying the vertebrate feature to plants is undefined. Thus, the vertebrate feature is said to depend on the animal feature or, conversely, the conceptual feature 'animal' dominates the conceptual feature vertebrate. The vertebrate classification can be applied to those things that have already been classified as animals.

A feature F_1 is said to dominate a feature F_2 just in case F_2 is defined only for items having a particular value of F_1. If for a given vocabulary we have a sequence of fea-

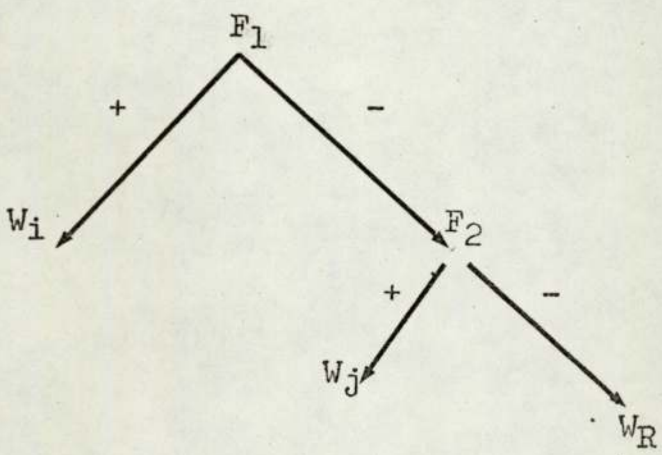


Figure 8. A hierarchical semantic system. The semantic feature F_1 dominates feature F_2, ie. F_2 is defined only for lexical items having the value - for F_1 (After Miller 1969, page 176).

tures such that F_i dominates $F_i + 1$, then whenever a judge decides to ignore F_i, he must also ignore all the features that F_i dominates, since he will not know whether they are relevant or not without taking F_i into account. This fact will impose a hierarchical ordering on the data obtained by the sorting method'

Miller goes on to show that 'the fewer features for which two items in a hierarchical conceptual system differ, the smaller is the distance between them'. Hence presumably similarity or closeness in meaning is measurable in these terms within a hierarchical structure.

Summary.

Card sorting as an experimental method to investigate semantic relationships were examined and found to be promising sources of data to test hypothetical structures.

3.2. ANALYSIS : HIERARCHICAL CLUSTERING SCHEMES

Miller defines a hierarchical Clustering Scheme (after Johnson, 1967) as consisting of 'a sequence of clusterings having the property that any cluster is a merging of two or more clusters in the immediately preceding clustering. eg.

h/i/j/k; h/i/jk; h/ijk; hijk.'

This can, of course, be represented by a tree graph. When two items Wi and Wj form a cluster, Miller points out that 'there cannot be any subsequent cluster ik that excludes Wj, or any cluster jk that excludes Wi; once they have been placed together, they stay together in all subsequent clusterings.'

It was mentioned earlier that a necessary requirement for sorting data was the triangle inequality. This can be strengthened further so that, as Johnson has shown, the ultrametric inequality is satisfied. For this the distance between any three items in such a system must all be equal, or if any one distance is less, the other two must be equal. Thus for any choice of i, j, k,

$$Djk \leq \max (Dij, Djk)$$

(Miller, 1969 page 178)

The weaker triangle inequality expressed in terms of N rather than D, becomes,

$$Njk \geq \min (Nij, Nik)$$

Johnson (1967) has developed a clustering programme for the functions MAX and MIN; such that the two methods are available in building an hierarchical clustering scheme (HCS). The step in the programme where the two calculations differ is shown by the following:

$$d[(x,y),z] = \min[d(x,z),\ d(y,z)]$$
and $$d[(x,y),z] = \max[d(x,z),\ d(y,z)]$$

(Johnson, 1967 page 248)

Miller, using Johnson's arguments, states firmly that, when the ultrametric inequality is satisfied, 'there is a perfect match between a matrix of distances and a tree graph of the hierarchical clustering scheme; from a complete specification of either one, the other can be directly obtained.'

In practice, when a hierarchical system is envisaged there is 'bound to be 'noise' when sorting procedures are involved so that in the merging of two items the distances will not be precisely equal. Some 'noise' might be from failure to follow instructions, some from the use of idiosyncratic features by some judges.' Johnson's proposal to overcome this problem of discrepancies is to solve the problem twice, first using the minimum distance and secondly using the maximum distance. For, as Miller neatly puts it,

'If, as the ultrametric inequality demands, the two distances are really equal, then the maximum and minimum should not be widely discrepant and the two solutions should give more or less the same answer. But if the two hierarchies are quite different, we should be warned either that we are not dealing with a hierarchical conceptual system, or that the data are too noisy for precise analysis.' (Miller 1969, page 181).

Miller finally looks for two further criterion to be satisfied, viz. the results must be plausible and have linguistic relevance. He demonstrates that the results from the method of card sorting are both plausible and have linguistic relevance. 'When it (the method) is used cautiously with appropriate consideration for the choice of items and instructions it may prove a useful test for semantic hypotheses derived on other grounds.'

Summary.

Johnson's hierarchical clustering scheme was reviewed and note taken of the MAX and MIN methods of calculation as a very important check to confirm the presence of hierarchical structure. Miller's criterial of plausibility and linguistic relevance were also noted.

3.3. RESEARCH APPLICATIONS OF HCS.

Two examples of research projects using the methodology of card sorting (judgment of similarity) which resulted in HCSs are examined as applications of the proposals of Miller (1969) and Johnson (1967). These are the work of Fillenbaum and Rapoport (1971) and the experiment of Anglin (1970).

1. Fillenbaum and Rapoport (1971) in their book entitled, 'Structures in the Subjective Lexicon' (FR) study nine semantic fields, or as they call them, domains. These range from well-specified domains like that of Kinship terms to ill-specified ones like verbs of judging and evaluative adjectives. The methodology adopted in their study is of particular interest as they collected their data in a number of different ways and then subjected it to various methods of analysis. Three points from their study are of major concern here;

a. the specific semantic domains chosen,

b. the methods of data collection.

c. the comparison of the types of data analysis.

If an examination is proposed of the structural organisation of the so-called internalised dictionary, or as FR have it, the subjective lexicon, then it is a useful strategy to move from a structure whose characteristics are intuitively obvious to one that is less well defined. As it happens some of these domains have been investigated for other purposes and these findings too can be used for comparison and for substantiation.

Two of the domains chosen by FR for the examination of their internal structures were Kinship terms and Colour Names. It was thought that these would also be appropriate in this study for it could be assumed that the semantic fields involved would be well within the verbal capabilities of young children, (the subjects of this investigation), and more could be learnt from an examination of the structure of these domains by tracing their development. There was an added advantage in that FR's subjects were adults. The results of their work therefore would give an adult model to which the children might be seen to approximate.

The second point of major interest and pertinence here was that FR used various methods of data collection thus allowing comparison of these methods. Again, this was of great advantage for some techniques are not workable with children. For instance, methods that require fluent reading of stimuli may not be usable with the pre-readers in the younger age groups envisaged by the study.

The results of the different methods chosen by FR to collect similarity data were seen to agree. The domains examined ranged over a continuum from 'pure' hypothesis testing to 'pure' discovery procedure and in answer to their own question, 'why all this fuss about choice of procedures for the structural analysis of similarity data?' They reply, 'The reason must be obvious, namely the particular procedures for analysis of data (and for obtaining data) may force or impose a structure on the data.' (FR, page 238). Later in a few observations on substantive outcomes of their work, FR state that their studies yielded what appear very plausible sensible results, consistent with some prior models or structural hypotheses. They further point out that although the results may appear to some as 'trivial, truistic demonstrations of the obvious' nonetheless they validate the methodology and investigating techniques being used. It should be recognised that the concern of FR was not, of course, with creative imagination but in discovering semantic properties on which there is 'consensual agreement in the service of communication', fitting very well with the objectives here.

Three procedures were used to obtain the proximity data for their study. They were:

1. Tree construction,
2. Construction of complete undirected graphs, and
3. Direct groupings or classifications.

In the tree construction method the subjects are asked to construct ordinary linear graphs by linking words in a given vocabulary set in terms of some specified criterion. Like the tree construction method, by requiring the rank-ordering of all pairs of N words, the construction of complete undirected graphs allow for sequential constructions of proximity matrices. FR note however, that 'This is done at a certain cost, for the task is tiring and exhausting, demanding the continuous re-scanning of the large subset of remaining pairs'.

The third method of direct grouping or classification simply requires subjects 'to sort words into as many classes as they wish, with any number of words placed in any class'. The strategy was then to employ Multidimensional Scaling (MDS), clustering and graph theoretic procedures in the following way. If the graph construction methods indicated that the proximity matrices did not occur by chance the data was analysed by non-metric MDS techniques (Young and Torgerson, 1967) and by means of a hierarchical technique. (Johnson, 1967).

The MDS technique transforms the proximity matrix into a spatial model of low dimensionality and it does this 'on the basis of assumptions about the general form of the to-be-revealed structure that seem minimally vulnerable and, hopefully provide for the possibility of an acceptable reconstruction of the original data'. (Shepard 1969, page 6).

The basic reason for using the hierarchical clustering procedure given by FR was simply that a particular configuration may be taxonomic or hierarchical rather than say linear or a cross-classification. Miller (1969) already cited above is then quoted on this point.

FR employ MDS and hierarchical clustering methods as 'quantitative psycholinguistic models' rather than as methods for merely organising, summarising and displaying data. The methods are, of course, two distinct classes of analytic techniques.

2. Anglin's (1970) studies on the growth of word meaning.

It was noted above that the subjects used by Miller (1969) and FR (1971) were adults. As the purpose of this study is to examine the performance of children for developmental patterns, it is necessary to choose only those data collecting techniques that take immaturity into consideration. Anglin appears to have been the researcher reported in the earlier paper by Miller (1967) for when discussing the card sorting procedure he (Anglin) says, 'The immediate precursor to this research was a study conducted by the writer which has been reported by Miller (1967)'. In the 1967 experiment four groups of child subjects were from grades three and four (8 and 9 years), grade seven (12 years) and grade eleven (16 years) and graduate school (adult). Anglin's experience with the card sorting technique is then, of considerable interest for the majority of his subjects are children.

Each subject in this experiment was given thirty-six slips of paper on which appeared one of the 36 words used in an early study of Brown and Berko (1960) on word association and the acquisition of grammar. Anglin reports that the words were simple and 'presumed to fall within the vocabulary of all the subjects tested'. The subjects were asked to sort the words into piles on the 'basis of similarity of meaning'. Words thought to be similar were put into the same pile and subjects were allowed to make as many piles as they wished with any number of words per pile. Matrices were then constructed for word pairs for each age group showing the percentage of subjects that had put the two words into the same pile. These matrices were then subjected to Johnson's hierarchical clustering scheme programme. The results demonstrated that the method was successful and that the hierarchical clustering scheme provided an adequate analysis of the data. MDS was also applied to the data and it was shown that the majority of adults with a few exceptions were 'fairly homogenous in their sorting and congeal together in the first quadrant of the plot. The children, on the other hand, are more idiosyncratic as evidenced by their being scattered among the other three quadrants as clearly shown in Figure 9. (See next page).

It would seem then from the experimental evidence of Miller, (1967, 1969); Anglin (1970) and FR (1971) that it should be possible, given the precautions outlined, to set up an investigation into the way in which children's perception of the structural relationships between words procedes from one which is diffuse and idiosyncratic to one which is more homogeneous like that of an adult. Furthermore, in tracing a developmental pattern, information about the features of words might be found and something learned of the storage of their relationships in memory.

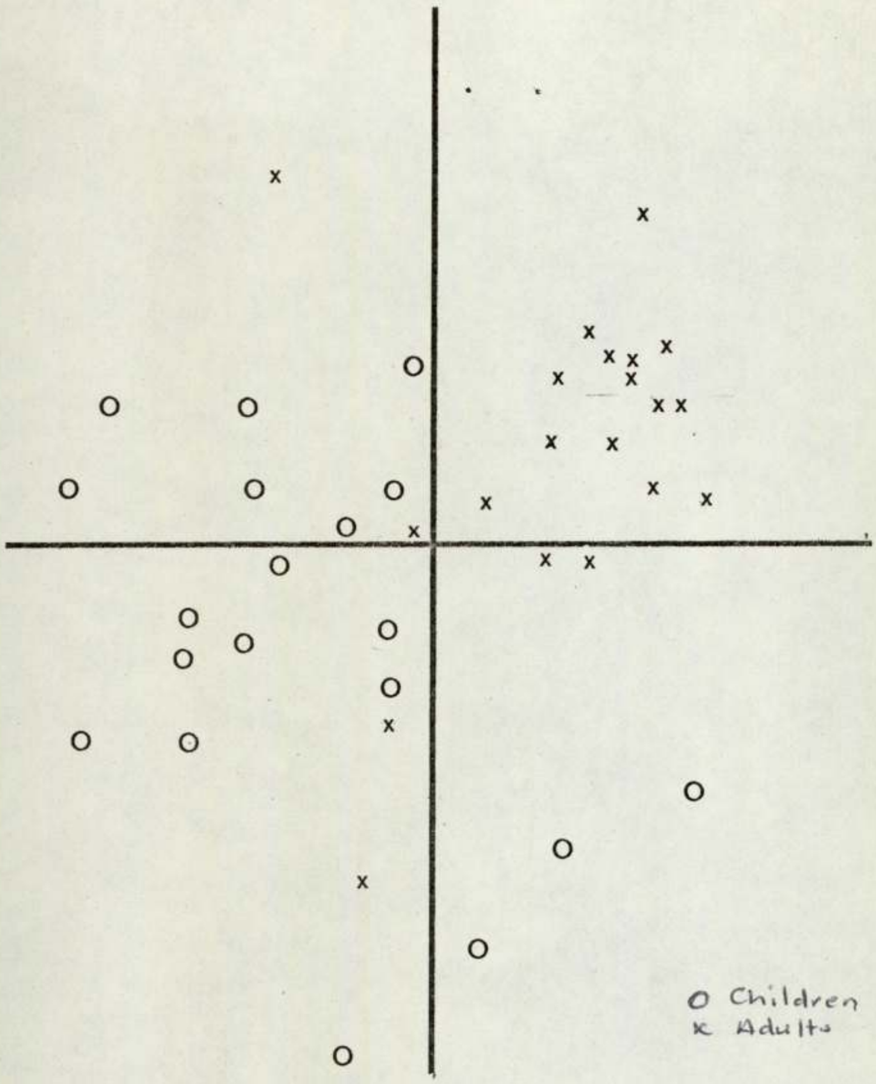


Figure 9. The two-dimensional subject space for the original sorting experiment. (Anglin 1971, page 27).

Summary.

1. Two applications of the proposed research methodology supporting the viability of the experimental techniques and data analysis procedures were reviewed.

2. That of Fillenbaum and Rapopart (1971) gave comparisons of both data collection and its analysis and also adult models of semantic structures.

3. Anglin's (1970) work was useful for his subjects were children of the same age group envisaged in this study.

. .

SUMMARY 3.

1. It was shown that 'judgment of similarity' could be used as an experimental instruction to child subjects as well as adults, and that card sorting was a viable method for obtaining semantic data.

2. Johnson's (1967) programme for hierarchical clustering schemes was cited and the MAX and MIN methods of calculation particularly noted.

3. Application of these techniques with adults and children were reviewed and found to give substantial support to the methods and data analysis to be used in this study.

4.0 EXPERIMENT 1

Introduction

The aim of this work, it will be recalled, is to examine a model for the acquisition of semantic structures by young children so that pedagogy may be better informed. Such a model will involve an adequate storage system otherwise children would have to re-learn each element anew, and progressive development would not take place.

A model for the storage of semantic structure.

Kintsch provides a useful model for such a storage system and it is this model of Long-Term Memory that is to be investigated by the experiments that follow.

Kintsch gives his model the following major characteristics (see section 2.2)

1. Each word is encoded in memory as a list of markers.
2. In general these markers are other words.
3. Although, in a way, this produces an associative network; Kintsch claims that his suggested markers perform other functions than those traditionally attributed to association, e.g. redundancy.
4. The model provides for redundancy and examples of redundancy and examples of redundancy rules are given, but this aspect is not dealt with here.
5. The markers envisaged by Kintsch are given the complex symbol notation <S.I.P.>

   S is a list of semantic-syntactic markers.

I is a list of sensory features or image markers.

P stands for phonetic features.

6. Meaning relations, which are, of course, amongst the most important in the organisation of memory, are embodied in the list S of semantic-syntactic members.
7. The word, despite linguistic difficulties of definition, is taken as the formal unit of meaning and is defined by its relationship with other formal units. i.e. A word does not have meaning in itself, but meaning is given entirely by context.
8. A formal unit, therefore, is meaningful because it can be located somewhere in a semantic field. (Words are ambiguous only if they are isolated from semantic fields, as in a conventional dictionary).
9. Different structural types are accounted for by the model, but it is the hierarchy that receives prominence.

The acquisition of semantic fields.

Having reviewed the model being investigated, it is necessary to outline next how such a semantic system might fit into developmental sequences. Some research by Clark (1972) is pertinent here, for she suggests that children set-up semantic fields automatically as they learn something of the meaning of relative words. She argues that, as children acquire language, they gradually add meaning components, or features, to words until the meanings of those words coincide with that of the adult. The proposal, then, involves a system of markers very like the Kintsch system and provides a very useful starting point. Clark's experimental subjects were young, (4 to $5\frac{1}{2}$ years): those in this present work are aged from 5 to 11 years. She suggests also that, in the semantic field examined by her, a distinct order of acquisition, based on the complexity of the structure of the field, might be discerned together with a word frequency effect.

Using Clark's findings as a developmental base-line, two hypotheses are proposed for investigation of the appropriateness of the Kintsch model. These are that,

1a. with increasing age, growth of meaning, (envisaged as the adding of further markers to words already known in embryo) will be detectable within semantic fields.

1b. this growth of meaning will be demonstrable by the children's ability to judge similarity or nearness of relationships between words within semantic structures.

2. Acquisition of the structure of a particular semantic field will depend upon the complexity of the dimensions of the structure of that field and the familiarity of the words that compose it. The extent of the complexity of any semantic field will be indicated by the lateness of the acquisition of its structure in developmental terms.

As already stated, one of the most frequently occurring relationships in language is that of the hierarchy, and as this is prominent in the Kintsch model, it is this type of structure that will be investigated within the semantic fields.

4.0. EXPERIMENT 1. OBJECTIVES

An experiment was set up having the following objectives:

1. To investigate the possibility of using the card sorting technique (eg. Miller,1967) with children in the age group five to eleven years. (This extends downwards the work previously published).
2. To explore hierarchical clustering schemes to analyse the data provided by the method.
3. To discover how the children in the chosen age groups organise stimuli which have discernible semantic structures.

4.1. CHOICE OF SUBJECTS

As discussed fully earlier, the experimental method chosen as most likely to reveal the type of information required, is the card sorting technique. Obviously, it can only be used by children who have at least mastered the early reading processes. In practice this meant that the youngest children would be about six years old. In this country we have an advantage, for English children start school at five, a year younger than their American counterparts. (c.f. the work of Anglin (1970) where the youngest children were from Grades 3 and 4, the eight and nine year olds). In the school chosen the children are admitted as 'rising-fives' and are reading sufficiently well to perform the tasks adequately by six years of age.

Before embarking on the full experiment however, a pilot experiment was run in another school to test the methods to be used. This was carried out with a group of six 6 year old children, (three boys and three girls), chosen by their teachers for their differing abilities.

In order to test the instructions and in particular to ensure the correct mode of response, the children were asked first to sort packs of Happy Families* cards into their correct sets. This was quickly done and then the sorting procedure, using cards with words only as described in the Material Section of the experiment to follow, was tested. This too was successful but a few questions were asked by one of the boys who could barely read the words. This was noted carefully so that a check could be included in the later procedure. The results of this pilot work were encouraging and it was decided that the process of indicating the type of behaviour required by the Happy Families game would not be needed.

In the full experiment which is now reported, the age groups chosen were aged 6/7, 8/9, and 10/11 years. These three age groups will be referred to as Group C, Group B, and Group A.

*Happy Families.

For the reader who is unfamiliar with this game, it consists of a pack of cards made up of four person families - Father, Mother, Son, Daughter. The rules of the game require the player to assemble the family in sets. The person with the largest number of complete families is the winner.

The socio-economic background of the children was one of recent redevelopment in an industrialised urban situation. The majority of the children's fathers were skilled or semi-skilled workers.

Table 1 shows the detail of the age groups for the number of Boys and Girls in each and their mean ages in months. All the children in the chosen classes, which were unstreamed, were used as subjects.

Table 1

Groups by Age (in months) and sex

	N	Mean age in months	Group mean age	SD
A Boys	13	135.8	136.9	2.9
A Girls	16	137.9		
B Boys	11	112.9	113.5	3.6
B Girls	13	114.0		
C Boys	13	90.4	89.6	3.9
C Girls	11	88.7		

4.2 MATERIALS

Following the work of Fillenbaum and Rapoport (1971), subsequently referred to as FR, already cited in Section 3.3, and guided by the procedures outlined by Anglin (1970), it was decided to concentrate on Kinship terms in the first experiment. This semantic field, or domain, is closely defined and the associations among the words clearly within the grasp of the youngest children. And yet, intuitively, it is suggested that many of the youngest group may find some Kinship terms more difficult to judge as similar than others. For example, the intersection of overlapping of features occurring between Cousin and Brother may cause the relationship to be less apparent than between Brother and Sister. As well as these factors there is other work that can be used for analysis. Romney and D'Andrade (1964), for instance, have a paradigmatic model of the Kinship terms under discussion. This model is shown in Figure 9.

Figure 9.

Paradigmatic Model of Kinship Terms

	C_1 (Direct)		C_2 (Collateral)	
	a_1	a_2	a_1	a_2
$b^{\pm}2$	Grandfather	Grandmother		
	Grandson	Granddaughter		
$b^{\pm}1$	Father	Mother	Uncle	Aunt
	Son	Daughter	Nephew	Niece
b	Brother	Sister	Cousin	

Kinship Model after Romney and D'Andrade (1964)
quoted by Fillenbaum and Raporport (1971, page 60)

Dimension a in the model is a sex dimension with two levels male a_1 and female a_2. Dimension b is a generation level with three levels, ego's own generation (b), one generation above or below ego (b $\pm$ 1) and two generationa above or below (b $\pm$ 2). 'Differences between say Grandfather and Grandson are marked by differences on a third dimension called the 'reciprocal' dimension'. The final contrast is between direct C_1 and collateral C_2.

Romney and D'Andrade's analytic procedures use a certain notation scheme to represent the relationships between the Kinship terms and,

> 'since the notation scheme represents the genealogical elements, it may be assumed that terms joined by dotted lines are somehow 'closer' than terms separated by solid lines. Terms within solid lines are defined as constituting a range set'.

In RD's model then there are five of these range sets.

As the level of vocabulary has been shown to be so sensitive in previous work with children, the Kinship terms were checked against Burroughs' (1957) lists. The asterisk indicates that the word does not appear in the lists and the other figures refer to List 1 (first 500 most frequently occurring words in children's vocabulary) List 2, the second 500 ..... and so on. The fifteen terms and their vocabulary ratings were:

Grandfather	2	Brother	1
Grandmother	1	Sister	1
Grandson	*	Aunt	1
Granddaughter	*	Uncle	1
Mother	1	Nephew	*
Father	1	Niece	*
Son	*	Cousin	2
Daughter	*		

The semantic domain is highly structured and studies of the semantic relations have been carried out by Wallace and Atkins (1960) and Romney and D'Andrade (1964) by means of componential analysis. These analyses are quoted by FR (1971) who show how the psychological reality of their data can be tested by proximity data. The fifteen words listed on previous page were printed in Indian ink onto white card in lower case letters. The Script used was the same as that taught in the school. The cards measured $2\frac{3}{4}$" x $1\frac{3}{4}$" as in the example.

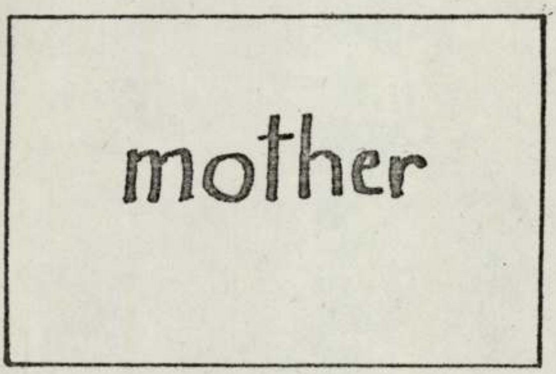


Figure 10. Example of card actual size.

These cards were made up into sets so that each child had a complete set. One set of cards was put into an envelope with a number of elastic bands.

4.3. PROCEDURE.

The experiment was carried out in the children's own classroom, a group at a time, with the class teacher helping. There were two additional helpers also present as well as the experimenter. This enabled each group of eight children to be supervised to eliminate the possibility of the children following one another's performance. This was deemed to be most important as the calculations to be made later involved grouping or pooling the data so collected.

Instructions.

When the envelopes containing the cards were given out the children were asked to open the envelopes, take out the fifteen cards and spread them out on their tables. They were then told to write their names on the envelopes and put it with the elastic bands at the top of the table, 'out of the way'. Next a number of exercises were carried out to ensure that each child could read each card. This was achieved by writing the words on the blackboard and asking the children to identify the same word by pointing. The assistants then checked that the matching was correct. Each word was gone through in this way with particular attention being paid to the asterisked words in the list. After the assistants were satisfied that the children could read the words, the following instructions were given by the experimenter.

'I want you to put the cards in front of you into piles so that the words that are closest in meaning are in the same pile. That is, put the words that have the nearest meanings together in the same pile. You can make as many piles as you like and you can have as many or as few words as you like in any pile - from a lot down to one'.

After the sorting had proceeded for five minutes the instructions were repeated again slowly and deliberately. Any child not understanding the instructions was helped by one of the adults in such a way as not to compromise the essential wording of the instructions. Help was given if the actual reading of the card was requested.

When the children had finished they were asked to take each pile and put an elastic band round it. They were then instructed to put another rubber band round the lot. Each child's sorting was put into the envelope with his/her name on and the envelope sealed to prevent accidental spillage.

The whole exercise took about three-quarters of an hour and the children enjoyed the task asking if they could have more to sort!

4.4. RECORDING OF THE DATA.

The raw data of each child's performance was recorded so that each subject's result could be retained for later reference. Examples of these original sheets appear in Appendix 2. After listing the constituents of each pile, it was possible to construct a similarity matrix for each group from the data whereby the number of times a particular word occurred with another, was calculated. This grouped data provided the input for Johnson's clustering programme, the results of which are discussed in Section 4.5.2.

4.5. RESULTS.

The first element of the data to be reported is the overall number of piles made by the children in each age group.

4.5.1. NUMBER OF PILES.

As the number of children in the age groups varied, the median number of piles for each age group was calculated for comparison. This data is given in Table 2. It will be seen that the medians decrease with age and that in Group A and C, the girls made more piles than the boys.

The reverse was true however and to a greater extent for Group B. It follows that there are more cards in the

Table 2

Mean number of piles by Age Groups and Sex

Age Group	N	Median	Range	Group Median	Range
A Boys	13	6.2	3-7	6.5	3-8
A Girls	16	6.4	3-8		
B Boys	11	6.8	3-8	5.2	3-8
B Girls	13	4.6	3-8		
C Boys	13	4.6	3-8	5.0	3-9
C Girls	11	5.3	3-9		

piles of the younger children.

4.5.2. HIERARCHICAL CLUSTERING SCHEMES (HCS).

The results of Johnson's clustering technique is next reported. First of all it is necessary to confirm that clusters are actually present in each set of data and that the hierarchical system is appropriate. Maximum (MAX) and Minimum (MIN) calculations were made therefore for each Group and then for the Boys and Girls in each Group. The set of diagrams Figures 11-13 show the details which were examined.

Group A.

In Figure 11 (AR) the two methods of calculating the analysis are seen to agree as to the overall shape of the clustering system and it is safe to claim that the hierarchical scheme is a fair representation of the way in which the Kinship terms are perceived by this Group of eleven year old children although the values of the strong clusters are low. The measure of similarity runs along the top of the figure, the highest value being at the centre and the lowest at the two extremes.

In Johnson's (1968 page 252) example where the MAX and the MIN methods are compared in the establishment of the system, he says,

> 'although the precise numerical values associated with the clusterings differ somewhat between the two methods, the topological structures of the two representations are alike. That is above the level of three clusters we find that exactly the same subclusters appear in both representations and (consequently) that each subcluster divides into exactly the same subclusters. This close agreement suggests that these data do not seriously violate the assumed ultrametric structure'.

Pursuing this type of examination and working from centre out, the results presented for Group A show the data to have the same shape thus, 'Father and Daughter' are paired by all to give the highest value 1.0. (The node with 0

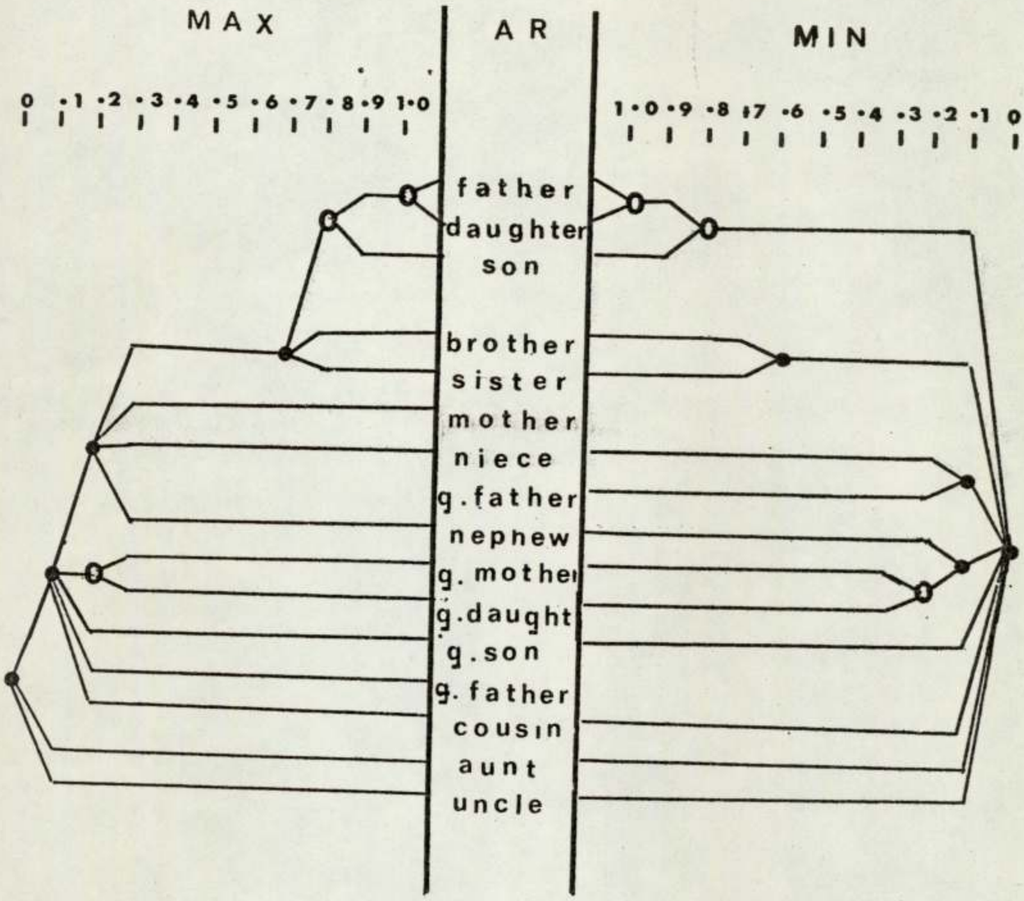

MAX
AR
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
father
daughter
son
brother
sister
mother
niece
g.father
nephew
g. mother
g.daught
g.son
g. father
cousin
aunt
uncle

Figure 11

indicates perfect agreement as to value). This pair is joined by 'Son' at the 0.8 level and then 'Brother' and 'Sister' are joined at about the same level of similarity. After this there is a considerable drop to the grouping of 'Grandmother' and 'Granddaughter', but the topological features match. The odd feature here is the absence of 'Mother' from the initial clustering.

The percentage of triangles that satisfy the ultrametric inequality for the two methods was 90.55% and the correlation between the data matrix and the ultrametric distances was: MAX, r = 0.73 and MIN, r = 0.56. As a large correlation value is said to indicate a good fit, these values appear quite satisfactory.

Group B

Figure 12 (BR) gives the results of the performance of the twenty-four children in Group B. Again the two methods of measurement (MAX and MIN) compare very favourably, verifying the shape of the data. In these HCS's the percentage of triangles that satisfy the ultrametric inequality was 94.29%. The correlation obtained between the data matrix and the ultrametric distances was MAX. r = 0.54 and MIN. r = 0.56. The structure underlying this Group's performance is evident and much clearer than Group A. The clusters and subclusters are almost identical and the strong clusters containing (Aunt, Uncle, Cousin, Nephew, Niece) and (Mother, Father, Son, Daughter, Brother, Sister, Grandmother, Grandfather, Grandson, Granddaughter) subsume subclusters which in turn are in virtual agreement. The

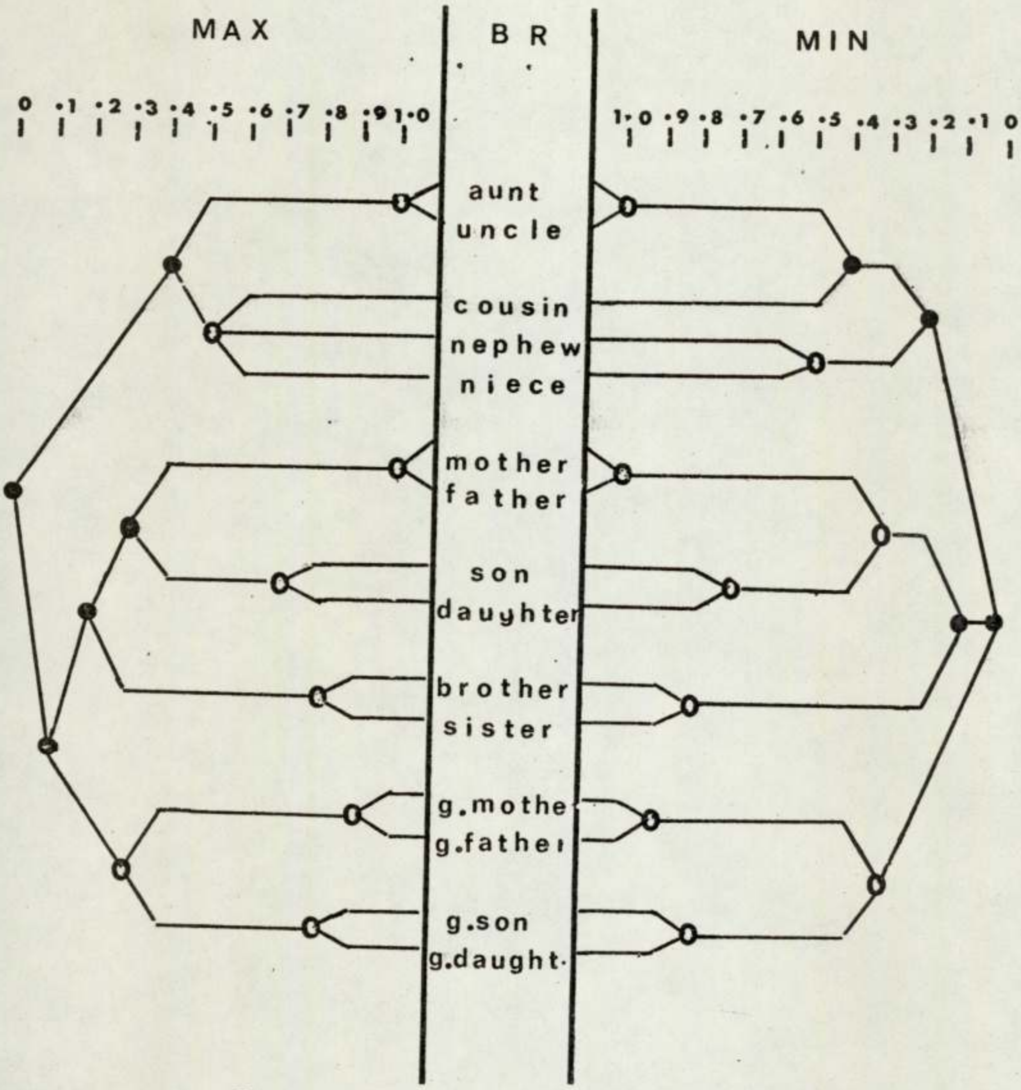

MAX
B R
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
aunt
uncle
cousin
nephew
niece
mother
father
son
daughter
brother
sister
g.mothe
g.fathe
g.son
g.daught·

Figure 12

hierarchical presentation of structure as calculated here clearly substantiates this method of analysing the data as meaningful. The structure also follows closely the adult models in FR (1971, pages 69-71).

Group C.

The data for the youngest Group is shown in Figure 13 (CR). Here again the two ways of calculating the clusters are in fairly close agreement. The percentage of triangles satisfying the ultrametric inequality was 81.54%. The stronger clusters however, are not quite as stable as in Group B, the two methods giving different items in the clusters. For example, 'Cousin' is clustered with (Aunt, Uncle) by one method (MIN) but does not appear by the MAX method until the subclusters (Son, Daughter, Brother, Sister) is joined by the subclusters (Aunt, Uncle) and (Nephew, Niece).

The first check on the data provided by the three age groups shows a broad agreement by the two methods of calculation and this confirmation and substantiation now makes possible further detailed investigation of the similarity judgments made by the children.

Content Analysis of the HCS's.

Another useful way of portraying the data is by adapting the lay-out given by the computer print-out. The first diagram Figure 14, shows the performance of the oldest Group of children. The figures down the left hand side are the similarity measures running from complete agreement 1.0

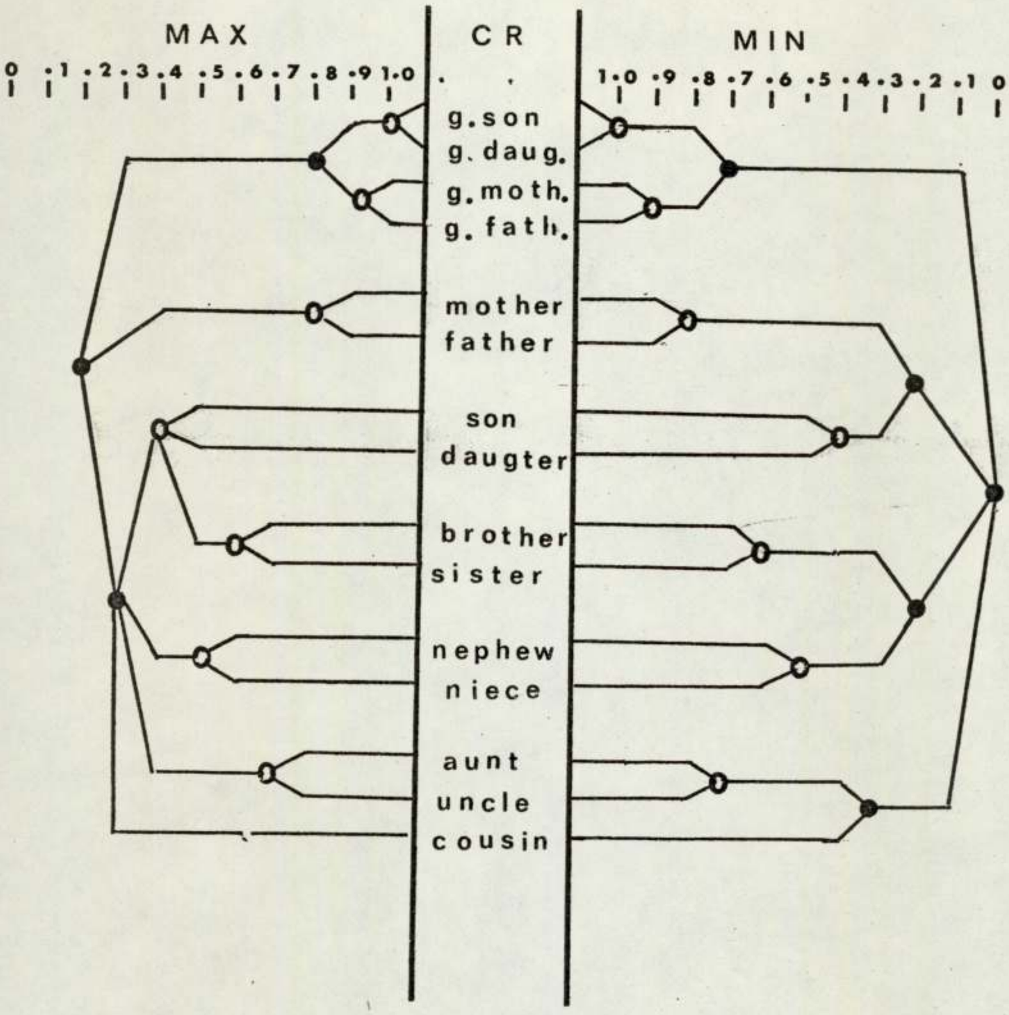

MAX
CR
MIN
0 .1 .2 .3 .4 .5 .6 .7 .8 .9 1.0
1.0 .9 .8 .7 .6 .5 .4 .3 .2 .1 0
g.son
g.daug.
g.moth.
g.fath.
mother
father
son
daugter
brother
sister
nephew
niece
aunt
uncle
cousin

Figure 13

to 0 where all the items are in one large cluster. It should be noted here that the terminology in cluster analysis might appear misleading for the clusters formed at the top (in this type of format) of the HCS are termed 'weak' and those at the bottom 'strong', and yet the highest values are attached to the weak cluster. However, FR (1971, page 33) give guidance here saying,

> 'To locate the largest number of significant clusters regardless of the proportion of stimulus objects they include, (the investigator) should scan the HCS from top to bottom. If... interested in finding the largest number of stimulus objects which form significant clusters, the HCS should be scanned from bottom to top ....'

In the figures that follow, a cross under a term joined by another cross between the terms indicates a cluster, and the convention followed is to use round brackets () for cluster pairs and square brackets [] for clusters containing more than two items. The letter R after the Group's initial indicates that Group's performance with the Kinship terms. The MAX method is chosen for this detailed examination throughout the study as being more applicable to this type of language data. (For discussion of the applicability of the MAX and MIN versions, see Levelt, 1970, page 106).

Figure 14

HCS for Group AR (MAX)

Figures down left hand side give similarity values. F = Father; D = Daughter and so on.

```
Similarity                                        G G G G
  Values     F D S B Ss N Np M C                  M D S F  A U

  1.00     (xxx)
  0.89     [xxxxx]
  0.67     [xxxxxxxxxx]
  0.22     [xxxxxxxxxxxxxxxxxxx]  (xxx)
  0.11     [xxxxxxxxxxxxxxxxxxxxxx][xxxxxxxx]
  0.00     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between data matrix (DM) and ultrametric distances (UD)for this group $r = 0.73$. $p < 0.001$)

In Figure 14 the terms Father and Daughter are paired as having the greates similarity. This is of course the children's interpretation of the instructions (Section 4.3) 'closeness' and 'nearness'. (It would seem that sex is not regarded as a distinguishing feature). This indicates that all the subjects in this age group put these two terms in the same pile. At the next level in the hierarchy (0.89), the item Son joined these two to form a cluster. Next at the 0.67 level, these are joined by Brother and Sister. There is now a considerable drop in the level of similarity to 0.22 when Nephew, Niece and Mother are clustered and a further cluster Grandmother and Granddaughter occur. At the 0.11 level Cousin joins the strong cluster and Grandson and Grandfather join the smaller cluster. The HCS concludes by bringing in Aunt and Uncle at the final level, but as this is at 0.00 it is but a formality of the process.

The picture presented here is of the nuclear family gradually extending apart from the absence of Mother which is puzzling as she does not join the inner family grouping until the lower 0.22 value.

It should be noted that the ordering of the terms along the top of these diagrams of HCS's gives an indication of their 'order of nearness' and is a useful way of scanning the results.

The results of the next age group, Group B are given by the MAX method in Figure 15.

Figure 15.
HCS for Group BR (MAX)

```
Similarity   A U Np N C M F S D B Ss  G G G G
  Values                              M F S D

   1.00     (xxx)      (xxx)
   0.96     (xxx)      (xxx)          (xxx)
   0.87     (xxx)      (xxx)          (xxx)(xxx)
   0.83     (xxx)      (xxx)     (xxx) (xxx)(xxx)
   0.78     (xxx)      (xxx)(xxx)(xxx) (xxx)(xxx)
   0.57     (xxx) (xxx) (xxx)(xxx)(xxx) (xxx)(xxx)
   0.52     (xxx) [xxxxx](xxx)(xxx)(xxx) (xxx)(xxx)
   0.48     [xxxxxxxxxx](xxx)(xxx)(xxx) (xxx)(xxx)
   0.39     [xxxxxxxxxxx(xxx)(xxx)(xxx) [xxxxxxx]
   0.30     [xxxxxxxxxx][xxxxxxx](xxx) [xxxxxxx]
   0.26     [xxxxxxxxxx][xxxxxxxxxxx]  [xxxxxxx]
   0.17     [xxxxxxxxxx][xxxxxxxxxxxxxxxxxxxxx]
   0.13     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD r = 0.54.
Conventions as in previous Figure.)

Indications that a clear hierarchical structure was present in this Group's performance was signalled by the MAX. MIN. presentation in Figure 12. Here the HCS structure is portrayed in its step by step orderliness which matches intuitive estimates of 'nearness' of Kinship term. If the Figure is scanned from top to bottom, the clustering down to the 0.57 level is by pairing of terms viz. (Aunt, Uncle); (Nephew, Niece); (Mother, Father); (Son, Daughter); (Brother, Sister); (Grandmother, Grandfather); (Grandson, Granddaughter). These seven pairs are judged as being very close or near in similarity. At the next level (0.52) [Nephew, Niece, Cousin] form a cluster which is then subsumed with (Aunt, Uncle) at the next level 0.48, giving the interesting cluster [Aunt, Uncle, Nephew, Niece, Cousin]. At level 0.39, [Grandmother, Grandfather, Grandson, Granddaughter] are clustered followed by [Mother, Father, Son, Daughter] at level 0.30. The latter is next clustered with (Brother, Sister) making [Mother, Father, Son, Daughter, Brother, Sister]. At the 0.17 level two strong clusters, [Aunt, Uncle, Nephew, Niece, Cousin] and [Mother, Father, Son, Daughter, Brother, Sister, Grandmother, Grandfather, Grandson, Granddaughter] are formed.

The youngest Group's performance with these Kinship terms is given by the cluster diagram in Figure 16. Again, the MAX method is given as best portraying the results.

Figure 16

HCS for Group CR (MAX)

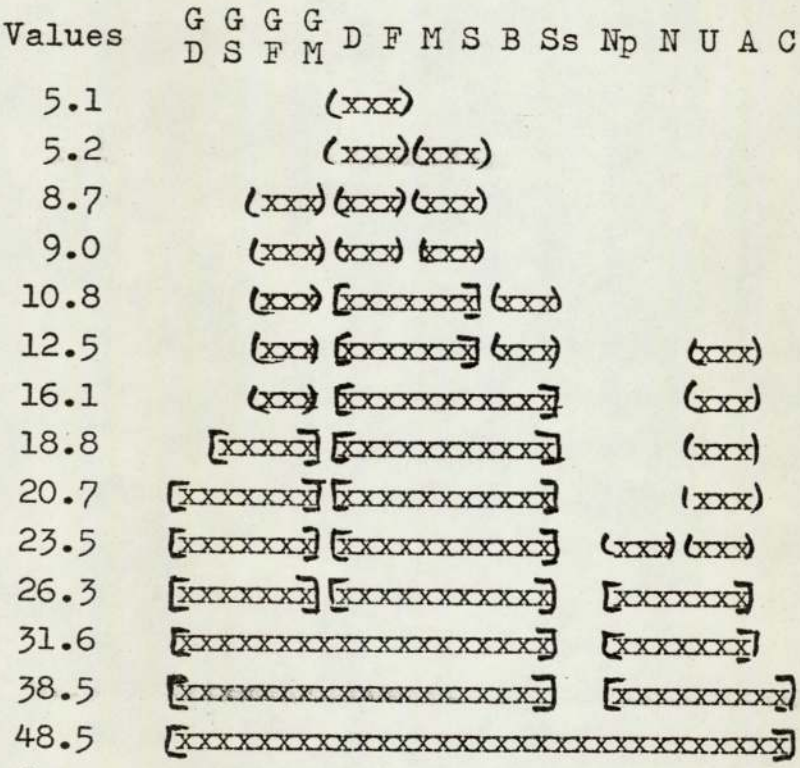
Similarity Values	GS GD GM GF M F A U B Ss S D Np N C
1.00	(xxx)
0.95	(xxx)(xxx)
0.81	[xxxxxxx](xxx)
0.76	[xxxxxxx](xxx)(xxx)
0.67	[xxxxxxx](xxx)(xxx)(xxx)
0.52	[xxxxxxx](xxx)(xxx)(xxx) (xxx)
0.43	[xxxxxxx](xxx)(xxx)[xxxxxxxxx] (xxx)
0.33	[xxxxxxx](xxx)[xxxxxxxxxxxxxxxxxxx]
0.29	[xxxxxxx][xxxxxxxxxxxxxxxxxxxxxxx]
0.24	[xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]

(Correlation between DM and UD $r = 0.59$. $p<0.02$. Conventions as in previous figures.)

It should be recalled here that there was not the same coincidence of structure as calculated by the two methods, and the figure shows differences in the younger children's results. At the 0.81 level the Group gave the terms [Grandson, Granddaughter, Grandmother, Grandfather] close proximity and at the same level as (Mother, Father). Apart from the pairing of terms, the next cluster comes at the 0.43 level where [Brother, Sister, Son, Daughter] are merged. After this at level 0.33 a large cluster containing [Aunt, Uncle, Brother, Sister, Son, Daughter, Nephew, Niece, Cousin] occurs, with (Mother, Father) joining them at the penultimate level. The younger Group perceive the Kinship terms as falling into two major groupings, those containing the second degree term 'Grand' and the rest.

An illustration next from the results of FR (1971). This example of an adult model is that of an HCS taken from FR for a group of thirteen female subjects sorting the same data by the same experimental procedure.

Figure 17
HCS for Group (FR) KTF



(The conventions are the same as in the other figures, but notice the increasing values down the left hand side as FR are using dissimilarity (distance) measures. (Taken from Fillenbaum and Rapoport 1971, page 70))

Viewing this array from bottom to top the two large clusters at level 38.5 fit a model (also given in FR) of Romney and D'Andrade (1964) well illustrating the distinction made by those authors between the closer type of direct relationship and the collateral. It can be noted too that the direct terms are clustered from the two subclusters at the next level in the diagram (26.3) where those terms containing 'Grand' are clustered apart from the others.

Comparing AR : BR : CR for these clusterings, the middle age Group BR clustered the collateral terms [Aunt, Uncle, Nephew, Niece, Cousin] at level 0.48. The 'Grand' group were clustered from the direct terms at level 0.39 although the latter's constituent (Grandmother, Grandfather), (Grandson, Granddaughter) were strongly paired at the top of the HCS at level 0.96. The middle Group's performance comes very close to the adult (female) model but the pairings are very cohesive indeed.

The older group do not approximate the adult model so clearly, collateral terms appear with direct although there is a clustering of the 'Grand' terms at the 0.11 level. It is interesting to note here that joining (Nephew, Niece) with (Brother, Sister) in the cluster at the 0.22 level is closer to the other model quoted by FR, that of Wallace and Atkins (1960) where the colineal dimension contains Brother; Sister; Nephew; Niece. However, for close agreement Aunt, Uncle should appear with them, and these children do not group them in this way.

The youngest Group, CR, cluster the 'Grand' terms and these appear towards the top of the HCS at the 0.81 level showing that these are perceived as being close in relationship. There is some approximation in the clustering of the rest of the terms to both the adult model cited and the older age group. The analysis of the younger children's clustering shows that the subclusters (Mother,Father) is favoured early and kept distinct as the rest of the clustered pairs, (Aunt, Uncle); (Brother, Sister); (Son, Daughter); (Nephew, Niece) merge. The clustering of (Brother, Sister) with (Son, Daughter) at level 0.43 does not fit Wallace and Atkins model, and crosses the boundary drawn in the Romney and D'Andrade model. It would seem as if some of the adult model characteristics are present in all three performances with that of the middle group closely approximating the HCS taken from FR and the Kinship analysis of Romney and D'Andrade.

Comparison of the Performance of Boys and Girls.

The data was further analysed to see if there are differences in the structuring patterns of Boys and Girls in the different age groups. The checking procedure comparing the MAX and MIN methods of calculating the cluster schemes is again employed and Figures 18 to 22a show that these comparisons reveal a fair measure of agreement in all cases. Minor differences will be noted in the detailed examination.

The convention using the Group initials followed by R for Kinship terms is extended to cover the Boys (B) Girls (G) distinction.

HCS ARB and ARG. (Figures 18 and 19)

Looking first at the HCS for the older Boys (ARB Figure 18) a clear hierarchical structure appears from the data. If the MAX version is examined, the Boys pair first by sex/age (Grandson, Granddaughter); (Grandmother, Grandfather);

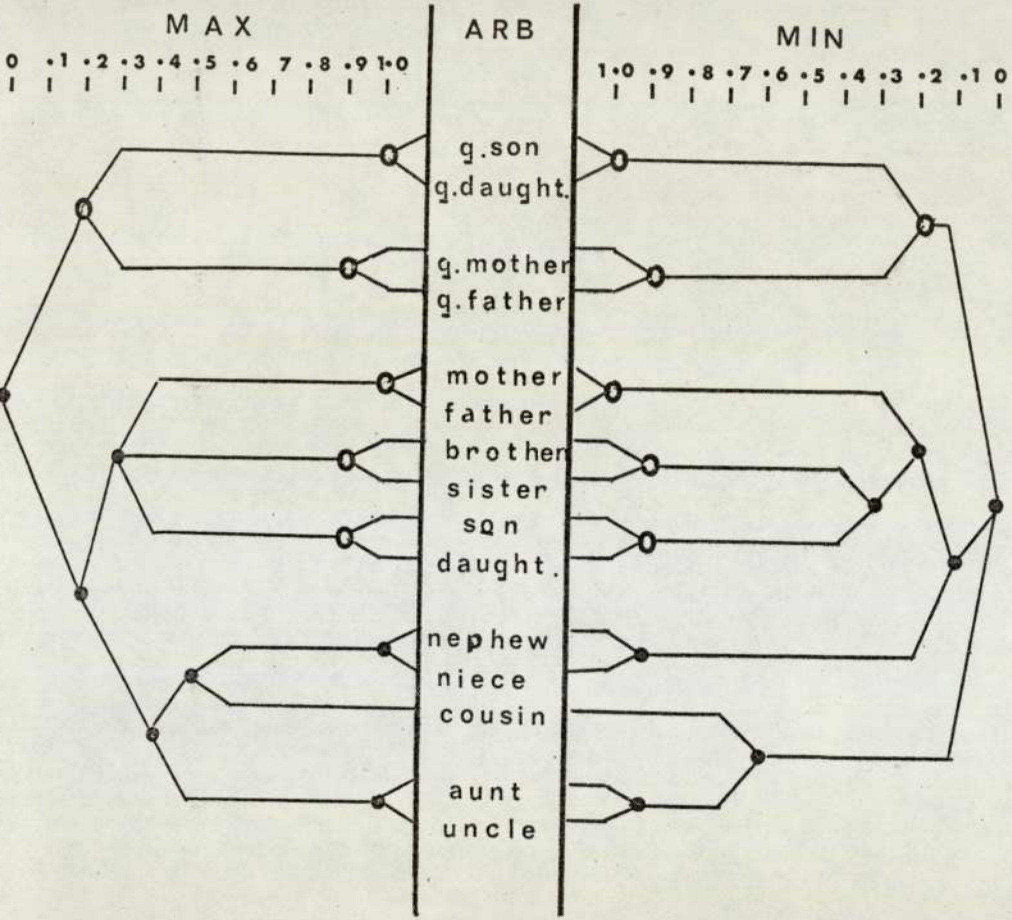


Figure 18

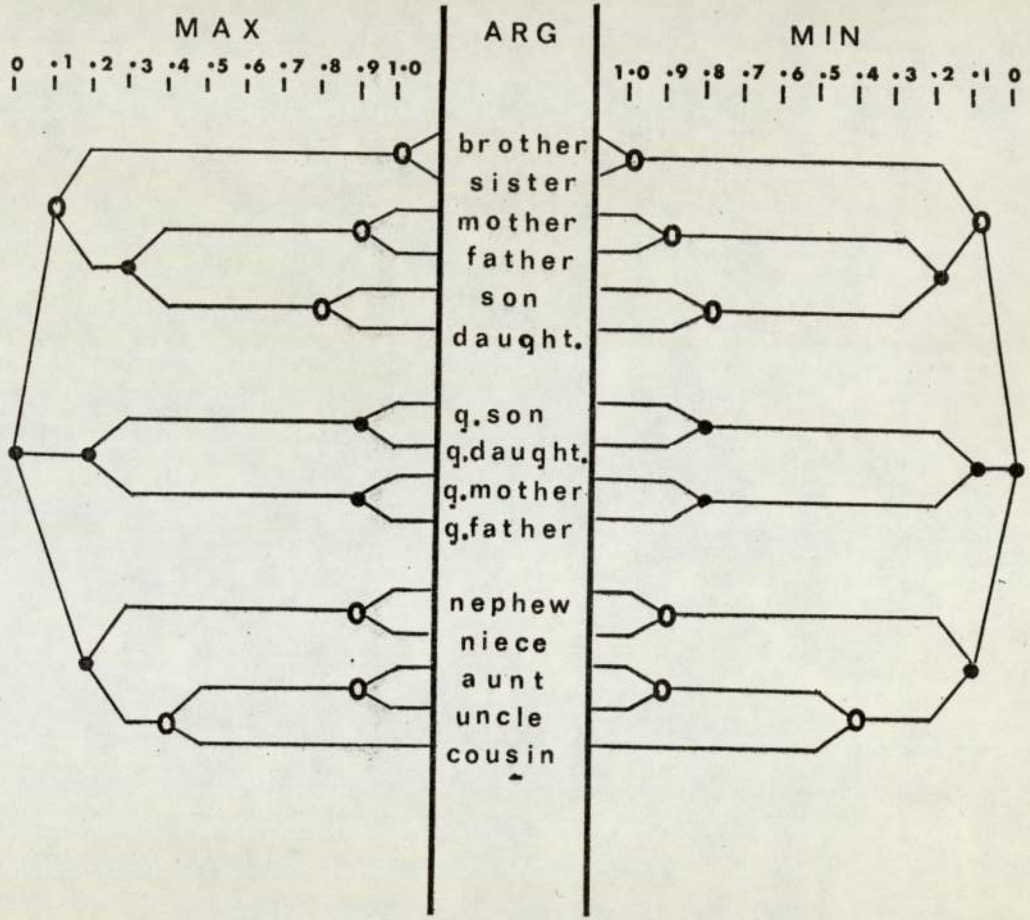


Figure 19

(Mother, Father); (Nephew, Niece) and so on apart from Cousin which can, of course, be either sex and is not one of a pair. The stronger clusters are very clear the 'Grand' terms going together, the inner family terms and the collateral. The two strong clusters at the 0.2 level being the terms containing 'Grand' and the rest made up by the merging of direct and collateral.

The Girls' clustering patterns (ARG) achieved by comparing the two methods are a good match. Their structuring does however have slightly different characteristics. There are three large groupings after the initial pairing by sex. The first cluster contains the direct inner family terms, the second the 'Grand' terms, and the third the collateral terms. The Boys clustered part of the direct group with the collateral keeping the 'Grand' terms as a separate cluster whereas the Girls keep the three clusters separate.

HCS BRB and BRG. (Figures 20 and 21).

The two methods of checking the clusters for the structure show agreement in the case of both Boys and Girls. The performance of the middle group of boys however shows considerable differences from the A Group patterns. Among these is the separation of (Mother, Father) from the Brother, Sister, Son, Daughter cluster. The collateral terms are clustered although Nephew is not first paired with Niece. Again, the two pairs of 'Grand' terms do not come together before the 0.20 level and when they do they join (Brother, Sister) and (Son, Daughter).

The performance of the Girls on the other hand gives a

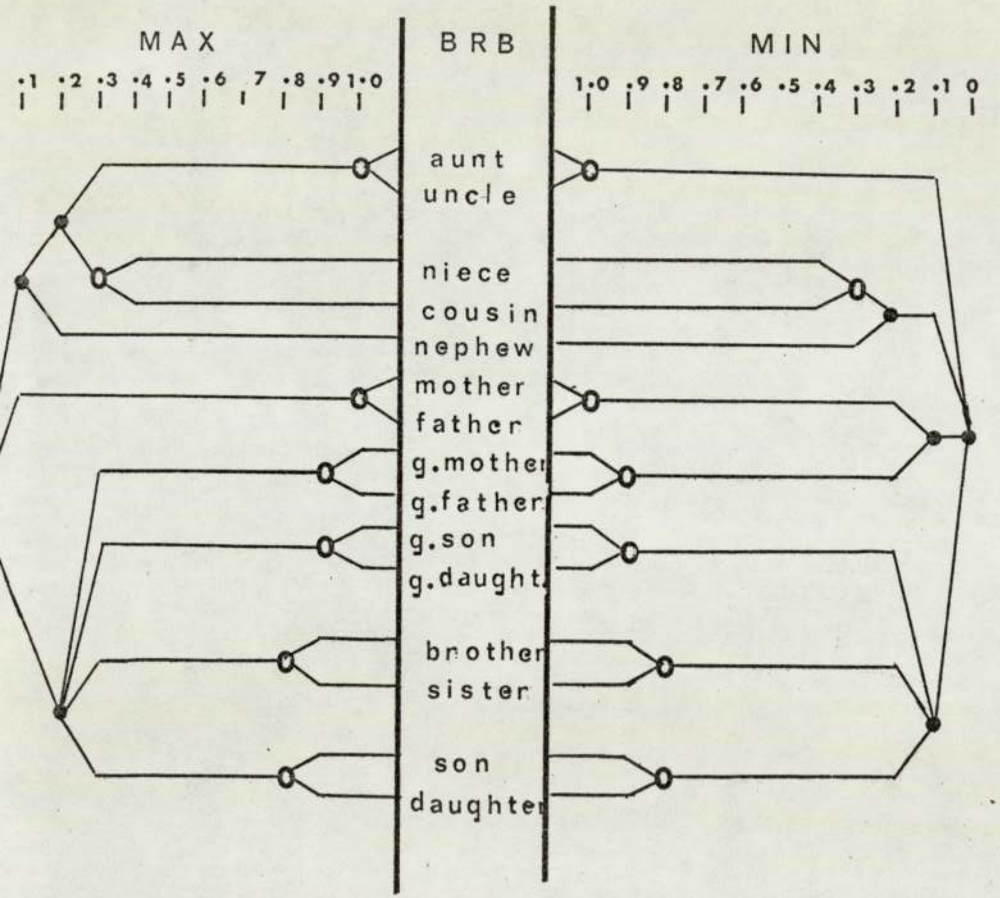


Figure 20

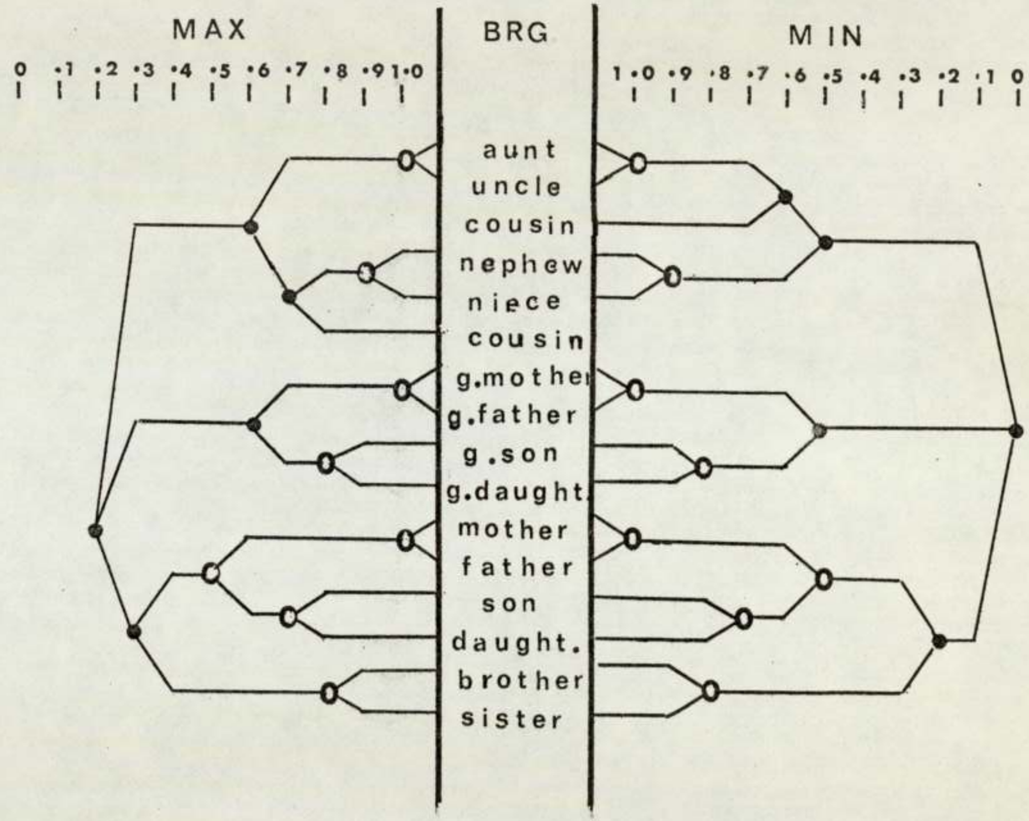


Figure 21

clear picture which closely follows the model of Kinship terms of Romney and D'Andrade. Reading from the MAX version, the terms are first paired for sex. Three strong clusters then occur with high values, i.e. the collateral terms are clustered at the 0.60 level and so are the 'Grand' terms, [Mother, Father, Son, Daughter] are clustered at the 0.50 level and together with (Brother, Sister) form the third major cluster at the 0.30 level. The only divergence from the Romney and D'Andrade model is that all the direct terms are not clustered before all the terms are clustered at the 0.20 level.

HCS CRB and CRG. (Figures 22 and 22a)

There are some differences between the two methods of calculating these clustering schemes for both Boys and Girls. Although there is overall agreement the two versions do not match as closely as the others. e.g. In CRB (MAX), Daughter is clustered with Nephew when that term joins (Son, Niece) at the 0.30 level. In the CRB (MIN) version however, Daughter joins (Mother, Father) at that level. In CRG, Cousin joins (Nephew, Niece) in the MAX version, and (Son, Daughter) in the MIN calculation. It might be observed therefore that the structuring to be examined is not as stable as that of the middle and older groups.

If the HCS derived from the Boys' performance is examined, it is quite clear that the 'Grand' terms are regarded as similar (0.80 level) but the rest of the cluster groupings noted in the other groups are not present, and pairing, a

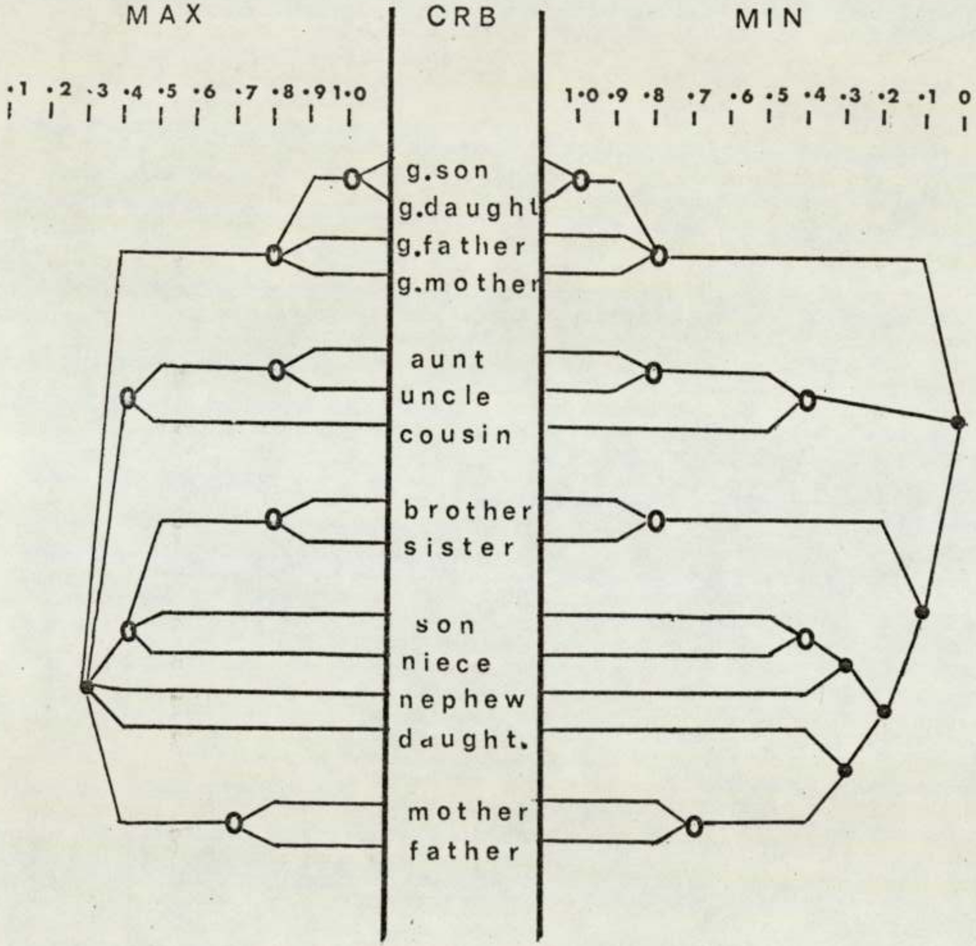


Figure 22

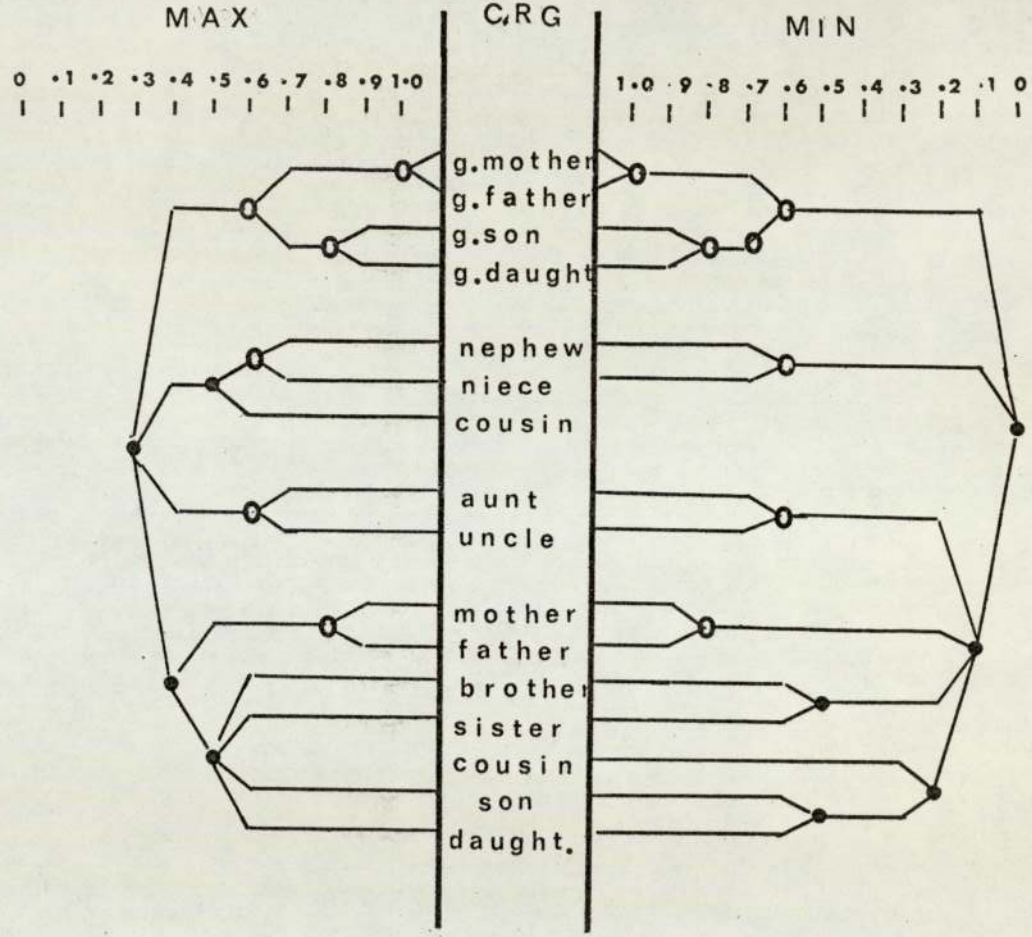


Figure 22a

characteristic pervading the performance of the older children, does not occur to the same extent. e.g. Niece is paired first with Son and not with Nephew and Nephew joins Daughter (MAX) not being in the same cluster as Niece until all the terms come together in the final cluster. The Girls on the other hand do pair the terms and the beginnings of putting the inner family group together as a cluster is apparent. The terms Brother, Sister, Son, Daughter are not initially paired but are merged as similar and then joined by Mother, Father to form the cluster of direct terms which is also found in the performance of the Girls in the other age groups. The Boys in Groups B and C do not perceive this relationship but it is clearly established by the older Boys.

4.6. DISCUSSION OF THE RESULTS.

The first experiment had three objectives (see Section 4.0) which re-stated are:

1. To examine the card sorting technique with children between the ages of five and eleven years.
2. To explore the application of hierarchical clustering schemes to the data.
3. To investigate, and, if possible, trace developmental patterns in the structuring of semantic relationships by children.

Broadly speaking the experiment achieved all three objectives although the emphasis tended to be placed on the first two as having greater importance at this stage. However, the trends and possibilities found in the data were encouraging for tracing developmental patterns.

The methodology for gaining insight into the children's ability to make judgments by card sorting proved to be successful. The main precautions taken were,

1. a thorough check on the children's ability to read the stimulus cards presented to them.

2. the staffing minimum of one adult to eight children to:
(a) check that the procedure was understood and
(b) to ensure that no individual was influenced by others around him or her.

This worked well and the assistants were most interested in the proceedings. Examination of the raw data give clear evidence that the sorting was not haphazard. This is fully supported by the analysis and the number of piles made by the children in the three age groups; (see Table 2), where the number of piles was shown to increase gradually with age. It follows from this that the older children put less cards in their piles than the younger children and examination of the content of these piles reveals greater discrimination in the judgment of these older children. It is safe then to assume for the next part of the study that the method of card sorting is capable of providing the data on structuring behaviour.

The exploration of the method of data analysis by clustering techniques, and in particular hierarchical clustering schemes, confirmed the work of others (eg. Miller and Anglin) in this field. It is clear that the format fits this type of data and looks promising in the search for those distinctive features that are thought to be present in semantic relationships.

The two ways of checking that structure is present (the MAX and MIN methods) showed that structures were indeed discernible and that the HCS format fitted the data well. This was not only shown in the positive areas of agreement but was confirmed by highlighting those sets of data where the structures were not quite so stable. (See Figures 22 and 22a). It might appear that the results are a demonstration of the obvious, nevertheless it was very important in view of the possibility that the cluster programme might impose a structure on data that has none.

If the results from the three age groups are scanned and compared with the RD model then areas of agreement can be sought for indications of developmental trends towards the attainment of the model which is, of course, an adult one. Progress in structuring can be conceptualised as ability to utilise increasing numbers of the features inherent in the organisation of the semantic domain, and use is now made of RD's dimensions for analysis.

If dimension a, the sex dimension, is taken first, and the results shown in Figures 19, 21 and 22a, ARG(MAX); BRG(MAX): CRG(MAX) compared, then the strength of this dimension can be fully appreciated. Starting with the HCS of the younger Group (CRG) and moving to the older Group (ARG), then the progression of the pairing of the male and female terms is quite clear. In the diagram CRG, Figure 22a, except for (Brother, Sister) and (Son, Daughter), the pairings occur between the levels of 0.60 and 1.00. In BRG (Figure 21) all seven pairs occur at the 0.70 level and above. The diagram of the older girls' performance ARG (Figure 19) shows the pairs at the 0.80 level and above. Over the years covered by these experimental groups, (the First School years), the pairing of terms along dimension a, the sex dimension, increases in strength. Relationships that are not so straight forward are detected by the analysis as exemplified by the children's performance with (Brother, Sister) and (Son, Daughter). The same is true of the term Cousin which can be either sex and in this semantic domain is at once by itself on one dimension, yet is more close to some terms than others on another dimension. As already intimated during the comparison of the methods MAX/MIN, Cousin is put in different clusters, (see CRG for instance), an indication that the structuring is not so stable. It is interesting to follow this term through the age groups for its characteristics are different from the other terms. In CRG (MAX) Cousin is clustered with (Nephew, Niece) and CRG (MIN) with (Son, Daughter). In BRG the same situation applies in that the structuring is not quite stable for in BRG (MAX) Cousin goes with (Nephew, Niece) and in BRG (MIN) with (Aunt, Uncle). However, here the other dimension c, the collateral in RD's model, appears to be operating and guiding the Girls' performance. Finally in ARG, Cousin appears with the pair (Aunt, Uncle) at the same value by both MAX and MIN methods. It could be said that the older Girls' judgments are operating along all three dimensions and that the outcome of their performance closely resembles that of the adult. The structure in the diagram is quite clear and stable; the three major clusterings matching the RD model.

Further evidence concerning the reality of the dimensions underlying the organisation of the semantic domain is provided by the geneality dimension b $\pm$ 2 containing the 'Grand' terms. In the three HCS's being discussed, these four terms are tightly clustered and there is agreement in both methods of calculation.

It could be claimed then that the semantic features illustrated in the domain by the sex dimension (a) is clearly operational throughout the age range and that its strength in clustering terms increases with age. Dimension (b) the geneality element is also growing in importance in terms of the effect it has on performance, and the same might be said of (c). However, the performance examined here in detail, that of the Girls in the three groups, is not replicated by the Boys. For example the middle group of Boys (BRB MAX/MIN) do not have the same clear strong clusters as the Girls in their age group. However, the older Boys' (ARB MAX/MIN) performance does approximate that of the Girls who follow the main dimension of the Kinship domain.

SUMMARY 4.

1. The method of card sorting to elicit similarity judgments and the cluster analysis of the experimental results into hierarchies were successfully demonstrated.

2. It was shown also that the ability to structure into homogeneous groups increased with age. Furthermore, the children's judgments of similarity provided evidence that the basic dimensions of the organisation of Kinship terms were increasingly appreciated with age.

5.0. EXPERIMENT 2.

One semantic field only was investigated by the preliminary experiment, the Kinship domain. In this second experiment two contrasting areas were chosen for further detailed examination, the domains of Colour terms (C) and Pronouns (P). The reasons for choosing these two were that they were thought to represent two areas of differing experience where the organisation of their features might add to knowledge of the structuring process. In the Kinship terms, the dimensions underlying their organisation were analysable in fairly clear ways and the accretion of features could be traced as they 'guided' the children's performance. It was thought that if the same cluster techniques were used to analyse children's judgment performance in two other semantic fields, further information would be gained. In this way it was hoped that more detail of the acquisition of semantic features might be learned.

Experiment 2. Objectives.

1. To discover whether there are dimensions that guide the children's performance on judgment tasks in the two domains chosen.

2. To trace a developmental pattern, if any, in the acquisition of the features that distinguish the dimensions, and

3. To search for generalisations in the language behaviour being studies.

Experiment 1.

5.1. SUBJECTS

The subjects were the same for this experiment as in

Experiment 1. The same school and the same classes were used so that direct comparisons could be made. The children were a little older by 6 to 8 weeks. There was, of course, the additional advantage that the children would be aware of the type of behaviour expected of them during the experiment.

5.2. MATERIALS

1. Colour Names.

It is known that the range of colours are divided differently in different languages so that category boundaries occur in different places. Two examples of this phenomenon are that the English word Blue has no equivalent in Russian and the same is true of Brown in French. It follows then that the objective measurable physical property has a language-cultural variable where the perception and naming of colours is concerned. How colours are distinguished and named is a function that has long been discussed in psychological terms for there are some seven million discriminable colours and some 5,000 different colour names (Chapanis 1965, page 331). However, there appear to be only twelve colour names found in common use. These arranged in order of most to least common are, white, black, blue, red, grey, green, brown, gold, yellow, pink, silver and purple. (Evans 1948 quoted by Chapanis). These twelve colour names were taken as a basis for the set of colour names to be presented to the children. To them were added two others, Mustard and Orange, for the following reasons. It was thought that Orange being of strong hue lying with Brown between the Red and Yellow ranges would give an interesting number of possible combinations for the card sorting technique and require finer judgment. The colour name Mustard might serve a similar purpose in the Yellow, Green range. Both these colour names have the further advantage of being in the high frequency vocabulary of the children involved as the list shows. The colour names chosen, with their vocabulary ratings, were:

Colour Name	Burroughs' (1957) Vocabulary Level
White	1
Black	1
Blue	1
Red	1
Grey	1
Green	1
Brown	1
Gold	1
Yellow	1
Pink	1
Silver	2
Purple	2
Orange	1
Mustard	2

As in the first experiment these colour names and the Pronouns listed below were printed on to white card in large script with Indian ink. Enough sets of the names were prepared so that each child in the class had its own set.

2. Pronouns.

Another semantic domain likely to yield information about structuring behaviour is that of Pronouns. This has particular applicability in this work as,

a. The structured set of Pronouns has clearly definable boundaries and yet has distinctions where terms share features in different ways, and

b. This group of terms is of concern from the syntactical point of view in that there are clear distributional constraints on their occurrence in utterances.

The list of pronouns with their vocabulary ratings were:

	Burroughs' (1957) Vocabulary Level
I	1
Me	1
My	1
We	1
Us	1
Our	1
He	1
Him	1
His	1
She	1
Her	1
They	1
Them	1
Their	2
You	1
Your	1

5.3. PROCEDURE.

The same experimental procedure was adopted as before with even greater care being taken to ensure that each child's performance was his or her own. The same ration of assistants to children was achieved as before and the importance of their duties emphasised. Each of these assistants were known to the children, (one being the class teacher), so the experimental conditions and the relationships they entailed were excellent.

The children were given the sets of Colour Names first and asked to place the cards out in front of them. Again, a preliminary exercise was carried out and each child 'screened' for recognition of the words on the cards. This presented very few problems indeed and as the children were the same as in Experiment 1, they anticipated the card sorting task to come. However, they were asked to leave their cards whilst the standardised instructions were given. They were told first that instead of family names these were colour names and that each card had a colour name on it. The instructions given to the subjects were:

'I want you to put the cards in front of you into piles so that the words that are <u>closest in meaning</u> are in the same pile. That is, put the words that are nearest in meaning in the same pile. You can make as many piles as you like and you can have as many or as few words as you like in any pile - from a lot down to one'.

These instructions were repeated and, after the sorting had proceeded for 5 minutes, repeated again. In the same way as before when the children had finished they were asked to put rubber bands around their piles even if there was only one and then put them into the envelopes provided. These were then collected. The children then had a short break and then the Pronoun cards were given out and exactly the same procedure was adopted. It was noticed that the younger children took much longer to sort these words.

5.4. RECORDING OF DATA.

As in Experiment 1, the performance of each child was recorded onto a profile sheet so that a complete record was available. Examples of these original profiles appear in Appendix 2. Next, similarity matrices were constructed for each group from the data whereby the number of times a particular word occurred with another was calculated. This grouped data was then submitted to Johnson's clustering programme.

5.5. RESULTS

The Colour Name results will be reported first in total and then those from the Pronoun set.

5.5.1. COLOUR NAMES

For consistency, the method of reporting results in Experiment 1 will be followed and the data is first examined to see how many piles the fourteen Colour Names were put into by the children.

Table 3

Median number of piles of Colour Names by Age and Sex.

Group	N	Median	Range	Group Median	Range
AB	13	5.9	3-7	5.8	3-7
AG	16	5.7	4-7		
BB	11	6.31	6-7	5.8	4-7
BG	13	4.79	4-7		
CB	13	5.5	3-7	5.7	3-8
CG	11	5.8	3-8		

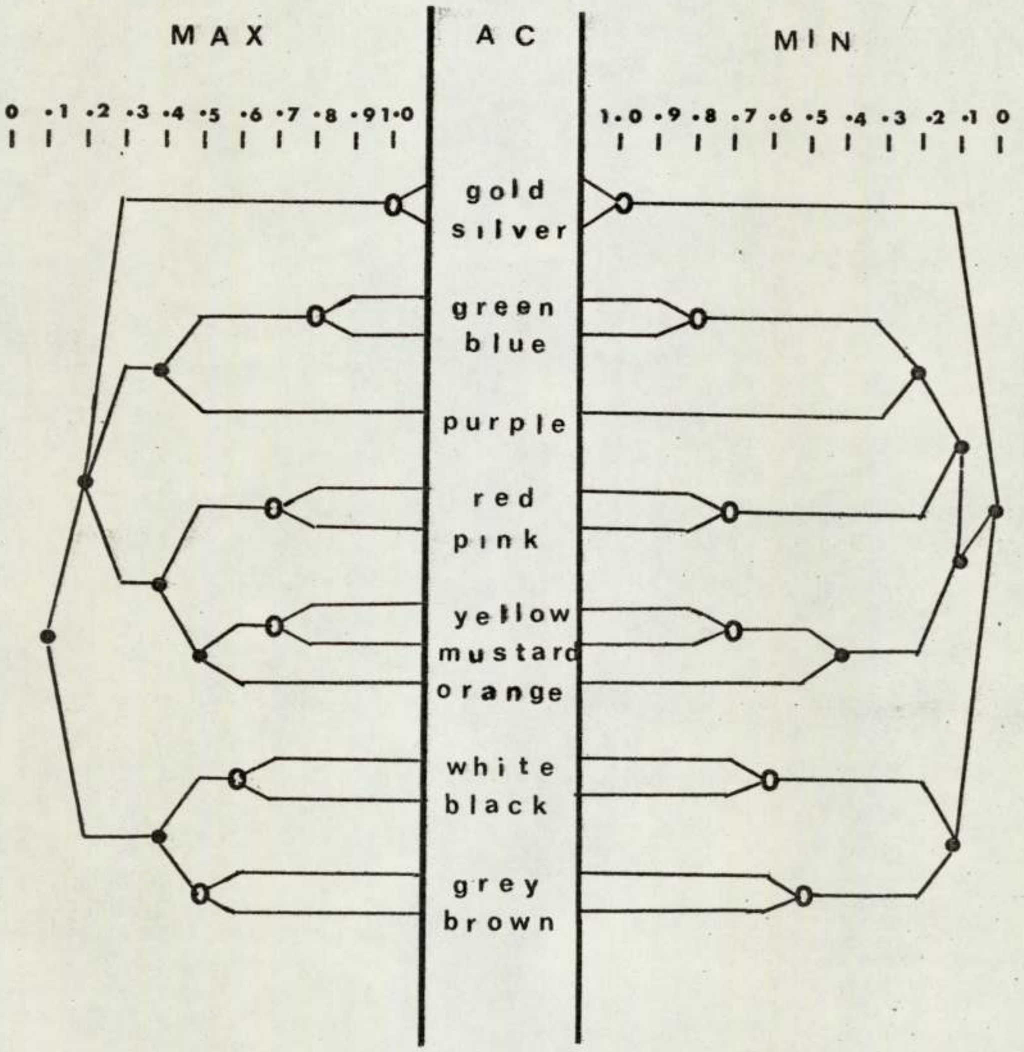
There is little difference in the medians of the groups or of the Boys and Girls in each group except for the middle age group where the difference in medians is 1.5.

Hierarchical Clustering.

The results were submitted to the hierarchical clustering programme of Johnson to ascertain how the grouped data was structured. The resulting HCS were examined first to confirm the presence of structure by using the method used by Miller and Johnson when demonstrating the validity of the technique. The set of diagrams, Figures 23 to 25, show the results of comparing the MAX and MIN versions of the same data first for the age groups in decreasing age order, and then separately in Figures 29 to 34 for Boys and Girls.

Group A.

In Figure 23 there is almost complete agreement as to the way in which the older group structure the terms at the pairing and subcluster levels. There is some difference in the values at which some of the clustering of these subgroups occur but there is overall topological agreement. The percentage of triangles that satisfy the ultrametric inequality was MAX 81% and MIN 77% and the correlation between the data matrix and the ultrametric distances was MAX, $r = 0.81$, $p < 0.001$, and MIN, $r = 0.77$, $p < 0.001$.



MAX
AC
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
gold
silver
green
blue
purple
red
pink
yellow
mustard
orange
white
black
grey
brown

Figure 23

Group B.

Again there is considerable agreement between the two methods as can be seen by comparing the two sides of the diagram in Figure 24. However, there are differences where the subclusters merge at the lower levels.

The percentage of triangles that satisfy the ultrametric inequality was MAX 83.8% and MIN 83.8% and the correlation between the data matrix and ultrametric distances was MAX, $r = 0.70$, $p < 0.01$ and MIN, $r = 0.69$, $p < 0.01$.

Group C.

The situation as conveyed by this diagram, Figure 25, shows that the structuring as calculated by the MIN method has the appearance of being similar to the other groups. If, however, this is compared with the MAX version the results of the analysis are markedly different. The subclusters are shown as being merged at a large value (0.7) into one large final cluster. If the criterion of agreement of the MAX/MIN methods of calculation are held then the younger group's performance is only at the level of a few pairs.

The percentage of triangles that satisfy the ultrametric inequality was MAX. 81.3% and MIN. 81.3% and the correlation between the data matrix and ultrametric distances was MAX, $r = 0.75$, $p < 0.001$ and MIN, $r = 0.65$, $p < 0.01$.

Content Analysis of HCS's AC, BC, CC.

Group AC.

The results of the first check on the data for structure and hierarchy makes further detail reporting possible and if the

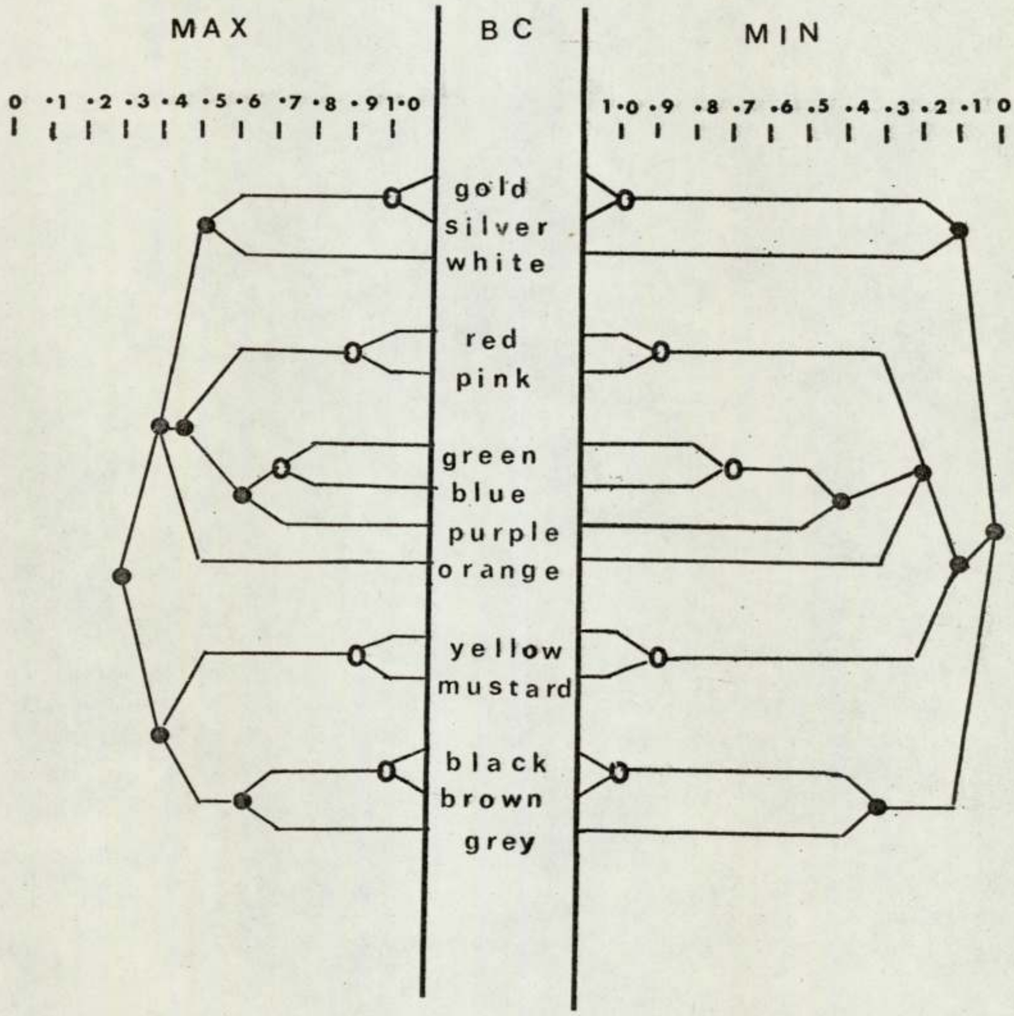

MAX
BC
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
gold
silver
white
red
pink
green
blue
purple
orange
yellow
mustard
black
brown
grey

Figure 24

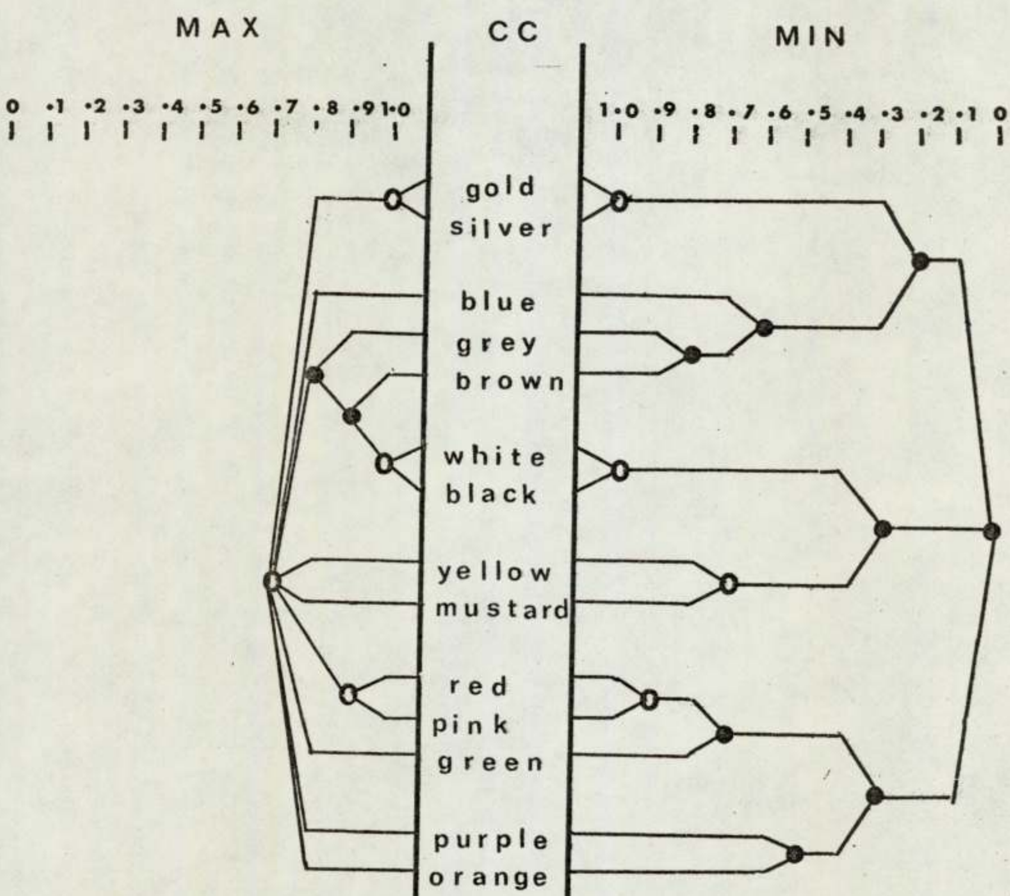

MAX
CC
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
gold
silver
blue
grey
brown
white
black
yellow
mustard
red
pink
green
purple
orange

Figure 25

data from the performance of the older children are examined as in Figure 26, the following statements can be made.

Figure 26.
HCS for Group AC (MAX)

Key to letters:

G = Gold	Y = Yellow
S = Silver	M = Mustard
Gr = Green	O = Orange
B = Blue	W = White
Pp = Purple	Bk = Black
R = Red	Gy = Grey
P = Pink	Br = Brown

```
Similarity
  Values    G S Gr B Pp R P Y M O W Bk Gy Br

  1.00     (xxx)
   .87     (xxx) (xxx)
   .71     (xxx) (xxx)    (xxx)(xxx)
   .63     (xxx) (xxx)    (xxx)(xxx)  (xxx)
   .50     (xxx) (xxx)    (xxx)[xxxxx](xxx)  (xxx)
   .46     (xxx) [xxxxx] [xxxxxxxxx][xxxxxxxxx]
   .42     (xxx) [xxxxxxxxxxxxxxxxx][xxxxxxxxx]
   .25     [xxxxxxxxxxxxxxxxxxxxxxxxx][xxxxxxxxx]
   .17     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD distances, $r = 0.81$. $p < 0.001$.)

There are nine levels of clustering in the older age group's judgment of similarity with Colour Names. After the early pairings, (scanning the HCS from top to bottom) the first three colour subclusters appear at the 0.5 level. ie. [Yellow, Mustard, Orange] . At the next level, a subcluster containing [Green, Blue, Purple] is formed and (Red, Pink) joins [Yellow, Mustard, Orange] in a further cluster, with [White, Black, Grey, Brown] forming the third. At level 0.42, Green, Blue, Purple join [Red, Pink, Yellow, Mustard, Orange] in one strong cluster. At the .25 level (Gold, Silver) join that cluster making [Gold, Silver, Green, Blue, Purple, Red, Pink, Yellow, Mustard, Orange] , the other cluster being [White, Black, Grey, Brown]. This then is the detail of the twenty-nine children in the oldest age group. Their clustering appears orderly within the step by step hierarchical progression.

Group BC.

The middle age group' performance is given in Figure 27, which shows that the MAX calculation results gives a similar orderly progression if the HCS is scanned from top to bottom. There are no abrupt leaps between the nine levels of the hierarchy and this, together with the MAX/MIN agreement shown in Figure 24 provides confidence in the HCS supplied by the clustering programme.

The details show again that the children's performance is orderly and follows the same patterning behaviour as was

Figure 27.
HCS for Group BC (MAX)

```
Similarity
 Values    G S W R P Gr B Pp O Bk Br Gy Y M
  1.00    (xxx)                (xxx)
   .93    (xxx)  (xxx)         (xxx)     (xxx)
   .73    (xxx)  (xxx) (xxx)   (xxx)     (xxx)
   .67    (xxx)  (xxx) [xxxxx] (xxx)     (xxx)
   .60    (xxx)  (xxx) [xxxxx] [xxxxxx]  (xxx)
   .53    [xxxxx](xxx) [xxxxx] [xxxxxx]  (xxx)
   .47    [xxxxx][xxxxxxxxxxx] [xxxxxx]  (xxx)
   .40    [xxxxxxxxxxxxxxxxxx] [xxxxxxxxxxxx]
   .33    [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.70, p<0.01.
Conventions as in previous Figures).

noted in the older children's HCS. The early pairing in this HCS down to level 0.67 includes (Gold, Silver), (Black, Brown), (Red, Pink), (Yellow, Mustard) and (Green, Blue) which is clustered with Purple to form the first three term cluster [Green, Blue, Purple]. At the next level (0.6), [Black, Brown, Grey] are clustered, and at the next White joins (Gold, Silver). At the 0.47 level [Red, Pink, Green, Blue, Purple] form a subcluster, and the two large clusters [Gold, Silver, White, Red, Pink, Green, Blue, Purple] and [Black, Brown, Grey, Yellow, Mustard] occur at level 0.40. These two strong clusters are joined by Orange at the final level. There are two interesting features to be noted here, firstly the separation of Black from White and the pairing of Black with Brown, and secondly the merging of White with (Gold, Silver).

Group CC.

When reporting the HCS of the youngest group, the difficulty concerning the lack of agreement in the measurement of structure should be recalled. Figure 28 gives the detail of the youngest children's similarity judgments.

Figure 28.
HCS for Group CC (MAX)

```
Similarity
  Value     G S Pp W Bk Br Gy R P O B Y M Gr
   1.00     (xxx)  (xxx)
    .90     (xxx)  [xxxxxx]    (xxx)
    .80     [xxxxx] [xxxxxxxxx] (xxx)
    .70     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between the DM and UD, $r = 0.75$, $p < 0.001$. Conventions as in previous figures)

This then is the clustering scheme for Group C. The two pairs (Gold, Silver) (White, Black) are prominent at the 1.0

level as is the clustering of Brown with the latter pair at the 0.90 level. (Red, Pink) are paired at this level of the HCS too and at the next level one other term Grey joins the subcluster [White, Black, Brown]. After this there is no discrimination evident in the results.

Although this result may appear negative it is important as it indicates that the younger children are not structuring the Colour Names as their older colleagues. Further, this result gives evidence that the important checks employed to safeguard the tendency of this type of analysis to impose structure where little or none exists, are effective. It is possible now to proceed with more confidence as long as strict adherence is paid to the comparison safeguards.

The Performance of Boys and Girls Compared.

Mention of any inconsistencies in the MAX/MIN methods of calculating the HCS's will be made before each HCS receives content analysis and comparison made. The MAX/MIN diagrams for the Boys and Girls in the three age groups will be found in Appendix 3 Figures 29 to 34. The data is described then by comparing the Girls' and Boys' results.

ACB and ACG.

Figures 29 and 30 give the structure comparison details for the oldest group of Boys and Girls. These show considerable agreement in the main. In the case of the Boys (ACB) there is some difference in the detail as the strong clusters appear. e.g. Purple is clustered with (Green, Blue) at the 0.2 level in the MIN calculation and with (Red, Pink) at the

0.4 level by the MAX method. The Girls' performance also shows agreement both in the specific Colour Names and their values at pairing and later clusterings. There is some divergence in the values at which the strong clusters occur, but the structuring is nonetheless clear and consistent.

Figure 35.

HCS for Group ACB(MAX)

```
Similarity
  Value     G S Gr B R P Pp Y M O Gy Br W Bk
  1.00     (xxx)
   .85     (xxx) (xxx)
   .77     (xxx) (xxx)        (xxx)
   .69     (xxx) (xxx)(xxx)   (xxx)
   .62     (xxx) (xxx)(xxx)   [xxxxx]
   .54     (xxx) (xxx)(xxx)   [xxxxx] (xxx) (xxx)
   .39     (xxx) [xxxxxxxxx]  [xxxxx] [xxxxxxxx]
   .23     (xxx) [xxxxxxxxx]  [xxxxxxxxxxxxxxx]
   .00     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.68, $p < 0.01$. Conventions as in other figures.)

Figure 36.

HCS for Group ACG(MAX)

```
Similarity
  Value     G S Y M W Bk Br Gy Gr B Pp R P O
  1.00     (xxx)
   .91     (xxx)                (xxx)
   .73     (xxx)     (xxx)      (xxx)    [xxxxx]
   .64     (xxx)(xxx)[xxxxxx]   (xxx)    [xxxxx]
   .55     [xxxxxxxx][xxxxxx]   [xxxxx]  [xxxxx]
   .46     [xxxxxxxx][xxxxxxxxx] [xxxxxxxxxxxx]
   .36     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.66, $p < 0.01$. Conventions as in other figures.)

Examining the two MAX. HCS's in Figures 35 and 36, and looking at the subclusters after the initial pairings, it is interesting to note that the Boys judge Orange to be nearest to the (Yellow, Mustard) pair at level 0.62 whereas the Girls put Orange with (Red, Pink) at level 0.73. Throughout the Boys HCS, the (Gold, Silver) pair remains outside the strong clusters which are [Green, Blue, Red, Pink, Purple] and [Yellow, Mustard, Orange, Grey, Brown, White, Black]. The Girls, on the other hand, cluster [Gold, Silver, Yellow, Mustard], [White, Black, Brown, Grey] and [Green, Blue, Purple, Red, Pink, Orange] is the third final strong cluster.

BCB and BCG.

Turning now to the middle age group and looking first at the MAX/MIN calculations (Figures 31 and 32 in Appendix 3), there is less agreement between the two versions with the Boys' HCS than there was with the older Boys. The three Colour Names, Blue, Orange, Grey are clustered differently by the two methods. The Girls' performance on the other hand shows a much closer agreement and only one Colour Name, Orange, is clustered differently. The MIN method clusters Orange with (Red, Pink) at the 0.30 level, and the MAX method joins it to the [Gold, Silver, White] cluster at the 0.40 level. In the main, however, there is considerable agreement in the structures as presented.

Having these factors in mind, the two clustering schemes BCB and BCG (both MAX) are examined. Figures 37 and 38 give diagrams of the HCS's.

Figure 37

HCS BCB (MAX)

```
Similarity
  Value    G S R P B Pp Y M Gy O Gr Bk Br W

  1.00     (xxx)
   .86     (xxx)(xxx)
   .71     (xxx)(xxx)     (xxx)       (xxx)
   .57     (xxx)[xxxxx]   [xxxxx]     [xxxxxx]
   .43     (xxx)[xxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
   .29     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between the DM and UD, r = 0.76, $p < 0.001$. Conventions as in previous figures.)

Figure 38

HCS BCG (MAX)

```
Similarity
  Value    Bk Br Gy R P Gr B Pp G S W O Y M

  1.00     (xxx)                      (xxx)
   .90     (xxx)
   .80     (xxx)   (xxx) (xxx)  (xxx)  (xxx)
   .70     (xxx)   (xxx) [xxxxx](xxx)  (xxx)
   .60     [xxxxxx](xxx) [xxxxx][xxxxx](xxx)
   .50     [xxxxxx][xxxxxxxxxxx][xxxxx](xxx)
   .40     [xxxxxx][xxxxxxxxxxxxxxxxxx](xxx)
   .30     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between the DM and UD, r = 0.64, $p < 0.01$. Conventions as in previous figures.)

The first feature to be noted in Figure 37 (BCB) is that the (Gold, Silver) pair remain a pair until the final all-term cluster, whereas the Girls (BCG) provide an interesting sub-cluster at the 0.60 level, [Gold, Silver, White] thus splitting the pair (Black, White). At the level (0.71) the boys pair (Black, Brown) but at the next level (0.57) White joins that pair to create the subcluster [Black, Brown, White]. The term Black is paired with Brown by the Girls also, but it is joined by Grey at level (0.60) to make the sub-cluster [Black, Brown, Grey]. The Girls form a cluster of the pairs (Red, Pink) (Green, Blue) and Purple to make a strong cluster at the 0.50 level, ie. [Red, Pink, Green, Blue, Purple]. The Boys on the other hand do not pair Green with Blue leaving it unattached until the very large cluster at the 0.43 level. The structure given by the Girls' HCS is worthy of note as the initial pairings, kept throughout in the structures of the older children, are split. Furthermore, the structure presented is stable.

CCB and CCG.

The youngest group's HCS's are presented below and the checking procedure by comparing the MAX and MIN methods of calculation is observed first. The two clustering schemes involved of the Boys and Girls are shown in Figures 33 and 34 and appear in Appendix 3. Here the importance of attending carefully to the procedure is exemplified. In the Boys' HCS, the MAX method shows the clustering of all the Colour Names at the 0.50 level whereas this does not happen until the final 0.00 level in the MIN calculation. In the latter also the structure is far from clear. The Girls' HCS, on the other hand, shows closer agreement in comparison to the Boys in the same age group, but even here, is far less sure than that of the older children.

When the two HCS's CCB(MAX) and CCG(MAX) are compared, (White, Black) in the case of the Boys and (Gold, Silver)

Figure 39

HCS CCB (MAX)

```
Similarity
  Value      W Bk O R P Br B Gy S Pp Y M Gr G

   1.00      (xxx)
    .75      (xxx)    (xxx) (xxx)
    .63      (xxx) [xxxxx] [xxxxx] (xxx)
    .50      [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.62, $p < 0.01$. Conventions as in previous figures.)

Figure 40

HCS CCG (MAX)

```
Similarity
  Value      G S B R Gr P Pp Y M W O Bk Br Gy

   1.00      (xxx)
    .83      (xxx)(xxx)                  (xxx)
    .67      (xxx)[xxxxxxxxxx]           [xxxxxx]
    .50      [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.70, $p < 0.01$. Conventions as in previous figures.)

in the Girls' HCS remain as pairs until the all-term cluster at the 0.50 level. There is little structuring behaviour as with the other age groups although a beginning may be discernible.

Data Comparisons.

Next, the direct reporting of the data is supplemented by comparing them with other available data. In the results reported by FR for Adult Males (page 50) performing the same type of similarity judgment with Colour Names, three significant clusters appear. (The Colour Names underlined are the ones used in the present experiment).

Cluster 1. A Green-Violet cluster, [Chartreuse, Green, Olive, Blue, Turquoise, Pink, Crimson, Red, Scarlet, Magenta, Purple, Violet].

Cluster 2. A Brown cluster, [Bronze, Brown, Rust, Khaki, Beige, Tan].

Cluster 3. An Orange-Yellow cluster, [Orange, Gold, Mustard, Yellow].

The results recorded by FR for Adult Females in the same work gave four significant clusters:

Cluster 1. A Brown cluster, [Ivory, Silver, Brown, Khaki, Beige, Tan].

Cluster 2. A Red-Violet cluster, [Pink, Red, Crimson, Scarlet, Magenta, Purple, Violet].

Cluster 3. An Orange-Yellow cluster, [Orange, Bronze, Rust, Gold, Mustard, Yellow].

Cluster 4. A Green-Blue cluster, [Chartreuse, Green, Olive, Blue, Turquoise].

These clusterings are not absolute models: their origin lies in adult judgments of Colour Name similarities. Moreover, as the Colour Names presented to the adult subjects were more in number than those presented to the children, direct comparisons cannot be made. However, the clusters do give some approximation of adult performance which, with the clustering in the children's performance can, in turn, be compared with the Chapanis (1965) model of Colour Name dimensions. Bearing these cautions in mind, it is possible to discern similarities with these adult clusters as the children get older. For instance, the Girls in Group A put (Green, Blue) together at level 0.90; (Red, Pink) at level 0.73; (Yellow, Mustard) at 0.64 level. Gold, together with Silver, joins (Yellow and Mustard) at 0.55 level, but Orange joins (Red, Pink) at 0.73 level, Purple joins the (Red, Pink) pair at level 0.46 when (Green, Blue) merge with (Red, Pink, Orange) making the strong cluster [Green, Blue, Purple, Red, Pink, Orange] as though Purple linked (Green, Blue) with (Red, Pink). One of the main differences in Experiment 2 with the children, was the inclusion of the examples of the saturation dimension Black, White and Grey. These do not appear in the Colour Names presented to the adult subjects and alter the possibility of further comparison.

Comparing the Boys in Group A with the Adult Male subjects of FR, the (Green, Blue) pair occur at the 0.85 level, and (Red, Pink) at the 0.69 level. It is interesting to note also that these two pairs are clustered with Purple at the 0.39 level. (Compare Cluster 1 (Adult Males) with clusters at level (0.39 ACB). The Boys pair (Yellow, Mustard) at the 0.77 level and cluster Orange with that pair at 0.62. However, Gold stays with Silver.

Some of the children's HCS's clearly approximate to those presented for FR's Adult subjects.

It is possible then to discern something of the progression through the hierarchical structure as the clustering develops. When the HCS's are scanned from top to bottom, there appears to be,

1. A pairing stage of (Weak) clusters, with high values in all age groups.

2. A stage of sub-clustering of terms in excess of two : a further term joining one of the original pairs, or pairs joining pairs and so on, and

3. The large (strong) clusters made up of the sub-clusters and/or pairs.

These, of course, are the characteristics of an HCS, but having shown that it is present in the data and not imposed, a tentative progression in the structuring patterns can be established for these Colour Names.

At the first pairing stage, certain Colour Names are clustered at high similarity values. (Gold, Silver) for instance mostly at 1.00 level, and (Green, Blue) by Group A and B at the next highest levels, but not by Group C. The next pair (Yellow, Mustard) occurs at levels 0.71 and 0.93 by Groups A and B respectively, but not in Group C. (White, Black) are clustered by Group A at 0.63 level and by Group C at level 1.00. However, Group B splits this arrangement putting Black with Brown and White with Silver still attached (?) to Gold at level 0.53.

After these pairings, the next stage of weak sub-clusters [Green, Blue, Purple] are found at level 0.46 in Group A, and at level 0.69 in Group B. At the 0.50 level, Group A has the sub-clusters [Yellow, Mustard, Orange] occurring and at the 0.60 level [Black, Brown Grey] appears in Group B's HCS.

Fairly strong clusters, at the final stage in the HCS, occur at 0.46 level in Group A thus:

[Green, Blue, Purple]; [Red, Pink, Yellow, Mustard, Orange]; [White, Black, Grey, Brown].

At about the same level, 0.47, Group B approaches the adult clusters mentioned earlier with [Red, Pink, Green, Blue, Purple] amongst the penultimate clusters. The HCS for the youngest group shows that the three stages are present in a rudimentary form. (Gold, Silver); (White, Black) are paired first, then [White, Black, Brown] and (Red, Pink) appear followed by three clusters at the 0.80 level, [Gold, Silver, Purple] [White, Black, Brown, Grey] and (Red, Pink).

Summarising the results so far,

1. The comparison of the MAX/MIN calculations established that the method is sensitive enough to both detect structure and signal its absence.

2. The HCS shows that the older children are more sure in their structuring of Colour Names than the younger children.

3. There is little (agreed) structure in the data for Group C.

4. There are indications that the Girls' judgment of similarity more closely resembles the data drawn from FR's adult subjects' performance.

5. The data from the three groups follows a step by step HCS progression, pairing, sub-clustering, and strong clustering and this progression becomes more evident as the children get older.

Before these results are discussed, the results of the similarity judgments with Pronouns are reported.

5.5.2. PRONOUNS.

As with the previous results, the raw data was first examined to find how many piles were made by each group of children. There are sixteen English pronouns in common use, (all are used in this study) and the median number of piles made by each group are given in Table 4.

Table 4
Median number of piles of Pronouns by age and Sex.

Group	N	Median	Range	Group Median	Range
AB	13	7.1	3-8	7.3	3-8
AG	16	7.5	3-8		
BB	11	7.4	5-8	6.0	2-8
BG	13	3.9	2-8		
CB	13	5.5	3-12	6.0	3-12
CG	11	6.5	3-8		

The Table shows that in the case of Pronoun sorting, although it is clear that the older children make more piles, there is not the gradual increase noticed with the Kinship terms and Colour Names. There is little difference in the performances of Boys and Girls except for Group B where there is a difference in the median of 3.5.

Hierarchical Clustering
(MAX/MIN Comparisons)

Group A. Figure 41 shows that the two methods of arriving at the HCS for the older children, are in agreement and that the structures are alike as the hierarchy develops. Apart from You which is clustered with (Our, Your) by the MIN method and with (Me, My) by the MAX method, it is clear that a structure is present.

Group B. The structuring in the middle group's performance is very clear indeed as can be seen in Figure 42 where the two methods show agreement. There is a discrepancy with the pronoun I however, as I is merged with (Me, My) in the MIN version and with (We, Us) by the MAX method. The MAX method gives a final clustering at the 0.20 level whereas the MIN drops to 0.00.

Group C. The two methods of calculating the HCS for the youngest group is shown in Figure 43. This shows some agreement in the initial stages, for the terms (Him, Her), (Me, My), (He, We), [Their, Them and They], (You, Your) are clustered and at the same values by both methods. As

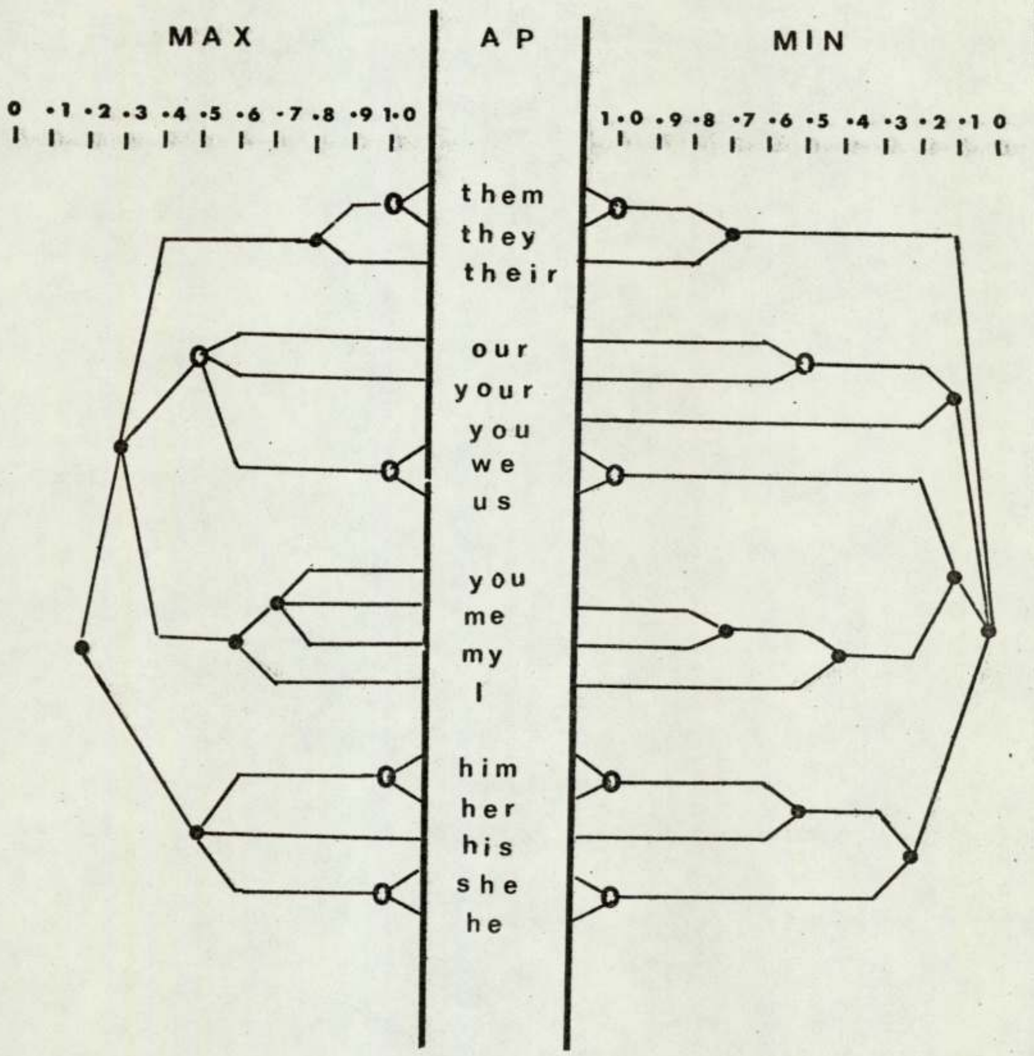

MAX
AP
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
them
they
their
our
your
you
we
us
you
me
my
I
him
her
his
she
he

Figure 41

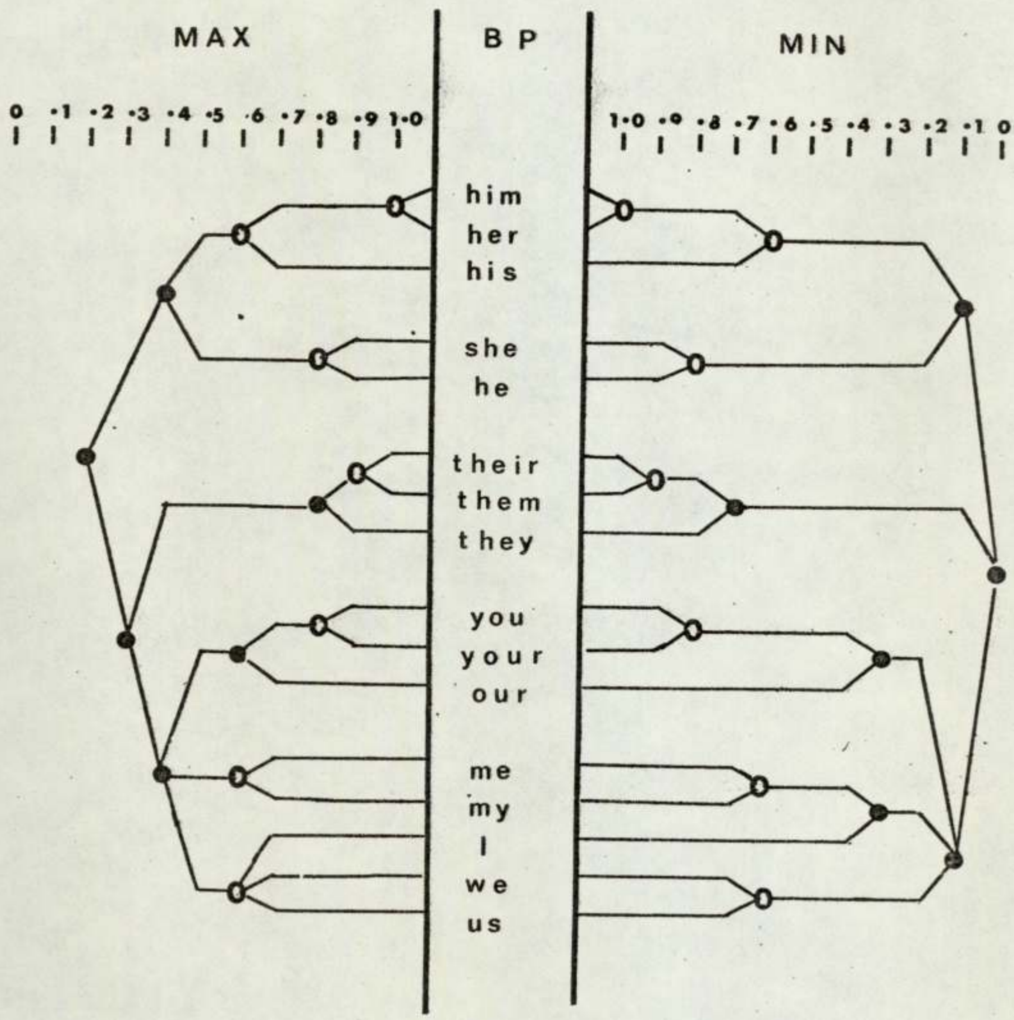
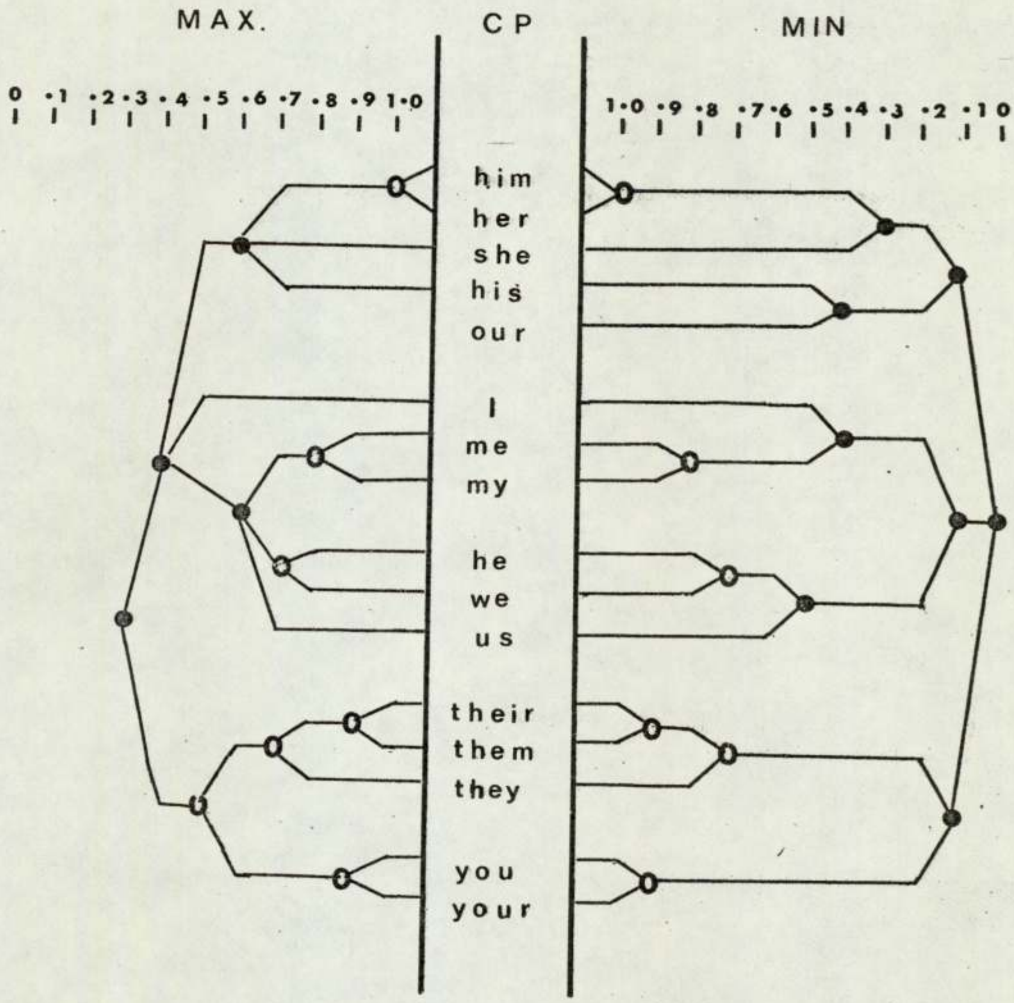

MAX
BP
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
him
her
his
she
he
their
them
they
you
your
our
me
my
I
we
us

Figure 42



MAX.
CP
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
him
her
she
his
our
I
me
my
he
we
us
their
them
they
you
your

Figure 43

As the HCS develops however, the structuring is less clear. (Figures 41, 42 and 43, see Appendix)

Content Analysis of HCS's AP, BP, CP.

For this reporting stage it is useful to refer to the underlying organisation of this group of terms in order to compare the children's performance.

Pronouns are classified traditionally into four components, Person, Gender, Number and Case and then further subdivided. The eight personal pronouns occur in four forms and their relationships can be displayed by the paradigm such as the one shown in Figure 44.

Figure 44.

				Not used in study
1st P. Sing.	I	Me	My	Mine
1st P. Plur.	We	Us	Our	Ours
2nd P. Sing./Plur.	You	You	Your	Yours
3rd P. Sing(M)	He	Him	His	His
3rd P. Sing (F)	She	Her	Her	Hers
Not used in Study	It	It	Its	Its
3rd P. Plur.	They	Them	Their	Theirs
Not used in Study	Who	Whom	Whose	Whose

Paradigm of Personal Pronouns
(After Gleason (1969, page 105))

Key:
P = Person; Sing. = Singular; Plur. = Plural;
(M) = Male; (F) = Female.

The personal pronouns inside the dotted line, apart from It(s), are used in the present study. Person can be first, second or third or distinguished into first and 'not first' and thereafter second and third.

Using this format and the adult performance given by FR (page 91), where the same terms are used, it is possible to analyse the experimental results in some detail. Figures 45-47 give the HCS's for the three age groups and for comparison the MAX version is chosen.

Figure 45
HCS AP (MAX)

Key to terms:

Tm = Them	Yr = Your	Hm = Him
Ty = They	Me = Me	Hr = Her
Tr = Their	My = My	S = She
W = We	Y = You	He = He
U = Us	I = I	Hs = His
O = Our		

```
Similarity
 Value     Tm Ty Tr W U O Yr Me My Y I Hm Hr S He Hs
  1.00     (xxx)    (xxx)                (xxx) (xxx)
   .82     [xxxxxx] (xxx)                (xxx) (xxx)
   .71     [xxxxxx] (xxx)      [xxxxxx]  (xxx) (xxx)
   .65     [xxxxxx] (xxx)      [xxxxxxxx](xxx) (xxx)
   .59     [xxxxxx] (xxx)      [xxxxxxxx][xxxxxxxxxxx]
   .53     [xxxxxx] [xxxxxxx]  [xxxxxxxx][xxxxxxxxxxx]
   .35     [xxxxxxxxxxxxxxxxxxxxxxxxxxx] [xxxxxxxxxxx]
   .24     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.61, $p < 0.01$)

Figure 46
HCS BP (MAX)

```
Similarity
 Value     Hm Hr Hs S He Tr Tm Ty Y Yr O M My W U I
  1.00     (xxx)
   .94     (xxx)         (xxx)
   .88     (xxx)   (xxx) [xxxxxx]
   .81     (xxx)   (xxx) [xxxxxx] (xxx)
   .69     [xxxxxx](xxx) [xxxxxx] (xxx)  (xxx) (xxx)
   .63     [xxxxxx](xxx) [xxxxxx] [xxxxxx](xxx) [xxxxx]
   .44     [xxxxxxxxxxx] [xxxxxx] [xxxxxxxxxxxxxxxxxx]
   .31     [xxxxxxxxxxx] [xxxxxxxxxxxxxxxxxxxxxxxxxxx]
   .25     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.61, $p < 0.01$)

Figure 47

HCS CP (MAX)

```
Similarity
  Value     Hm Hr Hs S O Me My He W U I Tr Tm Ty Y Yr
  1.00      (xxx)
   .92      (xxx)                            (xxx)    (xxx)
   .85      (xxx)         (xxx)              (xxx)    (xxx)
   .77      (xxx)         (xxx)              [xxxxxx] (xxx)
   .69      (xxx)         (xxx)  (xxx)       [xxxxxx] (xxx)
   .62      [xxxxxxxxx]   [xxxxxxxxxxx]      [xxxxxx] (xxx)
   .54      [xxxxxxxxx]   [xxxxxxxxxxx]      [xxxxxxxxxxx]
   .46      [xxxxxxxxxxxxxxxxxxxxxxxxxx]     [xxxxxxxxxxx]
   .39      [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, $r = 0.62$, $p < 0.01$.)

FR's adult group made six distinct clusters:

1. First Person Sing. [I, Me, My]
2. First Person Plur. [We, Us, Our]
3. Third Person Sing.(M) [He, Him, His]
4. Third Person Sing.(F) (She, Her)
5. Third Person Plur. [They, Them, Their]
6. Second Person (You, Your)

Looking now at the HCS's in Figures 45, 46 and 47 in relation to these clusters, the first difference provided by the children's data is that of the position of the First Person Singular, I. This appears in the HCS's of the three age groups thus,

AP Level 0.65 with [Me, My You]

BP " 0.63 " (We, Us)

CP " 0.46 " [Him, Her, His, She, Our, Me, My, He, We, Us]

If the First Person Plur. (Adult cluster 2) is similarly examined, the following differences emerge:

AP Level 1.00 (We, Us)

BP " 0.69 (We, Us)

CP " 0.62 (We, Us) in the cluster [Me, My, He, We, Us]

The third element, Our, does not cluster in the same way as the adult scheme and it does not appear solely with (We, Us). The older group have [We, Us, Our, Your], the middle group have [You, Your, Our, Me, My, We, Us, I] and the younger group had the three terms in a strong cluster [Him, Her, His, She, Our, Me, My, He, We, Us, I]. The pattern is a gradual approximation to the adult, the Nominative (We) and Accusative (Us) are becoming clearly established, but the Genitive (Our) is, as yet, only tentatively aligned.

The third distinctive Adult cluster from the FR data contains 3rd. Person Singular Male items. In the children's clustering there is a very noticeable pairing of (Him, Her). This follows the general characteristic noted with the Kinship HCS's where the children consistently pair Gender opposites. The cluster [He, Him, His] occurs at Level 0.59 in HCS AP but this cluster is made up by the merging of His with (Him, Her) and (She, He) which were paired at Level 1.00. In Figure 46 (BP), the identical cluster appears at Level 0.44 and this contains the sub-clusters (She, He) from Level 0.88, and [Him, Her, His] from Level 0.69. Again the children pair the Gender opposites as similar in meaning rather than cluster the items with Male attributes. The youngest group paired (Him, Her) at the 1.00 level and clustered [Him, Her, His] at the 0.62 level. These two clusteres merge at Level 0.46 in a large cluster but without She. (cf. (He, She) at high values in the other two groups).

The fourth distinctive cluster is the Female form of 3rd. Person Sing. (She, Her). As She has been paired so often with He, it is not surprising that this pair does not appear in the children's clusters as such but with their opposite Genders.

When the fifth distinctive cluster is compared with the three groups, [They, Them, Their] considerable agreement is found as the cluster appears as such in all three Figures. Group AP, Level 0.82, Group BP, Level 0.88, and Group CP, Level 0.77.

The final distinctive cluster, (You, Your) does not appear in Group AP's HCS, Figure 44, until the strong cluster at Level 0.35 as You has earlier been clustered with (Me, My) and Your with [We, Us, Our]. The pair occurs in Group BP's HCS at the 0.81 Level and at the 0.92 Level in Group CP's HCS.

The diagrams presented in Figures 48 to 51 illustrate the developmental progress of the children towards the adult model. Examining the diagram of the youngest group's HCS, the three strong clusters at Level 0.54 shows the beginning of the to-be-acquired structure. The appearance of the 3rd. Person Singular cluster without He is interesting as is the clustering of the 1st. Person Singular and Plural terms. The 3rd. Person Plural is clustered with the 2nd. Person at this stage but was separated earlier in the HCS.

Figure 48

FR (ADULT)(MAX)
(M + F)

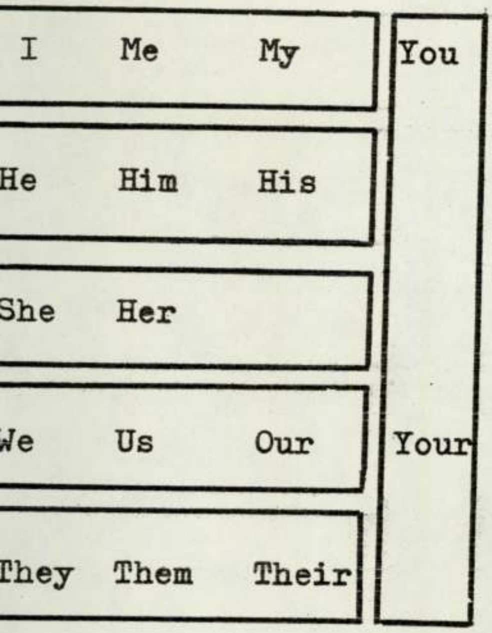
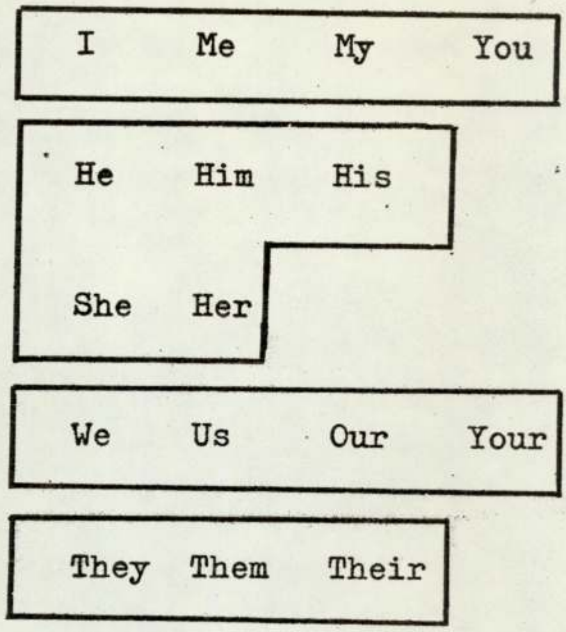


Figure 49

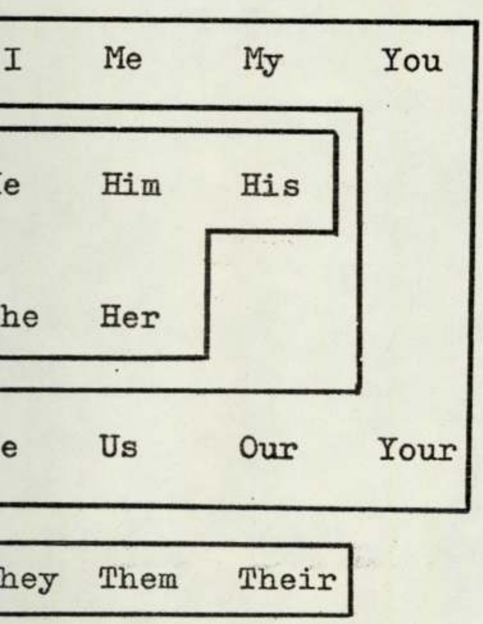
HCS AP (MAX)



Clusters at Level 0.53

Figure 50

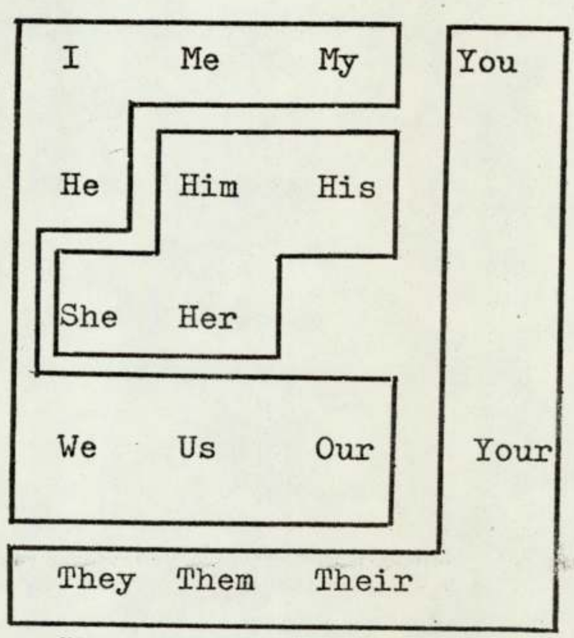
HCS BP (MAX)



lusters at Level 0.44

Figure 51

HCS CP (MAX)



Clusters at Level 0.54

If the middle group's performance is next inspected, Figure 50, it will be seen that at Level 0.44 there are again three distinct clusters. The 3rd. Person Singular now includes all the terms and the 3rd. Person Plural is separate. However, the other cluster contains a mix of 1st. Person Singular and Plural terms together with the two 2nd. Person terms.

The older Group's HCS, taken at Level 0.53, shows four distinct clusters. The two strong clusters established earlier, the 3rd. Person Singular and Plural terms are now clear and stable as in the diagram (Figure 49) and the 1st. Person Singular and Plural are established as distinct clusters. Number is now a component helping them to distinguish the terms but, as yet, the children do not recognise the Gender distinction as do the Adults. According to FR's results, Case is not a prominent component and these terms are clustered first. In the children's HCS's it is the Gender terms (He, She) (Him, Her) that are clustered first in the same case. However, the Adult characteristic of pairing nominative and accusative terms has begun with (We, Us) (They, Them) but here, of course, Gender is not applicable.

The Performance of Boys and Girls Compared.

Having examined the performance of each age group in turn, it is now necessary to discover whether the data conceal differences in the ways in which Boys and Girls judge similarity. The MAX/MIN versions for the three groups will be checked first. They are to be found in Appendix 3, Figures 52 to 57.

APB and APG.

Figures 52 and 53 give comparisons of the structure details of the oldest group. It is clear from the two diagrams that latent structure is present in the children's judgment performance, although there are minor variations. In APB, the term I is clustered with (Me, You) by the MAX method and with Your by the MIN method. Again Our varies in its position. By the MAX method it occurs with (Him, Her) when those terms join [She, He, His], and by the MIN method it clusters with (His, My). In APG, there is almost complete agreement by the two methods with no differing terms.

BPB and BPG.

The performance of the middle group is given in Figures 54 and 55, and the detail of the two calculations shows minor variations in the versions of the structure. For instance in the BPB diagram, the MIN method shows Our joining His, and then Us joins this cluster, whereas by the MAX method, Our joins (You, Your) and Us clusters with (We, Me). In BPG, there are also small variations. I clusters with (We, Us) in the MAX version and with Your by the MIN method, but the 'topology' is the same although the values vary.

CPB and CPG.

The comparisons of the MAX/MIN methods of calculation are given in Figures 56 and 57 and there are differences in the two HCS's for both Boys and Girls. We, for example in CPB, is clustered with He by the MAX version and with (Me, My) by the MIN method. There are variations with other terms also, and the topology matching indicates that the structures are not stable. The same is true of the Girls' performance in CPG, where the differences are even more marked.

Figure 58.
HCS APB (MAX)

```
Similarity
  Values    Tr Tm Ty W U M Y I Yr O Hm Hr S H Hs My

   1.00     (xxx)
    .90     (xxx)          (xxx)          (xxx)
    .70     [xxxxxx]       (xxx)          (xxx) (xxx)
    .60     [xxxxxx] (xxx)[xxxxx]         (xxx) (xxx)
    .50     [xxxxxxxxxxx][xxxxx]          (xxx) [xxxxx]
    .40     [xxxxxxxxxxxxxxxxxxxxxx] [xxxxxxxxxxx]
    .30     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.6237, p< 0.01.)

Figure 59.
HCS APG (MAX)

```
Similarity
  Values    W U O Yr Tm Ty Tr M My I Y S H Hm Hr Hs
   1.00    (xxx)
    .91    (xxx)       (xxx)    (xxx)     (xxx)
    .72    (xxx)       [xxxxxx] (xxx)     (xxx) (xxx)
    .64    (xxx)       [xxxxxx] (xxx)     (xxx) [xxxxxx]
    .55    (xxx)       [xxxxxx] (xxx)     [xxxxxxxxxxx]
    .46    [xxxxxxx]   [xxxxxx] [xxxxxx]  [xxxxxxxxxxx]
    .36    [xxxxxxxxxxxxxxxxxx] [xxxxxx]  [xxxxxxxxxxx]
    .27    [xxxxxxxxxxxxxxxxxxxxxxxxxxxx][xxxxxxxxxxx]
    .18    [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.6184, p< 0.01.)

If the Boys' and Girls' performance (Figures 58, 59) is next inspected, the following differences emerge. The Boys in Group A have two strong clusters at Level 0.40, one containing the 3rd Person terms and the other clustering the rest apart from I. The Girls in that Group on the other hand cluster the terms in the same way but include My. It is worth noticing that at the level before the two cluster level, they cluster [Me, My, I] as in the FR adult model.

The middle Group's diagrams shown in Figures 60, 61, have the following features of interest. The Boys' two strong

Figure 60.
HCS BPB (MAX)

```
Similarity
  Value     Hm Hr Hs S H Y Yr O I My W M U Tr Tm Ty

   1.00     (xxx)
    .88     (xxx)     (xxx)
    .75     (xxx)     (xxx)(xxx)                    (xxx)
    .63     (xxx)     (xxx)(xxx)                    [xxxxxx]
    .50     (xxx)     (xxx)(xxx)   [xxxxxxxx]       [xxxxxx]
    .38     [xxxxxx]  (xxx)[xxxxxx][xxxxxxxx]       [xxxxxx]
    .25     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]  [xxxxxx]
    .13     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, $r = 0.5870$, $p < 0.02$.)

clusters, at Level 0.25, have the 3rd Person Plural terms in one, and all the other terms in the other. The Girls' on the other hand have the 3rd Person Singular terms clustered at the 0.56 level on one of their final two strong clusters.

Figure 61.
HCS BPG (MAX)

```
Similarity
  Value     Tm Ty Tr W U I O Yr Y M My Hm Hs Hr S H
  1.00      [xxxxxx] (xxx)               (xxx)
   .89      [xxxxxx] (xxx)  (xxx)   (xxx) [xxxxxx]
   .78      [xxxxxx] (xxx)  [xxxxxx](xxx) [xxxxxxxxxxx]
   .67      [xxxxxx] [xxxxx][xxxxxx](xxx) [xxxxxxxxxxx]
   .56      [xxxxxxxxxxxxxxxxxxxxxxxxxxx] [xxxxxxxxxxx]
   .44      [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.61, $p < 0.01$.)

The youngest age Group's HCS's are shown for Boys and Girls in Figures 62, 63. Here the final two strong clusters in the Boys' performance show 3rd. Person Plural and 2nd. Person terms clustered in one and the rest in the other.

Figure 62.
HCS CPB (MAX)

```
Similarity
  Value     Tr Tm Ty Y Yr M My W H I U Hm Hr S Hs O
  1.00      (xxx)        (xxx)
   .88      [xxxxxx] (xxx) [xxxxxx]      (xxx)
   .75      [xxxxxx] (xxx) [xxxxxxxx]    [xxxxxx]
   .63      [xxxxxx] (xxx) [xxxxxxxx]    [xxxxxx]
   .50      [xxxxxxxxxxx] [xxxxxxxxxxxxxxxxxxxxxxxxxx]
   .38      [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, r = 0.6254, $p < 0.01$.)

The Girls on the other hand have 3 clusters at the penultimate stage in their HCS. At Level 0.67 they also cluster the 3rd. Person Plural terms with one of the 2nd. Person terms. They cluster the 3rd. Person singular terms [Him, Her, His] but not She, He and finally [We, Us, He] come together. However the topology of this CPG (MAX) HCS has

Figure 63.
HCS CPG (MAX)

```
Similarity
  Value      Tm Ty Y Yr Tr I Hm Hr Hs O W U H S M My

  1.00       (xxx)           (xxx)
  .83        (xxx) (xxx)     [xxxxxxx]
  .67        [xxxxxxxxxxxx]  [xxxxxxx]  [xxxxx]
  .50        [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

(Correlation between DM and UD, $r = 0.7181$, $p < 0.001$.)

not the characteristics of the others and some doubt as to the presence of structure has already been mentioned in the earlier comparisons.

5.6. DISCUSSION OF THE RESULTS.

The dimensions of the semantic domains, or the to-be-acquired structures, are discussed in the order presented and then comments made on the three Domains of the two experiments.

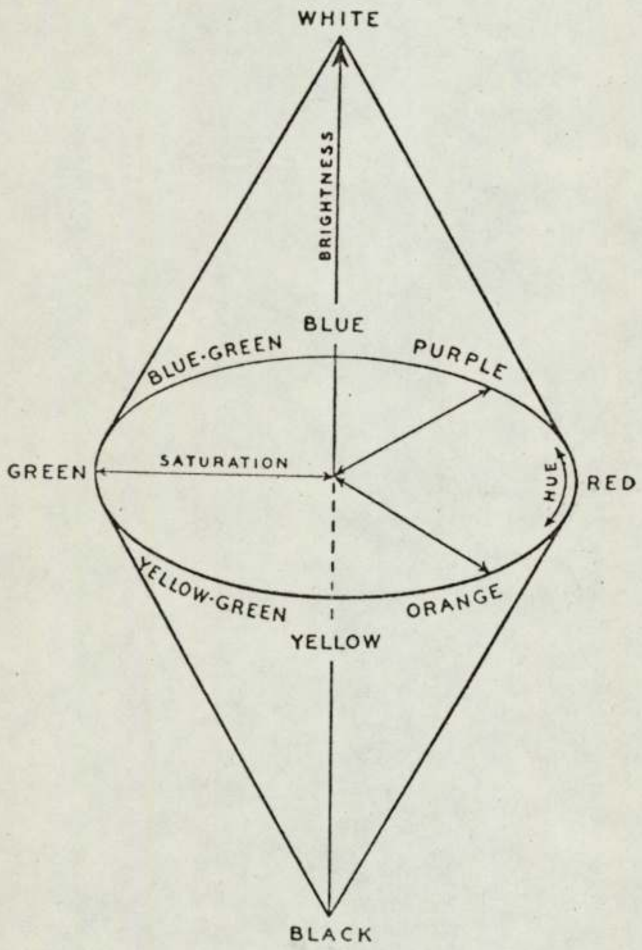
1. The dimensions of Colour Space (Names)

Chapanis (1965) gives three dimensions for Colour Space. These are:

1. Hue, which is the reflection of light at different wave-lengths.
2. Brightness, the reflection of more or less light, commonly referred to as 'light' and 'dark', and
3. Saturation, the degree of freedom from dilution from White, commonly referred to by words such as 'weak' or 'strong', 'pale' or 'deep'. Colours are usually referred to by all three dimensions of variation.

In Figure 64, there is a schematic representation of these dimensions as given by Chapanis (1965, page 329) showing how Colour Space might be comceptualised. According to this model, colours, it is suggested, can be placed according to their position in the three dimensions. Thus, eg. Pink refers to a range of colours of reddish Hue, fairly low Saturation. Brown refers to a range of colours between Red and Yellow in Hue, fairly low Saturation and Brightness.

Figure 64



However, Black, Grey, White differ mainly along one dimension, Brightness. Among the three dimensions, Chapanis points out that, 'Hue is perhaps the most important variable of colour as a mental phenomenon' for it is the main quality factor. The Brightness dimension is said to have largely a quantitative aspect and as with Hue forms a continuum. Examples given for 'zero Saturation' are Black, White, Grey. Colour Space is defined by Chapanis (1965, page 330) as 'that three-dimensional space which models Colour in all possible variations of Hue, Brightness, and Saturation'.

As mentioned earlier the total number of discriminable colours is very large, but only some twelve terms are in common use. Children in the age groups with which this study is concerned probably employ these twelve terms daily and they all appear in the lists of 'most frequently occuring' words of Burroughs's (1957) Vocabulary Count. However, to make the judgments required by this experiment, the children also have to appreciate the relationships applying between the denotata. In other words, what children 'mean' by the various colour names. Thus, to put together Colour Names like Yellow, Mustard, Orange in a pile requires considerable experience of the physical properties of colours on which to base the fairly close discrimination required by the judgment task. It is plausible to hypothesise however, that if colours have the physical characteristics which can be defined by a model like the three-dimensional one of Chapanis, then children will appeal to these dimensions to guide their judgments. Further, if one dimension is said to have more importance than another, then this is likely to be appreciated earlier in the developmental pattern.

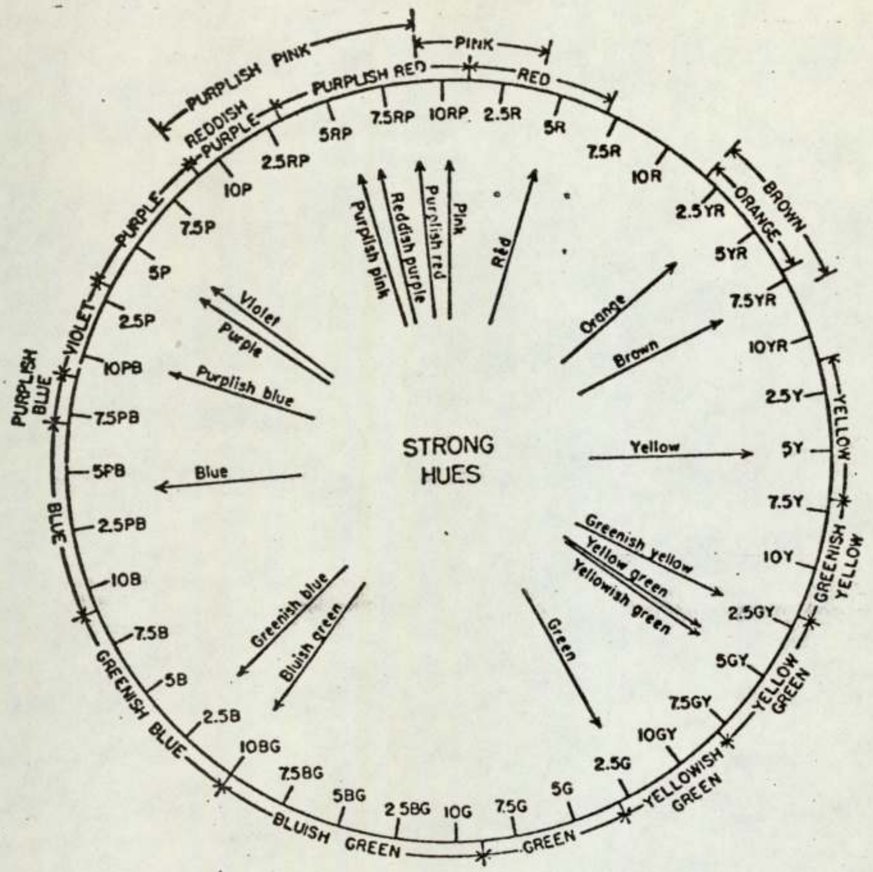
The set of Colour Names presented to the children included three (White, Black, Grey) which are colours of 'zero saturation' and these were included purposely to observe the children's performance with them. Others refer mainly to Hue, which is said to be the more important dimension, although there are more subtle interrelationships present.

The representatives of dimension 3, [White, Black, Grey] are clustered (with Brown) at the 0.80 Level by the youngest group. (Figure 28). This is a prominent cluster before the ultimate all-term cluster. In Figure 27, at Level 0.47, the middle age group clusters [Black, Brown, Grey], but cluster White with (Gold, Silver). The oldest group, (Figure 26), make [White, Black, Grey, Brown] one strong cluster of two at Level 0.25, although the terms were clustered earlier at Level 0.46.

It is interesting to notice that Brown, reckoned as low in Saturation, is included by the children in their clusterings and is clear evidence to support the hypothesis. In the earlier clusterings however, Black is paired with White by Group AC and CC, whilst Group BC splits this pair.

If the Hue dimension is examined in the same three HCS's (AC, BC, CC, in Figures 26, 27, 28), the strong Hue colours (Red, Pink) are clustered early indicating that they are judged as similar. This follows very closely indeed a second Chapanis (1965, page 341) diagram for strong Hues.

Figure 65.



The strong hues are shown in Figure 65 as arrows radiating out from the centre. The scale and the symbols around the inside of the circle show the location of the principal Munsell hues. The short arcs outside the circle are the ranges for strong Hues as defined by experts, and the arrows give the mean selection of Chapanis's subjects for these Hues. The outside arcs show the close relationship of (Red, Pink), but when Brown and Orange are observed, because perhaps of the domination of the Saturation dimension already mentioned, the children do not cluster them. However, if Orange, Yellow, Mustard (Greenish Yellow?) are examined in the three HCS's, they do not occur in the youngest Group's scheme, Yellow and Orange come together in the middle Group's HCS, and Yellow, Mustard, Orange in the oldest Group's HCS at

Level 0.50.

Continuing anti-clockwise round the circle, Green, Blue and Purple are the next strong Hue colours. These do not appear in the youngest Group's performance as clusters, but do occur clustered at Level 0.67 by Group BC, and at Level 0.46 by the older Group.

The other dimension Brightness has not been represented by the selection of Colour Names in the experimental material so it is not discussed.

The results show clearly that the underlying dimension of Saturation is well established in the early developmental pattern and so is the Hue dimension but this lags behind.

2. Turning now to the Pronoun results, the diagrams of the clusterings made by the children in the three age groups compared with the adult (FR) performance (Figures 48-51), clearly demonstrates the gradual approximation to the adult grammatical model. It is interesting to note, however, that within these strong clusters are the earlier pairings at the weak cluster stage which are also illuminating as they give a different measure of similarity. For instance, in AP(MAX) Figure 49, if the 3rd. Person Singular cluster is examined, it would appear that the Gender opposites are judged to be closer in similarity terms than those of the same sex. This is characteristic of the three age group's performances along this dimension. The acknowledgment of the antonymic Gender dimension is pervasive.

In each case, something about the prominence of the features involved is being indicated. It would seem that sex has less consequence than other differences, and that case has less cognitive weight for the children than the adults.

5.6.1 DISCUSSION OF CLUSTER ANALYSIS RESULTS.

To recapitulate, the main purpose behind these two experiments was to discover ways in which children structure relationships between word meanings in terms of an instruction to put together those that are 'nearest' or 'closest' in meaning. To do this, semantic domains having clear structures were chosen and the method of card sorting adopted to learn how children judged the extent of the relationships existing between the words in any particular domain.

Among the reasons for choosing semantic domains or fields, apart from the obvious that they are to be acquired by children, was the availability of sources for analysis. Such studies as those provided by Wallace and Atkins (1960) and Romney and D'Andrade (1964) in the Kinship domain, by Chapanis (1965) in the case of Colour Names and the rules of grammatical analysis with Pronouns. These studies provided models with which the performance of the children might be compared.

To comply with the experimental instructions, the children had to judge which words were closely related to each other within a restricted organisation of know dimensions. This, it was hypothesised, would require of the children discriminating ability based on knowledge of the features that distinguish one word from another together with an estimation of the saliency of those features.

Looking at the results in these terms, the following generalisations might be made.

1. The oldest children showed greater discrimination with the Pronouns when 'piling' the terms, but there was little difference with the Colour Names.

2. That there was a progression in the children's performance so that the oldest group's performance was more like the models than the youngest group's. This was shown by the progress in structuring; the oldest children's HCS's being much more stable than the youngest children's as well as the content which showed greater appreciation of the dimensions of the domains.

The stages of the hierarchical clustering schemes, termed in this study pairing, sub-clustering and clustering, revealed some detail of the acquisition process. Firstly the pairings, within the limites of the material, were largely antonymic. That is terms that were essentially opposite were judged as close or near in meaning. eg. (Mother, Father); (Uncle, Aunt); (Gold, Silver); (Black, White); (Him, Her); (He, She). This persisted throughout, although there was a slight tendency in some groups for this not to be clear. eg. White going with Silver (and Gold) in Figure 38 when a sub-cluster was formed in the HCS. Again, in Figure 46, His joins (Him, Her), and although this may be a 'Case' feature, it is an indication that the feature 'Male' is assuming dominance.

SUMMARY 5.

1. The experimental results gave clear indications that the children's establishment of 'meaning relationships' was one that gradually approximated to that of the models and FR's adults with increasing age.

2. In this process, it was the children's increasing awareness of the organisation of the underlying structure of the semantic domains that increased their ability to perceive finer relationships between the lexical items involved.

3. The initial pairing stage of the children's HCS, within the limits of the experimental material, was largely in terms of opposites and contrasts. There were indications that this stage was followed by a sub-clustering stage which showed the developmental growth of discrimination.

6.0. EXPERIMENT 3.

There is no doubt that linguistic models, such as those of Katz and Fodor discussed in Section 2.1, provide the researcher with powerful insights, however, the main concern of the linguist remains a study of the 'ideal speaker/hearer'. The linguistic focus is naturally on language itself, (that which is being acquired by the subjects in this study) whereas the psychologist is much more concerned with the language user. Chomsky pointed to this division in his earlier works when he drew the distinction between competence and performance. (Chomsky, 1957). No dichotomy is intended by recalling this distinction but rather to call attention to the strengths of the two areas of scholarship which will be utilised where applicable. That they are bound to be closely connected is obvious, and Hamilton and Deese (1971) have demonstrated in their study, 'Does Linguistic Marking Have a Psychological Correlate?' that they are associated in the specific area of this present work.

It is well nonetheless to heed the advice of Marshall (1970) who observes,

> 'If closer attention were paid to the psychological structure (ie. interpretations) of lexical items, certain suspicions on the form of the dictionary entries would be brought to light. In particular, one might wonder if it is possible to discover a single evaluation metric that captures relevant generalisations about semantic structure'.

Whilst the two experiments reported in Sections 4.0. and 5.0. do not pretend to reveal a 'single evaluation metric';

at a more humble level, some of the evidence points to general trends underlying the performance of the children as they made their judgments, for the children's response patterns have clear psychological implications.

It should be recalled that the perspective adopted for this study was a dynamic one, perhaps best encapsulated by Rommetvëet's proposed 'associative state' (see Section 1.2). This was defined as 'an induced state of evocating a temporary reordering of an internal vocabulary in terms of relative availability'. Putting the strategies adopted by the children, as revealed by their structuring patterns in terms of this definition, it could be said that the instructions to pile together words that were 'close' or 'near' in meaning would cause the children to judge from among the many various associations alerted by the array of stimuli presented to them. The set of terms available would have the clear boundaries of the semantic field being investigated and these boundaries would have been tightened still further in some cases by the experimenter's selection of particular terms within the field. For example, a subset (those most frequently occurring) of Colour Names was chosen from among the many that exist.

Although the areas chosen for study were restricted in this way, many types of association would be alerted within these closely bounded sets arising from each semantic field's particular organisation. Thus, when complying with the experimenter's instructions, the subjects would attend to certain features and neglect others. It is plausible to hypothesise that the choice of the words grouped together in the piles would reflect the saliency of these features to the children at the time of the experiment. It is further suggested that the strength of the associations available to the subject would vary according to the children's placement along the developmental continuum. Some features, for instance, would increase in strength as the children aged, and others might possibly decrease. This, of course, assumes that most types of association are present in embryo within the organisation of the internal vocabulary of the youngest group. Support for this was given by Macnamara et al (1972) when they claimed that 'all the essential features of the adult lexical structure are already present' at the age of five. However, 'the body of information is much more limited in children'. From the results of Experiments 1 and 2 the children's ability to recover the structure inherent in the experimental materials was seen to increase with age. It was further shown that the details of the Hierarchical Clustering Schemes of the older children resembled more closely the adult models proved by Fillenbaum and Rapaport than those of the youngest group. It was suggested from the content of these performances that the characteristic progression of these cluster hierarchies was from an initial pairing (weak clusters), through a sub-cluster stage, (usually of one additional term or combination of two 'weak' pairs) to a cluster of many terms, (the strong cluster).

It is clear from these results that the children are associating terms during the judgment process, and some tentative generalisations can be made when these relationships are examined. Firstly, it would appear that the children associate what might be called opposites as 'close' or 'near' in meaning. Antonymy, or 'oppositeness of meaning' has long been recognised as one of the important semantic relationships, but as Lyons (1968, page 460) points out, has erroneously been regarded as complementary to synonymy. Synonymy and antonymy are sense-relations of quite a different kind. According to Lyons, Antonymy is best looked upon as one of three types of opposites. There is the complementary relationship which exists between such words as single : married, male : female, and can be regarded as a special case of incompatibility. That is, 'the assertion of one member of a set of incompatible terms implies the denial of each of the other members of the set taken separately'. For the second type of 'oppositeness' Lyons reserves the name antonymy exemplified by the terms big and small in English. The characteristic of antonyms being that they are gradable. The third-sense relation is termed Converseness such as the conditions that holds between buy and sell or husband and wife.

When exploring meaning, and similarity in particular, synonymy, the other type of relation mentioned above, must also be discussed. It is probably true to say that an instruction to put together words as 'close' or 'near' in meaning would be interpreted by many adults as a request to cluster synonyms. Lyons (1968, page 407) points out however, that synonymy can have stricter or looser interpretations. For two items are synonymous if they have 'the same sense'. It is widely held, however, that there are few, if any 'real' synonyms in natural languages. Making this distinction Lyons, (1968, page 448) puts forward a classificatory scheme illustrating four possible kinds of synonymy. 1. complete and total synonymy; 2. complete but not total; 3. incomplete, but total and 4. incomplete and not total. The purists, (from the linguistic point of view), have complete and total synonymy in mind when they speak of 'real' (or absolute) synonymy, but there are very few examples of this. Lyons further suggests that if this notion of complete identity is abandoned the whole question is much more straight forward.

> 'Synonymy', to quote Lyons again (page 452), 'is not essential to the semantic structure of language, it arises in particular contexts as a consequence of the more fundamental structural relations, hyponymy and incompatibility'.

The other type of semantic relationship considered by linguists to be fundamental in the structure of vocabulary is hyponymy, which is often referred to as 'inclusion'. Hence, 'the 'meaning' of scarlet is said to be 'included' in the 'meaning' of red, the 'meaning' of tulip is said to be 'included' in the 'meaning' of flower, and so on'. Class inclusion is thought to be important in this particular study as it carries with it the idea of superordination which was hinted at earlier in the evidence from other developmental studies. (See Section 2.4 where the work of Shaeffer et al (1971) was quoted). Lyons (1968, page 454 et seq.) for example refers to 'scarlet, crimson, vermilion etc. (as) co-hyponyms of red, and tulip, violet, rose etc. (as) co-hyponyms of flower. Conversely', he says, 'red is superordinate with respect to its hyponyms ....'

From the foregoing linguistic descriptions it is evident that intricate semantic relationships exist among apparently 'simple' terms and in acquiring his language the child obviously has to master this complexity. However, although the organisation of semantic relationships may be both complex and subtle, it appears possible to distinguish three broad linguistic classifications. The logical continuity of these relationships of synonymy, antonymy and hyponymy, is put clearly by the linguist Bierwisch (1970, page 170) who, in a subsection of an article on semantic entitled 'The Dictionary as a system of concepts', proposes that the meaning of a word is

> 'a complex of semantic components (or features or markers) connected by logical constraints'.

Following this assumption he suggests that,

> 'two entries E_1 and E_2 are synonymous if their meanings consist of the same components connected by the same logical constraints. E_1 is a hyponym of E_2 (ie. E_1 is included in E_2) if the meaning of E_1 contains all the components occurring in the meaning of E_2, but not vice versa. Thus WOMAN might be a hyponym of ADULT, since the former but not the latter contains for example the component FEMALE. E_1 and E_2 are antonyms if their meanings are identical except that the meaning of E_1 has a

> component C where that of E_2 had C^1, C and C^1 belong to a particular subset of mutually exclusive components.'

From this analysis it would appear that the words having antonymic or opposite relationships have many components in common except the mutually exclusive component. (Hamilton & Deese (1971) make the point also that it is generally assumed that 'binary opposition arises out of minimal contrast'). On the other hand synonyms have (strictly) the same components whereas the hyponym carries the characteristic of non-reversibility.

For the purposes of this study the analysis of Lyons will be followed for definitions of the linguistic terms, oppositeness (including antonymy), synonymy and hyponymy. So, the category of opposites (O) will include the relationships outlined above, Synonyms (S) will cover those words that have roughly the same sense-relationships. 'Two (or more) items are synonymous if the sentences which result from the substitution of one for the other have the same meaning', (page 428), and Hyponyms (H) will carry the inclusion concept.

Having discussed the results of Experiments 1 and 2 alongside linguistic descriptions, it is now necessary to explore more fully the psychological method to be used in the following experiment. As reported already, Kintsch (Section 2.3) advocates the use of free recall as the method most likely to provide insights about the storage of semantic relationships.

He states,

> 'semantic markers play a crucial role in the retrieval process; given that a word has been recalled its marker will determine what word will be recalled next. Thus output order in recall should reflect semantic relationships.'

The subjects in his experiments were adults and it was shown that their clustering organisation increased with the number of trials. Tulving (1966) also argued that multitrial-free-recall-learning was a better method than the single presentation free recall method.

A great deal of work has been carried out in this area, of course, and Cofer (1967) gives a useful summary of the work done as well as putting forward conclusions following his own experiments. He makes three assertions (page 212) which are pertinent to this work. The first of these was that,

> 'inter-item associations provide the major basis for variation in the amount recalled, for lists composed of categorized items as well as those composed of sets of associates to the list name'.

His second assertion was that,

> 'a major factor associated with the failure of recall to approximate list length, is the serial position effect'.

The third assertion was that,

> 'contextual or conceptual factors do not seem to be involved in recall of correct items'.

However, he does clarify his first statement later by saying that,

> 'pairs of words the members of which are easily categorized together (eg. eagle, crow) are better recalled and cluster more than pairs of words of equal associative overlap which are not easily categorized together (eg. soft, silk)'.

In a recent report, Cole et al (1971) examined the development of free recall learning in children in grades one to nine, (ie. aged 6 to 14 years). Their subjects' recall was investigated using measures of (a) category clustering, (b) components of clustering scores, (c) serial position effects and (d) seriation of response Orders. Their main findings were that,

> 'manipulations which increased amount recalled did so by increasing accuracy in the middle or early portions of the recall list. Age differences, for instance, do not occur in the late serial positions. Category clustering ordinarily increased with increased accuracy; when category clustering was of sufficient magnitude, it reduced serial position effects. Analysis of the subject's tendency to output the lists in serial order indicated a large difference between the first and subsequent learning trials; serial outputting was characteristic of Trial 1 only. Although performance on the accuracy and clustering measures increased with grade, interactions between grade and other independent variables was generally lacking'.

In their work the authors do point out that,

> 'In several studies using college students, clusterable lists have produced the expected augmentation of recall. The mechanisms for this augmentation is, as yet, unclear; but the basic phenomenon is sufficiently well established to warrant an enquiry into the relation between age and augmentation of recall for clusterable lists'.

Before reporting the final experiment, it is important to discuss briefly the general findings of another large area of study that is intimately connected, that of Word Association. As is well known there is a great wealth of data already collected on this and a very useful summary has been made by Cramer (1968). This work can be used as a basis for comparing some of the experimental results that follow. Among the most pertinant of Cramer's divisions of the field are the demographic variables of age and sex. Recording Age Variables, Cramer states that,

> 'an examination of the words which constitute the associate response hierarchy shows
>
> (A) Considerable response overlap from year to year, and
>
> (B) that changes are continuous and incremental rather than occurring in discrete, independent stages.
>
> Studies of the grammatical form class of associative responses indicate that
>
> (A) primitive noun responses decrease from nursery school on,
>
> (B) syntagmatic responses decrease from age 5 to college, and
>
> (C) paradigmatic responses increase from age 5 to college.
>
> (a) This increase occurs earliest (5-6 years) for adjectives, reaching an asymptote by age 8;
>
> (b) an increase for verbs occurs most markedly between 8 and 10 years;
>
> (c) a relatively small increase for nouns is due to the fact that noun responses are already very frequent at age 5.
>
> Supraordinate responses
>
> (A) increase from Grade 1 through 6, and then decrease;
>
> (B) for stimuli of low Thorndike-Lorge frequency, the increase continues to Grades 7 and 8 (ie. 12 and 13 years of age);
>
> (C) are given more often in Grade 4 (ie. 9 years of age) than by adults.
>
> Contrast responses increase from Grad 1 (ie. 6 years of age through college.
>
> Sex variables.
>
> The frequency of responses of rank 5 and lower in the associative hierarchy is not different for females and males.

Response heterogeneity is greater for males than for females.

Response availability is the same for female and male children.

Paradigmatic Primary responses are given more often by male than by female college students.

Supraordinate responses are given more often by males than by females.

Contrast responses are given more often by females than by males.'

Experiment 3.

If, as Kintsch suggests, 'output order in recall should reflect semantic relationships,' then it is hypothesised that the linguistic features of Oppositeness, Hyponymy and Synonymy as defined above, will be examples of major association categories falling within a semantic marker type organisation in lexical memory. It is further suggested that these association types would operate according to their saliency within the child's internal vocabulary. If this is correct, (and it does seem plausible,) then the effects mentioned would vary in recall within the three categories of association and will predominate in clustering along the developmental continuum.

An experiment was set up to investigate these proposals having the following objectives and using free recall as its method.

1. To observe the effects of pairs of words controlled for differing association saliencies.

2. To examine the ability of children to recall three

types of association defined as:

a. Opposites (O) e.g. King, Queen.
b. Hyponyms (H) e.g. Fruit, Apple.
c. Synonyms (S) e.g. Children, Kids.

3. To trace clustering patterns of these associations in recall along a developmental continuum, and in relation to objectives 1 and 2 above.

6.1. CHOICE OF SUBJECTS.

The subjects selected for this experiment were taken from a school in the County Borough of Warley. The area is one of high-rise flats and recent development. Many of the parents of the children work in local factories in skilled or semi-skilled occupations.

The organisation of the school is such that there is a two year age spread in each group excluding the reception class. Hence children in their first and second years at school (six and seven years old) are divided into two groups or classes. This pattern, known in educational circles as vertical grouping, is repeated throughout the school. Three groups of children were drawn at random from these class age groups and Table 6 gives the mean ages of these children by group and sex. English was the mother tongue of all the children involved in the experiment, and no child chosen as a subject was reported as being deficient in hearing or speech.

The composition of the three groups was such that A had children from 10 to 11 years, Group B, 8 and 9 years and

Group C, 6 and 7 years. The age spread was from 11 years 1 month to the youngest girl who was barely six years

Table 6
Groups by age (months) and sex.

GROUP	N	Mean Age in months	Group Mean Age	SD
A Boys	14	123.95	124.25	6.8
A Girls	16	124.50		
B Boys	16	99.6	100.00	6.0
B Girls	14	100.4		
C Boys	16	74.3	74.3	6.5
C Girls	14	74.2		

old at the time of the experiment. The groups were comparable in age between group and by sex within groups.

6.2 MATERIALS.

Two lists of twelve words were composed such as to meet the following criteria:

1. All twenty-four words were in List 1 of Burroughs (1957) Vocabulary Count. Word frequency was thus controlled to the more frequently occurring words in the child's vocabulary.

2. One of the lists, List 1 represented words of relatively high association value and List 2 words of relatively low association value. The norms of association used were

those of Keppel and Strand (1970). This collection has been obtained by using the primary responses and some other responses from the work of Palermo and Jenkins (1964), and are presented as association hierarchies. The Keppel and Strand Norms contain frequencies which are listed as percentages.

In free association, the experimenter does not require the subject to favour any particular associative bond. Therefore, a number of different association type are produced in a response hierarchy. Some, probably because they are more common than others, have superior strengths of bondage. Part of the response hierarchy for the stimulus word 'animal' is tested overleaf as an illustration of a possible file of associations together with their percentages of occurrence. In the column on the right of the figure the present author suggests possible association types and origins. And here, paradigmatic has the sense given by the definition of Lyons (1968, page 429), 'all members of the set of semantically-related terms that can appear in the same context'.

Figure 66

Part of the list of responses to the stimulus word 'animal' with annotations. (Adapted from Keppel and Strand, 1970, page 188/9).

No.	Responses	%	Suggested association origin.
1.	dog	22.5	class inclusion : predicate 'is an'.
2.	vegetable	7.7	paradigmatic as in 'animal, vegetable and mineral'.
3.	cat	6.6	as 1, plus backward association to dog.
4.	man	4.4	as 1, (human animal).
5.	farm	3.8	as in Orwell's .... Animal Farm?
6.	horse	3.8	as in 1.
7.	cow	2.7	as in 1 plus various backward associations - to farm? to horse?
8.	cracker(s)	2.7	possibly as in 5 - popular song title 'Animal crackers in my Soup'. etc.

The percentage frequencies above give a measure of the relatedness of the words in association terms enabling the lists of relatively high and low association to be composed for each category. That is the percentage frequencies were always lower in List 2 for a specific category than in List 1, varying from 59.0% to 21.6% in List 1 and dropping to 23.3% to 6.6% in List 2.

3. The third criterion which governed the choice of words was that the association pairs selected from the Keppel and Strand norms should reflect the linguistic categories. The words chosen for the two lists are shown in Table 7.

Table 7

Words selected for List 1 and 2 from Keppel and Strand (1970) Norms to meet the three criteria of Word and Association frequency and Linguistic category.

	List 1		List 2	
	Relatively High association		Relatively Low association	
O	King (1)	Queen (1)	Live (1)	Die (2)
	Boy (1)	Girl (1)	Find (1)	Loose (3)
H	Vegetable (4)	Carrot (1)	Fruit (2)	Apple (1)
	Colour (1)	Red (1)	Flower (1)	Rose (1)
S	Children (1)	Kids (3)	Sick (3)	Ill (2)
	Sheep (1)	Lamb (1)	Near (1)	Close (1)

(The figures in parenthesis after each word is that word's position in List 1 of Burroughs (1957) vocabulary count.)

The length of the lists was twelve words (three lots of two pairs) so as to exceed the short-term memory span of the oldest children and at the same time not be too long as to discourage the youngest group. This had been established previously in another school by way of a pilot experiment when the materials were pre-tested.

The words in the lists were arranged in two differing presentation orders so that (1) on no occasion was a word followed by its pair, and (2) to overcome some of the serial position effects noted by Cofer (1967) as much as possible, words occurring in the first half of presentation order 1, were in the latter half of the second presentation order. The lists so formed were recorded onto tapes by a male voice. The time interval between each word in the list was three seconds and intonation was controlled so that no word received undue stress.

Each child had three trials for each list.

6.3. PROCEDURE.

The subjects came individually to the experimenter in a quiet room set aside for the purpose by the Headmaster. After some preliminary conversation to ensure rapport, the child was told that the experimenter had recorded a list of 'easy' words on to a tape. The instructions given then had the following pattern. 'You will hear my voice saying some words. The words are quite easy - you will understand all of them. After you have heard the words, I will stop the tape like this .... I then want you to say all the words you have heard. There is no hurry, but wait until you have heard all the words and the tape has stopped before you start. I will tell you when. Ready?"

After stopping the tape, a second tape recorder was started and the performance of each child recorded. Each child had three trials on each list. List 1 was always presented first as this was found to be important for the younger children in the pilot experiment. It was thought at that time that the 'high' association words helped to establish confidence. Half the children in each age group were selected at random to receive the first presentation order, the other half received the second presentation order.

6.4. RECORDING AND ANALYSIS OF THE DATA.

The tape recordings made of the children's performance were first transcribed on to paper and the following counts and analyses made.

1. The number of words correctly recalled over the three trials were summed for each presentation for each list for each age group.

2. The two presentation orders were compared for serial position effects.

3. The number of completed category pairs were counted (irrespective of other items intervening in the output) and recorded as a function of the total number of words recalled in 1 above.

4. Output adjacencies were calculated according to the order in which the words were recalled (after Kintsch 1970, page 366) and the resulting matrices submitted to Johnson HCS. computer programme.

6.5. RESULTS OF EXPERIMENT 3.

6.5.1. Mean Recall Scores.

The first table shows the mean recall scores for the three age groups. The number of words recalled over three trials are summed and the means and standard deviations presented for the two lists.

Table 7

Mean recall scores (summed over three trials) by age group.

		List 1		List 2	
Age Group	N	Group Mean	SD	Group Mean	SD
A	30	24.36	4.7	19.9	5.4
B	30	22.50	4.5	17.3	4.3
C	30	16.80	6.1	11.7	3.9

The companion table, Table 7a, gives the significance level of the differences between the mean of each cell. Only one difference was not significant, that is the difference between the oldest group's performance (List 1) and the middle group's (List 1). All other differences were significant. (A1 = Group A's mean recall score for List 1; A2 = Group A's mean score for List 2, and so on).

Table 7a

Difference between the means with significance levels (from Table 7) (Student's 't')

Between	Sig.	p
A1 and A2	S	0.001
B1 and B2	S	0.001
C1 and C2	S	0.001
A1 and B1	NS	
A1 and C1	S	0.001
B1 and C1	S	0.001
A2 and B2	S	0.050
A2 and C2	S	0.001
B2 and C2	S	0.001

It will be seen that there are significant differences between the children's performance on each list within each age group. In addition, there are significant differences between each age group apart from one (A1 and B1).

These recall results are presented in graphical form in Figure 67 which clearly shows the descending mean scores with age and the lower scores for List 2.

Tests of significance were carried out to see if the order of presentation of the words made any difference to the recall. All the tests showed there were no significant differences between the presentation orders of the two lists. (Details in Appendix)

6.5.2. Category Recall.

The results of the category data are given next, and Table 8 gives the overall performance for the age groups in terms of the three categories.

Table 8

Category pairs recalled regardless of the number of items intervening in output.

Age Groups	List 1. No. of pairs recalled (Raw Scores)		
	S	O	H
A	70	112	98
B	53	112	76
C	31	69	43

Apart from the same score in category O, the pattern is

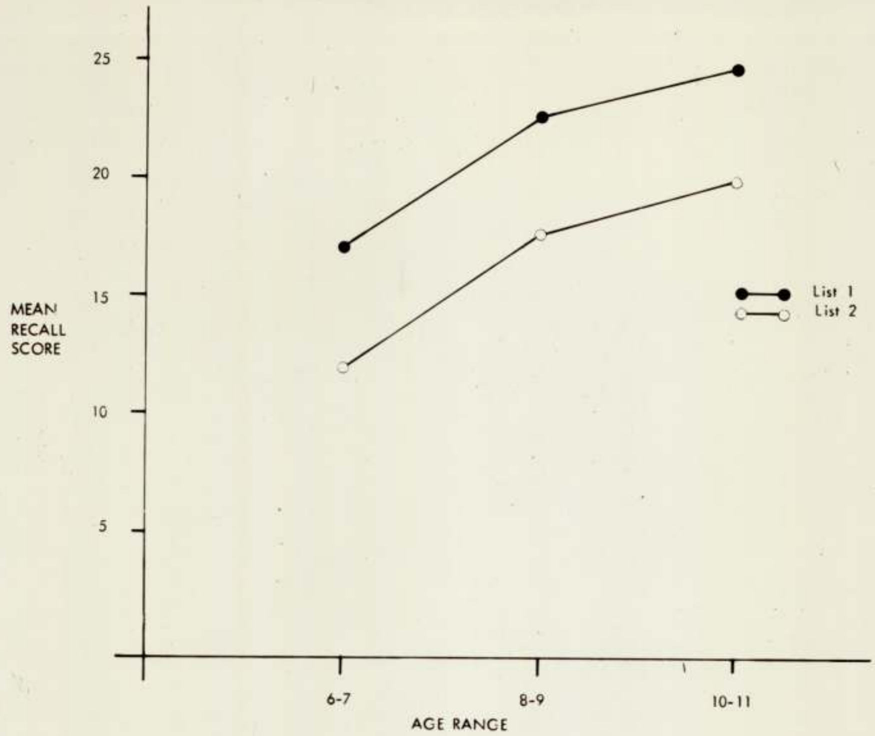


FIG. 67: Mean recall scores for each age group for lists 1 and 2

one of decreasing scores by age. The A category scores are highest followed by H and S. These raw scores are comparable as there are the same number of children in each group (N = 30).

In the next table, the data for List 2 is given and it will be noticed that in each case the scores are much lower.

Table 9
Category pairs recalled regardless of items intervening in output.

Age Group	List 2 No. of pairs recalled (Raw Scores)		
	S	O	H
A	52	60	82
B	29	47	65
C	14	16	28

The same pattern in developmental terms pertains, that is the scores become lower as children get younger. However, there is one difference in the position of the categories as type H is better recalled for List 2 with O and S following in that order.

The data given in these tables are presented in graphical form (Figures 68, 68a) to show the features of interest, that is the age effect and the difference in category recall scores according to association saliency.

Next the category results given in Tables 8 and 9 are given in relation to the overall recall scores of the

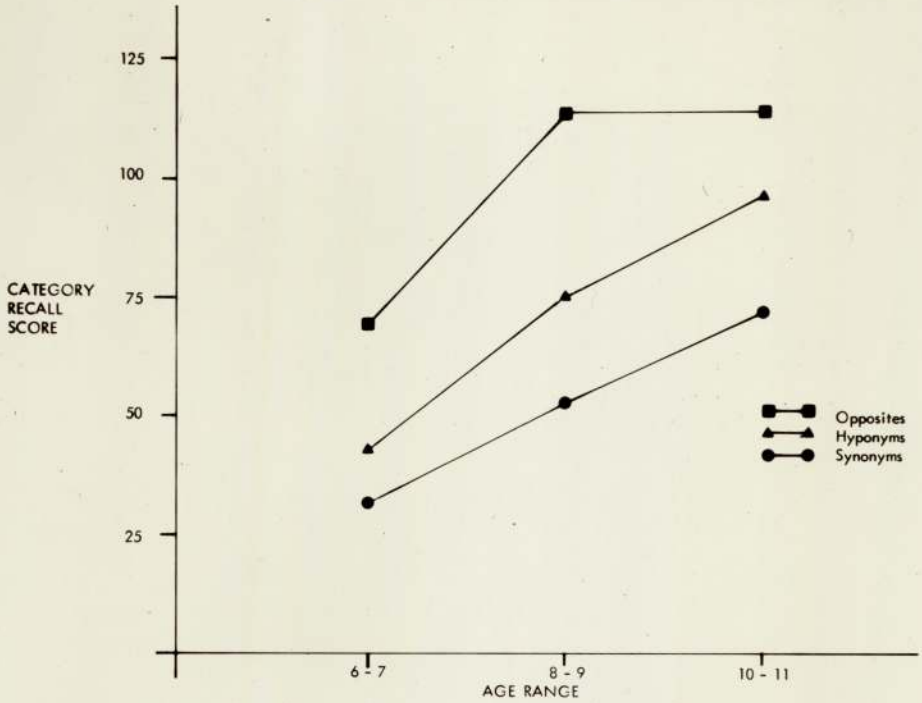


FIG. 68: Category recall score for each age group for synonyms, hyponyms and opposites in List 1

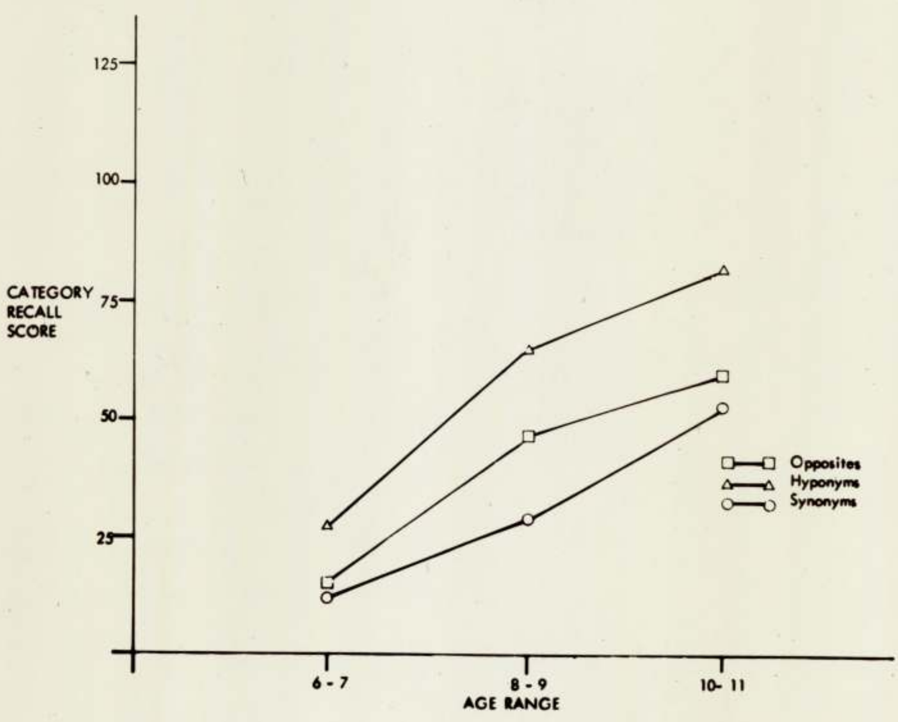


FIG. 68(a): Category recall score for each age group for synonyms, hyponyms and opposites in List 2 groups. The number of pairs from all three categories (regardless of items intervening) summed over three trials are presented as a proportion of the number of words correctly recalled summed over the three trials.

Table 10
Number of category pairs recalled as a function of the total number of words recalled.

Age Group	List 1	List 2
A	0.38	0.33
B	0.38	0.27
C	0.28	0.17

It will be noted that each value for List 1 is greater than the corresponding one in List 2, and that the older children achieve greater scores than the younger. On List 1 however, the proportion of Group A and B are similar.

There were a number of repeats and intrusions during the recall process and these are given in the next table.

Table 11
Repeats and Intrusions summed over 3 trials for Lists 1 and 2 (Raw data)

Age Group	List 1		Total	List 2		Total
	Repeats	Intrusions		Repeats	Intrusions	
A	36	20	56	34	20	54
B	49	17	66	52	33	85
C	27	9	36	17	36	53

It will be noted that Groups B and C make more repeats and intrusions on List 2 than List 1, but there is little difference in the older group's performance.

When the recall scores of the children over the three trials are examined it will be seen that in each age group there was an increase in mean score, with the older children making the greater increase in Trial 3. The data for the trials is given for Boys and Girls separately in Figure 69. The Girls' scores are superior but do not reach significance. There were no significant differences between the mean scores of the Boys and Girls on the pairs either on List 1 or List 2. Table 12 gives the actual mean scores for the pairs recalled.

Table 12
Mean Scores for the three category pairs recalled by Age and Sex.

		List 1		List 2	
		Mean	SD	Mean	SD
A	B	8.4	2.6	5.9	2.9
	G	10.1	3.2	7.0	4.3
B	B	7.6	2.8	4.3	1.8
	G	8.4	2.2	5.4	2.0
	B	4.9	2.9	1.4	2.7
	G	4.6	3.5	2.5	1.8

Although there are no significant differences, the mean scores of the Girls are, in most cases, superior, with the exception of Group C, List 1.

When reporting category recall, it was shown that there

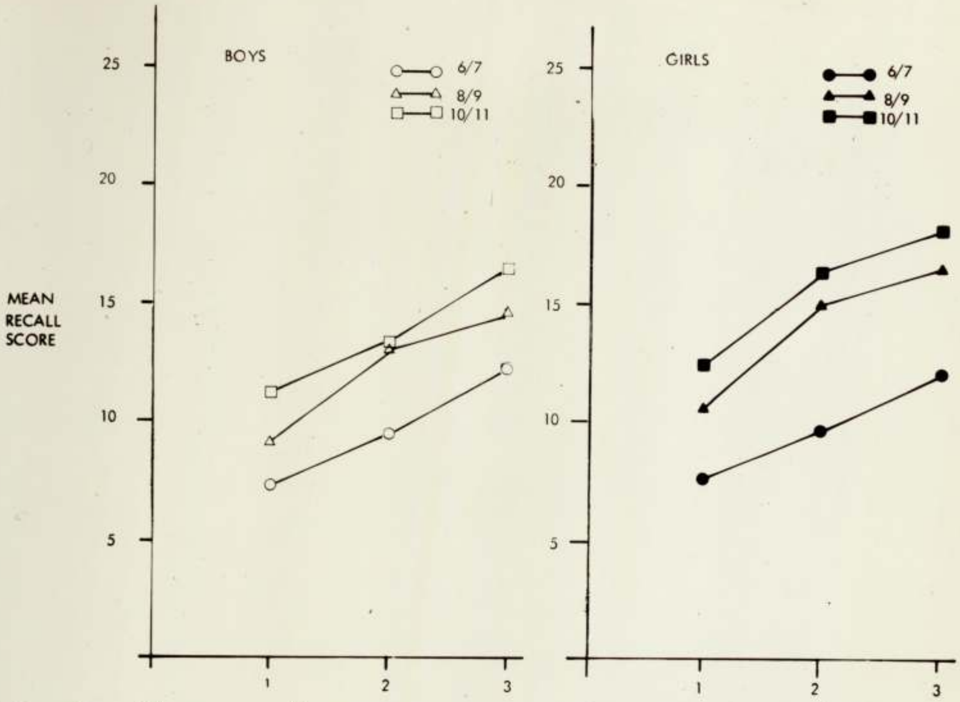


FIG. 69: Mean recall scores against trial number for each age group and sex. (Lists 1 and 2 combined)

was a difference in the status of the categories according to whether they occurred in List 1 or List 2. (See Figures 68 and 68a, where type O has the highest recall in List 1, and type H in List 2).

It is possible then that the developmental process is not quite as straight forward as may first appear. Due to this difference in an otherwise regular pattern, and the possibility of interaction effects between the three types of association and the other variables, levels of association strength and age, it was decided to subject the results to further statistical treatment.

Analysis of Variance.

The model adopted for this analysis was that of Winer (1962); a = the three age levels, b = the two levels of

Table 13

	b1			b2		
	c1	c2	c3	c1	c2	c3
a1	g1	g1	g1	g1	g1	g1
a2	g2	g2	g2	g2	g2	g2
a3	g3	g3	g3	g3	g3	g3

association strength and c = the three categories of association within the lists.

The results of this analysis of variance are given in Table 14 where A = Chronological Age, B = the two levels of association and C = the categories.

Table 14.

Analysis of Variance between Age, Association strength and category

	ss.	df	Variance	Variance Ratio	p
A. Age	0.2145	12	0.179	22.092	<0.01
B. Association.	0.2145	12	0.179	21.984	<0.01
C. Category	0.2145	12	0.179	10.341	<0.01
AB	0.5213	4	0.130	0.508	NS
AC	0.5213	4	0.130	0.593	NS
BC	0.5213	4	0.130	4.535	NS

The analysis demonstrates quite clearly that age, association strength and association category are the main significant variables in the recall of the lists, but that these do not intereact to an appreciable extent. However, it should be remembered that when the number of pairs, being recalled as category pairs (S, O, H), were calculated, items intervening between one word and its pair, were disregarded. This count gave a measure of the way in which linguistic categories were differentiated in the recall of the children in the context of association strength.

6.5.3. Adjacency Measures.

In order to study further the storage of these items in terms of a model of LTM an adjacency measure is to be preferred. Such a measure is given by Kintsch (1970, page 366) and the output adjacencies for the categorized word list for Trial 3 appear in the six matrices on pages 156 and 157.

The higher the entries in Table 15, the more frequently the corresponding row and column words were recalled together either way. It will be seen that for the oldest group the output adjacency measures for the categorized words are the largest.

The middle age group's performance (Table 16) shows again that, apart from one, the output adjacency measures for the selected word pairs are superior to the other combinations.

In the matrix given in Table 17 for the youngest age group, many of the adjacency measures in the body of the table are larger than the pairs chosen for the three categories.

Table 18 gives the matrix of the older children's performance on List 2 with the relatively low association strengths. There are some measures as large as those between the chosen word pairs.

It will be noticed in the matrix given for Table 19 that one of the adjacency measures for the chosen word pairs

Table 15. Output adjacencies (List 1, Trial 3) for Group A. (Decimal point omitted).

	Kids	Children	Sheep	Lamb	Red	Colour	Carrot	Vegetable	Boy	Girl	King	Queen	
Kids													
Children	40												S
Sheep	8	6											
Lamb	15	17	58										S
Red	8	21	25	4									
Colour	4	19	8	28	54								H
Carrot	17	4	18	8	17	14							
Vegetable	9	4	4	7	12	26	65						H
Boy	21	3	15	11	12	15	17	8					
Girl	0	13	17	4	8	13	13	9	67				O
King	7	0	12	11	7	3	11	20	7	17			
Queen	38	4	3	7	8	12	0	15	11	11	80		O

Table 16. Output adjacencies (List 1, Trial 3) for Group B. (Decimal point omitted).

	Kids	Children	Sheep	Lamb	Red	Colour	Carrot	Vegetable	Boy	Girl	King	Queen	
Kids													
Children	34												S
Sheep	9	19											
Lamb	17	4	79										S
Red	26	15	14	9									
Colour	5	10	11	17	51								
Carrot	34	17	4	15	16	14							
Vegetable	0	16	13	13	7	30	48						H
Boy	7	4	4	10	28	10	0	4					
Girl	8	20	4	12	19	6	23	13	76				O
King	3	19	15	15	8	5	0	23	14	15			
Queen	21	12	9	0	17	16	3	15	11	12	83		O

Table 17. Output adjacencies (List 1, Trial 3) for Group C. (Decimal point omitted)

	Kids	Children	Sheep	Lamb	Red	Colour	Carrot	Vegetable	Boy	Girl	King	Queen	
Kids													
Children	15												S
Sheep	14	0											
Lamb	23	26	41										S
Red	35	36	27	19									
Colour	0	4	0	0	61								H
Carrot	23	16	21	0	18	15							
Vegetable	6	16	0	22	20	16	19						H
Boy	15	5	7	15	23	7	0	39					
Girl	0	11	23	15	5	30	31	8	48				O
King	14	0	6	8	6	0	21	7	13	11			
Queen	8	23	0	11	0	5	25	11	4	31	67		O

Table 18. Output adjacencies (List 2, Trial 3) for Group A. (Decimal point omitted)

	Near	Close	Sick	Ill	Apple	Fruit	Rose	Flower	Live	Die	Find	Lose	
Near													
Close	44												S
Sick	10	0											
Ill	11	11	36										S
Apple	5	11	28	4									
Fruit	26	12	0	7	51								H
Rose	19	5	14	12	23	36							
Flower	14	17	4	25	24	35	.45						H
Live	14	7	27	8	4	4	5	4					
Die	4	0	0	5	26	8	19	5	37				O
Find	7	28	6	47	0	11	4	14	0	25			
Lose	8	10	30	44	5	15	8	10	20	18	26		O

Table 19. Output adjacencies (List 2, Trial 3) for Group B. (Decimal point omitted)

	Near	Close	Sick	Ill	Apple	Fruit	Rose	Flower	Live	Die	Find	Lose	
Near													
Close	45												S
Sick	8	0											
Ill	5	17	30										S
Apple	24	12	26	12									
Fruit	35	0	0	6	4								H
Rose	10	0	17	9	36	11							
Flower	0	0	13	19	31	24	58						H
Live	0	0	26	5	13	0	14	21					
Die	12	50	11	34	18	27	24	7	38				O
Find	0	12	14	6	0	10	0	24	9	30			
Lose	14	12	28	38	12	0	14	4	27	27	22		O

Table 20. Output adjacencies (List 2, Trial 3) for Group C. (Decimal point omitted)

	Near	Close	Sick	Ill	Apple	Fruit	Rose	Flower	Live	Die	Find	Lose	
Near													
Close	16												S
Sick	0	12											
Ill	17	0	23										S
Apple	8	7	20	18									
Fruit	10	16	10	0	38								H
Rose	25	0	0	0	18	10							
Flower	15	6	15	6	22	27	38						H
Live	12	13	39	17	8	14	33	6					
Die	6	0	10	33	0	40	15	21	12				O
Find	25	0	0	0	0	0	0	16	13	16			
Lose	16	0	16	35	41	0	16	16	9	21	0		O

is very low and that there are many measures elsewhere with high values. The number of cells with a zero entry begins to increase.

The youngest group's performance shown in the matrix (Table 20) has small measures along the leading diagonal and some larger ones elsewhere within the table.

These six matrices are next used as input for Johnson's Hierarchical Clustering programme to find how the various combinations cluster in recall. The details of these results are shown in Figures 70 to 75.

MAX/MIN Comparisons.

Group A. List 1. (Figure 70).

When a comparison is made between the two methods of calculating the older group's HCS, there is considerable

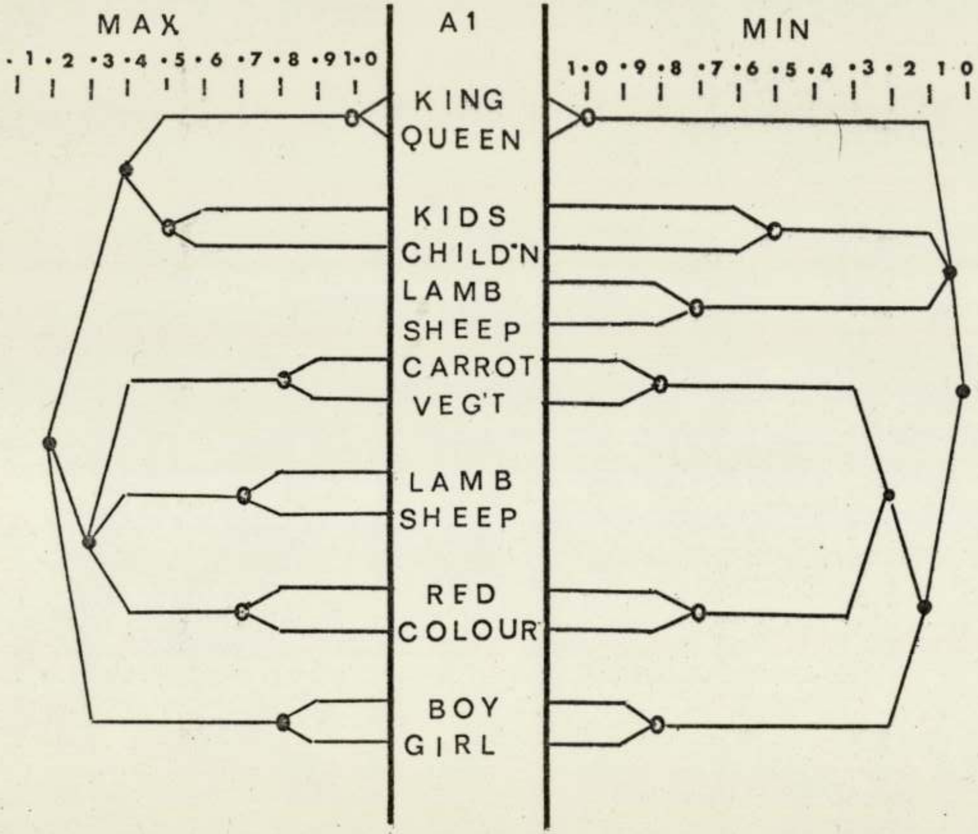


Figure 70

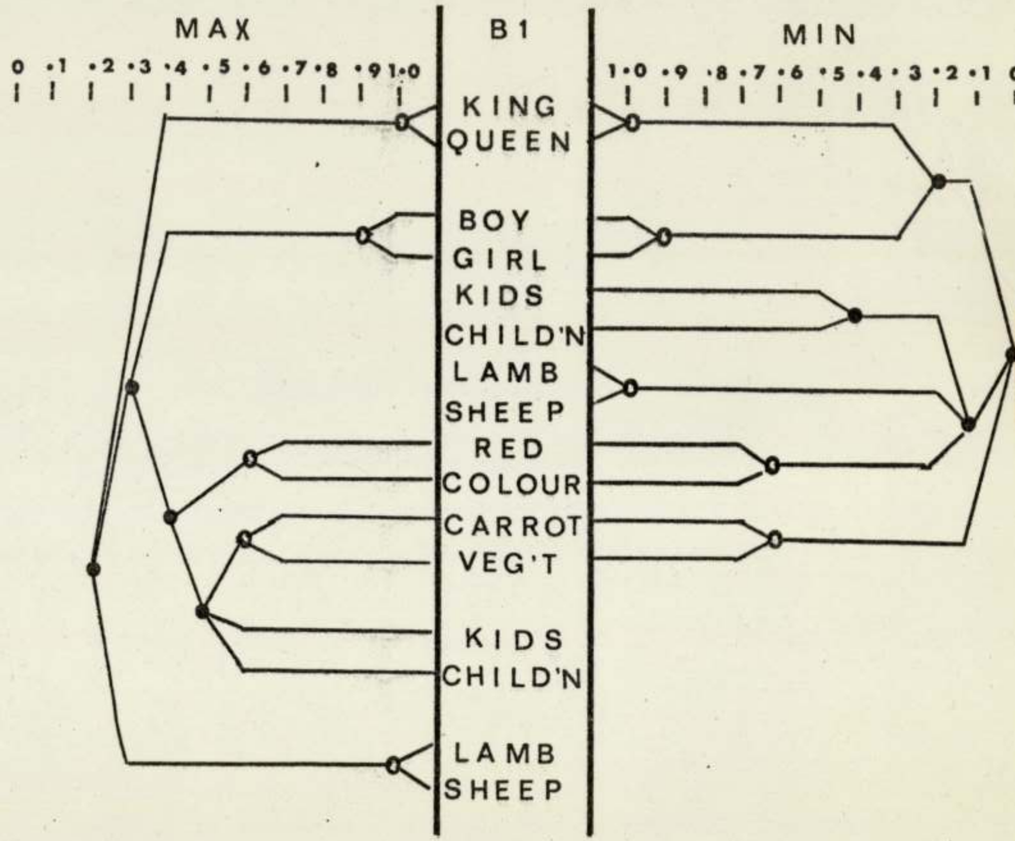


Figure 71

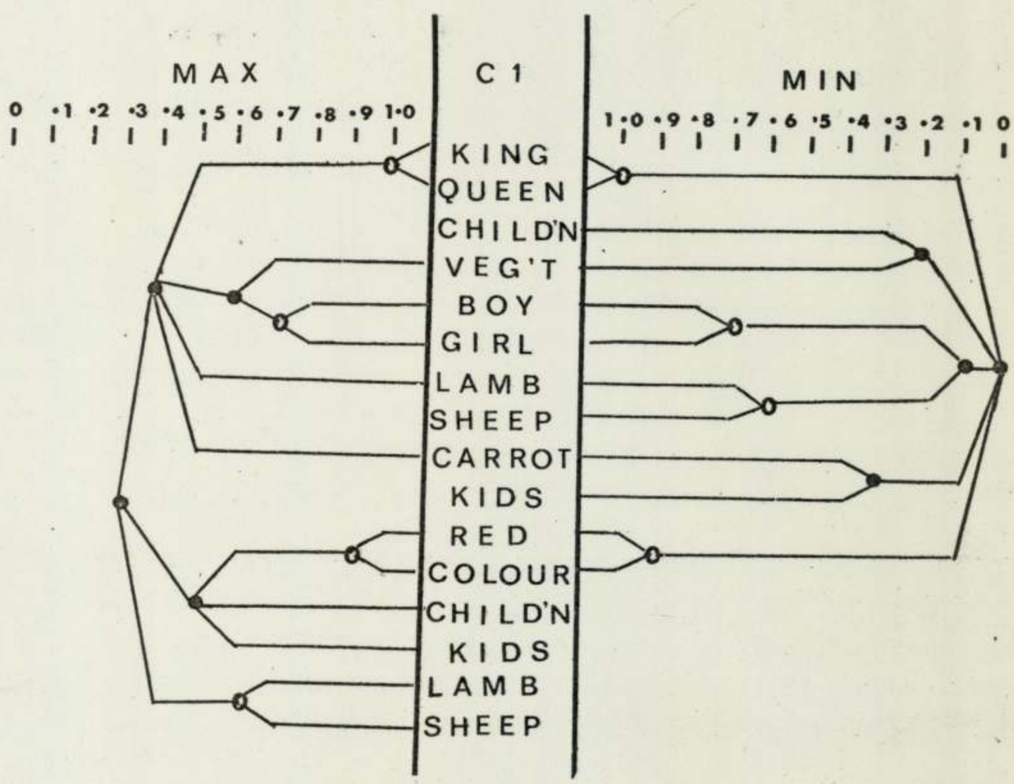

MAX
C 1
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
KING
QUEEN
CHILD'N
VEG'T
BOY
GIRL
LAMB
SHEEP
CARROT
KIDS
RED
COLOUR
CHILD'N
KIDS
LAMB
SHEEP

Figure 72

agreement in the early pairing stage. This is particularly so for values which are high. Thereafter the shape of the two is not strictly identical but there is considerable agreement at the lower levels where clusters merge.

Group B. List 1. (Figure 71).

With the middle age group, the position is similar to Group A, (except that at the early pairing stage the values are not so high), but the two versions are broadly similar

Group C. List 1. (Figure 72).

There are differences in the younger group's performance detected by the MAX/MIN methods of calculating the hierarchy. The MAX version shows the children recalling the words in their 'correct' pairs at fairly high values, but there is not the same regularity in the MIN version. The MAX version allows a build up of the clustering according to linguistic category but the difference in the content of the original pairs is not reflected in the MIN version.

Group A. List 2. (Figure 73).

Looking now at the hierarchical cluster scheme for the second list of words the situation is much the same for the older group as for List 1. There is agreement as to pairs and their values. However, the words clustered as pairs are not always according to their linguistic associates, e.g. (Find, Ill) and (Lose, Sick). Due to this there is no longer cluster development as in List 1, and

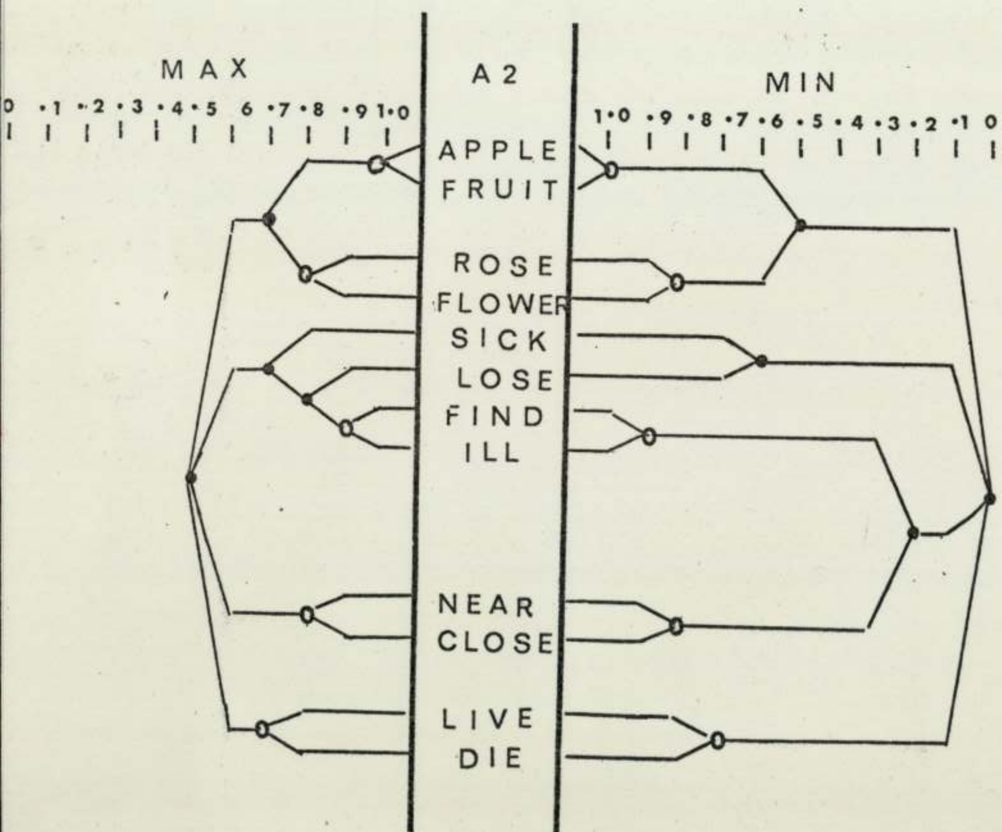


Figure 73

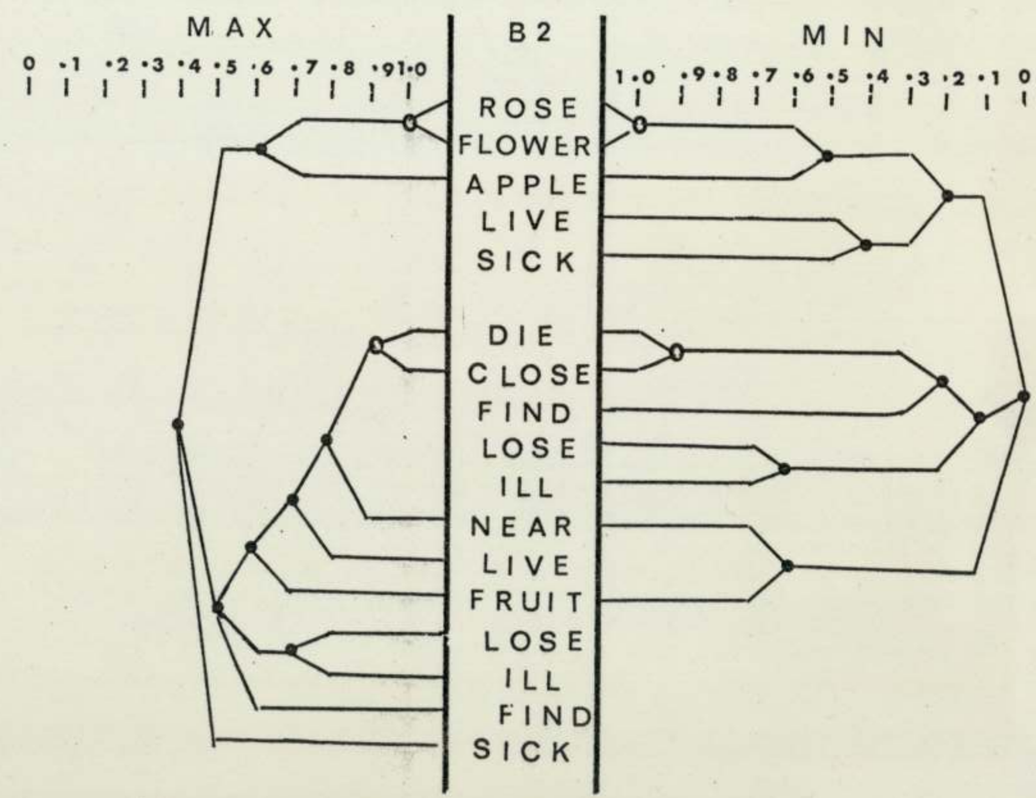


Figure 74

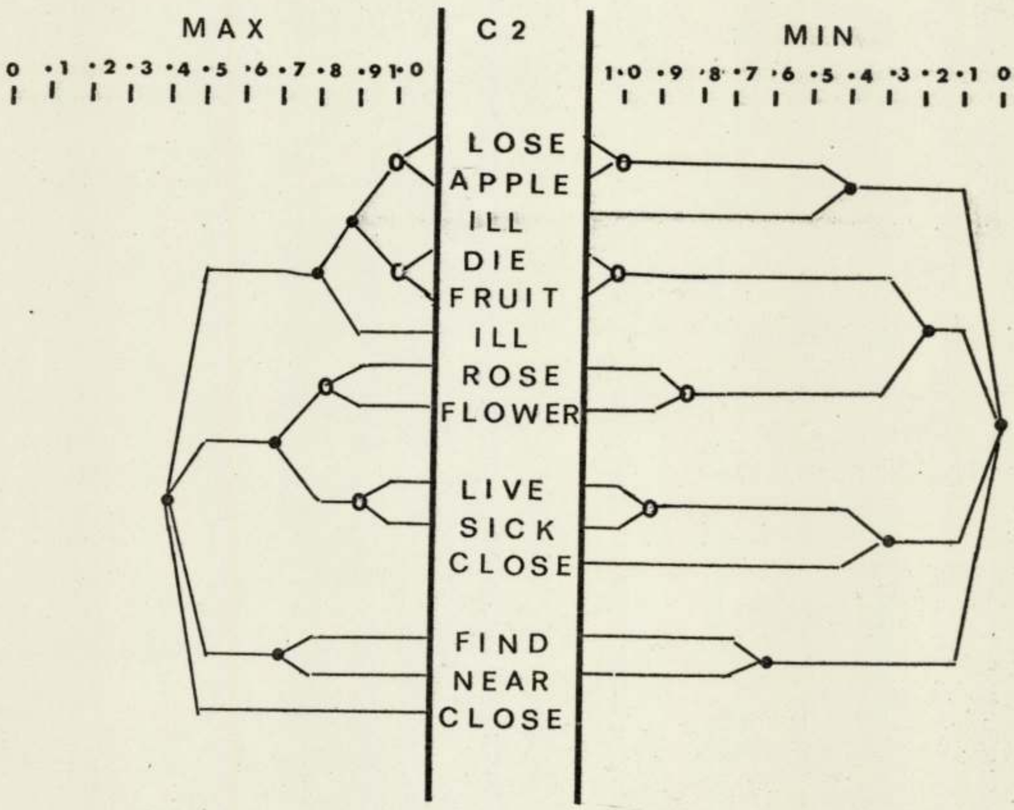

MAX
C 2
MIN
0 ·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0
1·0 ·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 ·1 0
LOSE
APPLE
ILL
DIE
FRUIT
ILL
ROSE
FLOWER
LIVE
SICK
CLOSE
FIND
NEAR
CLOSE

Figure 75

there is only partial concord evident in the two versions.

Group B. List 2. (Figure 74).

There is little agreement when the outcomes of the two methods of calculation are compared for the middle age group. In addition, the initial pairing, so obvious in the other cases, is largely absent. Consequently, there is little structural agreement as the cluster schemes are examined for development.

Group C. List 2. (Figure 75).

Here again the two methods confirm that the younger group's performance lacks the structuring so evident with List 1. The words being paired have high values but are not the original 'correct' pairs. There is little agreement as to the presence of structure.

HCS Content Analysis.
Examining next individual Hierarchical Clustering Schemes for content, the following statements can be made.

Figure 76.
Group A. HCS (MIN) List 1.

```
Similarity
  Value     Kg Q   B G   Ct V   R Cl   L S   Kd Cd
  1.00      (xxx)
   .84      (xxx) (xxx)
   .81      (xxx) (xxx)  (xxx)
   .73      (xxx) (xxx)  (xxx)         (xxx)
   .68      (xxx) (xxx)  (xxx) (xxx)   (xxx)
   .50      (xxx) (xxx)  (xxx) (xxx)   (xxx)  (xxx)
   .15      (xxx) (xxx)  [xxxxxxxxx]   (xxx)  (xxx)
   .10      (xxx) [xxxxxxxxxxxxxxx]    (xxx)  (xxx)
   .08      (xxx) [xxxxxxxxxxxxxxx]    [xxxxxxxxxx]
   .00      [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

Correlation between DM and UD, $r = 0.64$. $p < 0.02$

Key to Letters:

Kg = King	R = Red
Q = Queen	Cl = Colour
B = Boy	L = Lamb
G = Girl	S = Sheep
Ct = Carrot	Kd = Kids
V = Vegetable	Cd = Children.

The first point to note is the appearance of the words correctly paired with their associates at fairly high values. Next, if this MIN version is inspected, it is interesting to note the linguistic arrangement of the pairs. The two Hyponyms are clustered at Level 0.15, and are joined by the Opposite pair at Level 0.10. At level 0.75 there are three clusters, a weak cluster (O), the cluster mentioned [O,H,H] and a cluster containing two pairs of Synonyms [S,S]. This progresses to a final cluster [O,O,H,H,S,S] the original linguistic categories, but at Level O.

Figure 77
Group B. HCS (MAX) List 1.

```
Similarity
  Value    Kg Q  B G  R Cl  Ct V  Kd Cd  L S

  1.00     (xxx)
   .95     (xxx)                         (xxx)
   .92     (xxx) (xxx)                   (xxx)
   .61     (xxx) (xxx) (xxx)             (xxx)
   .58     (xxx) (xxx) (xxx)   (xxx)     (xxx)
   .41     (xxx) (xxx) (xxx)  [xxxxxxxxx] (xxx)
   .36     (xxx) (xxx) [xxxxxxxxxxxxxxxx] (xxx)
   .34     (xxx) [xxxxxxxxxxxxxxxxxxxxxx] (xxx)
   .28     [xxxxxxxxxxxxxxxxxxxxxxxxxxxx] (xxx)
   .23     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

Correlation between DM and UD, $r = 0.70$. $p < 0.01$.
Key as previous figure.

If the MAX version for the middle age group is next examined, the characteristic weak clusterings first occur with the words appearing in their correct pairs at fairly high values. Clustering at Level 0.41 shows a cluster [H,S], followed at Level 0.36 by the subcluster [H,H,S]. After this a strong cluster of [O,H,H,S] occurs at Level 0.34, and at Level 0.28 there is a cluster containing all but one pair [O,O,H,H,S]. Finally at Level 0.23, there is the complete cluster that resembles the original theoretical organisation of the list before the randomising of the word order. ie. [O,O,H,H,S,S].

Figure 78
Group C. HCS (MAX) List 1.

Similarity Value	Kg Q	Kd Ct	R Cl	Cd V	B G	L S
1.00	(xxx)					
.91	(xxx)		(xxx)			
.72	(xxx)		(xxx)		(xxx)	
.61	(xxx)		(xxx)		(xxx)	(xxx)
.34	(xxx)	(xxx)	(xxx)		(xxx)	(xxx)
.24	(xxx)	(xxx)	(xxx)	(xxx)	(xxx)	(xxx)
.12	[xxxxxxxxxx]		(xxx)	(xxx)	(xxx)	(xxx)
.10	[xxxxxxxxxx]		(xxx)	(xxx)	[xxxxxxxxx]	
.06	[xxxxxxxxxx]		[xxxxxxxxxxx]		[xxxxxxxxx]	
.00	[xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]					

Correlation between DM and UD, $r = 0.65$. $p < 0.02$.
Key as previous figure.

The MAX version of the youngest group's performance as analysed by this HCS shows, more or less, the same characteristics as that of the older and middle age groups. Here the words are correctly clustered in four of the six cases but the H pair (Vegetable, Carrot), and the S pair, (Children and Kids), do not come together as pairs in the first instance. Following this the final cluster, at Level 0.40, although having the appearance of original theoretical organisation [O,O,H,H,S,S] does not have the same clarity as that of the other two groups.

Figure 79

Group A. HCS (MIN) List 2.

```
Similarity
  Value     A Ft   R Fr   Lv D   Fd I   N C   Ls S

  1.00     (xxx)
   .92     (xxx)                 (xxx)
   .88     (xxx)  (xxx)          (xxx)
   .86     (xxx)  (xxx)          (xxx) (xxx)
   .73     (xxx)  (xxx)   (xxx)  (xxx) (xxx)
   .59     (xxx)  (xxx)   (xxx)  (xxx) (xxx)  (xxx)
   .45     [xxxxxxxxxx]   (xxx)  (xxx) (xxx)  (xxx)
   .14     [xxxxxxxxxx]   (xxx)  [xxxxxxxxx]  (xxx)
   .08     [xxxxxxxxxxxxxxxxxx]  [xxxxxxxxx]  (xxx)
   .00     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

Correlation between DM and UD, $r = 0.72$. $p < 0.01$

Key:

A = Apple	Fd = Find
Ft = Fruit	I = Ill
R = Rose	N = Near
Fr = Flower	C = Close
Lv = Live	Ls = Lose
D = Die	S = Sick

Moving now to the second list of word pairs of lower association values, the first point of note in the older group's HCS, is that two of the six pairs do not come together as was the case with the higher association pairs in List 1. Both versions (MAX/MIN) show this difference which remains, of course, throughout the structure. The H category pairs (MIN) are merged at Level 0.45 but the other types do not follow a clear progression.

Figure 80

Group B. HCS (MAX) List 2

```
Similarity
  Value     R Fr A   D C N Lv Ft   Ls I Fd S

  1.00     (xxx)
   .86     (xxx)    (xxx)
   .78     (xxx)    [xxxxx]
   .66     (xxx)    [xxxxxxxxx]     (xxx)
   .62     [xxxxxx] [xxxxxxxxxxxx]  (xxx)
   .58     [xxxxxx] [xxxxxxxxxxxxxxxxxxx]
   .52     [xxxxxx] [xxxxxxxxxxxxxxxxxxxxxxx]
   .48     [xxxxxx] [xxxxxxxxxxxxxxxxxxxxxxx]
   .44     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

Correlation between DM and UD, $r = 0.69$. $p < 0.01$
Key as in previous figures.

This HCS of the middle age group shows that the chosen word pairs are less well structured in recall than was the case with the older group. Only one pair, an H pair, in this MAX version is clustered early and the rest do not follow any clear order. Another H term, Apple, joins this original pair (Rose, Flower) but, although the orderly structure, noted in List 1 results, is not present, there are indications that the associated pairs do come together as the hierarchy is built up. For instance, the 'incorrect' pair, (Die, Close) are clustered at Level 0.86, to be joined at Level 0.78 to give [Die, Close, Near].

Figure 81

Group C. HCS (MAX) List 2.

```
Similarity
   Value     Ls A  D Ft I  Lv S  R Fr  Fd N C
    1.00     (xxx)
     .98     (xxx) (xxx)
     .95     (xxx) (xxx)   (xxx)
     .93     [xxxxxxxxx]   (xxx)
     .88     [xxxxxxxxx]   (xxx) (xxx)
     .85     [xxxxxxxxxxxx] (xxx) (xxx)
     .81     [xxxxxxxxxxxx] [xxxxxxxxx]
     .66     [xxxxxxxxxxxxxxxxxxxxxxxx]
     .61     [xxxxxxxxxxxxxxxxxxxxxxxx]  (xxx)
     .39     [xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx]
```

Correlation between DM and UD, $r = 0.72$. $p < 0.01$
Key as in previous figure.

The comments made about the middle group's performance apply to this HCS also, for the same H pair (Rose, Flower) come together in the early clustering. The other ten words however, are not put together according to their chosen associations, although there is a rudimentary type of association patterning in the clustering. For example, two incorrect pairs are made up one from each going together, ie. (Lose, Apple) and (Die, Fruit). Here, one 'correct' pair (Apple, Fruit) is involved with an 'incorrect' pair (Lose, Die). These two pairs come together early in a subcluster at Level 0.93 so that (Apple, Fruit) are effectively merged.

6.6. SUMMARY AND DISCUSSION OF EXPERIMENT 3 RESULTS.

The results will be summarised according to the objectives stated for the Experiment. These were:

1. to observe the effects of pairs of words controlled for differing association saliencies,

2. to examine the ability of children to recall three types of association called here,

a.	Opposites	eg.	King, Queen.
b.	Hyponyms	eg.	Fruit, Apple.
c.	Synonyms	eg.	Children, Kids.

3. by using a learning/recall method, to trace clustering patterns of these associations along a developmental continuum, and in relation to objectives 1 and 2.

The results concerned with the differing association strengths in the lists, (objective 1), are summarised first. The mean recall scores for the three age groups show that, except for one instance, (see Table 7), there were significant differences between the performances of the children on each list and within each age group. In overall terms, the performance of the children was superior on List 1 than on List 2, as Figure 67 shows, and apart from the case already mentioned, (A1, B1), the children's mean scores increased with age on both lists but was much lower on List 2. When this result is considered alongside the main differences in the construction of the two lists, it might be said that the strength of association was the main factor that assisted or hindered the learning/recall process.

Data of the occurrence of Repeats and Intrusions showed that the middle and youngest age groups made more errors on List 2 than List 1, but there was little regularity in the figures.

The differences between the performances of the Boys and Girls were not significant, but that the Girls' mean scores were superior except for Group C. List 1.

Looking next at the second objective which was concerned with the linguistic/logical categories, it will be observed that not only were more words recalled by the older children, but this recall was related, as Table 10 demonstrates, to the chosen categories. Furthermore, the category pairs were differentially recalled. The analysis of variance however, indicates quite clearly that the main significant variables are age, association strength and association category, and that there are no interaction effects.

Having these results clear, the final objective concerning cluster in recall can be summarised. Here, Kintsch's output adjacency measures made the calculation of category recall more precise, and when the matrices resulting from the calculations were submitted to Johnson's cluster programme, the results showed that:

1. the structure of the hierarchies become more stable with increasing age,

2. there was far less agreement as to the presence of structure in the recall of List 2,

3. List 1 words are paired 'correctly' (ie. according to the original linguistic categories) at high values early in the clustering, but List 2 words were paired 'erroneously'.

The first observation that can be made when discussing these results is that they are in accord with the findings provided by experiments 1 and 2, and also with recent research data of word association and free recall. Looking at the free recall findings, Cole et al (1971) reported that performance on the accuracy and clustering measures they used increased with age, and they suggested that category clustering ordinarily increased as recall accuracy increased. Further, when category clustering was 'strong enough', it reduced the effects of serial position. It is probable that the serial position effects that might have reduced accuracy in the present lists have been largely overcome by the strength of the association bonds. It is quite feasible that the variation in the association strengths built into the present material helped to increase or decrease accuracy in much the same way as Cole et al's 'manipulations'. Another related point was made by Cofer (1967, page 212) when he suggested that the recall of pairs of words that are easily categorised together are better recalled and cluster more than pairs of words of equal 'associative overlap' which are not categorised together. Here there appears to be a distinction between categorisation and 'associative overlap' which may or may not have been in quantitative terms such as percentage frequency used in this work. The word pairs in List 1 and List 2 were chosen according to logical/linguistic categories and for associative strength: both were shown to be significant variables in free recall. Cofer suggests however, that when 'associative overlap' is equal, it is the easily (more frequently?) categorized words that assist recall. Perhaps then both a connection and a distinction should be recognised here between the number of features or markers present in an overlap situation and the saliency of the resulting associative bond.

Next the relationship between this experiment and the previous two is discussed for, of course, the earlier experiments suggested the latter. When the results of the cluster schemes resulting from children's judgments (see Summaries 4 and 5) were compared, a pattern of cluster growth was discerned. This was characterised by the build-up of the cluster hierarchy as a movement from an initial pairing through the accretion of single elements, and/or the coming together of sub-clusters, to the later formation of strong clusters. When the contents of these clusters were examined, it was found that the initial pairing was largely a case of the children putting together terms that might be called opposites such as (Mother, Father), (Black, White), (He, She). The next stage, that of subclusters, saw these commonly associated terms joined by others of similar relationship, but of less cohesion. Black and White, being joined by Silver, is an example of this step. Here Silver has moved away from Gold to become a member of a sub-cluster with White. The relationship might now be seen as more akin to synonymy than oppositeness. A further important relationship, covered by the term hyponymy, was added to synonymy and oppositeness to cover some other areas of clustering. For instance the establishment of the cluster [Yellow, Gold, Mustard] might be described as a cluster of Yellow with two of its co-hyponyms.

From these linguistically described relationships it was hypothesised that the children's judgment behaviour might have been underpinned by the logical/linguistic categories. The experiment therefore investigated these category relationships and the results showed that recall was assisted by the categorisation of the words but that it was probably facilitated as much by the strength of the association bonds.

In the developmental pattern, recall accuracy increased with age and category recall proportionately. The reduction of association strength, however, had similar effects to those of age. That is, the youngest age group's performance on List 1 was in many ways similar to the oldest group's performance on List 2.

It would seem also that, if, as Kintsch suggests, output order in recall reflects semantic relationships, access to the storage of these relationships can be by way of logico/linguistic categories.

SUMMARY 6.

1. The objectives of the third experiment were achieved.

2. The List containing association pairs of high percentage frequency were recalled more readily by all children than the List of low association pairs.

3. Category types were differentially recalled.

4. The children's hierarchical clustering schemes became more stable with increasing age, but there was less agreement as to the presence of structure for List 2 results.

5. List 1 words were paired 'correctly' (ie. according to the original linguistic categories) at high values in the clustering, but List 2 words were often paired erroneously at high values.

6. A clear developmental pattern was observed.

7.0. CONSPECTUS.

This final section is in three parts. First the summaries of the previous six sections are brought together and specific methodological and analytical aspects discussed. In the second part, the work is reviewed and discussed as a whole prior to some final comments regarding pedagogy.

7.1. SUMMARIES OF SECTIONS 1-6.

The first section emphasised the central position of communication skills in modern society and the requirement for educators to understand and improve them. From the many facets of language study involved, it was decided to concentrate on semantics. In particular, Rommetveit's 'associative state' was chosen for detailed treatment. This led to an examination of a model of the structure and storage characteristics of an internal dictionary.

The method of card sorting was chosen as having potential for studying the judgment of semantic relationships and Johnson's cluster programme was used to analyse the resulting data.

The first two experiments using this method and analysis looked at three semantic fields, those of Kinship, Colour Names and Pronouns. The first experiment gave clear indications that both the experimental method and its analysis by Johnson's programme were useful ways of studying the processes involved. The results showed that the children increasingly appreciated the basic dimensions of the semantic domains with age. The results of the second experiment indicated that the children's establishment of meaning relationships was one that gradually approximated to that of the models of the fields. It was the children's increasing awareness, with age, of the organisation of the underlying structure of the domains that enabled them to perceive finer relationships between the lexical items presented to them.

The hierarchical clustering schemes of the three age groups showed an orderly development within the limits of the experimental material. This progression was from an initial pairing of items, through a sub-clustering stage to the final strong clusters. The pairing was largely in terms of opposites or contrasts and the sub-clustering a merging of these pairs and/or the accretion of other related terms.

From a study of the three domains, it was hypothesised that the growth of the clusters could have been assisted by the subjects' awareness of logical-linguistic categories and rules of association. The categories involved, (Opposites, Hyponyms, and Synonyms), were seen as connected by logical-linguistic relationships such as those defined by Bierwisch (1970).

The children's free recall of examples of these pairs showed that the strength of the association bonds was an important variable in the developmental pattern. It was association strength, measured by the normative percentage frequency data, that enhanced the correct recall of the list items. When the pairs were of relatively high association more words were correctly recalled than those of relatively low association, and the number of category pairs increased proportionately.

The use of the adjacency calculation provided by Kintsch (1970), as well as being a more stringent measure, allowed the results to be submitted to Johnson's clustering programme. Examination of the HCS's showed that, when association value was low, words were 'incorrectly' paired at the 'top' of the hierarchy and that the structure of such schemes was unstable according to the MAX/MIN calculations.

From the developmental viewpoint, the results showed that mean recall scores on both lists increased with age, and the HCS of the oldest group on List 1 (High association) had the same type of structural instability as that shown by the youngest group's HCS on List 1 (High association). In other words, as the children aged, they were better able to take advantage of their increasing awareness of the associations existing between certain pairs of words. This knowledge assisted recall in proportion to the strength of the bond existing between the pair in the adult norms.

7.1.1. SOME SPECIFIC METHODOLOGICAL AND ANALYTICAL ISSUES.

Marshall (1970, page 194) makes three observations about experimental work of this type. These were,

> '1. How are the data affected by seemingly minor changes in instructions?
>
> 2. To what extent has the experimenter pre-determined the results merely by his selection of stimulus words?

3. What is/are the logic and latent assumptions of the various statistical manipulations to which such data can be subjected? ....'

Using these three points as a check-list, some specific points are made about the present work.

Firstly, when asking children to make judgments of the kind involved in experiments 1 and 2, much depends on the instructions given to them. In this study two key phrases are used, 'closest in meaning' and 'nearest in meaning'. It was hoped that these would give the children just enough indication of what was required without being too directive. This is clearly a matter of guaging instructions to experimental purposes. Anderton (1974) has shown how experimental results may be varied according to task instructions. Discussing the relationship between instruction and experimental purposes, Fillenbaum and Rapoport (1971, page 241) point out that changes in instructions in this type of 'judgment' procedure might make other properties or attributes salient for the subject. They report a communication from H. Clark who suggests that 'relatedness' is a more basic term and 'similarity' was a special form of 'relatedness'. A particular instance of distinction was that of an antonym which might be regarded as dissimilar yet, on the other hand, be intimately related. In the present study, it was found that the terms 'close' and 'near' were preferable when meaning relationships were being elicited, for the use of 'related' was not easily understood by the younger children. Other work confirms lack of comprehension of this type, for example, Donaldson and Balfour (1968) showed that children between the ages of $3\frac{1}{2}$ and $4\frac{1}{2}$ years found relational terms difficult to master. In a similar fashion, Webb et al (1974) studying the meaning of 'different' in children between 3 and 5 years 7 months found that the youngest confused 'different' with 'same', later ages interpreted 'different' as 'another', then at a later stage they believed that 'different' required a dimension of similarity, before they arrived at the fully formed adult concept. Due to these considerations, and the ambiguity found by Anglin (1970, page 30), when he used the terms 'same in meaning', the words 'close' and 'near' were chosen and successfully used in this study.

Marshall's second point refers to the choice of stimulus words: in this work the actual words employed were dictated by the prior choice of the semantic fields. The stimulus words were bounded by the dimensions and context of the domain. Finer adjustments were made, ie. the frequency of the word in the children's vocabulary, and in Experiment 3, the words also conformed to the association norms.

The third check concerns the 'assumptions of the various statistical manipulations' and here Johnson's Hierarchical Cluster Analysis requires comment. The basis of the method is an agglomerative one which proceeds as Everitt (1974, page 8) states,

> 'by a series of successive fusions of the N entities into groups, and divisive methods which partition the set of N entities successively into finer partitions. The results of both agglomerative and divisive techniques may be represented in the form of a dendogram, which is a two-dimensional diagram illustrating the fusions or partitions which have been made at each successive level.'

The step-by-step progression of the technique proceeds through the data leaving the interpretation of the clusters so formed to the user. In the present work, safe-guards have been applied to every HCS so that a structure is not imposed on the data by the technique itself. Everitt puts forward a further check to overcome some of the problems inherent in cluster analysis. He suggests (page 67) that the data could be divided randomly into half sample sizes and each half clustered separately for comparison. In this work the age group data was divided and examined according to sex to extract an obvious major variation in response but further division would have resulted in very small groups indeed. However, a check for consistency amongst the samples was provided in every case by the MAX/MIN method of calculation.

Particular care had to be taken in this work as the results could easily have been compromised in the following way. The collection of the data from young children in classroom conditions could lead to subjects influencing each other's performance, and as this data was to be pooled for the input to the cluster programme, extra care had to be taken. This is another reason for the constant checks made as the work proceeded.

7.2. A REVIEW AND DISCUSSION OF THE STUDY.

After outlining the main pedagogical purposes of the study and its derivation, the work concentrated on the acquisition and development of meaning relationships. Acquisition, of course, implies an adequate storage system, for without it the child's progress in language, or any other skills, would not be possible.

This storage system has been referred to variously as the subjective lexicon, lexical memory, Long-Term Memory, or an internal dictionary, but whatever the nomenclature, it is the organisation and the semantic theory which specifies its mechanisms that is of interest. Marshall (1970, page 190) made two valuable and pertinent observations regarding lexical representation to illustrate the present uncertain state of semantic theory when he stated recently,

> '1. Although the grammar as a whole can be regarded as specifying a 'sound-meaning' relationship for sentences, it has, I believe, become quite apparent that evaluations of the adequacy of the proposals for deep-structure syntax are impossible in the absence of well-confirmed lexical representations.
>
> 2. The generality of psychological studies of syntax is placed in considerable doubt if we cannot control for lexical relationships within and between sentences used, for example, in learning and recall experiments.'

Marshall also points out that semantic theory

> 'is in 'an undeveloped state', and that even the best papers on performance aspects of semantics give the impression of trying to solve one equation which contains two unknowns (Ibid, page 193).

The theoretical position of semantics then does not, as yet, present the definitiveness shown by some other theories such as that provided for syntax by Chomsky. However, it is possible that something of the way in which the internal dictionary is ordered may be assembled eclectically.

Starting from the card sorting model proposed by Brown and McNeill in their work on the 'Tip of the Tongue' (TOT) phenomena (1.4), it was suggested that subjects in the experiment prompted by dictionary type definitions and in a 'TOT' state, produced a series of words that were retrieved as meaning associates to the target word. These similar-in-meaning (SM) words were entered into the proposed filing system first followed by the generic features for similar sounding (SS) words. It might follow from the priority given by Brown and McNeill to SM words that meaning relationships were coded at a superior level or favoured in some way in the proposed structure of the storage system. However, it should be noted that the stimulus in this experiment was a dictionary definition and that this influenced the subject to seek for meaning associates in the first instance. Nonetheless, their experiment does demonstrate that the structure of the storage system is unlike the traditional page-bound dictionary where meanings are accessed via words, for their experiment the entry was, as it were, backwards via the definitions.

Many workers have made the further point that the number of dictionary entries is unrestricted, and that the structure of the storage system must take the vastness of the entries into account. The consequence of this is, as Brown and McNeill point out,

> 'the amount of detail needed to specify a word uniquely must increase with the total number of words known, the number from which only one is to be distinguished.'

This is one of the reasons why hierarchical systems are attractive for they have the great advantage of economical storage. Such a system was envisaged by Katz and Fodor with Markers and Distinguishers occurring at nodal points (2.1). Miller also stresses the superiority of hierarchical organisations as being among the most apt for the structure of the lexicon. (1.4).

Summarising the requirements so far, the model must be able,

1. to allow entry at various levels,
2. to be capable of storing vast numbers of entries in sufficient detail for one to be distinguished from the others.
3. to achieve 1. and 2. and, at the same time, encompass the 'generic' and semantic features outlined by Brown and McNeill.

A model that takes these factors and their implications into account was that provided by Kintsch. In his tentative model of Long-Term Memory (LTM), which is influenced by Katzian and other linguistic theories, Kintsch (1970, page 352) suggests that,

> 'Each word is encoded in memory as a list of markers. A marker .... is, in general, another word. Thus for the model is an associative network: each entry in memory consists of a list of references to other entries. However, different types of markers will be distinguished. In this sense, the model is no longer an associative network, but it contains different kinds of relationships of which associative relations are one.'

It would seem that Kintsch's hierarchical model subsumes various types of association which are distinguished by markers, and it is assumed that the use of the term association here refers to the response hierarchies of traditional word-association. Some caution is needed for the detail is unclear and the terminology can be confusing (see 2.2). The terms lexical field, for example, is used for the description of items belonging to the same class, and associative fields to cover syntagmatic relationships.

There is a further difficulty with theories that employ word-associations as such when they are applied to acquisition processes. If storage is a necessary part of language acquisition, and that storage contains association networks, then recent criticisms must be heeded. Clark (1970, page 272) makes it clear when he states,

> 'association theory cannot account for language comprehension and production: language, the critics say, should not be thought of as a consequence of built-up associations; rather, word associations should be thought of as a consequence of linguistic competence.'

However, although the importance of this alternative theory of word-association, which reverses the traditional position, is accepted, the findings of word-association studies are still very valuable for they provide a very useful tool for tapping the relationships among the stored items irrespective of the way those items entered the store. The important point here is that it must not be assumed that, when word-association data is used, it necessarily implies the way meaning relationships were acquired in the first place.

The theoretical framework for this study of the lexicon is largely that proposed by Kintsch with some updating amendments and clarification.

7.2.1. A REVIEW OF THE SEMANTIC FIELD DATA.

There were four main reasons for the choice of semantic fields as such: firstly, recent research has shown that the acquisition of semantic fields is an important part of language development, and that they are acquired by a method of gradual accretion of the elements of the field. Secondly, from the experimental point of view, the field's structure is closely knit and 'observable', and thirdly, there is data from anthropological and other sources with which to compare the results. Fourthly, the concept of the semantic field was basic to Kintsch's model of the storage of linguistic data.

The first semantic field to be examined was that of Kinship terms. Here was a set of meaning relationships that was well understood by children and would therefore serve the three main purposes of the experiment. These were to demonstrate that,

1. the method of card sorting was one that could be used with children and have intelligible results,

2. cluster analysis techniques could be applied to the results, and

3. there was a developmental pattern related to the logical/semantic structure of the field.

As was intimated in the results (4.5) these objectives were achieved. The children sorted the cards according to the instructions which were to make piles of those words that were closest or nearest in meaning. It was hypothesised that, in doing this, the children would draw on their knowledge of the structure of the semantic relationships among the terms to guide their judgment and that this awareness would be revealed in their performance. That this was so was demonstrated by the results. In seeking to discover the intentional meanings of a set of terms in this way, it was hoped to gather information about the criteria by which native (child) speakers classify the denotata in a particular field. It was clear that the children judged some terms as closer than others and that the words could be grouped or clustered according to logical patterns. Further the clusterings lent themselves to a hierarchical ordering so that the more closely related 'direct' terms were arranged at the top of the Hierarchical Cluster Schemes (HCS) and the not-so-closely related 'collateral' family terms at the lower levels. In addition, by examining the structure of the clusters, it was possible to detect by the MAX and MIN methods of calculation the presence, or absence, and shape of the hierarchical structures. The facility enabled the growth of the structuring to be traced in the children's performance through the three age groups.

When the detail of the children's judgments as revealed by the grouped data in the HCS's were examined, certain consistencies appeared. Firstly, the clustering progression that characterised the data was from an initial pairing of opposites or contrasts, then a less clear sub-clustering where two or more of the pairs were merged or joined by other single items, to the (older group's) strong clusters which resembled the main divisions of the semantic field's organisation, eg. the divisions between 'direct' and 'collateral' areas and regions of the Romney and D'Andrade model (page 62). In general terms, the experimental results could be said to show that structuring becomes more stable along the developmental continuum, and that the content of those structures gradually approximate those of the models of the semantic field. There are no stages or sudden shifts apparent in the data.

The first experiment's results enabled the second experiment to proceed with greater confidence for, as long as the safeguards outlined earlier were applied at the time of data collection and to the HCS's before and during interpretation, both the method and analysis was shown to yield the kind of information being sought.

Two further semantic fields were submitted to this type of treatment and an investigation of the ways in which the children judged the relationships within them carried out. The Colour Names were sorted by the children whose interpretation of the instruction, to put together words that are closest or nearest in meaning, were analysed by the cluster programme. The HCS's were examined as in the previous experiment and showed that the children's structuring behaviour increases in stability with age. This, of course, was from pooled data but there are clear indications from the raw data sheets that this group pattern is followed by individual children.

The structure of the HCS's for this set of Colour Names had the same characteristics as were observed with the Kinship terms, ie. a pairing of terms that could be categorised as Opposites or contrasts (eg. Black, White; Gold, Silver), then a sub-clustering where some of the original pairs were joined, to the larger (strong) clusters which resembled parts of the colour groupings of the Chapanis model. It might be mentioned here that the Chapanis Circle (5.6.1) is built up by reference to adult judgments of Colour Names, albeit they were expert judges, so the children's judgments are being compared to what is essentially adult (expert) judgments. Further, it should be remembered that the Colour Names were basically the twelve most frequently occurring, (from Evans', 1945, sample), with the addition of Mustard and Orange. Interpretation of the results then must take these factors into account, for the inclusion of Mustard and Orange, for instance, gives a potential for development in this colour area not given to other colour groupings. However, having provided the potential the results showed that, by a certain age, the possibility of the relationships involved were being detected.

The domain of Pronouns provided another organisation of meaning elements for judgment, but of a different nature. Here, the linguistic model gave clear indication of the field's organisation and this, in turn, enabled the actual build-up of the structure to be observed in detail. The diagrams of the strong clusters (page 115) showed that the children's judgments gradually approximated the linguistic model with age. The structures again followed a similar pattern of development as with the other two fields. Firstly, the stability of the structures increased with age, and their contents showed that the characteristic hierarchical groupings occurred. The initial pairings were strong, and the sub-clusters contained groupings that were alike. The final strong clusters were organised along the main divisions of the Gleason model (see page 110), and the oldest group's HCS closely resembled the adult models provided by Fillenbaum and Rapoport.

7.2.2. SUMMARY OF THE MAIN FINDINGS OF THE SEMANTIC FIELD DATA.

1. The structuring performance of the children becomes more stable with age, and these structures more closely resemble models of the field's internal organisation.

2. The characteristic cluster schemes provided by the children's judgments by pairing, sub-clustering to the strong cluster stage. The pairing was largely of Opposites, complements or contrasts, and the sub-clusters extended these by combination and accretion. The strong clusters were akin to the most prominent divisions of the field.

7.2.3. DISCUSSION OF ASSOCIATION DATA IN THE EXPERIMENTS.

The finding that the children paired words that were Opposites or contrasts in the initial stages of the hierarchical cluster schemes can be explained if some recent findings on associationism are included within the basic framework of Kintsch's theoretical model. This work on Word-association rules, in particular the Minimal-Contrast rule, originated in the writings of Clark (1970, page 275). This rule fits the present data quite well. The rule, (free word-association is being discussed) states,

> 'If a stimulus has a common opposite (an antonym), it will always elicit the opposite more than anything else'.

With child subjects, of course, 'common' needs close definition, for a 'common opposite' for an adult is not necessarily 'a common opposite' for the young child. It is clear that, for the adult, associations do vary a great deal in the strength of their bonds, and it is safe to assume that the saliencies of these bonds will be built-up gradually by the child's continuing exposure to his native language. In fact, there is evidence of differences in associationism between adults and children. Wicklund et al (1964, page 418) demonstrated that paired-associate learning varies according to association strength. They claimed that the data from their experiments indicated that free-association strength does exert a significant influence on the verbal paired-associate learning of children. The learning task, (in the experiment),

> 'was sensitive enough not only to extremes of associative-strength, but also to intermediate degrees of strength, demonstrating that for children such differences may be used in paired-associate learning to vary difficulties in a way that does not seem possible with adults...'

In the present work, the results of Experiment 3 showed that association strength clearly affected the children's recall of the lists. When the bonds were selected for low percentage frequency from the norms, (List 2), the mean scores of all three age groups were lower than those achieved by the same children for the list containing relatively high associated pairs. A further feature, shown by the HCS's derived from the children's performance on List 1, was that the words were recalled mainly according to their association pairs, whereas List 2 words were 'incorrectly' paired at the beginning of the hierarchy. Bearing in mind Kintsch's assumption that output in free recall will reveal something of the storage of semantic relationships, it could be that, as list-learning was facilitated by association strength, the storage must be organised in such a way that associations of high strength (or familiarity) are readily accessible. This availability fits readily into the Kintsch model, for he assumes that each semantic marker has a familiarity value and that, in the retrieval process,

> 'tagging a marker amounts to incrementing this familiarity value by some amount that depends upon the original familiarity value of the marker.' (Kintsch 1970, page 361).

Here, it should be noted, Kintsch is discussing his model in terms of a general memory model developed by Atkinson and Shiffrin (1968) and, in particular, that part of the process entailed in the transfer of information from short-term to long-term memory. In the present free-recall experiment, the results fit the model well as the three trials given for learning the lists could be seen as a process which would cause information to be transferred from short to long-term memory. The lists contained items which had existing interrelationships or, as Kintsch has it, marker overlap.

> 'If a marker X is found that is common to two (or more) words A and B, A and B are tagged in the marker list of X. Thus, a system of cross references is built up. Whenever a marker or set of markers is being worked with, its (original) familiarity value receives an automatic updating.' (Kintsch 1970, page 362).

It would be interesting to know how certain items come to have this 'original familiarity value', for it is surely of concern in the developmental process.

One suggestion might be that familiarity value is a function of marker overlap and it is possible that further detail of the association mechanism in this overlap can be specified by the rules of association provided by Clark (1970). As well as the Minimal-Contrast Rule already referred to, he posits a series of other paradigmatic and syntagmatic rules. The rules start from the position of 'greatest simplicity'.

> 'Perform the least change on the lowest feature with the restriction that the result must correspond to an English word.'

The following is an illustration of how the rule is thought to work. The characterization of the stimulus word 'man' might be [+Noun, +Det- , +Count, +Animate, +Human, +Adult, +Male]. Some associating rule is then applied such as 'change the sign of the last feature', and the associating mechanism would alter [+Male] to [-Male]. The altered feature list would then be [+Noun, +Det-, +Count, +Animate, +Human, +Adult, -Male] i.e. Woman. In this way the Minimal-Contrast rule changes only one feature, a simple binary operation. Examples of Animate Nouns, with the reversal of the sign $[\pm \text{Male}]$ are male-female, man-woman, Boy-girl, he-she, him-her, aunt-uncle and so on. Other features quoted are $[\pm \text{Polar}]$, $[\pm \text{Plural}]$ such as is-are, was-were, has-have, etc., $[\pm \text{Past}]$ among strong verbs, is-was, are-were, has-had, take-took etc., $[\pm \text{Nominative}]$ among Pronouns, he-him, she-her, they-them etc. 'Obviously', as Clark says, 'the Minimal Contrast rule accounts for a large number of the commonest responses in word association'. It is tempting to think of the 'common associate', or 'original familiarity value', in terms of minimal contrast which would then account for some aspects of association strength.

Clark adds to the Minimal-Contrast rule, suggesting that there is a hierarchy of rules such that the feature at the bottom of the list is changed rather than any one at random. Referring to the change of the last feature in the example above, he suggests then 'man' elicits 'woman' not 'boy', that is the feature $[+ \text{Male}]$ is changed not $[+\text{Adult}]$ which was the last-but-one in the list. His proposition for this process runs, 'Change the sign of one feature beginning with bottommost feature', (Clark, 1970, page 276). Further paradigmatic rules follow, The Marking Rule, The Feature-Deletion and Addition Rule, and The Category-Preservation Rule. There are also syntagmatic rules such as The Selectional Feature Rule and The Idiom-Completion Rule. Although there are undoubtedly many details of the rule system to be added to the examples quoted by Clark, there is enough in his work to show the attractiveness of his feature rules to account for the data from word-association.

Summarising the discussion so far, it has been suggested that the data resulting from the experiments fit a model of the structure of Long-Term memory proposed by Kintsch. The model accounts for the variety of hierarchical associative relationships and Kintsch demonstrates how the closeness of items in the output of free recall tasks reveal the way in which meaning relationships are stored. This theoretical framework is augmented by the inclusion of Clark's feature rules which fit the hierarchical structure and go some way to explain how 'marker overlap' may work. It is further suggested that these rules may account for Kintsch's 'familiarity values' or association strength, in that familiarity might be a function of minimal-contrast which in turn might be connected with the frequency with which words are associated by adult users of the language.

7.2.4. DEVELOPMENTAL IMPLICATIONS.

In the third experiment the associative categories involved were Opposites, Hyponyms and Synonyms. These were seen to have logical connections as Bierwisch (1970, page 170) showed: Synonyms have more or less identical features, Hyponyms also have many features in common but are distinguished by one-way directionality, and Opposites have a mutually exclusive feature. Analysed in this way, it is not difficult to accommodate these associative categories into a system of feature rules like those of Clark.

From the foregoing it is possible to speculate how such an associative mechanism might work in developmental terms. In the first place, the acquisition of the lower binary features would be needed for the child to be able to apply the minimal contrast rule. Mastery of this operation would allow a considerable increase in ability to deal with a variety of semantic relationships. Thereafter, progress would depend on the acquisition of further features.

A description that comes nearest to explaining feature acquisition is that proposed by Eve Clark (1973, page 72) who outlines her hypothesis for the early stages of semantic feature acquisition. This hypothesis states that

> 'When a child first begins to use identifiable words, he does not know their full (adult) meaning. He only has partial entries for them in his lexicon, such that these partial entries correspond in some way to some of the features or components of meaning that would be present in the entries for the same words in the adult lexicon .... The acquisition of semantic knowledge then, will consist of adding more features of meaning to the lexical entry of the word until the child's combination of features in the entry for the word corresponds to the adults'.

This is not to say, however, that progress will be a simple step-by-step development or necessarily from the bottom up!

The results of the recall of the word list in Experiment 3 could be accommodated by these hypotheses by suggesting that most of the features, or markers, of high frequency words are acquired early, but that those of low frequency words are only partially acquired. This presumes, of course, that knowledge of the rules and how to apply them are available and it is only (!) the features that need placement. However, this is not too great a speculation for rule governed verbal behaviour is observable in syntactical acquisition at a very early age.

The difference between the word-associations of adults and those of children has been referred to already and it has been shown that children, in contrast to adults, give mostly syntagmatic responses. (Entwistle, 1966). The preponderance of syntagmatic responses shifts to the adult preferred paradigmatic response between the ages of five and nine years. The syntagmatic-paradigmatic shift has been explained by the child's partly acquired feature lists. (McNeill, 1966). Lippman (1971), investigating this phenomenon with subjects at kindergarten, in the second and fourth grade, and college, found data to support McNeill's hypothesis. Francis (1972) puts forward a further explanation for the shift suggesting that,

> 'the syntagmatic-paradigmatic shift is caused by a lengthy reorganisation of the mental filing system of the preschool child based on abilities to isolate words from sentences and to make comparisons across related constituents.'

She points out, however, that

> 'neither syntactic nor semantic system learning appear to explain the syntagmatic-paradigmatic shift. Rather, they are ways of describing it, for they both rest on cognitive abilities that are rarely demonstrated in the preschool child.'

This, in some ways, echoes the recent comments on word-association in that it is a consequence of language ability and not vice versa. However, the work must take the growing cognitive abilities of the children into account, for their awareness of the underlying structures of the semantic fields probably owes much to cognitive factors as linguistic.

> 'It is quite likely that lexical structure is partly a reflection of universals of cognitive development.' (Flores d'Arcais and Levelt, 1970, page 187).

7.2.5. RESEARCH SUMMARY.

Semantic fields or domains are, by definition, structured. This must be so, otherwise they would be indistinguishable from any haphazard collection of words. It has been shown that these abstract structures are logically organised and are analysable by such techniques as componential analysis. Models have been devised thereby to represent the regularities within the fields.

Researchers (eg. Fillenbaum and Rapoport, 1971), studying adult subjects, have demonstrated fairly conclusively that the underlying structures of the fields are recoverable by 'judgment' methods and analysable by cluster analysis.

A recent researcher with children (Clark, 1972) has hypothesised that,

1. children set up semantic fields automatically and

2. in doing so learn something of the meaning of related words.

By using judgment methods and cluster analysis the present research has demonstrated that acquisition of semantic domains continues over a lengthy period and can hardly be termed 'automatic'.

The experiments on semantic fields showed that the children's structures of the three semantic fields became more stable with age, and that the structures produced from the older children's performance closely resembled models of the fields.

An examination of the construction of the children's hierarchical clustering schemes showed that they were built-up characteristically of the pairing of Opposites or complements, the sub-clustering of these and other items until a final strong clustering stage which resembled the organisation of the semantic field.

These results led to an investigation of possible models for the storing of meaning relationships, for acquisition requires some kind of storage. Kintsch's model of Long-Term memory was chosen as having the greatest explanatory power as it subsumed other semantic theories and could be tested by the adjacency of terms in free recall.

As the developmental process was believed to last a number of years, it was hypothesised that the 'original familiarity value', or association strength existing between related pairs of words, would be increasingly appreciated by the children as they aged.

A further experiment was set-up therefore to trace this development using the free recall of paired-associates as its method. The experiment investigated the effects of pairs of words selected according,

1. to certain linguistic criteria, and

2. differing associative strength,

with three age groups of children.
Results showed that age, linguistic category and associative strength were important variables, but that 'high' association strength enhanced overall 'correct' recall and that when associative strength was 'low', the linguistically related pairs no longer occurred in adjacent positions in recall. The effects of age resembled that of differing associative strength in that the recall of 'low' associative pairs by the oldest group was like the youngest group's performance with 'high' associative pairs. The words were not recalled according to their linguistic categories unless the associative bonds were relatively strong.

It was concluded that child subjects increasingly appreciated, with age, the familiarity value between pairs of words and that this awareness enhanced recall.

The results were interpreted according to Kintsch's theory of Long-Term memory augmented by Clark's semantic feature hypothesis.

7.3. SOME PROBLEMS OF PEDAGOGICAL IMPLEMENTATION.

The study's main purpose was to examine the research work on language acquisition, particularly during the early school years, so that the teaching of English and related topics might be assisted.

The exercise has shown that the complexity of language and its acquisition is vast even within the limited boundaries set for the study. However, some important implications for research and the school learning situation are raised.

In the first section of this thesis, the recommendation of a recent government report 'A Language for Life', (Department of Education and Science, 1975), the Bullock Report, were mentioned. These called for increasing emphasis to be placed during the initial training of teachers on knowledge of language and language acquisition. More recently still these recommendations have received adverse criticism. Crystal (1975) complains, for instance, that the Report does not 'bridge the gap between theoretical principles and pedagogic practice'. He points out that 'The teacher is expected to 'chart the process' of language development. He must plan the situations 'from which such uses are bound to emerge' and must therefore 'have a knowledge of how language works, and the ability to appraise children's language and operate on it accordingly ....' All of this is certainly a massive 'new dimension for the teacher ....' Crystal further criticises the Report stating that

> 'The whole field of language acquisition is also given short shrift - again an odd emphasis for a Report which is arguing for the integration of reading within language development as a whole.' (Crystal 1975, page 45).

However, the issue here is not the inbalance and shortcomings of government reports, but rather the problem of communication between researcher and practitioner. The fundamental difficulty concerns the translation of research results, such as are presented in this present work, into a format that will assist the practice of the teacher when planning actual classroom activities.

Some recent work by Carol Chomsky (1972) may be quoted as a typical of this problem. Working with children between the ages of 6 and 10 years she investigated linguistic competence with respect to syntax. Here she found that the disparities between adult grammar and child grammar are reduced as the children's knowledge of their native language increases, and that 'a regular order of acquisition of structures', accompanied by 'a wide variation in the rate of acquisition in different children', was of particular interest. Her results also showed strong correlations between a number of reading measures and language development. Discussing the practical implications of her work, however, she says, (page 32),

> 'It seems to me that its relevance may lie in the continuing language acquisition that it reveals in school children, and in the connections noted between this language development and reading'.

A few paragraphs later she adds,

> '.... perhaps the best thing we might do for him (ie. the child in the classroom) in terms of

encouraging this (language) learning would be to make more of it possible, by exposing him to a rich variety of language inputs in interesting, stimulating situations. The question is how.' (page 33)

Finally, after describing her remarks as speculative, she states,

'Their purpose is to emphasize that the potential relevance of work of this sort to language curricula will lie in its suggestiveness for effective classroom time, rather than its relation to the specifics of grammar teaching.' (page 33).

Teachers then may be better informed and trained to think systematically about language but still have the greatest difficulty translating this knowledge into classroom activity. It may well give greater understanding of the child's problems and produce a 'philosophy' to guide the approach, but unless the teacher's understanding of the research is as full as that of the research worker, there will still be a gap to bridge between the research and the classroom activities designed to instruct.

The inadequacy of the present position in semantic theory is a further obstacle, for this restricts the research itself. Some research into reading processes might be taken as an example of this aspect as the findings appear equivocal because there was no adequate control of semantic processes.

Pearson (1974-75) examined the effect of grammatical complexity on children's comprehension, recall and conception of certain semantic relations. The overall purpose of the study was to assess those linguistic variables that 'might conceivably affect the way in which children comprehend verbal data when they read'.

Pearson suggests that in this area of comprehension, grammatical complexity is often an aid to comprehension and recall rather than an hindrance. However, after reporting his results on comprehension as surprising, he comments, 'Perhaps the semantic content of the sentence was so simple that it masked possible differences due to form' (page 173). Here is a case which exemplifies the point made earlier, (Marshall 1970, page 190), that considerable doubt exists in the generalities arising from psychological studies when 'we cannot control for lexical relationships'.

A work in the field of language processes and reading that does look more promising is that of Goodman (1973) where an examination is made of the development of linguistics in terms of reading. A theoretical model of the processes has been worked out and detailed analyses performed that have direct instructional potential. This work which is by now virtually complete, analyses in detail the misuses made by children during oral reading. The method compares the performance expected from the graphic display (ER) with the observed performance (OR), the child's actual oral reading. Goodman suggests that 'much may be learned about the competence which underlies performance and the psycholinguistic processes of the language user'. For his research Goodman has built up a linguistically sophisticated 'Taxonomy of Reading Miscues' with which to analyse the children's oral reading performances. This work does give clear indications of how detailed research can inform actual classroom practice.

SOME CLASSROOM APPLICATIONS.

The theoretical model that has been investigated in this study could be used to guide classroom practice in three ways.

1. In the selection of texts that will be used for teaching beginning readers.
2. To provide materials for the direct teaching of certain semantic-syntactic elements.
3. For diagnostic purposes.

1. The selection of texts for early reading. Teachers have been encouraged in the past to select books for reading instruction according to certain criteria. Such factors as clear print, colourful illustrations, familiar words and settings have often been brought to their notice but recently more attention has been directed to the actual language structures used in early reading material. It has been suggested, for instance, that the syntax should be simple and as close to the children's everyday speech as possible. It is when this detail of the structure of the sentences in the texts are being assessed for suitability that the model that has been investigated can be used as a guide. The pronouns cluster details in Experiment 2, for example, can be followed quite closely in the following way.

To establish correct usage selected pronouns could be repeated frequently in texts so that markers can be gradually added and potential confusion avoided. It was seen in Experiment 2, for instance, that 3rd person

pronouns were clustered even by the youngest group but 'He' was not included. This appeared later in its associated with 'His' and 'Him' in the clustering of the middle age group. (see Figures 48-51).
If this point of detail is followed then books written to help establish these features should be selected, especially for children who are experiencing difficulty.

A chapter from each of two early readers are analysed in detail next to illustrate this point. The first is from a very well known series of readers, the Janet and John books, in which pronouns are frequently found. In some instances they are used in such close proximity however, that the child might easily become confused. The second example is taken from the Dolphin series of readers where the 3rd person singular masculine pronoun is used clearly and repeated in such a way that should provide helpful to the young reader. Both readers are written for approximately the same age group which is the same as Group C in the present study.

<u>Analysis 1.</u> (Only those pronouns used in Experiment 2 are marked).

<u>The Toy Mender. Janet and John, Book 3 Pages 66-72</u>

There was a little shop near Janet's house. It was kept by a man who mended broken toys. <u>He</u> was called the Toy Mender.	...'He' refers to 'a man', ...	1.
All day long boys and girls came to <u>his</u> shop.	...'his' refers to 'He', ...	2.
"Bring <u>me</u> your old toys", <u>he</u> said.	..'me' & 'he' refers to Toy Mender	3.
"<u>I</u> will mend <u>them</u>".	..'I' refers to Toy Mender, 'them' refers to toys.	4.
If a doll's bed was broken, the Toy Mender mended it. If an aeroplane would not fly, <u>he</u> mended it.	..'he' refers to Toy Mender.	5.
Boys came with <u>their</u> boats, and girls came with	...'their' refers to boys	6.
<u>their</u> dolls.	...'their' refers to girls	7.
"Bring <u>me</u> <u>your</u> broken toys," <u>he</u> said.	...'me' refers to Toy Mender, 'your' refers to boys and girls and 'he' refers to Toy Mender.	8.
"I will mend them".	...'I' refers to Toy Mender.	9.
One morning Janet was playing with Betsy Lee.		
'Janet ! Janet! called Mother.		
"Here <u>I</u> come", said Janet.	...'I' refers to Janet.	10.
<u>She</u> jumped up.	...'She' refers to Janet.	11.
Betsy Lee fell to the ground.		
Betsy Lee was broken.		
"Mother! Mother!" called Janet.		
"<u>My</u> new doll is broken, <u>she</u> fell to the ground.	... 'My' refers to Janet. 'She'refers to doll.	12.
Janet began to cry.		
"Do not cy", said Mother. "Take Betsy Lee to the Toy Mender".		

my poor broken doll".	... 'my' refers to Janet	14.
"She will soon be all right", the Toy Mender said.	... 'she' refers to doll.	15.
"I will mend her now, and make her well again".	... 'I' refers to Toy Mender, 'her' refers to doll.	16.
The Toy Mender started to mend Betsy Lee.		
Janet sat down and waited.		
She looked all round the shop.	... 'she' refers to Janet.	17.
There was a long shelf with toys on it.		
Near the window was a blue box.		
It was a pretty box with red birds on it.		
"Please", said Janet, "what is that box?".		
The Toy Mender looked up.		
"That box can play a tune", he said.	... 'he' refers to Toy Mender	18.
"It was my little girls'. She was just like you".	... 'my' refers to Toy Mender, 'she', refers to Toy Mender's girl.	19.
	... 'you' refers to Janet	20.
He went to the blue box and picked it up.	... 'he' refers to Toy Mender.	21.
The box started to play a merry little tune.		
Janet waited until the tune came to an end.		
"I like that tune," she said.	... 'I' refers to Janet, 'she' refers to Janet.	22.
"May I hear it again?".	... 'I' refers to Janet	23.
The Toy Mender made the box play the tune again.		
"Where is your little girl?" said Janet.	... 'your' refers to Toy Mender.	24.
"She is grown up now", said the Toy Mender.	... 'she' refers to Toy Mender's girl.	25.
"She is too old to play with the box.	... 'she' refers to Toy Mender's girl.	26.
But look your doll is mended. Betsy Lee is	... 'your' refers to Janet.	27.
as good as new. Run home with her. Then	... 'her' refers to doll.	28.
come back I want to give you the blue box.	... 'I' refers to Toy Mender, 'you' refers to Janet.	29.

Comments Potential problems.

Instances 3 & 4 ('me', 'he', 'I') all refer to the same person, the Toy Mender, and as they are in close proximity might be muddling for the young reader who may not, at this age, have established the relationships involved. In addition, at this stage of decoding the print, meaning in the passage is not always evident to the child.

Instances 5 & 6 Here 'their' refers first to boys then to girls. This is a simple (to the adult!) example of the marker theory, for the third person plural can refer to a group of boys (only), girls (only) and boys and girls together. The markers have to be acquired and this may well be a useful teaching point but again could cause problems for the young reader.

Instances 8 & 9 In these two short sentences 'me' 'he' and 'I' refer to the Toy Mender and 'your' to boys and girls in general. This could be a source of difficulty if the child has been instructed to 'read for meaning'.

Many pronouns are used throughout the story, some having indirect antecedents which call for inferences by the child. If all the semantic - syntactic markers have not been acquired then their usage might be potentially difficult and comprehension of the passage could be delayed.

The second example is of a text which uses relatively few pronouns.

Analysis 2

Ian had ten pence to spend. He	...'He' refers to Ian	.... 1.
put his hand in his pocket and felt it there.	...'His' refers to Ian	.... 2.
He could buy what he liked.	...'He' refers to Ian	.... 3.
But he knew what he wanted to buy.	...'He' refers to Ian	.... 4.
It was something he had always wanted to buy.	...'He' refers to Ian	.... 5.
It was something he had always wanted. It was a rabbit, a black-and-white rabbit.	...'He' refers to Ian	.... 6.
He walked along the street humming a song. He was thinking about the rabbit.	...'He' refers to Ian	.... 7.
It was a long way to the market, but he did not mind.	...'He' refers to Ian	.... 8.
He passed a little house with a green garden gate. The gate was shut.	...'He' refers to Ian	.... 9.
He passed the red-brick school.	...'He' refers to Ian	.... 10.
Then he passed the farm with the pond.	...'He' refers to Ian	.... 11.
He stopped to look at the ducks on the	...'He' refers to Ian	.... 12.
"Quack, quack", said the ducks. They	...'They' refers to the ducks	.... 13.
stood on their heads in the water.	...'Their' refers to the ducks	.... 14.
They were funny. But not as funny as a rabbit.	...'They' refers to the ducks	.... 15.
At last he came to the market.	...'He' refers to Ian.	.... 16.
At the market.		
How gay the street looked!		
It was full of stalls.		
They were piled, with all kinds of things.	... 'they' refers to stalls	.... 17.
Each stall had something different to sell.		
One stall sold oranges, ripe plums and green grapes. Ian looked at the green		
grapes for a very long time. But then he	... 'He' refers to Ian	.... 18.
remembered the rabbit. He passed by.	... 'He' refers to Ian	.... 19.

fleet of ships sailed towards him.
Ian wanted a ship with a funnel.
But he remembered the rabbit. ....'he' refers to Ian ....21.
He passed by all the time he was looking ....'he' refers to Ian ....22.
for another kind of stall with rabbits
for sale.

A rabbit for sale.

Ian saw a man selling fish.
"Fresh fish, fresh, fish", called the
fisherman. "Cod and herrings, all
fresh!"
The fisherman wore a black jersey and big
black boots. He looked a jolly sort of man. ....'he' refers to the Fisherman ....23.
But Ian did not want a herring. A lady
was selling hats. "Come on, now, buy
a pretty hat", she cried. "Hats of pine ....'she' refers to a lady ....24.
straw. Sun-bonnets of silk. Just the
thing for a hot day".
The lady's hat was red with a long
feather. She had a big smiling face. She ....'she' refers to a lady ....25.
looked a kind lady. But Ian did not want
a sun-bonnet.
He stood still and listened hard. There ....'he' refers to Ian ....26.
was another lady calling. She was a long ....'she' refers to a lady ....27.
off. It was hard to tell what she was ....'she' refers to a lady ....28.
calling, the other stall-holders were making
such a noise and clatter.
There, he could hear her quite well now. ....'he' refers to Ian, 'her' refers to another lady ....29.
She shouted, "Who will buy my rabbit"?. ....'she' refers to another lady ....30.
....'my' refers to another lady ....31.
"Rabbit!" cried Ian. "She is selling rabbits". ....'she' refers to another lady ....32.
He ran back the way he had come. ....'he' refers to Ian. ....33.

Comments.

In this example of an early reading book, the pronouns, although as numerous as in the previous excerpt, are kept distinct and repeated constantly without apparently causing boredom. The story is simple yet effective. The sentence structure is simple and there is not too great a distance between an individual pronoun and its antecedent.

The model could be used effectively in this way as a direct guide for the selection of texts as illustrated by the analysis of the two extracts quoted above.

The second suggested application was to provide materials for the direct teaching of certain semantic-syntactic elements.

There is a stage in the teaching of reading where for fluency to develop satisfactorily, knowledge of backward and forward acting cues, like anaphora, has to be established. Various kinds of relations exist amongst words in a passage of prose. There are, for instance, the grammatical relations between parts of speech like nouns and verbs, articles and nouns, adjectives and nouns and so on. Some of these syntactic relations are referred to perhaps less often yet are, nonetheless, of importance. One such relation is termed anaphora, which is the process of shortening or substituting for an expression which is usually antecedent to it and which has the same referment as the antecedent. (Bormuth et al 1970).

The existence of this function with pronouns was utilised engagingly by Lewis Carroll, as the following verses from Alice's Adventures in Wonderland clearly demonstrate:

> "They told me you had been to her,
> and mentioned me to him:
> She gave me a good character
> But said I could not swim.
>
> He sent them word I had not gone
> (We know it to be true):
> If she should push the matter on,
> What would become of you:"

Here, there are plenty of pronouns but, one of the reasons for the poem's puzzling quality, is that there are no antecedents. The pronouns do not refer back to, or replace, any nouns. Adult language users, and children to some extent, have become so proficient at processing the relations between pronouns and their antecedents, that it is not until they are faced with the ambiguities in something like Carroll's poem, or a very lengthy gap between the pronoun and the antecedent, that they are in any way aware of the process of anaphora.

Two further sentences illustrate the process at work between nouns and pronouns and pronouns and pronouns. e.g. (1) 'After I had locked <u>George</u> in the shed, I began to feel sorry for <u>him</u>'. In this example George and him are related and we understand that <u>him</u> refers back to George. In another sentence, there are similarly three pairs of relations: e.g. (2) 'From the time that Burton told her of his travels in Arabia, she longed to go there'. In this example

Burton and his,

her and she,

Arabia and there,

are related anaphorically.

There are, of course, other anaphoric structures and in their research Bormuth et al (1970) used fourteen types to test awareness of grammatical relations within and between sentences. Their examples were:

1. Joe may go. If so, we will .....
2. He works in the cellar. It is cool there.
3. The man who lives next door makes .....
4. John likes tennis. So does Bill.
5. The small boy came. This boy is .....
6. The black horse belongs to Joe. That is his ....
7. Several men went fishing. Two caught .....
8. Joe, Bill and Mary went to the show. All enjoyed .....
9. There are ripe and green apples. The green are mine.
10. Joe is sick. So is Bill.

11. Bill and Joe went shopping. No one bought .....

12. Joe is stuck in the mud. This leaves us .....

13. Those steel towers are Antennas.

    Those objects are .....

14. Joe left the room. He had .....

Although adults cope with the functioning of anaphora skilfully, it is clear that children have to learn these relations. Clay (1968) reported that the error behaviour of children was guided by the syntactic framework of sentences and that self corrections involving pronouns occurred more often than errors involving nouns.

A further indication of difficulty with anaphora was given by Lindsay (1972) when he referred to Piaget's task for an eight year old boy who was told a story and asked to retell it to another child.

The original story was:

> Once upon a time, there was a lady who was called Niobe, who had 12 sons and 12 daughters. She met a fairy who had only one son and no daughter. Then the lady laughed at the fairy because the fairy had only one boy. Then the fairy was very angry and fastened the lady to a rock. The lady cried for ten years. In the end she turned into a rock, and her tears made a stream which still runs today.

When the story was retold it went like this:

Once upon a time there was a lady who had twelve boys and twelve girls, and then a fairy a boy and a girl. And then Niobe wanted to have some more sons.

Then she was angry. She fastened her to a stone.. He turned into a rock, and then his tears made a stream which is still running today.

It is quite clear that the boy lost the passage's organisation and in particular, it was the anaphoric structures that were violated as the story was recalled. It is obvious that children have to build up an awareness of anaphoric relations between pronouns and their antecedents and of other anaphoric types. As is so often found in reading, some children will have little difficulty in transferring their ability to cope with these relations in oral language situations to that of reading, but others will need to have them taught and their presence made explicit: To achieve this learning, materials could be prepared so that relations within and between sentences are highlighted. Here the experimental work with Pronouns would provide a basis for the materials which could then be designed to follow developmental trends. The materials would first have to establish a 'learning set' towards the anphoric process by employing cloze procedure, the method of deleting certain words from a passage and asking a child to supply them by using the content of the extract. For instance, a very simple passage like the following could be tried to begin the work.

---

e.g. 1. he, his

Poor little Jack Rabbit
did not have a safe hutch.
-- home was in the sand.

-- ran and ran,

but, could not find it.

-- was far from the pretty garden.

-- was safe from the dog,

but -- was lost.

-- could not find Mother Rabbitt.

p.63 O'Donnel M, and Munro R.(1950)
Janet and John Book 3. Nisbet & Co.

It will be necessary to diagnose the child's present awareness of the relations under discussion to begin with, and then provide materials to assist in the development of particular features. Each sub-set of the relations within the field will need examination, and, for overall guidance, the developmental pattern of the Pronouns semantic field could provide a framework for the materials. It should be recalled that the cluster patterns for the young, middle and older children compared with the adult group were as follows:

Pronoun clusters for three age groups of children and an Adult Group

Youngest Age Group (5-6)	I, Me, My, He We, Us, Our	Him, His She, Her	You, Your They, Them, Their
Middle Age Group (7-9)	I, Me, My You, Your We, Us, Our	He, Him, His She, Her	They, Them, Their
Older Age Group (7-9)	I, Me, My, You We, Us, Our, Your	He, Him, His She, Her	They, Them, Their
Adult Group	I, Me, My We, Us, Our	You, Your He, Him, His She, Her	They, Them, Their

If a programme of work with pronouns is envisaged, then it could begin with those clusters that had the highest values - i.e. those that the children judged as being closest in meaning. In the research the pronouns that formed the closest clusters were the third person pronouns, Masculine and Feminine (Him,His), (She, Her).

However, the complete Third Person Group was not firmly established and was, furthermore, initially composed of opposites so unlike the adult group's clustering by gender. To begin a programme to assist correct relations, a number of simple stories which demonstrate the existence of pronoun-antecedent relationships are required. They should use the clusters of highest value i.e. 'Him' and 'Her' first as these pronouns are the obvious candidates for this early material. An example of such a simple story might be as follows: -

e.g. 'Jim lost <u>his</u> dinner money on the way to school.
The teacher told him not to worry as <u>she</u> would
lend <u>it</u> to <u>him.</u>'

Here are five pronouns that could be deleted. The exercise could be graded in various ways so that for instance only '<u>his</u>' and '<u>him</u>' are entailed or just '<u>it</u>'.

One stage of the work would need to look more closely at - 'He' to build up the correct usage of the third person singular pronoun as this was not clearly identified with the third person clusters of the youngest group. This would then anticipate the clustering of all the third person singular pronouns as found in the middle group's clusters.

As the progression develops, further work reinforcing what has been done and preparing for the next would be required. For instance, clear distinction between the first person singular and first person plural is envisaged as the clusters develop.

The following twelve examples show how these original materials might be supplemented by material from the reading books of children at this stage of reading.

e.g. 1. (See pages 215-216)

E.g. 2. <u>She</u> and <u>her</u>

Meg was the mother hen.

- had ten eggs

in - soft nest of hay.

- was thin, for - had no time to look for food.

- sat on - eggs in the hen house all day and all night.

p.51 E.R. Boyce (1958) The Yellow Book
The Gay Way Series. MacMillan and Co.

E.g. 3. he, she, his

Mary has a baby brother called Nibs. - is two years old. One day mother made twelve little cakes. - put them on the kitchen table to cool. Then - went upstairs.

Nibs went into the kitchen and saw the cakes. - tasted one. - tasted another, and another.

When - mother came back - found only one cake left. Later, Nibs had a very bad pain.

Flowerdew, P. and Ridout, R. (1961)
Reading to Some Purpose Book 1, page 25.
Oliver and Boyd

E.g. 4. she, her, them.

Pat has a bedroom in - doll's house.

- plays at mothers and fathers,

and - is the mother.

- puts - girl dolls and - boy dolls to bed.

- gets - up and washes -

p.31 ibid

E.g. 5. I, we, you, me.

'Shall - play hide and seek?

said Ken to Pat and Pipkin.

' - can play in and out of the barn. Who will start?'

' - will', said Pat. ' - will not peep.

- will stay in the barn.

When - call out, - will come to look for - '

p. 66 ibid

E.g. 6. I,my,she,it.

" - wish - did not rain," said Mother,

as - went out to the shops.

" - have no umbrella.

Pipkin left - blue umbrella in the garden.

- must dash down the road to the fish shop".

p.5. ibid

E.g. 7. he,you, it.

This boy has found some money.

- found - in the school playground.

- did not see anyone drop - .

Should - keep the money?

What should - do with - ?

What would - do if - found some money?

p.88 Roscoe,F. (ed.) (1950)
Revised Edition The Beacon
Study Reader. First lessons.

E.g. 8. he, him, us, our, you.

The farmer works very hard to grow

food for -.

- could not grow - food if -

did not have help.

Can - think of anything that helps -.

p.58. ibid

E.g. 9. he, she, you, me.

John set off to find Janet.

Soon - met Peter and said,

"Have - seen Janet?"

"Yes", said Peter.

" - came to play with the rabbits.

Then - went away".

"Come with - ", said John.

"Help - to look for Janet.

- may be lost."

p. 15. O'Donnel M., and Munro, R. (1950)
Janet & John Book 3. Nisbet & Co.

E.g. 10. we, it, their, me, your, them.

If a doll's bed was broken,

the Toy Mender mended -.

If an aeroplane would not fly,

- mended - .

Boys came with - boats, and girls

came with - dolls.

"Bring - - broken toys,"

- said "I will mend - ".

p. 67 ibid

E.g. 11. he, it, my, she, you, I

The toy mender looked up.

'That box can play a tune',

- said.

' - was - little girl's.

- was just like'.

- went to the blue box

and picked - up.

The box started to play

a merry little tune.

Janet waited

until the tune came to an end.

'I like that tune', - said.

'May - hear - again?'

P. 71 O'Donnel, M., and Munro, R. (1950) Janet and John Book 3. Nisbet & Co.

E.g. 12. her, she, he

Just how far Ann had progressed was demonstrated when Jack decided to decorate - bedroom. - insisted on choosing - own wallpaper and paint. - demanded that Jack let - help, and after an hour's instruction - was painting and pasting like a professional. When Jack realised that - would not have enough wallpaper, Ann begged to be allowed to go to the shop.

Copeland Jones (1976)
For the Love of Ann
Reader's Digest April, 1976,p.212.

3. The third application, that is to provide material for diagnostic purposes, is related to both the foregoing suggestions. By selecting exercises like those in the direct teaching examples (e.g. 1-12 above) a series of texts of increasing anaphoric difficulty could be constructed. This would provide the necessary test material to allow the teacher to find an invididual child's present level of general development as well as areas of specific weakness. These deficiencies could then be made good by constructing direct teaching material as outlined in section two.

At the beginning of this study, it was pointed out that 'research begets research' and it will be appreciated that in this final section on the application of the research results presented here, another series of research projects is already implied. In the second type of application for example, materials need to be devised, categorised and tested in classroom conditions. At the same time, a number of other semantic fields need researching. Indeed, to be beneficial and for one to inform the other, both the theoretical and applied aspects need to be researched together for only then could a researcher claim to have assisted the teacher to help children acquire their 'Language for Life'.

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APPENDICES

Contents

Reading comprehension in a College of Education

L. J. CHAPMAN

A recent investigation into students' complaints about the unevenness and severity of their work loads, revealed a considerable discrepancy between the time a lecturer expected a piece of work to take, and the time actually spent by the student on that piece of work. One of the factors suggested as being involved in this important difference was an over-estimate by the staff of students' reading ability.

Coincidental with discussion of these findings, a course in Education was stressing the importance for all students to study, during their initial training, 'the complete range of reading growth' as suggested by Moyle (1969). In trying to implement these proposals it was found that, although students preparing to teach young children readily accepted such a study, and indeed showed great enthusiasm for it, those intending to teach children in the post-infant age group showed far less interest.

To overcome these problems, an attempt was made to illustrate the continuing developmental nature of reading by requiring all students in their first term at College to take a test of Reading Comprehension at their own level. Part of the rationale of this procedure was that, by seeing their own inadequacies (if such were revealed), the students would appreciate the importance of an Education course dealing not only with the beginning of reading but with the complete range of reading growth. In this way it was hoped to increase motivation by a form of self-revelation.

After the students had taken the Comprehension Tests, they were told, in general terms, that some had low scores and that they could, if they felt the need, discuss their performance with their Education tutor. A number of students took advantage of this and after discussion began voluntarily to follow a structured reading programme designed to increase reading comprehension skills.

After these purposes had been met, it was realised that an analysis of the Reading Comprehension scores might help the staff to understand more fully the problems being raised in the work-load study. The following report contains a description of the student groups and a simple analysis of the Reading Comprehension scores provided by the 1970 intake together with a comparison with the scores of the following year's intake.

Student groups

When the students enter College, they are put into one of ten groups for their course in Education and for other organisational purposes. Although these groups contain a mixture of students by academic subject, the composition of the group is decided by the age group they have chosen to teach. Thus there are groups preparing to teach either Infants only (I), or Infants and Juniors (I/J), or Juniors and Secondary (J/S) and some only Secondary (S) pupils. The I and I/J groups consist of women only and the J/S and S groups have both sexes. The allocation of the students to the groups has no other significance; for example, group J/S (1) does not differ from J/S (2) or any other J/S group. The 1970 intake contained 185 women (70·3%) and 97 men (29·7%). In 1971 the proportions were almost the same, 194 women (69·8%) and 84 men (30·2%). The average size of the groups for 1970 was 26·6 and for 1971, 27·8.

Entry qualifications

Table 1 shows the percentage of students entering College with passes at GCE 'A' level. Although the figures show that more students entered College with no 'A' levels in 1971, the overall difference was not significant.

TABLE 1

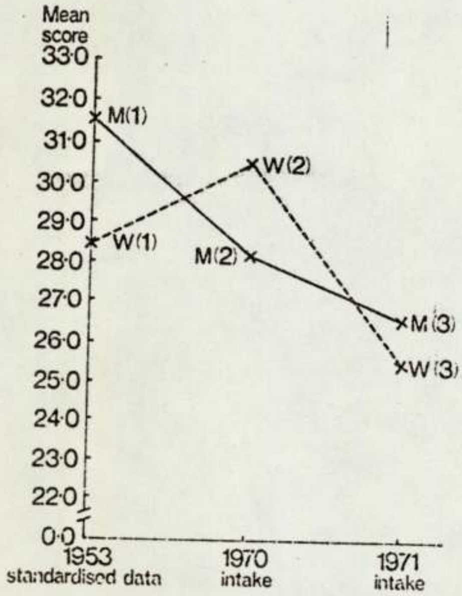
Year of entry	*Percentages of students entering College with GCE 'A' level passes*			
	None	*1 'A' level*	*2 'A' levels*	*3 or more 'A' levels*
1970	24%	33%	29%	14%
1971	31%	33%	27%	9%

The comprehension test

The test chosen from the very few available for this level was the Comprehension Test for College of Education Students by E. L. Black, published by the NFER in 1962. The test was standardised in 1953 by giving it to 679 men and 911 women in their first year at Training College. The details in the Manual state that the group was randomly selected from 'normal' and 'newer' Colleges and included, in correct proportions, some students preparing to teach technical and art subjects. The test was validated by comparing the marks gained by 144 students (the complete intake of two Colleges) at the end of their course with their scores on the Comprehenson Test taken at the beginning of the course. The correlation

FIGURE 1

Mean scores by year groups



Key

Men students		*Women students*	
M(1) =	1953 students	W(1) =	1953 students
M(2) =	1970 students	W(2) =	1970 students
M(3) =	1971 students	W(3) =	1971 students

between the test and the written examination in English was found to be significant, but the other correlations with Principles of Education, Practice of Education, Crafts, and English Literature were not significant.

Administration of the test

The test was given to the ten Education groups by each group's Education tutor. The same group of tutors administered the test in the following year.

Results of the tests

The scores on the reading comprehension tests are presented in three ways. First, by looking at the average scores of the students in their Year groups. Secondly, by comparing the scores when arranged by Education group, and thirdly, by making comparisons when the data is analysed according to the main 'academic' (or 'principal') subject followed by the students.

Comparison of scores by Year group

If the mean scores for both intakes of students are compared graphically (men and women separately) with the mean scores given in the 1953 standardisation, two features are apparent. First the differences in the mean scores of men and women, and secondly, the different levels of the scores of the Year groups (see Figure 1).

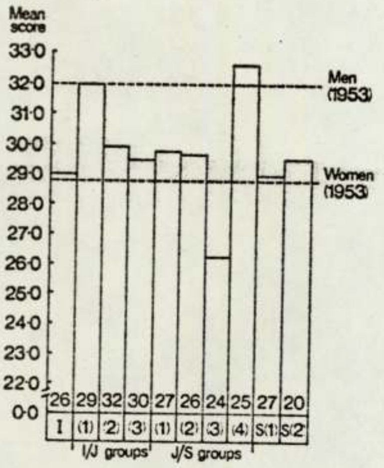
The mean score of the men students entering College in 1970 is much lower than the 1953 figure, falling still further in 1971. On the other hand, the 1970 mean score of the women students rises above the 1953 mean, and then falls below both the standardisation figure and the men's mean score for that year.

Mean scores by Education group

Next, the results of the test are reported by Education groups. Here in the two histograms (Figures 2 and 3) the different levels of reading comprehension ability between the groups in 1970 are shown to increase considerably in 1971.

FIGURE 2

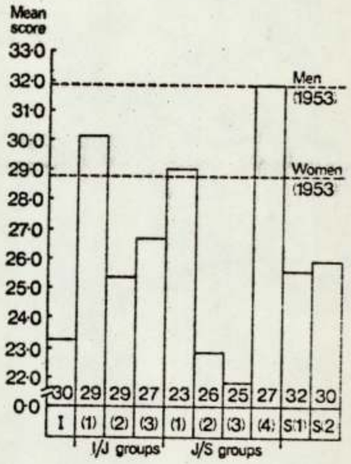
Mean scores (by Ed. group) for 1970 intake



Figures at base of blocks = numbers in that Ed. group

FIGURE 3

Mean scores (by Ed. group) for 1971 intake



Figures at base of blocks = numbers in that Ed. group

Further differences in test scores between groups of students within the same age-specialisation areas can also be seen. The mean scores of the J/S(3) and J/S(4) groups in the 1971 intake provide a clear example of the extent of these differences.

Mean scores by academic subject

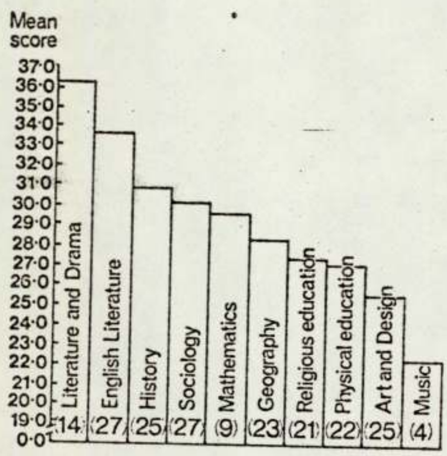
If we rearrange the scores in this third way, further differences can be seen as illustrated in Figure 4. Here, although the low numbers in two of the groups requires caution of interpretation, the histogram shows a relationship between the choice of academic subject and the mean test scores.

Discussion

It is important at the outset to note that the scores of the students on the Comprehension Test are only briefly described here, no rigorous statistical analysis having been performed on the data. Despite this, however, some general features of interest emerge, especially to those concerned with the levels of reading ability required by Higher Education programmes.

FIGURE 4

Mean scores by academic subject



Figures at base of blocks = number of students

The difference in the performance of men and women on the test, for instance, deserves mention. There is little doubt that in this comprehension test the men students in these two intakes to this particular College are less skilful than men entering Training College in the mid-1950s. The position of the women students is not so clear, as their mean scores vary, rising first above the standardised mean and then falling well below it. However, the 1971 women's mean score was below that of the men and due to this fluctuation any conclusions drawn must be tentative and restricted to the actual groups of students being studied.

These lower levels of performance prompt the question, why do these student teachers appear to be less skilful than those entering Colleges in the 1950s?

It may be that the particular skill tapped by this test is not now regarded as being of all round educative importance. In other words, Secondary Schools no longer require all their students to become proficient in reading comprehension skills as they did two decades ago, other than for those subjects for which a close examination of texts is an integral part, like English

Literature. The analysis of data by academic subject supports this, as there is a difference of over ten points in mean scores between the Literature and Drama students and those, for example, studying Art and Design (see Figure 4).

Another explanation for the differences may be linked, on the one hand, to the particular method of selecting students for College places, and on the other to the rapid expansion of Higher Education and changing patterns of curriculum which have occurred between the test's standardisation and the present day. Often, those interviewing candidates for College places, after ascertaining the number of Ordinary and Advanced GCE level passes gained, look primarily at the candidate's grounding in an academic subject and thereafter at personality characteristics. If this procedure is followed, perhaps the number of passes at Advanced level in GCE no longer indicates that level of all-round reading ability expected by those teaching Higher Education courses. Table 1 shows that as far as entry qualifications are concerned, although there were less students with 'A' levels in 1971, the overall position was substantially the same. However, when reading comprehension skills are examined, the lower ability levels are evident. As these differences are not shown by all, then it might be assumed that the skill only receives attention in Secondary Schools by those studying certain subjects, where comprehension skills receive constant attention. This is important for tutors in Colleges of Education, for if earlier levels of reading ability are not being maintained, then staff may, unwittingly, over-load students by expecting of them a proficiency beyond their ability.

When the selection procedure referred to above is set within the context of place demand, the apparent higher levels of reading comprehension skills engendered by the academic subject *per se*, are further enhanced. The higher mean score (see Figure 4) of the 'Literature and Drama' students could reflect this competition for places on 'popular' College courses as could the higher mean score for all women students in 1970 (see Figure 1).

A further reason for the lower mean scores may be due to the test itself. It might be argued, for example, that the material set for comprehension is biased towards certain literary styles largely unfamiliar to the present generation of students, and that this unfamiliarity requires a high level of a particular skill. This criticism of the test has important implications, however, for if it is accepted, then what standard is to be expected for adequate progress in Higher Education? Or what is the lowest level of reading comprehension compatible with successful teacher education? Surely, this is a skill in which every teacher must be proficient.

Further implications are raised by the analysis of the scores by Education groups; for the considerable differences illustrated must raise questions as to the best methods of teaching those groups, and the levels of reading matter recommended for study. In 1954, Black pointed out the need for Training College staff to pay attention to students' reading standards; it may be even more necessary today, especially with men students. The errors made are complex, and remedial reading programmes may be required for those College of Education students who have been selected for their prowess in other fields than reading. It would seem then, that not only must the College of Education student be taught to teach reading, but in many cases he must be taught to read.

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*The Development of the Control of Syntactical Structure**

L. JOHN CHAPMAN

In her recent research, Clay (1971) showed a marked increase in the ability of children to repeat sentences which were longer than their memory span for words during the ages of 5 to 7 years. (At the same time she demonstrated that sentence repetition was one possible way of checking the child's imitative control.) Carol Chomsky (1970) too has provided evidence that some structures are still being acquired by nine or ten year old children. It would seem from these results that a developmental process towards the full acquisition of syntactical structures is continuing in these early years despite the oft-quoted declaration by McNeill (1968, p. 21) that the child at four has mastered "very nearly the entire complex and abstract structure of the English language". The present research looks at some of the details of an early stage of this period of linguistic development and explores two of the psychological mechanisms that have been associated with language acquisition.

One of these mechanisms is short-term memory (STM) capacity. Savin & Perchonock (1965), for example, have demonstrated with educationally sub-normal (ESN) children, that different syntactical structures take up more (or less) space in the STM store. An active sentence, for instance, generally requires less space than a passive negative. Further, Graham (1968), also with ESN children, has shown that differing types of syntactic structures are significantly correlated with different levels of basic STM capacity. Another psychological factor thought to be associated with the generation of these syntactical structures has been envisaged by Miller *et al.* (1960) as a type of planning ability. They suggest that the mechanism of the 'grammar Plan' has as its structure "the hierarchy of grammatical rules of formation and transformation" (p. 156). Commenting recently on this planning facility, Graham (1970, p. 410) says, "It has been said that in order to be able to do this (i.e. plan in advance what we want to say), one of the characteristics of language process is a kind of unconscious planning by which the order of words is controlled."

METHOD

The experimental method used in the study was that of immediate recall of a sentence. This method, as well as being suitable for the young children involved, reflects the ability to perceive

* The author wishes to acknowledge the help he has received from Mr R. S. Easterby of the Applied Psychology Department, University of Aston in Birmingham, in completing this research.

a sentence. As Neisser (1966) comments, "we deal with sentences we hear by reformulating them for ourselves—we grasp their structure with the same apparatus that structures our utterances".

Materials

1. Syntactic structures. Fourteen syntactic structures were chosen representing different transformations (Chomsky, 1965), and as suggested by the work of Brannon (1968), Graham (1968), Slobin (1966), Hayhurst (1967), Menyuk (1963a, b), Fraser *et al.* (1963) and Savin & Perchonock (1965).

Each structure was restricted in length to eight words which were, in turn, controlled for vocabulary level. This latter was achieved by selecting the words composing the structure from the lists of words most frequently used by children of the age being investigated (Burroughs, 1957). The word lists in Burroughs's study are arranged showing the more and the less frequently used words. The more frequently used words are subdivided into groups of 500, referred to as 'the first 500', 'the second 500' and so on. As far as possible the words employed were taken from 'the first 500', but in some cases a word had to be used from a less frequent category due to the demands of the character of the transformation itself, e.g. reflexive words, 'himself' and 'themselves' occur in 'the second 500, and 'the fourth 500' word counts. In addition, so that some assessment of the relationship between vocabulary and structure could be made, one of the transformations 'Because' was replicated using words from lists of a different level of vocabulary (see Fig. 1). In this way the effect of the word frequency (familiarity) could be checked. Each of the syntactic structures (or transformations) was represented by six differently worded examples, and the ninety resulting structures were arranged in three sets of thirty, each set containing, in random order, two examples of each structure. These three sets of syntactic structures were tape recorded using a male voice at normal speaking speed and intonation. To prevent distraction and so that presentation might be identical, the children heard the structures through head-phones.

T. eg.	Because Transformation							
6 2	The	baby	laughed	because	she	saw	the	kitten
Vocab.	1	1	1	1	1	1	1	1
15 2	The	ambulance	rushed	because	of	the	awful	accident
Vocab.	1	4	3	1	1	1	3	4

Fig. 1

2. STM tasks. The capacity of the children's STM was found by using the traditional method of measurement of immediate memory (Woodworth & Schlosberg, 1957). However, instead of using digits, words taken from 'the first 500' of Burroughs's lists were used.

3. Planning Capacity. One of the few procedures that meet the requirements of the study, that is, to give an indication of children's ability to plan ahead, is the Porteus Maze test. These mazes were administered strictly according to the administration manual (Porteus, 1952).

Subjects. There were 31 in the group aged $4\frac{1}{2}$ to $5\frac{1}{2}$ years, 15 boys and 16 girls, comprising the reception class of a school in a recently redeveloped area of a low socio-economic urban community.

Experimental Procedure

The children were introduced to the taped syntactic structures by the experimenter, who was known to them, in a quiet room in the school set aside for the purpose of the experiment by the Headmaster. The children were taken through the procedure individually, although initially they came in pairs to hear the introductory tape. The first section contained instructions and simple 'messages' for immediate repetition to allow the children to settle and to ensure correct mode of response. This worked well and the children enjoyed the tasks. The presentation of the structures was followed by the STM tasks and then the Porteus Maze. To avoid fatigue only one of the tasks was presented on any one day, and the experiment took about three weeks to complete.

RESULTS

The following data were collected for the investigation:

Syntactic structure scores	(Set 1)
,,	(Set 2)
,,	(Set 3)
Short term memory score	(STM)
Porteus Maze scores	(PM)
Chronological Age	(CA)
Sex of the children	(S)
Length of Schooling	(SCH)

Scoring of Syntactic Structures

These were scored by awarding one point for a completely correct reproduction; fractional points were not given. This was strictly adhered to, and responses like 'cos' and 'his-self' were counted as incorrect as they might be implicated in the developmental processes involved. The children's performance on the recall of the structured material is given first by the group's mean scores (with standard deviations) for the three sets of material. The scores are analysed by sex and shown in Table I.

TABLE I. Mean scores of the children on the 3 sets of structure.

	Set 1	SD	Set 2	SD	Set 3	SD
Boys	17·33	7·3	17·40	6·4	15·13	6·5
Girls	18·81	6·5	16·43	7·2	16·00	7·0
Group	18·07	6·9	16·91	6·3	15·56	6·3

The syntactic structures are further analysed in terms of their transformational differences. The effect of this differential is shown by the histogram in Fig. 2. In particular, the marked effect of the vocabulary levels can be seen by comparing the immediate recall of T5 and T13, both 'Because' transformations.

The mean STM and PM scores are given in Table II. It will be noticed that the girls have a slight superiority on the STM tasks whilst the boys are superior on the Porteus Maze test, but these differences were not significant.

Children's STM capacity is shown to be significantly correlated with the recall of the different syntactical structures (e.g. $r = 0{\cdot}71$ (Set 3), $p < 0{\cdot}001$). There is some variation in the size of the correlation between STM and the three sets of materials. The correlation with Set 1 was 0·69; Set 2, 0·65; and set 3, 0·71. All correlations were positive and significant, $p < 0{\cdot}001$. The other

TABLE II. Children's performance (Mean Scores) by sex on STM tasks and Porteus Maze.

	N	STM	SD	PM	SD
Boys	15	3·49	0·57	109·97	24·03
Girls	16	3·67	0·68	100·87	24·77

TABLE III. Correlation matrix of data collected.

	CA	STM	PM	SCH	Set 1	Set 2	Set 3
CA	1·00	0·25*	0·19	0·84*	0·26	0·34*	0·34*
STM		1·00	0·25	0·19	0·69***	0·65***	0·71***
PM			1·00	0·34*	0·38*	0·39*	0·39*
SCH				1·00	0·24	0·21	0·32
Set 1					1·00	0·78***	0·91***
Set 2						1·00	0·83***
Set 3							1·00

All coefficients are positive. Levels of significance are shown thus: $p<0·05$* $p<0·001$***

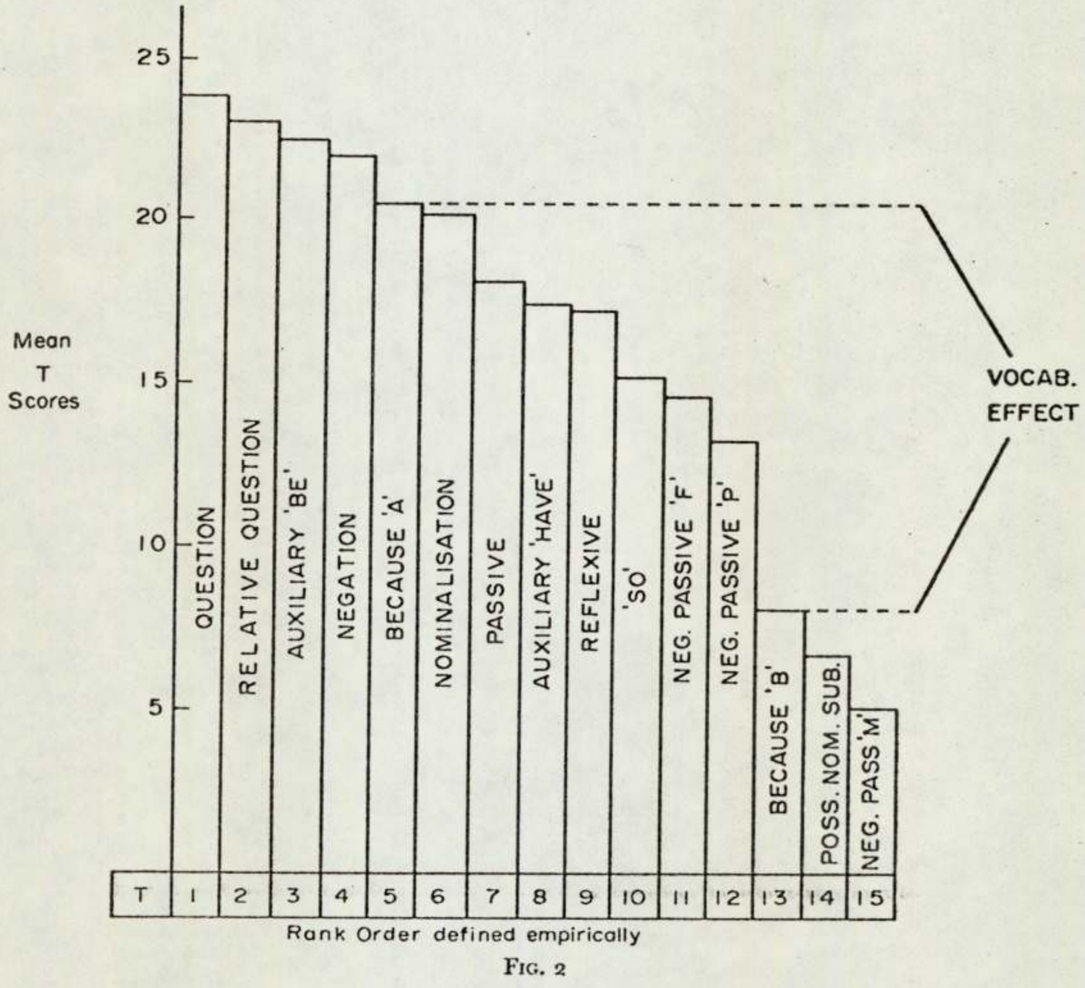

FIG. 2

variable, that of planning ability as measured by the Porteus Maze, was also found to be significantly correlated with the recall of the syntactic structures ($r = 0{\cdot}41$), $p < 0{\cdot}05$). A matrix of the correlations of these and the other data is shown in Table III.

DISCUSSION

At first sight, the immediate recall of syntactic structures might not appear to be discriminatory, nevertheless no child in the experiment had a set of structures completely correct. The highest score for one set was 28 (max. 30). Scores, however, ranged from 1 to 28, reflecting the extent of the individual variation, with a mean for all children over the three sets of materials of 16·85 (SD 6·8). Further, the high level of correlation between the three sets of structures (Table III) showed considerable stability of performance. Unfortunately, there is, as set, no satisfactory method of quantifying syntactic structures although many suggestions have been made (Yngve, 1960; Miller & Chomsky, 1963; Schlesinger, 1966; Graham, 1968; Sheldon & Osser, 1970). Further, although Chomsky's (1957, 1965) theoretical description does bring objectivity nearer, it does not allow us to say that one structure is more or less complex than another, let alone by how much. By indicating the structure's transformational history, however, Chomsky does identify differences in structural characteristics, and it is clear from the children's responses in the experiment that some structures were perceived more readily than others.

In Fig. 2 a pattern is discernible when the empirically derived scores are arranged in descending order, the Question transformation and the Relative Question transformation have the highest mean score and the Negative Passive construction the lowest. The position in the pattern of the Possessive Nominalisation concurs with Graham's (1968) finding where a similar transformation was recalled least by his ESN pupils. Among the structures with comparatively low mean scores is the replicated 'Because' transformation. In the rank order shown by the histogram (Fig. 2) this structure drops from 5th to 13th place. This considerable difference must be attributed to the vocabulary used, as the structure was held constant. The difference in the mean scores was found to be significant. ($p < 0{\cdot}01$.) It would appear from the observations made on the group, that if further demands are made on central processing mechanisms by the use of less frequently occurring vocabulary, performance deteriorates. Looked at in another way, it could be said that familiarity with vocabulary might enhance the immediate recall of differential structures. It should be noted also that the frequency of usage of the words employed in the experiment moved within relatively narrow limits. The performance, in fact, reflected the difference between using words selected from 'the first and second 500' and 'the third and fourth 500' in Burroughs's first main list (i.e. between the first thousand and second thousand most frequently occurring words).

Another interesting feature of the experiment is the close relationship between the recall of the sentences and the results of the STM tasks. As the method essentially compares unstructured word strings with structured sequences, a high positive correlation was expected. However, as the structured materials were chosen for their differences of syntax, the significance of the correlation ($r = 0{\cdot}71$, $p < 0{\cdot}001$), might be interpreted as indicating that the greater the basic STM capacity possessed by the child, the greater is his ability when processing syntactic structures reflecting different transformations. It is interesting to note here that the highest STM correlation was with Set 3 of the materials, and yet this set had the lowest mean recall score. In the school situation this is important for, if the ability to handle syntax adequately is a major factor in language skill, then limited basic STM capacity may well be a determining factor in the development of those skills. And, as the growth of basic STM capacity is known to be slow in the early years (Woodworth & Schlosberg show an increase in the span of immediate memory of only one unit between the ages of 4½ and 7 years), then the characteristics of short-term memory may be of greater significance to the teacher of language than chronological age. It should be emphasised that this refers to children in the normal school situation: it is, as Graham (1968) has pointed out, of great significance in the school for the educationally subnormal.

The Porteus Maze test was given so that the children might be described in other terms than verbal abilities and to probe the suggested planning capacity involved in language production. There may be a connection between this ability to look ahead when threading through a maze and the anticipation necessary to plan ahead when a sentence is being processed. As Graham (1970) remarks, "It has been said that in order to be able to do this (i.e. know what we want to say in advance of saying it) one of the characteristics of the language process is a kind of unconscious planning by which the order of the words is controlled." Although this relationship is at the moment speculative, nonetheless a small but significant correlation ($r=0{\cdot}39$, $p<0{\cdot}05$) was found between the Maze test performance and the recall of the syntactic structures and therefore deserves more detailed study. Perhaps an obvious explanation is that the child's perceptual-motor functioning is maturing quite rapidly at this stage, facilitating his ability to trace through a maze with a pencil. This increasing perceptual-motor skill is probably associated with the length of time the child has been attending school as the requirement to put pencil to paper now grows rapidly. There is some confirmation of this from the significant correlation between the PM scores and the length of schooling ($r=0{\cdot}45$, $p<0{\cdot}01$), whereas the correlation between performance on the syntactic structures and length of schooling did not reach significance ($r=0{\cdot}32$). Recently Sinclair (1971, p. 129) has commented on this relationship between language acquisition and sensori-motor patterns, stating, "it seems that there is a remarkable convergence between the types of base rules as described and formalised by Chomsky (1965) and the type of sensori-motor co-ordination and later pre-operational structures as described and formalised by Piaget". However, although perceptual-motor skills certainly demand some co-ordination by central mechanisms, the planning of verbal material as envisaged here may well require a more definite cognitive function.

SUMMARY

The research shows that some syntactic structures are perceived more readily than others by children aged 4½—5½ years, and that the pattern indicates that there may be an order in which structures are acquired reflecting the abstract characteristics of the transformation involved. The presence of an interaction effect between level of vocabulary and type of structure is also indicated. In addition the research provides some evidence that basic short-term memory capacity is a greater determinant of language facility than chronological age, but that the part played by 'planning ability' requires further investigation and clarification.

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Structure and Vocabulary in the
Language Development of First
School Children.

L. J. Chapman.
August, 1975.

Summary

One hundred and forty-two children aged $4\frac{1}{2}$ to $7\frac{1}{2}$ years were presented with two sets of five syntactical structures of differing complexity. The structures were strictly controlled for length and levels of vocabulary. The results provide further evidence that the control of syntax is still developing in the First School. The different levels of vocabulary used had marked effects on repetition and interaction effects were observed between chronological age, STM capacity, syntactical structure and vocabulary.

Introduction

Considerable research into the acquisition of language has been undertaken in recent years. The vast majority of these studies, and the genuine advances made, has been with very young children roughly from the period of the child's first utterance to about $4\frac{1}{2}$ years. However, little appears to have been done, at least not on the same scale, covering the later periods of development that are more pertinent to infant school teaching. There are, of course, reasons for this. The beginnings of language usage have considerable implications for psychological and linguistic theory and consequently many prominent researchers have been attracted as Brown (1973) mentions in the preface to his latest book. However, comments from some of these workers emphasising the creative nature and great speed of language acquisition have implied that there is little interest for the teacher in later language development. For instance, McNeill's (1966) statement that 'the child goes to school having mastered very nearly the entire complex and abstract structure of the English' is often quoted. Such statements from influential writers may be widely misunderstood by many and cause confusion and bewilderment among teachers who know intuitively that there is a vast amount to be taught, and from experience, that there are marked and demonstrable differences between the facility with which a child coming into the infant school uses language and the adult. Children's language is, of course, continuing to develop during the primary school years but little detail of specific growth areas is available.

The literature suggests that two facets are involved, the growth of word meaning and the increasing control of syntax. Anglin (1970) speaks of the 'lethargy of semantic development' and points out that lexical generalisation appears to be an extremely gradual process in contrast with the speed of the acquisition of syntax. He also shows by experiment that semantic growth is only just beginning at eight years when others (quoted in Anglin (1970)) have suggested growth was, by then, more or less complete. Although in general, syntactic facility does precede semantic, Carol Chomsky (1970) has shown that some syntactic structures are not acquired until 9 - 10 years. Frasure and Entwistle (1973) using sentence recall for their method compared semantic and syntactic development in different social and racial groups. The age range investigated was 5 - 8 years and they found that semantic cues appear to facilitate performance in the early years for all age groups and that syntactic cues appear to facilitate performance later. The position then is far from clear for these findings are seemingly contradictory.

Some of the confusion exists because there is no adequate definition of linguistic complexity. Therefore, if evidence of language growth is seen in terms of the child's increasing control of complex structures, then a clearer understanding of complexity is required. Unfortunately, whilst we can display differences in syntactic structures, it is not possible, at the moment, to say that one structure is linguistically more complex than another, let alone by how much. However, the analysis provided by Chomsky's (1965) transformational grammar has been used by many researchers as it has brought objectivity nearer, and a number of studies have shown empirically that some structures are indeed perceived more (or less) readily than others and levels of complexity have been inferred. (e.g. Graham 1968: Chapman 1970, 1975) Using complexity in this sense it is possible to hypothesise that evidence of language development will be shown by the child proceeding from the mastery of simple through complex structures.

It is interesting to note that both facets of language development, the syntactic and the semantic, have been shown to be associated with memory capacity, particularly short-term memory (STM). Savin and Perchonock (1965) have shown with ESN children that different syntactic structures take up more (or less) space in the STM store. Furthermore, Graham (1968), also with ESN children, showed that different types of syntactic structure are significantly correlated with different levels of STM capacity. As with the syntactic data, if levels of vocabulary are considered as indicators of semantic competence, (in that, for example, older children would more readily recall words of 'low frequency of usage' than younger children), then the work of Dale and Gregory (1966) demonstrating that memory capacity varies according to the familiarity (i.e. frequency of usage) of the item presented for recall, is also apposite. By using STM as a psychological variable it was shown recently (Chapman 1975) that young children between $4\frac{1}{2}$ and $5\frac{1}{2}$ years old recalled some syntactic structures more readily than others. It was also found that the level of vocabulary used within these structures facilitated or impeded that recall. However, in the experiment only one syntactic structure out of the fourteen investigated was replicated to probe the effects of different levels of vocabulary and only one age group of children was used.

In view of the conflicting statements quoted about semantic and syntactic growth and the limited findings of the recent study mentioned, an experiment was set up attempting to trace language development in a First school and to examine the function played by syntax and vocabulary growth.

Method

Subjects

There were no special reasons for the choice of subjects, except that the school they attended had sufficient space for the investigation to take place without interruption. All the children in the school were involved although this caused some imbalance in the sizes of the groups.
The children were divided into three groups, Group 1

Table 1 about here

was between $4\frac{1}{2}$ and $5\frac{1}{2}$ years; Group 2, $5\frac{1}{2}$ to $6\frac{1}{2}$ years and Group 3, between $6\frac{1}{2}$ and $7\frac{1}{2}$ years. The mean ages of the subjects and the sizes for the groups are given in Table 1.

The area in which the children lived was one of recent redevelopment with many families housed in 'high-rise' flats. The socio-economic levels in this district are a mixture of skilled and semi-skilled workers - with the latter predominant.

Materials

Syntactic Structures (S)

Five syntactic structures reflecting different transformations as defined by the Transformational Grammar of Chomsky (1965) were used, and graded approximately for complexity according to empirical data (Chapman 1970). To ensure a sufficient spread of scores, a transformation of simple construction was chosen as a base-line, (question) and a complex construction (a negative passive with 'might') to give discrimination.

It was envisaged that these two would give a top and bottom to any scale being sought as they were found to be the more and the less readily recalled by children in the earlier work. The three other structures chosen contained 'because' and 'so' and a 'reflexive'. The 'because' and 'so' structures were selected for their conjunctive qualities. In earlier studies of language acquisition following tranditional methods of data collection (Templin, 1957) (McCarthy, 1954) progress in language development was often shown to be from simple to complex sentences. One way of gaining complexity is by the use of conjunctions; 'because' and 'so' being two possible types. The 'reflexive' structure was chosen as the fifth type as this has an inherent quality which appears perhaps from the adult standpoint to be simple, the replacement of the object by '... self' when subject and object are the same person or thing. This may not be so simple for the child. From the transformational grammer point of view the reflexive is a clear example of underlying abstract structure. The 'deep' structure refers to the notion that subject and object are identical, whereas the surface structure, the result of the transformation, uses the overt form '... self'. The frequency of usage of reflexive words is another indication of the suspected difficulty for the child as most of the reflexives, apart from 'myself' are in the 'less frequently used' lists of Burroughs (1957) which are used throughout in this study, (e.g. 'himself', list 2; 'herself', list 3; 'itself', and 'themselves', list 4.). These then, were the five structures and the rationale behind their selection. S1, 'question'; S2, 'because'; S3, 'so'; S4, 'reflexive'; S5, 'negative passive with 'might'. All structures were restricted to eight words in length.

Having chosen the structures, it was decided to vary systematically the vocabulary used. Two sets of material (Set A and Set B) were generated. The first set was made up of the five structures at vocabulary level 1. For this the words were taken as far as possible from list 1 the first 500 words in Burroughs's lists.

Fig. 1 about here

The second set employed the same five structures as the first set but used words from Burroughs's lists 3 and 4. Fig. 1 shows examples from these two sets of material. There were then two sets of five structures varying in syntactical complexity, with vocabulary strictly controlled. In order to get an adequate measure of the differentiation between these five structures, seven examples of each of the five structures were composed, thus each set contained 35 structures. The following are examples of the five structures.

S1. How many girls are there in the class?

S2. John was tired because it was very late.

S3. The canteen caught fire so the fireman came.

S4. The boys and girls bought themselves some sweets.

S5. He might not have been stopped by them.

The order of the structures in each set was randomised and six sets of different randomisations were prepared.

The structures were tape recorded by a male voice using normal intonation. Each child heard the structures through a pair of headphones. This was found to be important in previous work when memory processes were involved as the headphones help to retain attention and eliminate outside noise distractions. Sharpe high quality low impedence headphones were used throughout and matched by calibration with a Band K artificial ear.

S. T. M. Capacity

A variable acheiving overall significance (Chapman '75) and of interest with the age groups concerned, was the STM capacity of the children. This was found by using the traditional method of measurement of immediate memory (Woodworth and Schlosberg, 1957). However, instead of using digits, words taken from list 1, of Burroughs's (1957) count were used. This list is composed of the first 500 most frequently occurring words in the vocabulary of children aged 5 - 6½ years in the Midlands. The details of this method and its testing are fully described in Chapman (1970).

P r o c e d u r e

Each of the 142 subjects had the five sets of material presented for repetition. In order to economise on time and to promote confidence in the subjects, the experimental procedure was organised so that a set could be given to five subjects at once. This arrangement needed four assistants to record the individual responses. They were students from a College of Education in the second year of their course. They had had two periods of practical teaching with the same age group as the experimental subjects and were soon trained to record the children's responses accurately.

The children came to a spare classroom in their school in groups of five. After some preliminary conversation with the experimenter and his assistants they were introduced to the procedure expected of them by an introductory tape. This consisted of simple recorded 'messages' to be repeated. After a short rest, the group was taken through a complete set of materials. Only one set was given to any one subject on any one day. The STM tasks were given to the subjects individually by the experimenter on a different day so as to prevent fatigue.

R e s u l t s

S c o r i n g

Any deviation from the structure as presented by the recording was counted as incorrect, and one point was given for each correct answer. During the scoring however it was noticed that a large number of children in Group 1 responded with 'cos' instead of 'because'. The graph (Fig. 2) shows the effect of scoring 'cos' as correct and incorrect.

Performance on Syntactical Structures

The mean scores for the three groups on the two sets of materials presented for immediate recall are recorded in Table 2 by age group and sex. The mean scores of the girls are superior to the boys in Groups 2 and 3 to a significant level.

Table 2 about here

The total mean scores for each group for the two sets of structures show a significant increase with age. The correlation (all subjects) between chronological age (CA) and syntactical structure (S) scores was $r = 0.35$ ($p < 0.001$).

Analysis by Structures

The children's performances are next analysed structure by structure. The mean scores in Set A increase with age and decrease with complexity of the structure. The details are shown in Table 3.

Table 3 about here

A similar analysis of Set B is shown in Table 4 where the marked effect of the low frequency vocabulary can be observed, the means in each cell being smaller than in Set A. However, the age pattern is clearly defined by the increasing means and again the mean scores decrease as the structural complexity increases.

Table 4 about here

When the results of the two sets are combined, the graph of the individual structures gives a developmental pattern as shown in Fig. 2. The crediting of 'cos' for 'because' as correct in S2 brings the results of that structure in line with the others. However, the pattern also shows that S4 is more readily recalled that S3 and this is especially marked with the

Fig. 2 about here

low frequency vocabulary. Due to variations within the over-all pattern, it was decided to submit the data to two analyses of variance to establish whether or not there were interaction effects between (1) Age, Structure and Vocabulary; and (2) STM, Structure and Vocabulary. The design followed for this further statistical treatment was a three factor model with repeated measures on two factors. This model and the procedure for unequal group size was taken from Winer, (1962). The first analysis gave the following result and is shown in Table 5 where A = Chronological Age, B = Structure, C = Vocabulary.

The results confirm that these three variables chosen as important in the experiment are significant ($p < 0.01$) and that there is a significant interaction effect between

Table 5 about here

B and C, (i.e., between vocabulary and structure). In the second analysis A = STM, B = Vocabulary, C = Structure.

Table 6 about here

Each factor and their interactions AB, AC, and BC, gave significant results although the STM/Structure interaction is less than the others. Table 6 gives the details of the second analysis.

S. T. M.

The results of the subjects' performance in the STM tasks are summarised in Table 7 by age group and sex. There was a significant correlation between chronological age (CA) and the STM scores. ($r = 0.27$, $p < 0.01$). It will be noted that

Table 7 about here

the girls in Group 2 have a higher mean score than both the boys in their own age group and the older girls. It should be noted however that the number of girls in Group 2 was small ($n = 13$).

Discussion

The investigation has confirmed that children's control of syntactic structures is still developing throughout the age range being studied. Although there is some variation from the original order (see Materials) of specific structures (S4 being more easily recalled than S3) nonetheless the graph (Fig. 2) clearly demonstrates a steady increase in mean scores by age. That this is so is not surprising despite the statements to the contrary mentioned earlier, for the increasing level of performance probably reflects the children's all round cognitive growth. Slobin (1973) puts this point succinctly when he says of early language acquisition '... it seems to me that the pace setter in linguistic growth is the child's cognitive growth, as opposed to an autonomous linguistic development which can reflect back on cognition'.

This is of particular concern here as one of the main cognitive processes, short-term memory, was involved in the experimental method and found to be significant. It is interesting to note that the girls had superior, though not significant, STM scores to the boys, (Table 7). This will have enhanced their ability to recall the structures as can be seen in Table 2 where their mean scores in Groups 2 and 3 are significantly higher than the boys. It is tempting to speculate, especially as this trend was also found by the author in another sample (Chapman, 1970), that the oft reported superiority of girls with language tasks (Templin, 1957) is associated with their STM capacity and their ability to employ it.

The experiment has also shown that within the overall development, the children's ability to recall specific structures was related to the linguistic simplicity or complexity of these structures. As stated, these structural differences were exemplified by selection from empirically derived data, (see Chapman, 1975 and the authors listed there), supported by the transformational grammar of Chomsky (1965). Tables 3 and 4 show that within the developmental pattern the mean scores decrease as complexity increases. S1 was found to be the most readily recalled by each age group and S2 'because' (with the 'cos' correction) next readily recalled. S4 'reflexive' was next in the pattern, followed by S3 'so' and S5 the negative passive with 'might' the least readily recalled of all. The structure containing 'so' was less readily recalled than the 'reflexive' structure and 'because' with which it has similar characteristics.

It is clear that the different levels of word familiarity used here had a marked effect and as the levels chosen were all from the relatively familiar (the first 2,000 words in the count) then this factor is demonstrably a sensitive one. Howes (1957) showed that there is a relationship between intelligibility and frequency of occurrence of English words, and in his summary he states, 'The threshold of intelligibility for a word in a wide-spectrum noise is shown to be a decreasing function of the frequency with which the word occurs in general linguistic usage.' This may explain some of the vocabulary effect here for although the structures were out of continuous context, nonetheless they were meaningful in themselves. Recall was enhanced then by the more familiar words making the structures intelligible to the children.

Perhaps the study's most important finding is the interaction effects reported in Tables 5 and 6. The two main factors, vocabulary and structure are seen to interact so that various levels of vocabulary interrelate with different types of structure. This is so for both chronological age and STM, although the latter is the more significant and may well indicate that this psychological mechanism is more of a determinant in language development than age. As far as is known these specific interaction effects have not been reported before and it is only possible at this stage to offer tentative explanations.

Some might protest as does Goldman Eisler (1970) that results employing this type of experimental method do no more than reflect the frequency with which the structures occur in everyday discourse. It is claimed that it is this frequency (or familiarity) that enhances recall rather than linguistic characteristics, in much the same way as does the frequency of ocurrence of vocabulary. This may in part explain these results, but what is important is that certain structures are more or less readily controlled as language ability develops and that the method used here could help to identify them.. As intimated earlier Dale and Gregory (1966) have shown that recall is more accurate for lists composed of familiar words (high frequency of occurrence) rather than relatively unfamiliar (low frequency of occurrence) words. The total meaning of a sentence is given partly by the value of the words and partly by the syntactic structure, However, the results show that the conveyance of meaning is not a simple additive process as is often assumed but an intricate interaction between the two elements. A simple illustration of the sensitivity of certain words in structures was shown here when 'cos' was counted correct in the youngest age group's performance allowing the mean scores to approximate that of the others in the pattern (see Fig. 2). Obviously, the character of some structures is determined by a key word such as 'because' in that structure. In this example, because's conjunctive properties linked two statements as causative, the word because and its positioning constraining what is to follow. During language development children have to appreciate that the use of a particular word carries with it not only that word's lexical meaning but also implications for syntax when it is used in a particular position in a specific structure. Thus although 'so' was in the same syntactic position in each example it was a slightly more complex structure than 'because' as the identical word 'so' can be used in similar ways and yet have different meanings. (for instance, 'so' can be used as a conjunction, as an adverb, as an interjection and so on!) Hence additional features or linguistic markers are required and mastery is delayed a little. In his study on the growth of word meaning, Anglin (1970) confirms a generalisation hypothesis whereby a gradual progression from concrete to abstract occurs as children's vocabulary matures. Extrapolating his results a little it may be that, although children already have a word in their vocabulary further features or linguistic markers defining its exact usage are yet to be added. The accretion of these markers may be reflected in the distinction between 'more frequently' and 'less frequently' occurring words. When words occur frequently in children's usage this may indicate that most of the word's markers have already been added or that that word required very few markers in the first place. Many interrelationships and the rules governing them are, of course not so straight forward. For instance, De Boysson - Bardies (1970) observed that the usage of negative transformations in children 2 - 3½ years was linked to certain features of the verbs employed and that with adults lexical negation still plays a role but 'only when interacting with negative syntax'. Much more research is needed to unravel the interaction effects observed here for they are not only theoretically interesting in helping to define complexity in language development but important for the construction of instructional materials and guidance for pedagogical procedures. For instance there are indications here, and further investigation may confirm, that children can handle relatively complex structures adequately when the load on cognitive processes is eased by using words controlled at 'familiar' levels.

Acknowledgments

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Table 1.

Mean Ages in months by Group and Sex:

Group	Boys		Girls		Groups		
	N	Mean	N	Mean	N	Mean	SD
1	17	62.18	21	61.91	38	62.03	3.49
2	20	75.45	13	77.31	33	76.78	3.39
3	33	86.34	38	85.13	71	85.68	4.13
Total	70		72		142		

Table 2 :

Mean Syntactical Structure Scores by Age Group and Sex.

Group	Sex	Set A	Set B	A & B	P<
1	Boys Girls	15.88 11.86	7.29 4.67	23.18 16.52	N.S.
2	Boys Girls	13.65 23.92	6.55 14.53	20.20 38.46	0.01
3	Boys Girls	20.00 23.97	10.33 16.08	31.76 40.24	0.02

Table 3:

Mean scores by age group for each structure in Set A.

Structure	Group 1	Group 2	Group 3
S1	4.16	4.97	5.57
S2	1.76	4.36	5.57
S3	2.34	3.39	4.32
S4	2.74	3.30	4.35
S5	0.71	1.67	2.26

Table 4:

Mean scores by age group for each structure in Set B.

Structure	Group 1	Group 2	Group 3
S1	1.47	2.03	3.19
S2	0.76	2.12	2.75
S3	1.08	1.94	2.53
S4	1.63	2.76	3.54
S5	0.63	0.85	2.59

Table 5:

Analysis of Variance: Age, Vocabulary and Structure, where A = CA, B = Vocabulary, C = Structure.

	df	Variance Ratio	P
A	2	20.450	<0.01
B	1	43.834	<0.01
C	4	10.923	<0.01
AB	2	1.411	NS
AC	8	1.677	NS
BC	4	11.467	<0.01

Table 6:

Analysis of Variance: STM, Vocabulary and Structure where
A = STM, B = Vocabulary, C = Structure

	df	Variance Ratio	P
A	2	87.073	<0.01
B	1	45.052	<0.01
C	4	10.932	<0.01
AB	2	9.587	<0.01
AC	8	3.821	<0.05
BC	4	41.319	<0.01

Table.7.

Mean STM Scores by Age and Sex:

	Boys	Girls	Group	SD
1	3.48	3.67	3.54	0.61
2	3.52	4.25	3.79	0.74
3	4.03	4.20	4.12	0.66

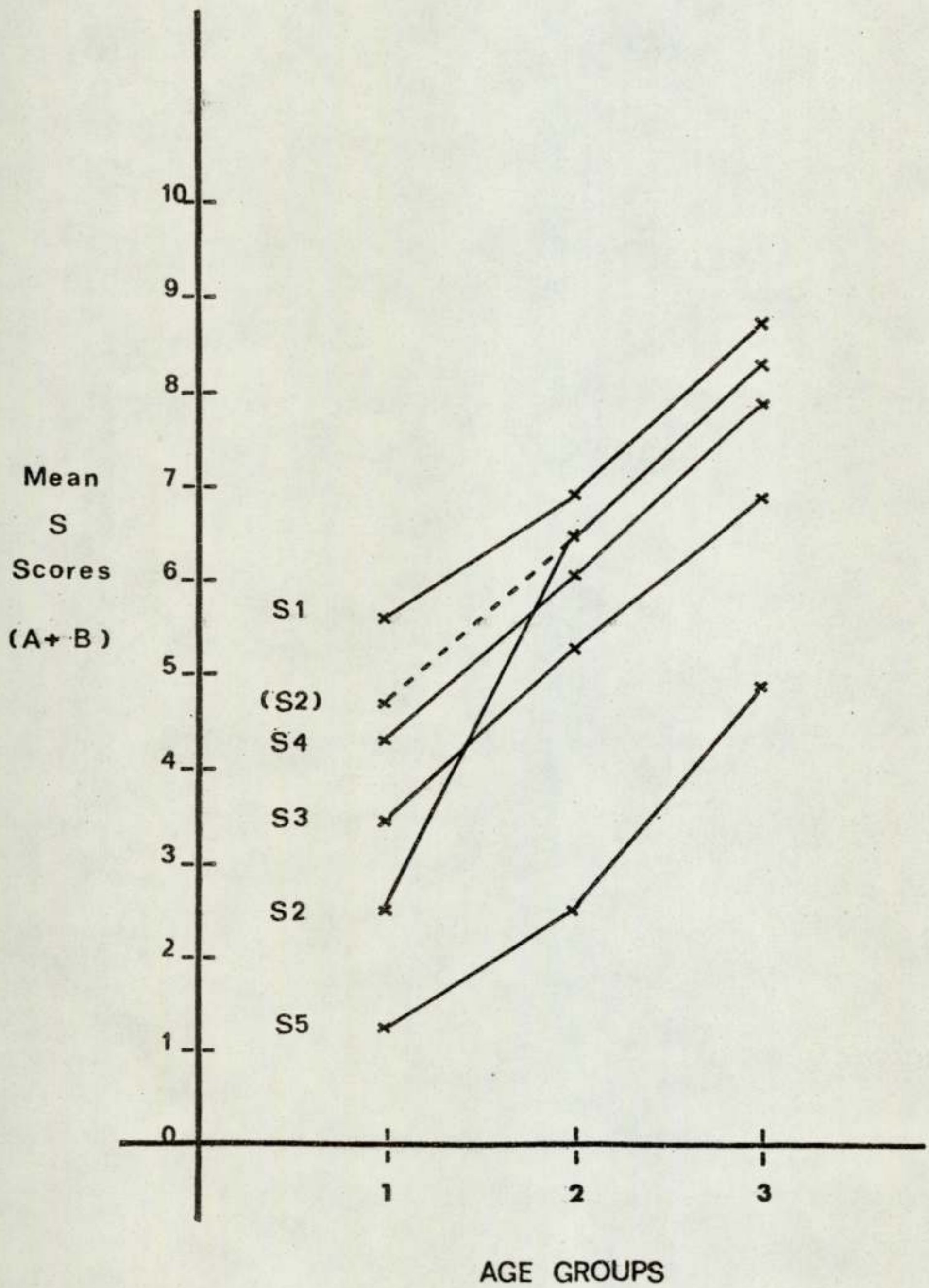
Fig. 1.

Two examples of 'Because' structure, illustrating different vocabulary levels.

S2	The	baby	laughed	because	she	saw	the	kitten
ocab. evel	1	1	1	1	1	1	1	1
S2	The	captain	was	afraid	because	of	the	storm
ocab. evel	1	4	1	4	1	1	1	4

Figure 2.

Mean 'S' scores by Age Groups.
---- 'cos' counted correct.



Appendix 2.

Examples of original piling data from Experiments 1 and 2.

Boy subject Group A.

Kinship Terms.

1. Nephew, Niece.
2. Cousin, Uncle, Aunt.
3. Father, Mother.
4. Grandmother, Grandfather.
5. Daughter, Son.
6. Sister, Brother.
7. Grandson, Granddaughter.

Colour Names.

1. Blue, Green.
2. Brown, Purple.
3. Mustard, Yellow.
4. Gold, Silver.
5. Pink, Red.
6. Black, Grey.
7. Orange, White.

Pronouns.

1. Our, His.
2. Us, We.
3. My, They.
4. Him, Her.
5. Your, I.
6. She, He.
7. Their, Them.
8. Me, You.

Boy subject from Group B.

Kinship Terms.

1. Mother, Sister, Father.
2. Daughter, Brother, Son.
3. Aunt, Uncle.
4. Cousin, Niece, Nephew.
5. Grandson, Grandmother, Granddaughter, Grandfather.

Colour Names.

1. Yellow, Gold, Mustard.
2. Orange.
3. Brown, Black, Grey.
4. Silver, White.
5. Pink, Red, Purple.
6. Green.
7. Blue.

Pronouns.

1. Him, Her.
2. You, Me.
3. We, Us.
4. Them, They, Their.
5. Your.
6. He, She.
7. Our, His.
8. I, My.

Girl subject from Group C.

Kinship Terms.

1. Cousin.
2. Grandfather, Grandmother, Granddaughter, Grandson.
3. Sister, Son.
4. Aunt.
5. Daughter, Brother.
6. Uncle, Nephew, Niece.
7. Mother, Father.

Colour Names.

1. Pink, Purple.
2. Gold, Grey, Green.
3. Yellow, White.
4. Black, Brown.
5. Red, Blue.
6. Orange.
7. Mustard.
8. Silver.

Pronouns.

1. Our.
2. Her, His, Him.
3. Their, They, Them.
4. You, My, Your.
5. We, He, Me.
6. She.
7. Us.
8. I.

Appendix 3.

HCS's for Boys and Girls (Experiment 2)

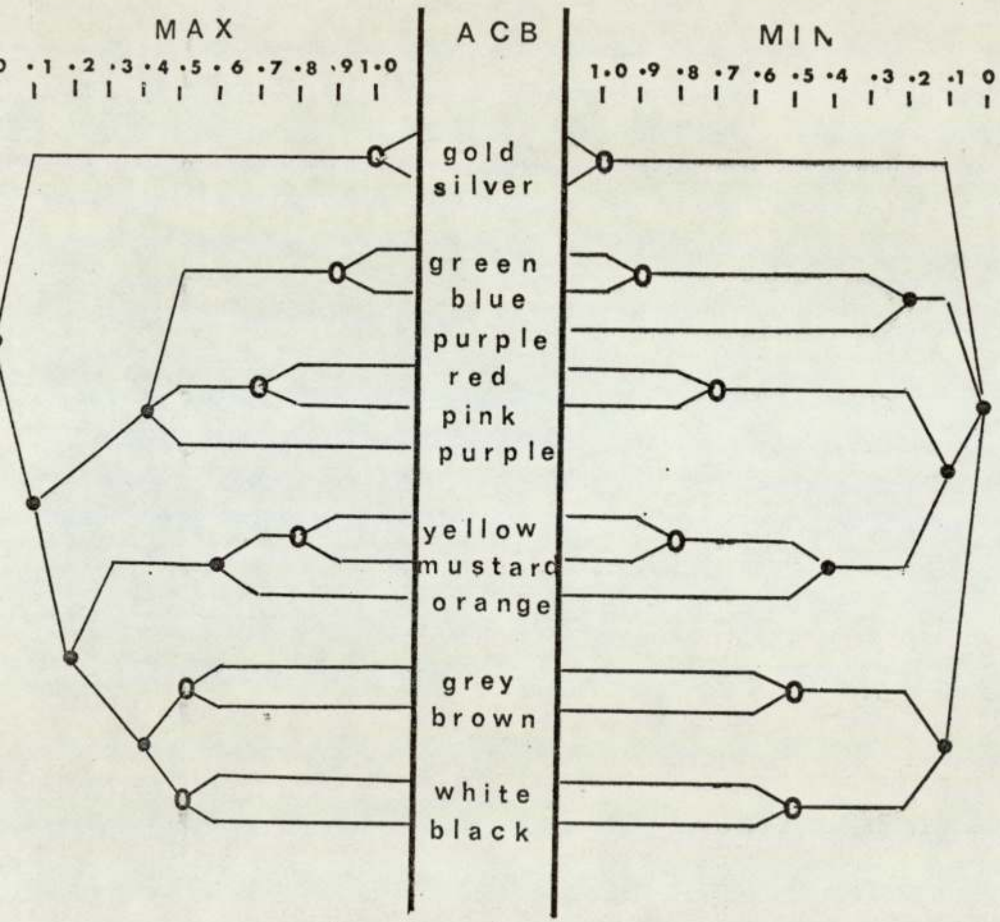


Figure 29

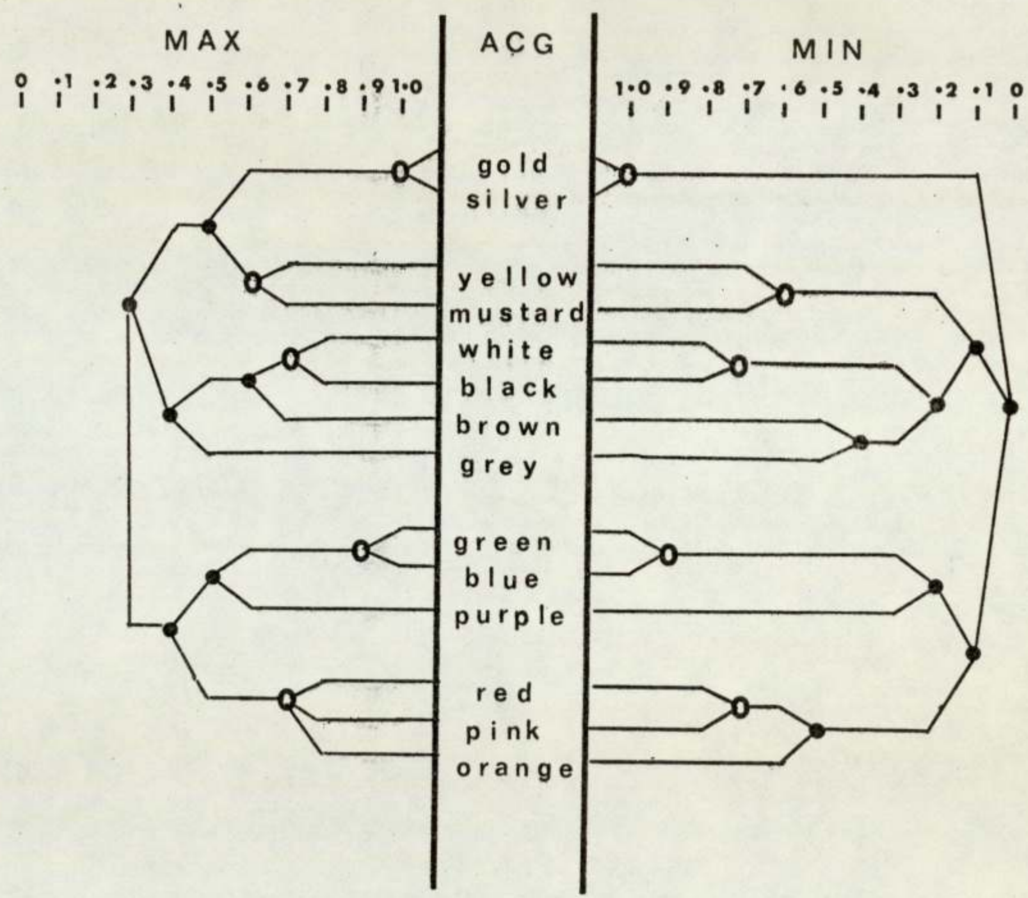


Figure 30

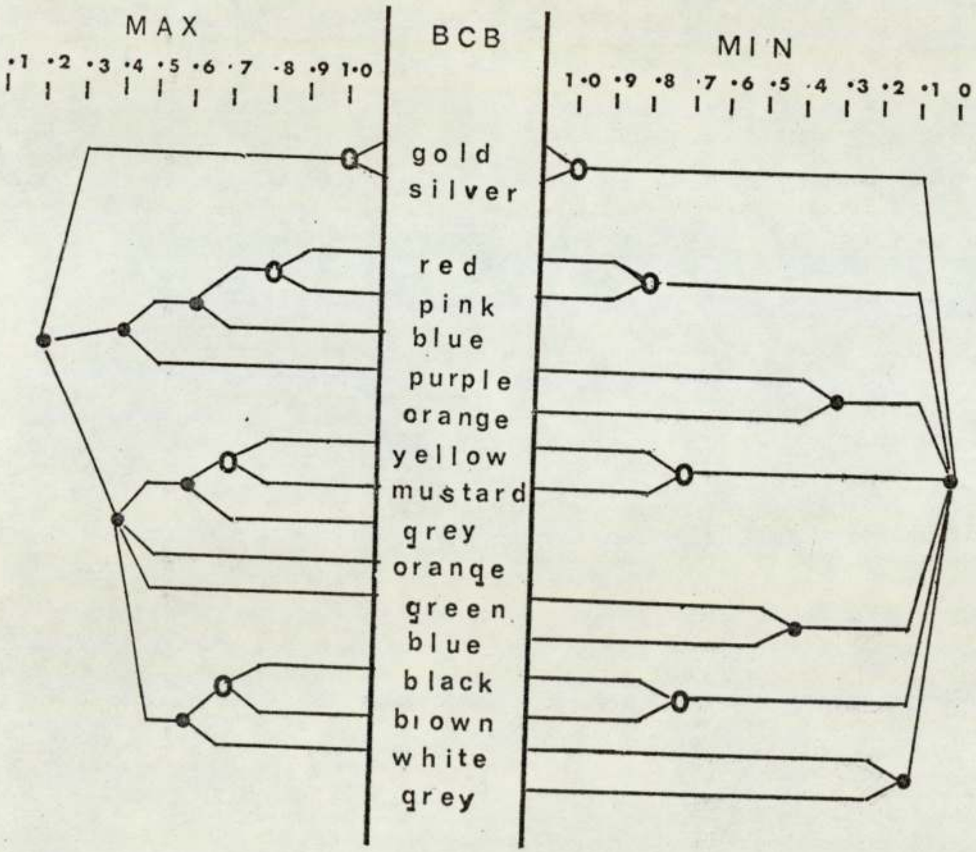


Figure 31

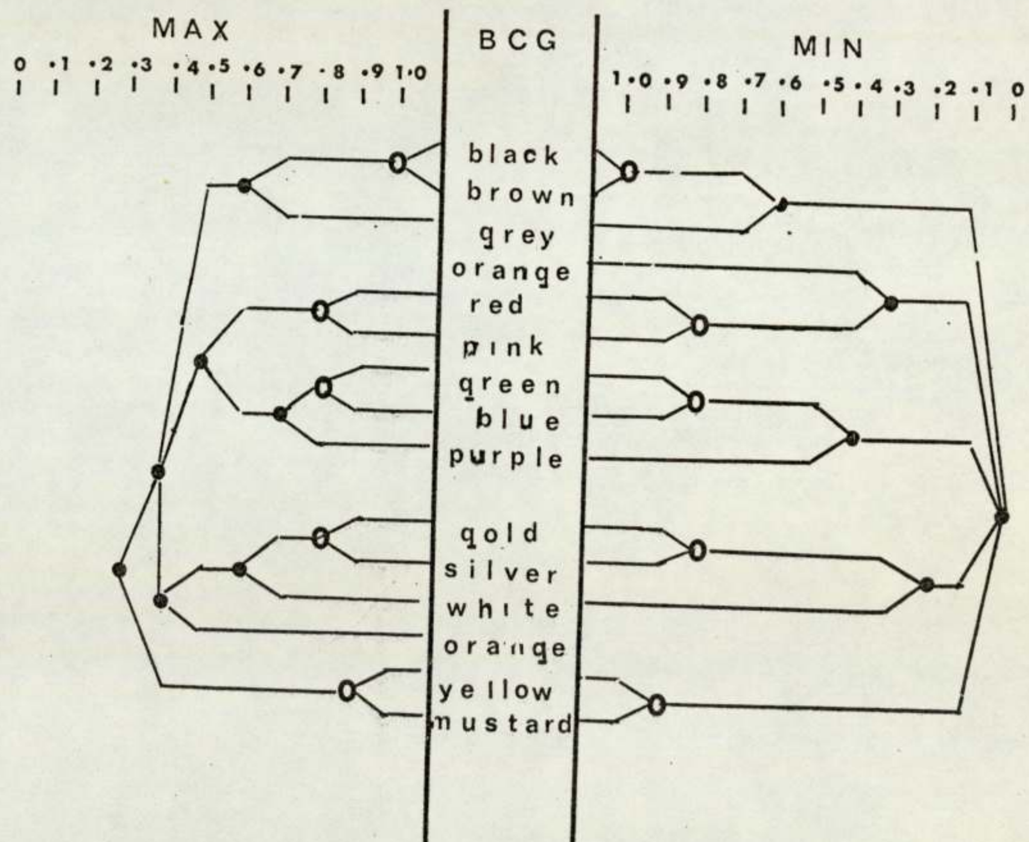


Figure 32

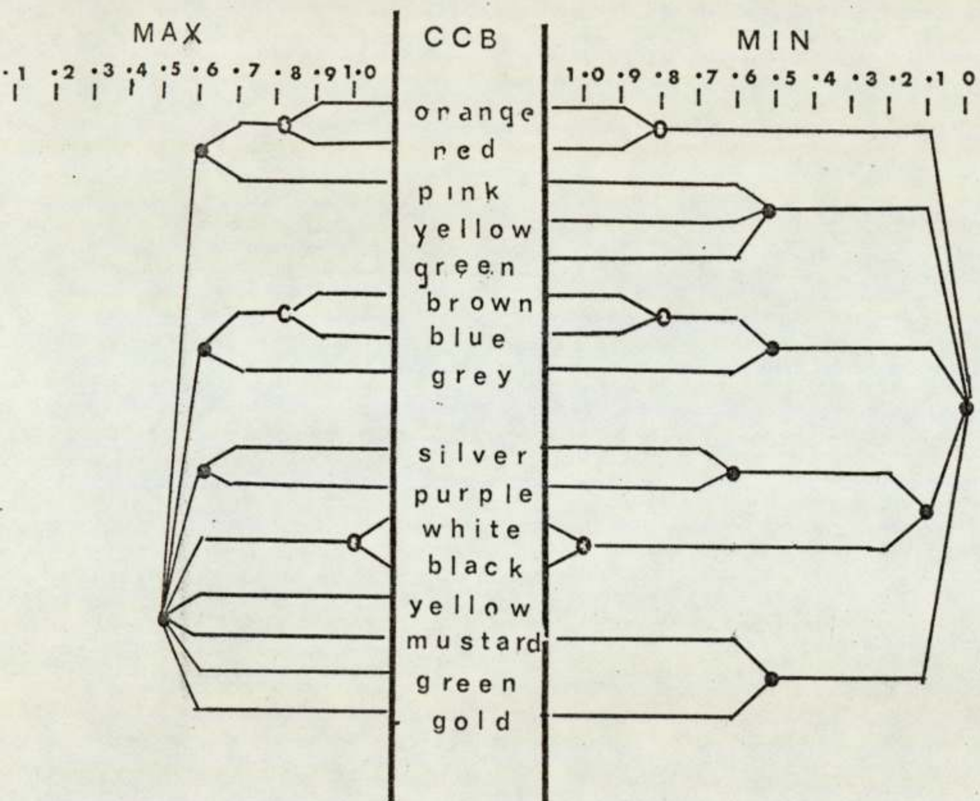


Figure 33

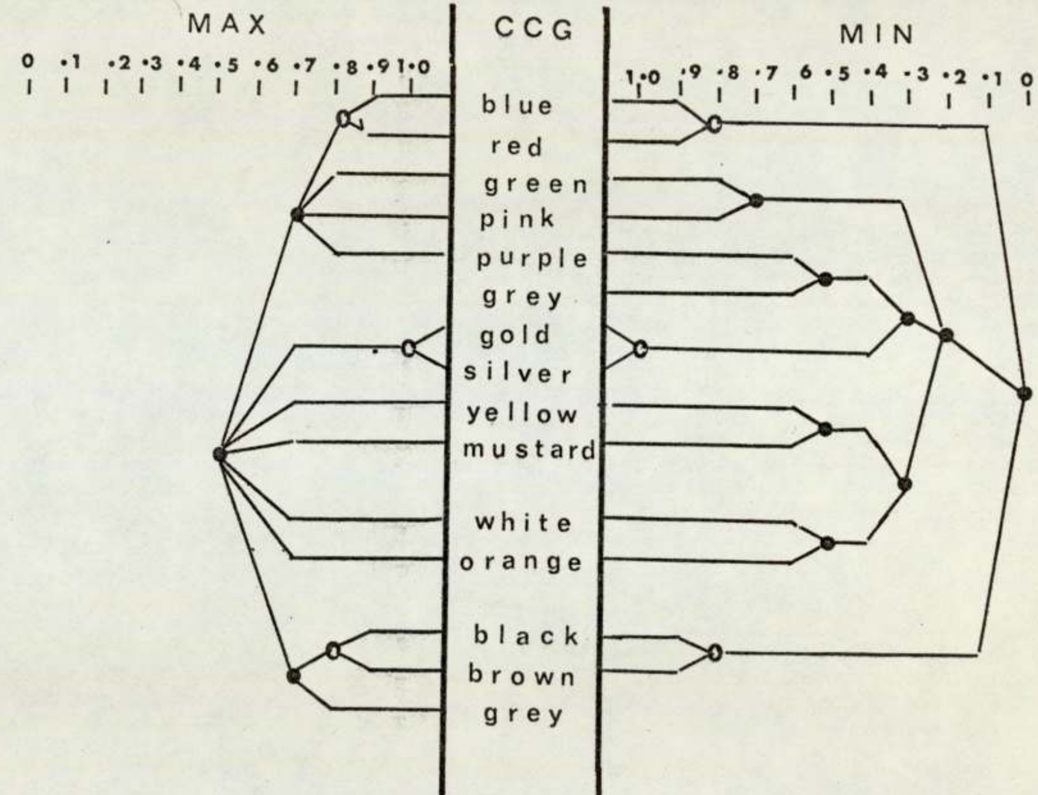


Figure 34

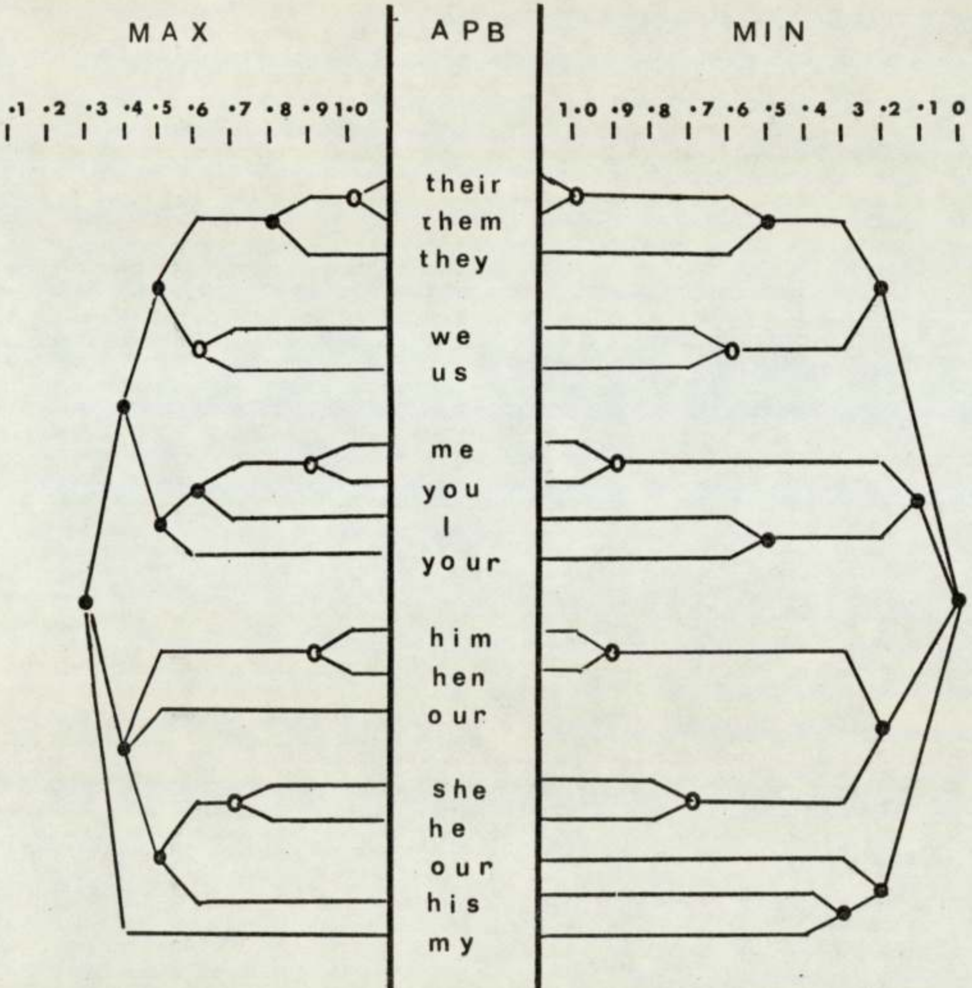


Figure 52

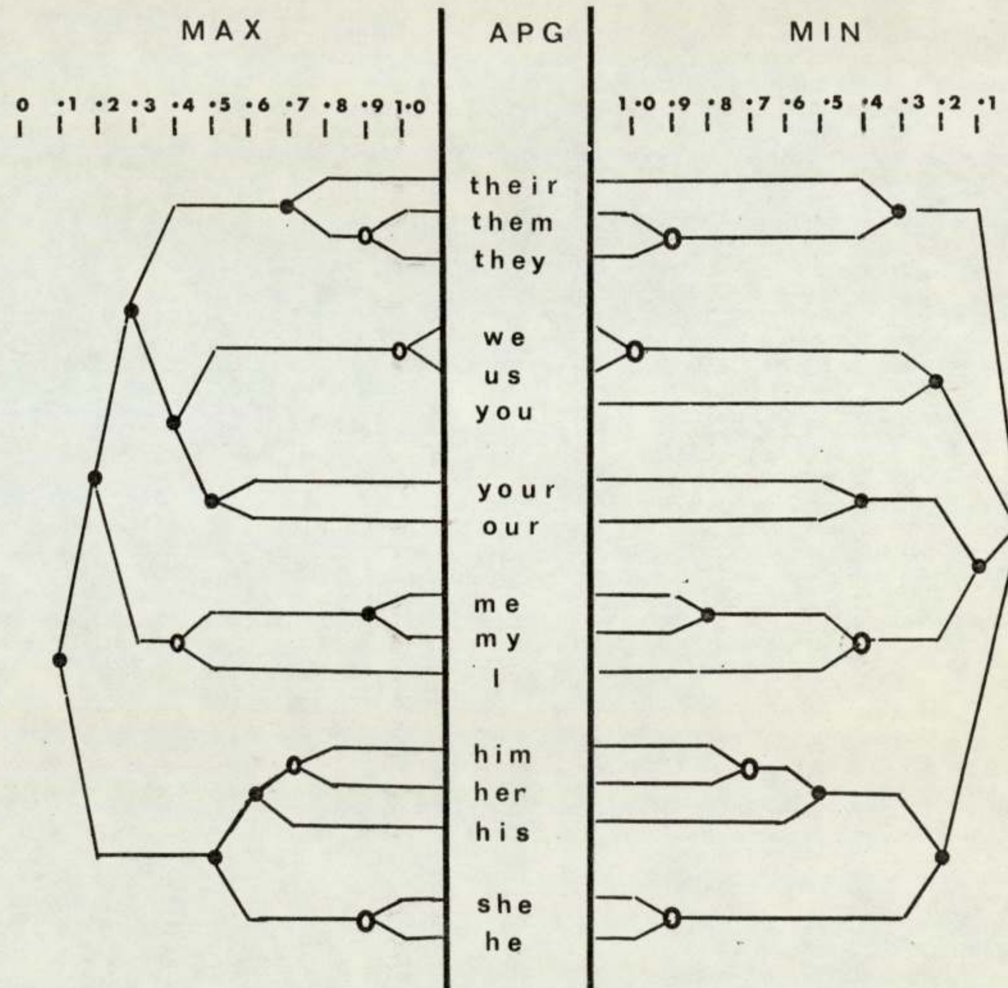


Figure 53

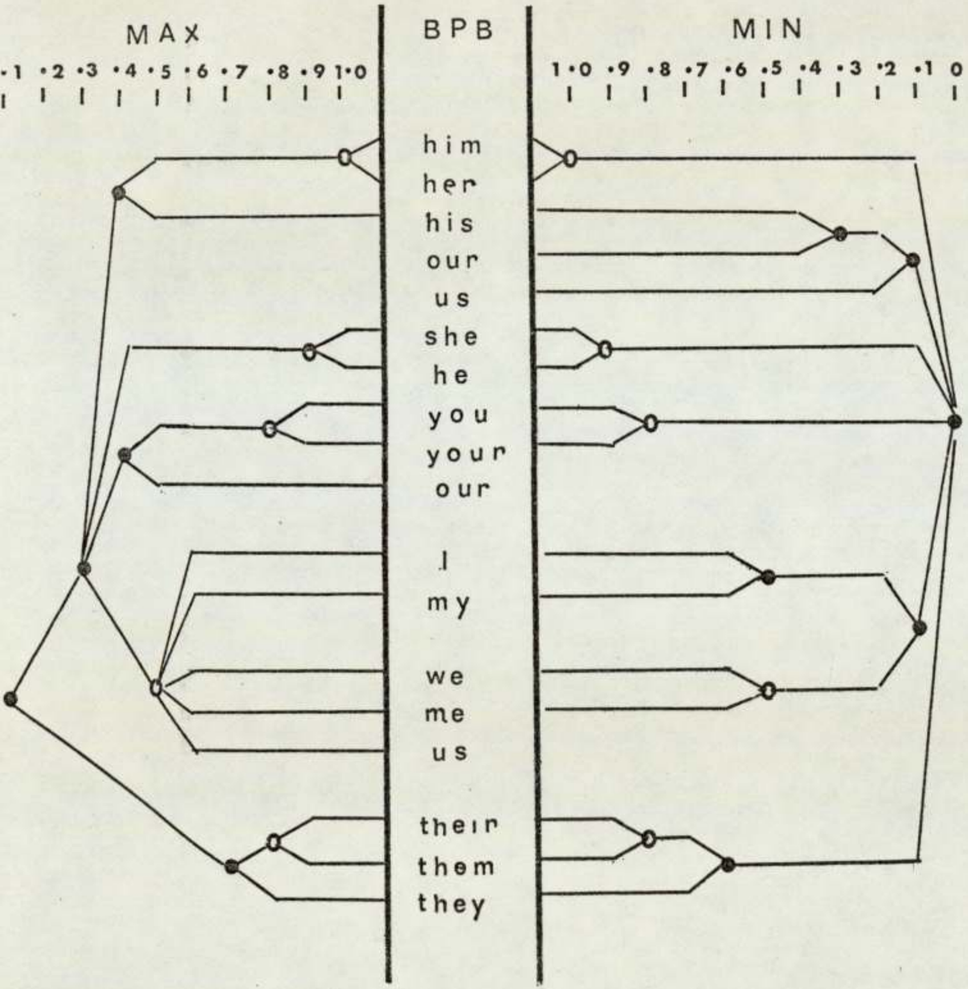


Figure 54

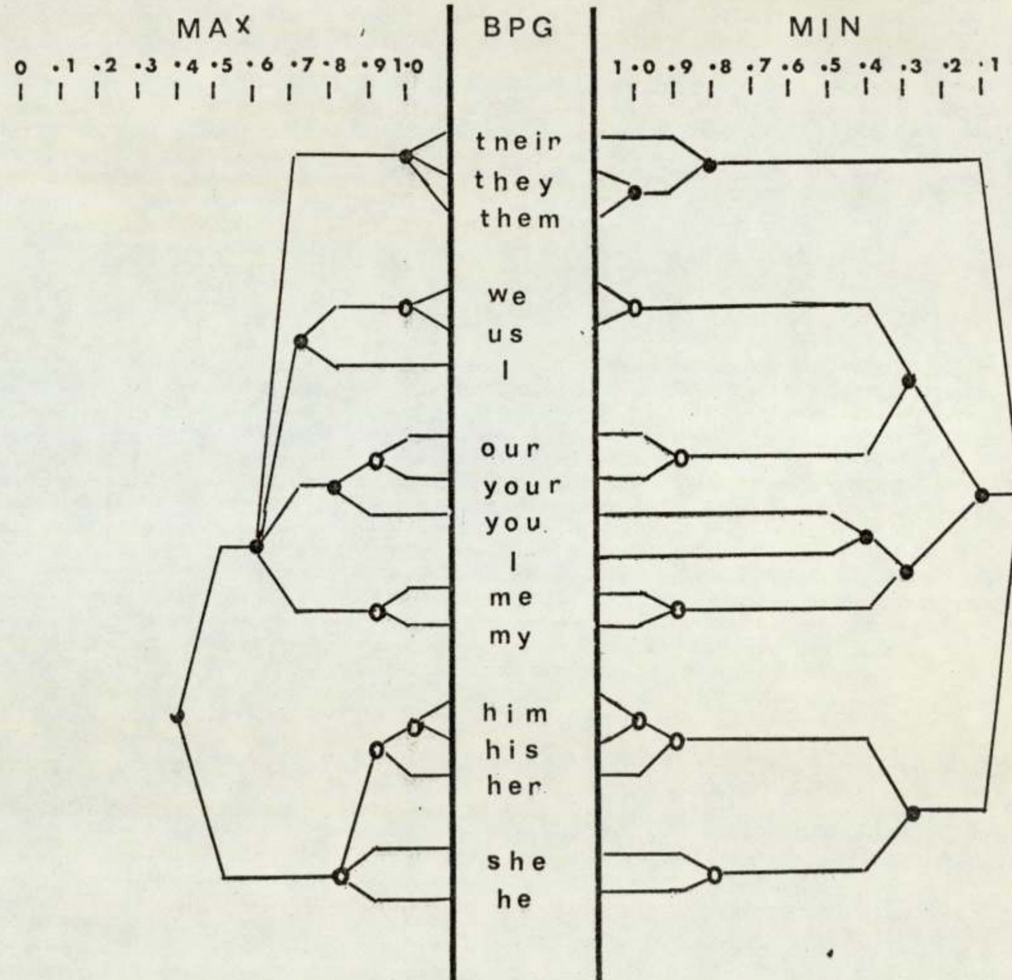


Figure 55

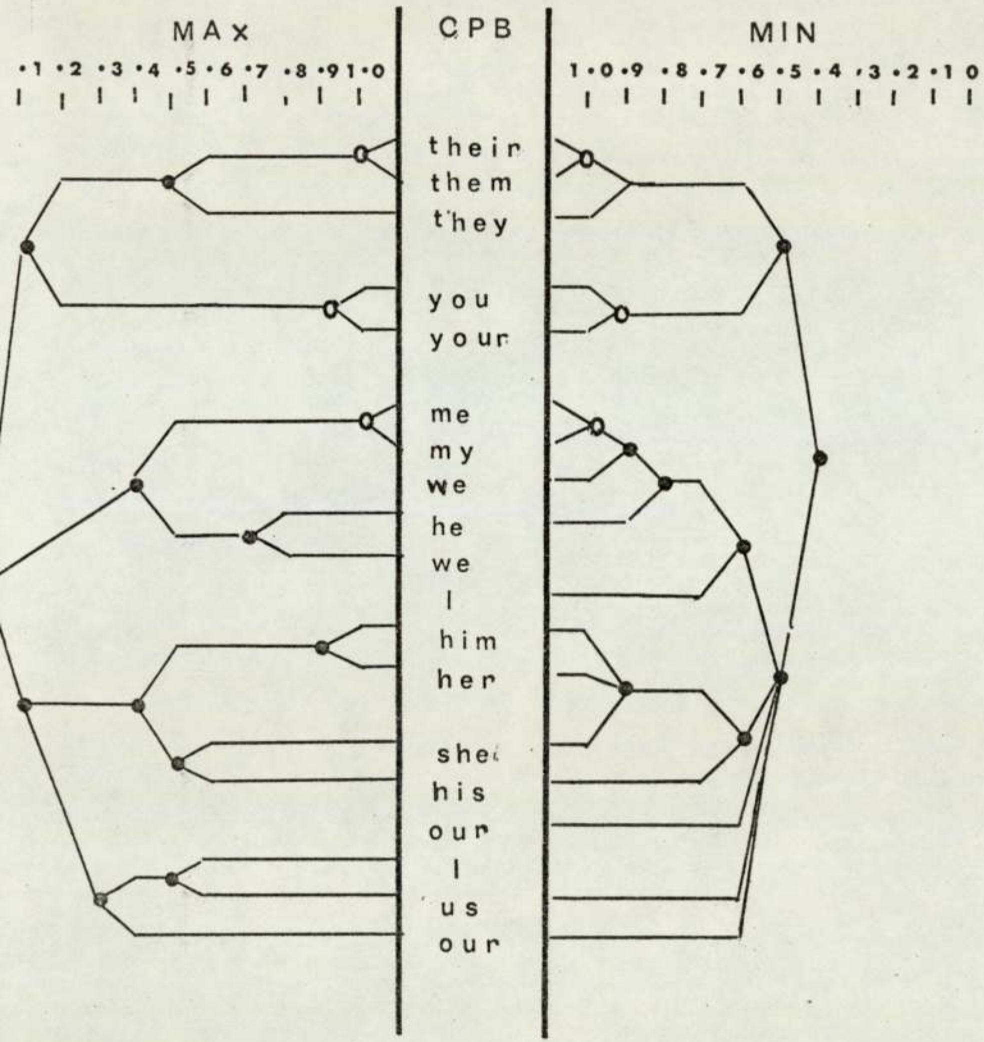


Figure 56

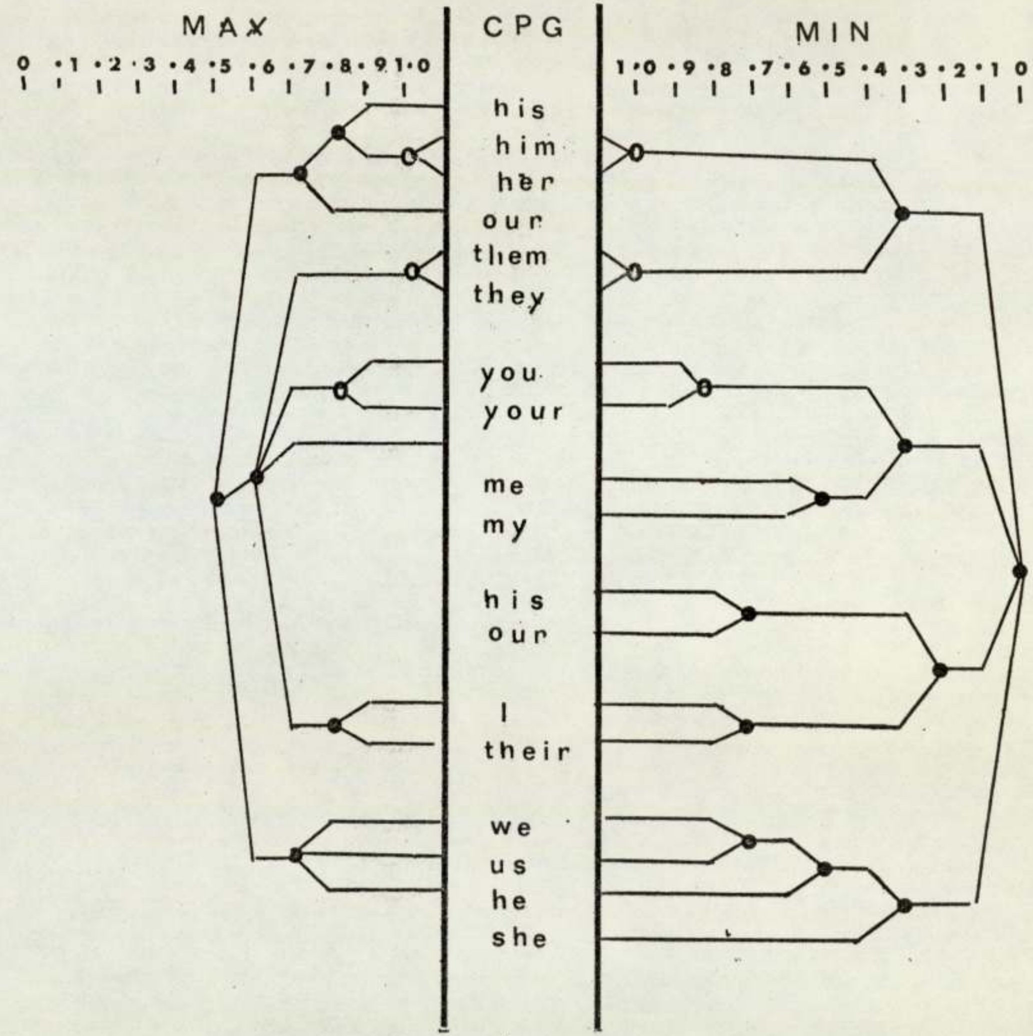
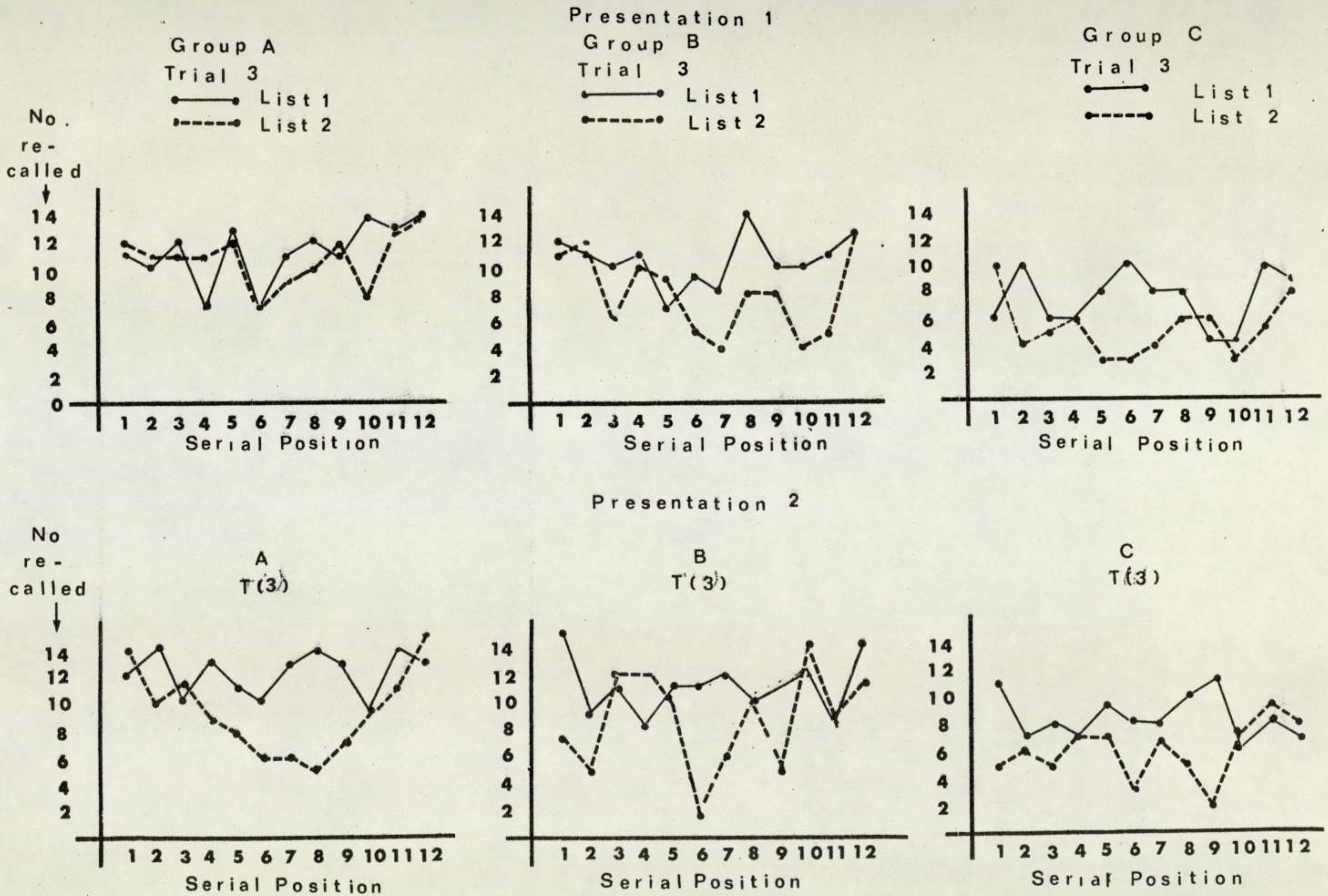


Figure 57

Appendix 4.

Serial Position Data (Experiment 3)


Presentation 1
Group A
Trial 3
List 1
List 2
No. re-called
14
12
10
8
6
4
2
0
1 2 3 4 5 6 7 8 9 10 11 12
Serial Position
Group B
Trial 3
List 1
List 2
14
12
10
8
6
4
2
1 2 3 4 5 6 7 8 9 10 11 12
Serial Position
Group C
Trial 3
List 1
List 2
14
12
10
8
6
4
2
1 2 3 4 5 6 7 8 9 10 11 12
Serial Position
Presentation 2
No re-called
A
T(3)
14
12
10
8
6
4
2
1 2 3 4 5 6 7 8 9 10 11 12
Serial Position
B
T(3)
14
12
10
8
6
4
2
1 2 3 4 5 6 7 8 9 10 11 12
Serial Position
C
T(3)
14
12
10
8
6
4
2
1 2 3 4 5 6 7 8 9 10 11 12
Serial Position