

THE ASSESSMENT AND IDENTIFICATION OF
DEVELOPMENTAL ARTICULATORY DYSPRAXIA
AND ITS EFFECT ON PHONOLOGICAL DEVELOPMENT

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PULLOUT**

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ABSTRACT

The condition developmental articulatory dyspraxia has been investigated to determine the following:-

1. that it exists
2. that it can be defined
3. that it has recognisable characteristics
4. that it has an adverse affect on the development of child phonologies.

A diagnostic procedure has been devised, tested and found to be valid and reliable.

The design of the experiment was based on the selection of four groups, two experimental groups and two validation groups. The experimental groups were assessed on the Reynell Developmental Language Scale, 1977, and the Edinburgh Articulation Test, 1970. All groups were assessed on the diagnostic procedure. Relevant data resulting from these assessments was analysed using the Phonological Analysis of Child Speech, Grunwell, 1985, in order to test the hypothesis that the presence of developmental articulatory dyspraxia would adversely affect the acquisition and development of child phonologies.

Results indicated that the condition developmental articulatory dyspraxia exists, but that it is a rare condition. It was revealed that there is a maturational condition which has been termed immature articulatory praxis and which is normally no longer present after 6;0. In the case of children with developmental or learning deficits, it was found that it persists beyond the age of 6;0. Developmental articulatory dyspraxia was found to be invariably associated with a developmental phonological disorder. It appears that immature articulatory praxis does not affect the normal development of a phonological system.

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ERRATA

- p 10 line 2 omit 'n' in 'completion'
- p 16 line 7 substitute 'psychology' for 'pyschology'
- p 27 line 26 insert 'e' in on(e)-place
- p 32 line 7 substitute 'children' for 'shildren'
- p 46 line 7 insert 'distinct' after 'disturbance'
- p 47 line 30 substitute 'taxonomic' for 'taxomomic'
- p 73 point 6 insert 'difficulty in' before 'spatial'
- p 81 point c insert 'immature' before the last 'articulatory'
- p 93 line 20 substitute 'was' for 'were'
- p 94 line 6 delete extra 'i' in 'remaining'
- p 113 line 1 substitute 'alveolar' for 'aveolar'
- p 115 line 19 substitute 'automatise' for 'automise'
- p 117 line 1 substitute 'noticeably' for 'noticably'
- p 128 line 1 insert 'are' before 'affected'
- pp 129-130 Chapter Six - title page should be between pp 124-125
- p 149 line 9 substitute 'phonotactic' for 'phontactic'
- line 10 substitute 'polysyllabic' for 'polsyllabic'
- line 11 substitute 'consonant' for 'constant'
- p 183 line 3 insert /θ/ for [f];
- line 12 substitute 'effect' for 'affect'
- p 188 line 6 substitute [ɛleɪ] for [ɛlələp]
- p 190 delete 3rd line in final paragraph
- p 205 in PACS insert 'SFWW consonant deletion 2'
- p 206 line 5 substitute '10' for '9'
- p 212 in PACS insert 'SIWI consonant deletion 1' and 'vocalisation 1'
- p 213 line 8 delete 'assimilation'
- p 226 line 25 substitute '5' for '7'
- in PACS insert 'SFWW CD 1' and 'SIWW CD 1'
- p 231 line 5 delete /wɪŋz/ → [wɪŋz]; substitute '4/8' for '5/9'
- p 235 delete lines 3-5; DADDP should read 'Included in the imprecisely articulated responses were some which indicated a possible regional bias'.
- p 241 line 7 substitute 'rhythm' for 'rythm'
- p 269 line 19 substitute '1775' for '1975'

PREFACE

This study resulted from the failure of the initial proposal that developmental articulatory dyspraxia should be identified as early as possible to prevent its misdiagnosis at a later stage. It was the contention of the present writer, that some patients in subnormality hospitals were originally diagnosed as mentally handicapped, when, in fact, they were unable to communicate intelligibly due to the presence of severe developmental articulatory dyspraxia. A diagnostic procedure was devised and pilot studies were carried out to test this hypothesis. It soon became clear that the task was impossible due to the impenetrable degree of institutionalisation which had accumulated in all of these patients. The contention remains despite the lack of evidence to support it.

The revised study was directed at a much younger group and evidence has been secured that early intervention is critical in the development of children with developmental articulatory dyspraxia. In addition, it has been revealed that a similar maturational condition exists, immature articulatory praxis, which, if it persists, creates a differential diagnostic problem which can be dispelled by the four-to-six monthly use of the diagnostic procedure.

CHAPTER ONE

INTRODUCTION

"There is insufficient evidence to substantiate claims that have appeared in the literature regarding the characteristics (symptoms, signs, criteria) that have been used to distinguish developmental apraxia of speech from other communicative disorders in children"

p2 Guyette & Diedrich, 1981

For many years there has been the need for research in the area of articulatory dyspraxia in children. This research requirement has been indicated by British speech therapists, Morley, 1972; Edwards, 1973; Stackhouse, 1982. Work done in the USA and Australia has produced inconclusive results, eg Yoss & Darley, 1974; Williams, Ingham & Rosenthal, 1981. This situation has motivated the present writer to investigate further.

In order to develop and refine a diagnostic procedure for the identification of developmental articulatory dyspraxia, pilot studies were carried out on 120 children in four categories, as follows:-

1. The pre-school children - age range 3;0-4;0 - N 30 - were drawn from nursery and play groups serving different areas in a city with a high ethnic population. Thus indigenous children; Asian children of Indian, Pakistan, Bangladesh and East African origins (the latter from families deported from Uganda and Kenya); West Indian children; Chinese children; Ukranian and Polish children were all included in the sample. Two important conclusions resulted from the work with these young children. In the first place, none of the children seen appeared to have developmental articulatory dyspraxia but several had some articulatory immaturities. Secondly, after assessing the initial group of 10, it was clear that the format of the diagnostic procedure would have to be revised so that the most complex sub-section, in which increasingly longer and more difficult phrases and sentences, came at the beginning instead of at the end. It appeared that the meaning-related sub-section made an easier introduction to the assessment. Success on difficult material

appeared to maintain motivation and interest sufficiently well to facilitate the less interesting combinations of segments which had been initially presented first, and which now complete the assessment.

2. The schoolchildren - age range 6;0-8;0 - N 30 -

were selected from three schools representing different social class catchment areas in the city. No child presented with developmental articulatory dyspraxia. Eight children had minor articulatory immaturities, one in the Social Class II school, one in the Social Class III school and six in the Social Class IV and V school, Social Trends, 1977.

3. Children with Special Educational Needs - age range 6;0-8;0 - N 30

were attending three schools for children with moderate learning disorders. One child had developmental articulatory dyspraxia. He was awaiting transfer to a language unit within the city. Seven children had marked immaturities of articulation, four of whom also had a language disorder to a moderate degree. All the children assessed had language delay.

4. Children in schools for the language impaired

- age range 6;0-8;0 - N 30 -

were selected from children who had been referred to special units due to severe language/speech disorders. Eighteen children had developmental articulatory dyspraxia and all of the remaining twelve had articulatory immaturities. Five of the eighteen children with the condition were so severely disordered that they could only communicate to a minimal degree. One school employed Makaton to alleviate the children's communication problems and a second used Paget Gorman signed speech. Speech therapy on a daily basis was available to all the children in these three groups.

Over a period of three years the children in the special school groups were assessed over six-monthly intervals. One pre-school group was also assessed over the three years at six-monthly intervals. From the results obtained from this group it was possible to support the findings of Kools & Tweedie, 1975, in which they claimed that oral and limb praxis develops between 0;0 and 6;0 in normally developing

children. In this thesis, the claim is made for articulatory praxis. On completion of the pilot studies, the diagnostic procedure was modified and the experiment was designed.

Four groups of children were randomly selected from four different school populations. Two groups were experimental groups, designated special educational needs, moderate, SEN(M), and language impaired, LI. There were ten children in each group. Two validation groups were selected, one from a pre-school play group and the second from a junior school. The children in the experimental groups and the schoolchildren were aged 6;0-9;0. The children in the pre-school group were aged 3;0-4;0.

The children in the SEN(M) and LI groups were assessed on the Reynell Development Language Scales (RDLS) and the Edinburgh Articulation Test (EAT), either immediately prior to or immediately following the assessment with the diagnostic procedure.

Strict testing conditions were adhered to on all occasions.

The results of the experiment, ie, of the SEN(M) and LI groups, and the validation groups, ie, schoolchildren and pre-school children were processed and examined closely.

The hypothesis was formulated that the presence of developmental articulatory dyspraxia would have an adverse affect on the acquisition and developmental of phonological systems.

To test this hypothesis, Phonological Analysis of Child Speech (PACS), Grunwell, 1985b, was carried out on the data samples resulting from the EAT and the diagnostic procedure

The version of PACS made available by Grunwell to be used in this study, was the experimental stage of the Phonological Assessment of Child Speech to be published in August 1985.

REVIEW OF THE LITERATURE

The following review of the literature in the study of developmental articulatory dyspraxia is confined to the discussion of the four issues which are most pertinent to the present investigation.

These are as follows:-

1. Views on the existence of developmental articulatory dyspraxia and appraisal of the nature of developmental articulatory dyspraxia, with discussion of different opinions existing among other researchers.
2. Consideration of the neurological and genetic factors.
3. Discussion of the speech characteristics which other authorities describe as the distinguishing characteristics of developmental articulatory dyspraxia.
4. Evaluation of associated phenomena, such as problems with early feeding, which may influence, or, in some way, contribute to the condition of developmental articulatory dyspraxia.

See Table 1. p 42.

Literature on the subject of developmental articulatory dyspraxia is limited. Of the forty-three publications identified as relevant to the present study, twenty-six originate in the United States, nine are British, six are Australian and two are French. Even in this small number there is a marked diversity of views.

There is a consensus among previous writers that further investigation is required into the subject of developmental articulatory dyspraxia. This is especially evident from the upsurge of interest which has taken place in the last decade (eg, Rosenbek & Wertz, 1973; Yoss & Darley, 1974; Hunter, 1975; Macaluso-Haynes, 1978; Prichard et al, 1979; Rosenbek, 1980; McLaughlin & Kriegsman, 1980, Williams et al,

1981; Crary, Landess & Towne, 1983.

In addition, in several studies, a need has been expressed for an assessment tool to be developed to identify children with developmental articulatory dyspraxia (Macaluso-Haynes, op cit; Yoss & Darley, op cit; Williams et al, 1980; and Guyette & Diedrich, 1981.)

It should be noted that writers in the American speech pathology tradition have identified a condition termed 'functional articulation disorder'. This title has been applied to more than one type of expressive language difficulty. For example, Yoss & Darley, op cit, designed a study to determine whether a difficulty in 'programming' the speech musculature for volitional production of phonemes plays any part in children's 'functional' articulation disorders.

Macaluso-Haynes, op cit, states:-

"A clear differentiation between developmental apraxia of speech and functional articulation disorders has, to the chagrin of the diagnostician and clinician, continued to prove somewhat elusive." (p 244)

Functional articulation disorders have been described:-

"in terms of four possible types of acoustic deviations in the individual speech sounds; omissions, substitutions, distortions and additions. An individual may show one or any combination of these deviations." (Powers, 1959, p 711)

The emphasis is traditionally placed on articulation and management is dependent on mechanical drills despite the fact that there is no evidence of structural anomalies. Ingram, 1976, undertook the redefinition of 'functional articulation disorders' and recommended the need to distinguish phonetic and phonemic abilities. Carrying this further, Grunwell, 1981a, defined a phonological disability as:-

"a linguistic disorder manifested by the use of abnormal patterns in the spoken medium of language (p 9)

Since phonology is a component of language, a phonological disorder must be regarded as a language disorder.

For the purpose of this investigation, developmental articulatory dyspraxia is defined as follows:-

Developmental articulatory dyspraxia is the inability in the developing child to execute, on command or by imitation, on some but not all occasions, the volitional movements required to produce articulation in the absence of any detectable major neurophysiological or neuromuscular disability.

(It should be noted that all definitions existing to date, define adult dyspraxia only. Yoss & Darley, 1974, emphasized the need for a working definition of developmental articulatory dyspraxia.)

Therefore this present study is based on the contention that developmental articulatory dyspraxia is an articulation disorder.

A further point of clarification has to be made before the corpus of literature is reviewed in detail. Numerous terms are used to describe the condition under investigation. There is a consensus in the American literature that the term used should be developmental apraxia of speech. The present author has elected to employ the description used by Morley & Fox, 1969. Developmental articulatory dyspraxia best depicts the condition as understood in this study. 'Developmental' indicates the fact that the investigation is into circumstances present in the developing child. The term 'articulatory' minimises confusion in the consideration of the speech production element of the problem, and 'dyspraxia' represents a partial rather than a total disturbance of praxis. To elucidate the situation further the operational definition, for this study, of articulatory praxis is:-

The ability in the developing child to maintain a consistent production of precisely formed articulatory movements.

In 1980, Blakeley published a Screening Test for Developmental Apraxia of Speech. This is comprised of eight subtests which include:-

I expressive language discrepancy which is scored on the results of previously administered tests to determine the child's language comprehension and expression ages.

II vowels and diphthongs, presented in the form of minimal pairs or trios.

III oral-motor movement, which tests for tongue and lip movements.

IV verbal sequencing, A single sequence of 3 syllables
B triple sequence of 3 syllables

V articulation, presenting phonetic segments in initial, medial and final positions, noting place, stricture and voicing.

VI motorically complex words, involving repetition of polysyllabic words.

VII transpositions, noting child's sound and/or syllable transpositions.

VIII prosody, achieved by checking a speech sample from child and noting deviance in rate, phonemic spacing, inflection or stress.

Several aspects of this procedure equated to those planned by the present author but others appeared less useful and on the whole the assessment is not as comprehensive as might be possible. For these reasons, a diagnostic procedure has been devised to meet the needs of this investigation.

The literature will now be considered.

1. Views on the existence and nature of developmental articulatory dyspraxia

A. Existence of developmental articulatory dyspraxia

Doubt as to the existence of developmental articulatory dyspraxia is

frequently expressed by practising speech therapists. Nevertheless it is acknowledged that a, so far unexplained, condition can be identified which requires close scrutiny and investigation. Eisenson, 1972, and Johnson, 1980, state emphatically that there is such a condition as that which is designated developmental articulatory dyspraxia. They also indicate the need for further inquiries aimed at providing greater understanding of the condition, its causes, manifestations and the possible means of managing it in clinical terms. Yoss & Darley, 1974, carried out a study to prove the existence of developmental articulatory dyspraxia in a group of children whose articulatory problems could not be accounted for within the accepted category of 'functional articulation disorder'. Macaluso-Haynes, 1978, described a population of speech defective children who require a specific classification of their articulation disorders. Both of these studies indicate that the authors accept the existence of developmental articulatory dyspraxia. British workers, Fawcus, 1971, and Edwards, 1973, present similar possible explanations for the articulatory difficulties manifested by a group which they term somewhat differently but, which, in both instances, could be termed developmental articulatory dyspraxia.

Morley & Fox, 1969, also acknowledge the existence of the condition and, as previously stated, call it developmental articulatory dyspraxia. Despite the fact that they reserve judgement in the case of a small minority of children, Guyette & Diedrich, 1981, question its widespread existence. They base their claim on insufficient evidence existing to support a separate condition known as developmental articulatory dyspraxia. Guyette & Diedrich, *op cit*, have produced a thought-provoking paper which discusses all the areas being examined here. As these authors develop their arguments cohesively and differently from other authorities, it is proposed to discuss their work discretely, later in this review. A number of authors have carried out experiments and/or studies into aspects of developmental articulatory disorders, thereby indicating that they accept its existence (eg Yoss & Darley, 1974; Hunter, 1975; Ferry et al, 1975; Stackhouse, 1982 and Ekelman & Aram, 1983).

B. Nature of developmental articulatory dyspraxia

To elucidate the nature of the condition of developmental articulatory dyspraxia it is necessary to consider the numerous variables both within the condition itself, and co-occurring with it. The presence of so many diverse factors has attracted the attention of several disciplines who variously attempt to describe the nature of developmental articulatory dyspraxia. These disciplines include neurology, psychology, linguistics and speech pathology. Since the speech pathologist is the professional who has to contend with all the variables present in the assessment, diagnosis and management of the condition, one of the aims of this study is to adopt a clinical standpoint. This may throw a more practical light on the subject.

The discussion of the neurological aspects of developmental articulatory dyspraxia will follow in the next section.

The psychological and linguistic variables can be considered together. Some authors regard developmental articulatory dyspraxia as an articulation disorder, some as a language disorder and some as both. Yoss and Darley, 1974, and Williams, Ingham and Rosenthal, 1981, claim that developmental articulatory dyspraxia occurs in the presence of normal language. Ferry et al, 1975, contend that receptive language development is normal or disproportionately high in this condition while a study by Ekelman and Aram, 1983, evidences concomitant syntactic disorders occurring with developmental articulatory dyspraxia. Edwards, 1973, recognises a close inter-relationship existing between language and articulation, while Greene, 1967, states categorically that language disorders accompany developmental articulatory dyspraxia.

Kools and Tweedie, 1975, carried out a longitudinal study to determine the age at which children develop oral and limb motor skills. They claimed that at around 6;0 children are completing their acquisition of precision and speed in their motor movements and this enables them to perform voluntary action automatically. This eventually facilitates the use of these

skills at a mature level. Evidence exists of a high incidence of immaturity in developing children (eg Fawcus, 1971; Morley, 1972; Yoss & Darley, 1974; Ferry et al, 1975). The term selected to describe this condition for the remainder of the study is 'immature articulatory praxis'. It is important to distinguish the immature movements of immature articulatory praxis from the trial-and-error attempts which are associated with developmental articulatory dyspraxia. In the literature, it is noteworthy that several writers describe, but unfortunately do not specifically acknowledge, the existence of a similar condition. For example, Ferry et al, 1975, state that "useful speech is not likely to develop after six years". The term 'useful' in this context requires clarification. It seems likely that the meaning intended by the authors is speech which is characterised by fully mature articulatory patterns. This claim cannot be made confidently of children younger than 6;0 who may, however, 'usefully' convey their intentions by employing articulated speech patterns which are not yet fully developed.

Developmental articulatory dyspraxia occurs sometimes in 'clumsy children'. Apparently, as in all other conditions which affect developing children, there are idiosyncratic features which indicate that children are predisposed to weaknesses in specific areas. See the discussion on genetic factors (p 25.). All clumsy children do not have developmental articulatory dyspraxia - some clumsy children have immature praxis, but some clumsy children do present with developmental articulatory dyspraxia, Gordon & McKinlay, 1980. Children with learning disorders can have developmental articulatory dyspraxia (Morley, 1972; Edwards, 1973; Gordon & McKinlay, 1980; Stackhouse, 1982). It appears to be the case on some occasions that the unintelligibility of speech due to the presence of developmental articulatory dyspraxia interferes with a child achieving his/her intellectual potential. In severe cases, the introduction of an alternative system of communication, eg signing, has enabled some children to start to learn educational skills, McLaughlin & Kriegsman, 1980.

2. Neurological and genetic factors in developmental articulatory dyspraxia

A. Neurological

This investigation is devised to identify whether the condition of dyspraxia can be present in the group of muscles which produce articulation, as it can be present in other groups of muscles in the body. In some movements of the hand, for instance, trial and error groping movements are evidenced. These are discernible in a failure to perform consistently and volitionally some everyday skilled motor activity such as pointing a finger as in ideomotor dyspraxia. Studies emphasise the importance of laying down sensori-motor patterns (kinaesthesia) in learning expressive language patterns.

Morley & Fox, 1969, proposed that developmental articulatory dyspraxia results from a disturbance of function arising in the sensori-motor pathways for speech in the central nervous system at a higher level than that found in oral and general dyspraxia. These authors indicate the difficulty in separating sensory output from motor skill and also in assessing the effect of defective sensory processes on the motor output. From empirical studies they show that, although the condition can and does affect the movement of the lips, it more frequently or more usually is related to the movements of the tip or the blade of the tongue.

Berry, 1969, describes early kinaesthetic feedback in the establishment of body image as an essential basis on which to build the complex patterning involved in speech. She claims that the apparent inability of some children to organise this complex patterning manifests itself in limited expressive language patterns and unintelligible speech. Gordon & McKinlay, 1980, suggest that dyspraxia results from lack of memory of patterns of movement so that although the physical ability is adequate for their performance, the organisation is lacking.

The existence of a sensori-receptive input deficit is also acknowledged by Frisch & Handler, 1974. In common with other authorities they suggest that defective kinaesthetic feedback

disrupts the ability to produce precise motor movements. The viewpoint hypothesised by Fawcus, 1971, is that conflicting input patterns may put an undue strain on some children's central nervous systems at the kinaesthetic, tactile and acoustic levels of feedback. Fawcus, op cit, also puts forward an alternative hypothesis, that the problems experienced by children with developmental articulatory dyspraxia may be attributable to 'noise' in the link between the metalinguistic decision system or encoding stage, and the effector selector, as described by Miller, Pribram & Galanter, 1960, in their TOTE system (Test-Operate-Test-Exit). The third important point made by Fawcus, op cit, is that 'true' dyspraxic children may have surprisingly normal language patterns underlying the unintelligible chaos which characterises the spoken utterances. By which he probably meant that syntax and semantics were developing along normal lines in the presence of unintelligible articulation. The main aim of the second part of this study is to try to determine what effect that fragmented articulation has on the development of phonology. Fawcus, 1971, is one of the authors who mentions that one puzzling observation made of children with developmental articulatory dyspraxia, is the fact that some of them show signs of considerable improvement from what had seemed a hopeless situation. One wonders whether this indicates that he was observing children with 'immature praxis'.

A different interpretation, which is both similar to and in sharp contrast to Fawcus is propounded by Edwards, 1973, who stipulates, like Fawcus, that children with developmental articulatory dyspraxia may have difficulty dealing with a 'barrage of multisensory input'. She suggests that the failure to integrate and organise this input may be the precipitating factor that is the primary cause of the breakdown. In addition, she indicates that such children have attention problems which prevent them from making reliable selections to input signals, leading them to a further difficulty in rejecting aural redundancies from the environment. In toto, this difficulty with selection is seen as a prolonged interruption of proprioceptive feedback which results in a marked disorder of expressive speech.

Edwards, op cit, presents this explanation simultaneously with a strong claim that children with developmental articulatory dyspraxia have difficulty in maintaining rhythm and sequence in the production of speech. She suggests that "articulation appears to disintegrate further under the influence of an extremely imposed rhythm". Edwards, op cit, also considers some of the frequently mentioned accompanying problems, (eg, lack of rhythm in gross and fine motor activity; prosodic differences in the expression of speech), as an intrinsic part of developmental articulatory dyspraxia.

Hunter, 1975, also believes that a sensory feedback disorder is responsible for developmental articulatory dyspraxia. She sees the condition as that which occurs when children are unable to organise "sensations of intra-oral haptic skills". By this she seems to mean the awareness of touch and feeling within the muscles of articulation. These sensations are thought to create feedback of accurate positioning. Hunter, op cit, claims that this disorganisation leads to distortion of proprioceptive feedback on some occasions; inconsistent access to the data of proprioceptive feedback at other times and infrequent total absence of the requisite information by this feedback channel. This explanation thus attempts to explain the inconsistency of response which is a prominent feature of developmental articulatory dyspraxia. It is noteworthy as being the first study to make this claim.

In her review paper, (drawing upon the work of Yoss & Darley, 1974; Rosenbek & Wertz, 1973; Morley, 1972; Edwards, 1973; and others) Macaluso-Haynes, 1978, contends that oro-sensory deficits may be present in developmental articulatory dyspraxia. She strongly advocates assessment of all sensory factors related to the speech skill involved. Macaluso-Haynes, op cit, refers to another sphere of neurological involvement when she points out that 'soft' neurological signs are frequently present in children with developmental articulatory dyspraxia. She cites the areas of fine co-ordination, gait and alternating movements in this context when referring to the findings of Haynes et al, 1977;

Yoss, 1972 and Yoss & Darley, 1974.

Other writers consider the implications of other neurological factors in the development and progress of developmental articulatory dyspraxia. For example, Rosenbek & Wertz, 1973, in their review of 50 cases of developmental articulatory dyspraxia publish results of a paediatric neurological examination on 36 of the children investigated. There is no explanation given for the absence of examinations on the remaining 14 children. Of 36 children, 22 presented as "essentially normal" except for the presence of either a generalised dyspraxia or a dyspraxia confined to the orofacial musculature. (Generalised, including oral dyspraxia N=12; orofacial dyspraxia N=7; unidentified dyspraxia N=3) In 14 children, dyspraxia was accompanied by other neurological deficits. For example, 3 patients presented with dyspraxia and muscle weakness; 8 had hyporeflexia and spasticity in addition to dyspraxia; 1 showed hyporeflexia and muscle weakness with dyspraxia and 2 evidenced hyperkinesia and dyspraxia. Eleven of the 50 children had signs of excessive drooling which is also a positive neurological sign. Six of the 11 children who drooled had no evidence of the paresis or paralysis which commonly accompany drooling, but they did exhibit generalised or focal dyspraxia.

Electroencephalographic findings were available on 26 of the 50 children. Eleven had normal results. Fifteen had either focal or generalised abnormalities. Ten of these 15 children showed generalised cortical disturbance, without records of lateralising or localising significance. The remaining five suggested focal abnormalities. Two children had bilateral abnormalities, one involving the motor strips and the other the Sylvian and parietal regions. The 3 remaining children had foci of disruption confined to the right hemisphere. One suggested a right temporal-parietal lobe lesion. One showed a focus in the right temporal lobe and reduction of cortical activity in the right hemisphere and the last child demonstrated a right parietal and posterior temporal focus. Some conclusions drawn by Rosenbek & Wertz, op cit, with regard to the neurological findings of their

study include the following:-

1. Both the high incidence of isolated dyspraxic signs and the electroencephalographic findings indicate that praxis centres in the developing cortex for speech movements may be quite diffuse.
2. The hypothesis that with maturation, praxis centres lateralise and become more focal. This is supported by Penfield & Roberts, 1959, who concluded from their findings that ideational speech centres undergo progressive lateralisation perhaps until age 6;0.
3. Before lateralisation and localisation take place any variety of left-right, anterior-posterior lesions may result in developmental articulatory dyspraxia.
4. It appears that developmental articulatory dyspraxia may occur in isolation, or may be part of a general picture of neurological deficit.

Kornse et al, 1981, researched in a different area when they explored the possibility that developmental articulatory dyspraxia does not indicate left cerebral hemisphere involvement. They used a quantitative test of fine motor function to compare the dexterity of the right and the left hands of normal children and children with developmental articulatory dyspraxia.

Eighteen normal and eighteen dyspraxic children were used in four groups; nine male normal; nine male DAD; nine female normal; nine female DAD. The developmental articulatory dyspraxic subjects were selected using some of the general procedures for speech screening for articulatory dyspraxia as employed by Yoss & Darley, 1974. The only significant difference between the nine female and nine male subjects with developmental articulatory dyspraxia was that the socioeconomic status of the females was higher than that of the DAD males. A Purdue Pegboard (Purdue Research Foundation, 1948) was used. The Purdue Pegboard is known to be sensitive to lateralised brain damage (eg Costa et al, 1963; Rapin, Tourk & Costa, 1966). Three types of tasks were employed: insertion, removal and sequencing insertion of pegs. Fifteen steel pegs were available for each task. The subjects, tested individually, were given a demonstration before each task and then instructed to perform the task as rapidly as possible. Each type of task was performed in each of three manual modes; with the right hand, with

the left hand and bi-manually (except sequencing insertion which was not performed bi-manually). Thirty seconds was allowed for each task. The results suggest that the left cerebral hemisphere of children with developmental articulatory dyspraxia is not predominantly impaired in regard to motor control of the upper extremities. In female, but not male, children with developmental articulatory dyspraxia, manual dexterity was impaired when compared to the normal control groups. Therefore, developmental articulatory dyspraxia is probably not due to a congenital or an acquired defect in Broca's speech area or adjacent brain areas of the left hemisphere, according to Kornse et al, op. cit.

A separate neurological issue is that of the co-occurrence of developmental articulatory dyspraxia and other neurological disorders such as dysarthria and dysphasia. Rosenbek & Wertz, 1973, categorise this possible co-occurrence with dysarthria and/or dysphasia as their first item in their list of speech and language characteristics of developmental articulatory dyspraxia. Of the 50 children reviewed by Rosenbek & Wertz, op cit, nine were diagnosed as having developmental articulatory dyspraxia without any other neurological disorder. Twenty children had dysphasia and developmental articulatory dyspraxia co-occurring. Thirteen had dyspraxia and dysarthria and eight had all three, dysphasia, dyspraxia and dysarthria. These authors claim that the spuriously high number of children with developmental articulatory dyspraxia in isolation (nine) may be accounted for by the difficulty in measuring dysphasic involvement in children, both because clinicians are not agreed upon the behaviours manifesting dysphasia in children and also because of the difficulties involved in testing children with severe disturbances of speech output. There is certainly empirical evidence that children with one predominant neurologically-based disorder of speech and/or language frequently present with others to a lesser degree. For example, Morley, 1972, cited children with developmental articulatory dyspraxia who also had dysphasia or dyslexia (a written language disorder). She also mentions a child with a stutter which improved spontaneously as articulation improved. Van Riper, 1971, reviewed the literature on both oral and limb

movements in stuttering children and as a result stated that:-

"After reviewing all these studies, it is difficult not to conclude that stutterers show co-ordinative deficiency in the timing of their speech musculatures."
(p 361)

Rosenbek, 1980, wonders if stuttering children may be telling us that their speech/language systems are impaired and that impairment is independent of their environment. He advises more research to determine whether oral dyspraxia may be connected with the onset of stuttering in children. Many writers contend that developmental articulatory dyspraxia frequently co-exists with oral dyspraxia (eg Aram & Horwitz, 1983; Chappell, 1973; Ferry et al, 1975; Kools et al, 1971; Kools & Tweedie, 1975; Macaluso-Haynes, 1978; Yoss & Darley, 1974; Williams et al, 1981.)

In fact, it is unfortunately difficult in some papers to determine whether the authors clearly discriminate between oral and articulatory dyspraxia, as they appear to assess the latter by testing the former. For example, Yoss & Darley, 1974, used a battery of tests to discriminate from a group termed "defective articulation children", some children with articulatory disorders different enough and severe enough to be regarded as having developmental articulatory dyspraxia. They may have succeeded in identifying just such a group, but the means they describe they used to isolate the group are somewhat dubious. The results appear to identify a group of children presenting with either articulation or phonological disorders in the presence of oral dyspraxia. The difference between the two groups of "defective articulation children" could be accounted for by severity of the speech disorder. In 1981, Williams et al replicated the study of Yoss & Darley, 1974, to attempt to make a further analysis of the behaviour that might distinguish developmental articulatory dyspraxia from "functional" articulation disorder. Their findings are at variance with almost every conclusion that Yoss & Darley reached in their original study. The only results shared by the two studies (that of Yoss & Darley, 1974 and that of Williams et al, 1981) are the rates of oral diadochokinesis in the

developmental articulatory dyspraxic children which were slower in each, than the rates of normal children. Williams et al, op cit, suggest that the two studies simply may have described two different groups of children with articulation disorders. Once again, the present author would wish to know how carefully both studies differentiated between children with articulation disorders and children with phonological disorders, as well as whether the children tested were specifically assessed for articulatory dyspraxia and not only for oral dyspraxia.

Rhythm and sequencing are also dependent on neurological development and normalcy, but they also occur as features in the linguistic study of language and speech and will be dealt with in that section.

B. Genetic Implications for Developmental Articulatory Dyspraxia

Several authors report studies of families in which there is a recurring appearance of developmental articulatory dyspraxia (eg Morley, 1972; Saleeby, 1978; McLaughlin & Kriegsman, 1980). Morley cites a family in Britain in which there were eight offspring. Five of the eight had an articulation disorder which appeared to be developmental articulatory dyspraxia. The first, second, sixth and eighth had severe disorders and the third had a much less severe degree of the problem. The fourth, fifth and seventh children had normal speech as had the parents. Surgical intervention such as tonsillectomy, adenoidectomy and excision of the uvula and fraenum had been resorted to, to no avail. The speech sound segments mispronounced and, in some cases, substituted were non-identical therefore direct imitation played no part. Morley, op cit, mentions developmental articulatory dyspraxia in the context of familial diathesis and also refers to it several times as possibly having an inherited association with stuttering.

McLaughlin & Kriegsman, 1980, describe an American family in which a great-uncle, two uncles and a half-brother of a child treated by

them, all appeared to have developmental articulatory dyspraxia. Their patient started treatment at 4;0 and despite his severe handicaps, a marked improvement in his ability to communicate was recorded as a result of teaching him sign language. McLaughlin & Kriegsman, op cit, contend that it is essential that such intervention should take place to prevent such severely handicapped people from becoming institutionalised unnecessarily.

Saleeby, 1978, carried out an extensive family study in the United States which shows that 34 of 66 family members had developmental articulatory dyspraxia. Indications in this study suggest that the defect was inherited in a single gene autosomal fashion with incomplete penetrance. The same gene, in this family, was apparently associated with demonstrable abnormalities in oral stereognosis and mandibular kinaesthesia. The appearance of developmental articulatory dyspraxia, was considered by Morley & Fox, 1969, although they cite no proof for the support of this contention except the presumption that it is not impossible that genetic influences may be implicated in causing some interference with the developing nervous system at a stage of foetal growth.

3. Speech Characteristics in Developmental Articulatory Dyspraxia

Most writers who discuss developmental articulatory dyspraxia as a separate articulation disorder have indicated a degree of consensus in the speech characteristics which appear most frequently in such speech (eg Rosenbek & Wertz, 1973; Yoss & Darley, 1974).

Rosenbek & Wertz, op cit, describe the following speech characteristics:-

1. Omissions of sounds and syllables (these omissions are the most frequent characteristic), substitutions, distortions, additions, repetitions and prolongations.
2. Frequent metathetic errors.

3. Errors increase as words increase in length.
4. Most frequent errors are found on fricatives, affricates and consonant clusters.
5. Mis-articulations include vowels as well as consonants.
6. Errors are highly inconsistent.
7. Groping trial-and-error behaviour manifested as sound prolongations, repetitions, or silent posturing may precede or interrupt imitative utterances.
8. Prosodic disturbances: slowed rate, even stress and even spacing.

Most, if not all of these errors are referred to by other workers in this field (eg Macaluso-Haynes, 1978; Chappell, 1973). Yoss & Darley list their characteristics as follows:-

1. Slowed rates of oral diadochokinesis, eg repetition of the combined syllables, are often produced with incorrect syllable sequence.
2. Greater difficulty is evident with polysyllabic words. Syllabic integrity is affected by omission, revision or addition of syllables.
3. A combination of error features may serve as predictive determinants when repeated speech tasks are used in obtaining a speech sample, eg two- and three-feature errors, prolongations and repetitions of sounds or syllables, distortions and additions.
4. Analysis of spontaneous speech shows a somewhat different group of error features such as, distortions, on-place feature errors, additions and omissions.
5. Prosodic features may be altered, especially in older children or those who have received speech therapy. Rate is slowed and stress tends to be equalised.

As will be appreciated, similarities and repetitions will be noted in these two lists of speech characteristics.

Morley, 1972, claims that some children with developmental articulatory dyspraxia are consistent in their use of consonants

and substitutions while other children use them more erratically. She mentions metathesis as a frequent occurrence. Vowels, too, may be affected in severe cases, especially diphthongs, according to Morley, op cit, who notes that many children with developmental articulatory dyspraxia spontaneously gain assistance from watching the speaker's lips, and she insists that, as in all other cases of articulation disorder, an audiometric assessment is essential.

Edwards. 1973, regards the inability in many children with developmental articulatory dyspraxia to maintain rhythmic speech, as a basic disorder closely associated with this condition, and she suggests that it might be equated with Lenneberg's basic time pulse, 1967. He suggests that articulation reflects a basic rhythm which is present through physiological and neuromuscular activities associated with speech.

Fawcus, 1971, refers to the 'unintelligible chaos' which characterises the spoken utterances of the developmental articulatory dyspraxic child.

In referring to the phonetic phenomena characteristic of acquired articulatory dyspraxia, Grunwell, 1982a, suggests that patients often 'experiment' with silent articulatory movements which are sometimes audible as very weak articulations, or 'tentative realisations'. This practice can also be seen used by some children with the developmental disorder.

Another feature mentioned by some authorities is voicing. For example, Yoss, 1972, found in her study that more than twice as many errors involving the voiced/voiceless feature were made by children with developmental articulatory dyspraxia, than by children with other disorders of articulation.

Although Prichard, Tekieli & Kozup, 1979, assessed the groups of developmental articulatory dyspraxic children and the functionally articulation disordered children in their study on the Arizona Articulation Proficiency Scale and found the latter scored higher than the former, they did not specify what types of errors the

dyspraxic children made.

In a study to discover phonological error patterns in developmental articulatory dyspraxia, Crary, Landess & Towne, 1982 report the following results:-

1. Cluster reduction)
Deletion of final consonants) were the most frequent
Deletion of inter-vocalic consonants) error patterns.
2. A moderate number of children presented with:-

Fronting)
Stopping and) associated with weak syllable deletion
Gliding)
3. The mildest errors were:-

Vocalisation and)
Deletion of initial consonants)
4. The errors which occurred least were:-

Vowel neutralisation)
Voicing errors)

The authors agreed with evidence of previous studies (eg Rosenbek & Wertz, 1973; Yoss and Darley, 1974) that their findings indicated the presence of a "multiple articulation disorder".

With reference to speech characteristics of children with developmental articulatory dyspraxia Ferry, Hall & Hicks, 1975, stated that "the dyspraxic speech varied from non-existent to partially intelligible or intelligible only to those who knew the patient well". No specific characteristics were enumerated.

4. Associated Phenomena

Empirical evidence from clinical reports suggests that a percentage of children subsequently identified as having developmental articulatory dyspraxia, show evidence of problems with early feeding and drooling. Rosenbek & Wertz, 1973, report that 11 of the 50 children reviewed by them had excessive drooling

and that parents informed them of feeding problems in early infancy. Six of the children who drooled had no other sign of neurological dysfunction than focal or generalised dyspraxia. Similarly, although some of the children had dyspraxia plus dysarthria and early feeding problems Rosenbek & Wertz, op cit, reported that some had dyspraxia only. No other specific mention of either drooling or early feeding problems is to be found in the publications reviewed for this study. Kornse et al, 1981, extend the following intriguing suggestion in their paper on developmental articulatory dyspraxia and manual dexterity:-

"Some constraint is placed on possible aetiologies for developmental apraxia of speech (DAS) by the major finding of the present study; that is, in DAS subjects compared to appropriate controls, dexterity in both hands is affected, but in females only. Perhaps the brain defect underlying DAS is the same for both sexes but affects some process which plays a greater role in the female than in the male while mediating manual performance. Coltheart, Hull & Slater, 1975, proposed that females rely more on inner speech than males in certain language perceptual tasks. Alternatively, future studies may find an impairment in the manual dexterity of male DAS subjects with a more severe speech involvement than those selected for this study." (p 327)

This finding may have some relevance to that of Buffery & Gray, 1972, who found that girls developed language in advance of boys. The latter showed greater development of spatial skills. This whole subject involves consideration of right and left hemisphere dominance for certain abilities and activities. Blakeslee, 1980, postulates that the right hemisphere of the brain is the non-verbal, creative, spatial and intuitive half of the brain. He describes the right hemisphere as being dependent on a spatial, visual input and not responding to language per se. This could account for the finding of Kornse et al, 1981, in which girls, more aware of language at an earlier stage than boys, took notice of the instruction for its linguistic worth but found themselves unable to relay it to the right hemisphere for involvement of left hand activity, and so created a confusion which affected the performance of both hands. No such impairment was discernible in boys who probably acted on visual and spatial memory and took less

notice of the language controlled part of the instruction. More discussion will be given to this aspect of contemporary findings at a later stage in this study in the light of the findings of the present author.

Ekelman & Aram, 1983, tested eight children who were considered to have developmental articulatory dyspraxia, to determine their use of syntax. The assessment battery used included the analysis of speech samples for:-

- A mean length of utterance
- B developmental sentence score
- C analysis of 14 grammatical markers
- D analysis of yes/no and 'wh' questions.

Results indicated:-

1. pronoun error
2. verb omissions
3. omission and/or incorrect use of grammatical markers especially after stage V of grammatical development
4. auxiliary and copula omissions in yes/no and 'wh' questions
5. no inversion in yes/no and 'wh' questions
6. incorrect auxiliary substitutions
7. omission of 'do' support in yes/no and 'wh' questions
8. some other syntactic omissions.

Conclusions drawn by Ekelman & Aram, op cit, were that the errors made by this group could not be attributed to motor speech and/or phonological imitations, but rather evidence concomitant syntactic errors. It should be noted that these syntactic errors are not unique to developmental articulatory dyspraxia, but may be attributable to delayed syntactic development.

Turning to other aspects of language, Stackhouse, 1982, tested children deemed to have developmental articulatory dyspraxia for reading and spelling performance. She then compared their abilities with normal and cleft palate children's performances and found that

they differed from both other groups qualitatively and quantitatively. For example, comparison between non-word matching and reading age in the cleft palate and normal children showed a significant correlation which was absent in the dyspraxic children. Qualitatively, controls and cleft palate children made reading errors which could be accounted for visually and phonetically. In contrast, the developmentally articulatory dyspraxic group of children showed "illogical" errors and responses incompatible with word length, number of syllables and the phonetic pattern of words. This indicated the presence of a specific difficulty in carrying out grapheme-phoneme conversions in the children with developmental articulatory dyspraxia. Stackhouse, op. cit. concluded from this that the pre-dominantly phonetic description of developmental articulatory dyspraxia is misleading.

Yet another view of developmental articulatory dyspraxia in children is propounded by Eisenson, 1972. He claims that the condition is a recognised speech disorder found in children who have a history of limited sound play and sparse early vocal activity. Again, it is difficult at such an early stage in development to discriminate between immature praxis and the first indications of developmental articulatory dyspraxia.

In their study, Prichard, Tekieli & Kozup, 1979, conducted an investigation into the performance of three children diagnosed as developmental articulatory dyspraxic and three others judged to have functional articulation disorders. The children were aged between 5;3 and 9;4 years. Since there is no indication of any definition of functional articulation disorder in this context it is not clear how the presenting speech production of the two groups differed. However, on completion of a battery of tests including:-

1. auditory attention
2. auditory discrimination
3. auditory memory
4. oral-tactile feedback
5. isolated and sequenced volitional oral movements

the findings displayed results showing that the children with functional articulation disorder performed consistently higher than those with developmental articulatory dyspraxia, except on items of

auditory comprehension in which no differences were found between the groups. Unfortunately, it is difficult to derive much informative data from this study as neither group is clearly defined with regard to its speech and language abilities.

The French authorities, Wallon & Denjean, 1958, approach the problem of developmental articulatory dyspraxia from yet another angle which they term psychopathological. They claim that such children know what they should do, have the motor ability to do it, but find it impossible to execute the action. They interpret this failure as a faulty visualisation of the spatial and temporal organisation of the action. Wallon & Denjean, op cit, submit that the children's personal space is so disturbed that the different parts of the body are confused to such an extent that the intended movement is either transferred to whole body movements or to only one part at a time, thus overall behaviour of the child is uncertain. On the other hand, de' Ajuriaguerra & Stambak, 1973, postulate that developmental articulatory dyspraxia may result from:-

"the lack of correspondence between the action and the instruction to perform the action. The performance may be affected by a reinforcement of instruction, either by repetition or by demonstration of the action." p 451

This description indicates a similar problem to that previously discussed in relation to the work of Kornse et al, 1981, in which language mediation appears to create difficulty for some developing children.

Several authors refer to the rhythm and sequencing of speech with regard to developmental articulatory dyspraxia. Aram & Horwitz, 1983, investigated sequential and non-speech praxic abilities in developmental articulatory dyspraxia. Motor organisation, other than speech organisation, has not been studied specifically and Aram & Horwitz, op cit, devised a study to measure two verbal and two non-verbal sequential tasks and five tests of non-speech praxic abilities, which were given to 10 children, 9 boys and 1 girl. Age range, 4;4 - 13;2.

The two verbal sequential tasks were:-

1. The auditory sequential subtest of the Illinois Test of Psycholinguistic Abilities, Kirk et al, 1961 (ITPA).
2. The Denver auditory phoneme sequencing test, Aten, 1979.

In the first there is verbal repetition of aurally presented digits, ranging from 2 to 8 digits presented at a rate of 2 per second.

The second comprises sequencing subtests which require the child to point from memory to aurally presented sequences of 2 to 6 nouns.

The two non-verbal sequential tasks were:-

1. The visual sequential subtest of the ITPA in which the child reproduces from memory a visually presented series of non-meaningful symbols by placing chips in the correct order. There are from 2 to 8 symbols and no time restriction.
2. The picture arrangement of Weschler Intelligence Scale for Children, Weschler, 1974, (WISC) which entails arranging pictures in order of sequential events within a story.

The five praxic tasks were:-

1. The Manual Expression Subtest of the ITPA which requires the child to pantomime the use of objects, eg, Binoculars, guitar.
2. The Block Design Subtest of the WISC was used for the 8 older children and the Weschler Preschool-Primary Scale of Intelligence (WPPSI) for the 2 younger.
3. The Object Assembly Subtest of the WISC which requires completion of 4 pictures (girl, house, car, face), the number of pieces ranging from 6 to 12, was also given to the 8 older children.

4. Single volitional oral movements, Spriestersbach et al, 1978, such as blowing, whistling on command or by imitation were presented.
5. Sequential volitional oral movements, Spriestersbach et al, 1978, which were sequences 2 and 3 of the movements presented in 4, and rated in the same way, this is normal, mildly impaired or moderately-severely impaired.

Results indicated that these children were deficient in verbal sequential abilities, both with reference to their non-verbal sequential abilities and to normative data. As a group, the children did not present manual-gestural or constructional apraxias, nor oral apraxias for single non-speech volitional movements. However, most had difficulty with sequences of non-speech volitional oral movements.

These results again indicate the specificity of verbal intervention on the performance of children with developmental articulatory dyspraxia. However caution must be taken about the implications of this finding as Cromer, 1978, pointed out that the sequential difficulty may be the result of a typical disordered language problem or it may be a more general symptom of higher cognitive disorder as seen in many children.

As previously mentioned, Edwards, 1973, (see p.28) indicated the importance of sequencing and rhythm on the speech behaviour of children with developmental articulatory dyspraxia. It is important to consider rhythm in this context. When speakers pause in the normal course of events, for example, to find the appropriate word, rhythm is not disrupted. Alternatively, when the speaker with a word finding difficulty interrupts his flow of speech, his rhythm can be totally disrupted and his speech can be considered dysrhythmic or in severe cases arrhythmic. In the case of developmental articulatory dyspraxia in which it is claimed that there are disruptions in the programming of motor commands for the production of speech or, as Wallon & Denjean, 1958, suggested, dyspraxic speakers do not know what to do next, and thus the flow of speech is disrupted, there can be consequent lack of rhythmicity. Since this characteristic is secondary to the primary disturbance, it cannot be regarded as a characteristic of the disorder, per se, but as a by-product of the

primary disturbance. According to Crystal, 1969,

"rhythmicality in spoken language is based
on the regular recurrence of perceptible
peaks of prominence" (p161)

To achieve the experience of "the regular recurrence of perceptible peaks of prominence" in spoken English, one must depend on recurrent patterns of continuous fluent speech. In children with moderate to severe articulatory dyspraxia this production is seldom possible, therefore the occurrence of rhythmicality is unlikely.

In discussion of the results of this present study much more will be said about the subject of rhythm.

As previously stated, one work in reference to the area of developmental articulatory dyspraxia takes a stand in opposition to the majority. Guyette & Diedrich, 1981, in their critical review of the subject, list many aspects of the problem which they feel require more investigation. There unfortunately appear to be several contradictions in their claims, which arise out of the study of most of the previously named authors. With reference to the developmental aspect of the condition, Guyette & Diedrich, op cit, argue that there is little empirical evidence to support the diagnosis of developmental articulatory dyspraxia with much conviction. They advance the following arguments to question the validity of the condition:-

1. All children with soft neurological signs do not have developmental articulatory dyspraxia.
2. Oral and articulatory dyspraxia do not necessarily co-exist.
3. There is no firm evidence to support the claim that slowed diadochokinetic rates co-exist with developmental articulatory dyspraxia.
4. Findings on sensory deficits are inconclusive. Children with all types of articulation disorders performed less well than normal children on sensory tasks.

5. Consistency of error could not be supported in the authors' empirical studies.
6. No particular error type was found to be peculiar to developmental articulatory dyspraxia.
7. Increased struggle with increased complexity was not seen as unique to this condition.
8. Evidence of the presence of prosodic errors and groping was inconclusive.
9. Insufficient evidence of sequential difficulties was available.
10. Oral motor skills were not acceptable as the best criterion to define developmental articulatory dyspraxia.
11. Too much variability in the diagnostic characteristics was made in claims for the diagnosis of developmental articulatory dyspraxia.
12. Specific writers were criticised for basing the diagnosis of the condition on slow progress of therapy (eg Prichard et al, 1979; Ferry et al, 1975; Macaluso-Haynes, 1978 and Aram, 1979).

On the positive side, Guyette & Diedrich, 1981, while claiming that the recognition of such a condition is neither acceptable nor appropriate, proceed to make some statements which indicate that they recognise some features of such a condition. For example, the following:-

1. The incidence of specific developmental articulatory dyspraxia is rare.
2. Language deficits may co-exist with developmental articulatory dyspraxia. The authors are uncertain but feel this may always be the case as suggested by Greene, 1967.
3. Cognitive deficits are not critical in developmental articulatory

dyspraxia. Some children evidence them and some do not.

4. Familial diathesis is strongly indicated in cases of developmental articulatory dyspraxia.
5. A predominance of male children appears to have the problem.
6. Difficulty in prognosis arises as a majority of the children affected appear to improve by adulthood.

Guyette & Diedrich, op cit, stimulate much food for thought and create a climate of critical and insightful comment which produces some answers to problems and supplies some additional problems as a result of their objective views and careful assessment of the evidence. They appear to be claiming that developmental articulatory dyspraxia exists in a very small number of cases and that workers must avoid, by careful and considered assessment, using the label developmental articulatory dyspraxia for cases for whom there is no easy and straightforward diagnosis.

It is expected that considerable discussion at later stages in this study will refer to points raised by this paper.

Finally, Williams et al, 1980, produced a questionnaire which was distributed to 31 clinicians working in child clinics in an urban area. All responded, but in the final analysis 28 fully completed questionnaires were used. The questionnaire included 3 subgroups of articulation disorders which were termed

'functional articulation disorders'

'organic articulation disorders'

'developmental articulatory dyspraxia'.

The criteria used to select all three categories were as follows:-

- (i) the behaviours were to be described so that they were observable and measurable;
- (ii) the behaviours were not described in terms of their 'severity'.

After careful selection, 18 items were randomly presented, preceded by

3 examples of answered items. Several analyses were conducted on the results. The first analysis indicated that 11 items were significantly associated with developmental articulatory dyspraxia. These 11 items were analysed further to determine whether the identified behaviour was 'always' or only 'sometimes' related to the disorder. The authors do not list in detail either the original 18 items or the 11 which were submitted to further analysis.

After careful scrutiny and analyses the following 7 behaviours were identified, in the survey carried out at that time, as associated with developmental articulatory dyspraxia:

1. Deviant error pattern in articulation development.
2. An inconsistent pattern of phoneme errors.
3. Searching behaviour in attempting some (or all) target phonemes.
4. Inability to produce volitionally an isolated phoneme, or sequence of phonemes, which have been produced on other occasions.
5. Ability to incorporate a target phoneme at slower than normal speech rate but not to be able to do so at normal speech rate.
6. At some time in treatment for some (or all) target phonemes there is an inability to progress from one step to the next, eg from syllable to word.
7. No nasal emission is evident in client's speech on some (or all) phonemes.

Behaviours 1 to 6 have been consistently identified by many writers (eg Rosenbek & Wertz, 1973). No previous writers have selected behaviour 7 as regularly observed. Williams et al, 1980, indicate that behaviour 7 is a relatively artificial category of behaviour which was identified because of the behaviours selected for the survey. The writers acknowledge that the clinicians approached to complete the questionnaire may have felt other behaviours can be

associated with developmental articulatory dyspraxia which were not included in the survey. However, a conclusion was reached to select certain behaviours as those which the majority of clinicians, experienced in the treatment of such cases, recognised as identifying developmental articulatory dyspraxia. Finally, Williams et al, op cit, claims that it appears that developmental articulatory dyspraxia is distinguished by 4 behaviours that are always and only associated with developmental articulatory dyspraxia.

1. Articulatory development shows a deviant rather than an immature error pattern.
2. Searching behaviour in attempting some (or all) phonemes.
3. An inability to volitionally produce an isolated phoneme, or sequence of phonemes, which has been produced on other occasions.
4. An inconsistent pattern of phoneme errors.

Despite the relatively small number of publications on, and references to, the subject of developmental articulatory dyspraxia, it is clear that the nature of the condition is so complex that it has led those who have worked in the area to propound many hypotheses. Ideas and findings from several of the works were incorporated into the preliminary stages of the present study. For example, the characteristics on which the diagnostic procedure is based include some of those used by Chappell, 1973, and Rosenbek & Wertz, 1973. It is noted that the directions given by Chappell, op cit, are included as being appropriate from the descriptive viewpoint and the present author's experience, rather than the study done by Chappell, whose paper is more concerned with the treatment of developmental articulatory dyspraxia.

Consideration of symptomatology to be assessed has been completed with careful references to many of the works (eg, Fawcus, 1971; Edwards, 1973; Macaluso-Haynes, 1978 and McLaughlin & Kriegsman, 1980).

Certain features from most publications provoke thought, disagreement and interest and their influence will be seen in the course of the description of the investigation.

CONTRIBUTORY FACTORS IN DEVELOPMENTAL ARTICULATORY DYSPRAXIA

FACTORS

AUTHORS

1. Neurological

Sensory Feedback

Lenneberg 1967
Morley & Fox 1969
Fawcus 1971
Morley 1972
Edwards 1973
de Ajuriaguerra & Stambak 1973
Hunter 1975
Macaluso-Haynes 1978
Saleeby et al 1978
Ayres 1979
Emerick & Hatton 1979
Prichard et al 1979
Edwards 1984

Motor Programming

Wallon & Denjean 1958
de Ajuriaguerra & Stambak 1973
Frisch & Handler 1974
Darley, Aronson & Brown 1975
Macaluso-Haynes 1978
Gordon & McKinlay 1980
Johnson 1980
Crary, Landess & Towne 1983

'Soft' Signs

Eisenson 1972
Rosenbek & Wertz 1973
Yoss & Darley 1974
Macaluso-Haynes 1978

Manual Dexterity

Kornse et al 1981

Motor Co-ordination

Chappell 1973
Aram & Glasson 1979

Cerebral Disorganisation

Morley & Fox 1969
de Ajuriaguerra & Stambak 1973
Rosenbek & Wertz 1973
McLaughlin et al 1980

Spatial/Temporal

Wallon & Denjean 1958
Edwards 1984

Oral Dyspraxia Co-occurring

Chappell 1973
Rosenbek & Wertz 1973

Table 1

FACTORSAUTHORS2. Genetic

Morley & Fox 1969
 Morley 1972
 Ferry et al 1975
 Saleeby et al 1978
 McLaughlin et al 1980
 Guyette & Diedrich 1981

3. Self-Monitoring

Morley & Fox 1969
 Fawcus 1971
 Morley 1972
 Edwards 1973
 Yoss & Darley 1974

4. Absence of Babbling

Eisenson 1972

5. Prosody

Rosenbek & Wertz 1973
 Edwards 1973
 Yoss & Darley 1974

6. Articulation

Searching

Eisenson 1972
 Chappell 1973
 Rosenbek & Wertz 1973
 Ferry et al 1975
 Williams et al 1980

Consistency Errors

Rosenbek & Wertz 1973
 Williams et al 1980

Sequential Errors

Morley & Fox 1969
 Morley 1972
 Chappell 1973
 Edwards 1973
 Rosenbek & Wertz 1973
 McLaughlin et al 1980
 Aram & Horwitz 1983

Reduced number of
segments used

Morley & Fox 1969
 Fawcus 1971
 Morley 1972
 Chappell 1973
 Edwards 1973
 McLaughlin et al 1980

7. Language

Phonological Errors

Johnson 1980
 Crary, Landess & Towne 1983

Syntactic Errors

Ekelman & Aram 1983

Table 1 (cont)

Recent Publications on Developmental Articulatory Dyspraxia

A paper included in the publication 'Speech Disorders in Children', 1984, and only available in February in 1985, is reviewed.

A recently published series of papers, available after completion of most of the work on this thesis, appeared in an Australian journal devoted to the study of developmental articulatory dyspraxia. It became available to the present writer in June 1985, and a brief review of the works related to this thesis follows.

In a publication devoted to speech disorders in children, Jaffe, 1984, discusses developmental articulatory dyspraxia. He describes behaviourally, the symptomatology of developmental articulatory dyspraxia, according to various authors, particularly that of Guyette & Diedrich, 1981. Jaffe, op cit, highlights confusion in the literature which he claims undermines the confidence of clinicians faced with the problem. He states that the authors interested in the condition are in no doubt of its existence, but that they express the need for further investigation and delineation. The present writer claims that the work included in this study may illuminate a little the problem, its implications and the direction which future study should take.

Jaffe, op cit, proceeds to discuss measurement and assessment tools. The two he describes are an unpublished protocol, Motor Speech Examination, by Logue 1983, and unknown to the present writer which examines the following:-

1. nonvolitional motor behaviours
2. indices of dominance and laterality
3. cranial nerve function
4. diadochokinesis or multiple cranial nerve integration
5. competitive articulatory posturing
6. motor speech integration
7. imitative and spontaneous articulatory production skills.

Jaffe's single comment regarding this assessment is that it attempts to identify deficits in children's motor speech planning. He also mentions the Screening Test for Developmental Apraxia of Speech,

Blakeley, 1980, which is developed to aid differential diagnosis and to suggest when further speech and language assessment and neurological evaluation is required. This assessment is comprised of 8 subtests as follows:-

1. Expressive Language Discrepance
2. Vowels and Diphthongs
3. Oral-motor movement
4. Verbal sequencing
5. Articulation
6. Motorically complex words
7. Transpositions
8. Prosody

Jaffe, op cit, reports that Guyette & Diedrich, in press, have produced a review on Blakeley's assessment. They suggest that the references cited by Blakeley offer little empirical support for his claim that the symptoms of developmental articulatory dyspraxia are those sampled in this test, and they conclude that the 'Screening Test for Developmental Apraxia of Speech' has yet to be validated and that no test/retest reliability data are reported for the children or the examiners. (In the case of the diagnostic procedure devised for use in this present investigation, two validation groups were selected from whose results validation could be claimed. Fifteen speech therapists throughout the area made test/retest reliability runs over the interval of one year, on three children each. One child was selected who was suspected of having developmental articulatory dyspraxia, one who was known to have a different form of expressive language disorder (usually a phonological learning disorder) and a third was of unknown diagnosis but having expressive language difficulties. A similar percentage of these forty-five children produced data indicating the presence of developmental articulatory dyspraxia as occurred in the experimental group, ie seven of the forty-five assessed.)

Jaffe, op cit, goes on to discuss treatment techniques for developmental articulatory dyspraxia and makes some final comments. These include:-

1. Need for further empirical evidence of clinically defined characteristics of dyspraxia and agreement between researchers on

the definition of developmental articulatory dyspraxia.

2. More information on early developmental non-speech, pre-speech and speech behaviours of children diagnosed as having developmental articulatory dyspraxia.
3. Possibilities of measurement of neurological dysfunction.
4. Question as to whether developmental articulatory dyspraxia is a motor sequential disturbance from the symbolic aspects of language, or exists as part of a language disorder, remains unanswered.
5. More analysis of connected speech samples.
6. Longitudinal and follow-up studies to aid differential diagnosis, describe changes over time and document the effects of treatment.
7. Role of oral perception and sensation in the condition. Measurements and their significance of such sensation.
8. Tolerance level for touch in children with developmental articulatory dyspraxia.
9. Sensory integration and its role in the treatment of developmental articulatory dyspraxia, Ayres, 1979.
10. More studies on normal development of children's abilities to perform nonverbal-oral motor tasks for comparison with those of children with developmental articulatory dyspraxia.
11. Careful studies of treatment approaches and their efficacy in this condition.

The work done in this investigation begins to answer some of these questions. In the case of 1., characteristics by which developmental articulatory dyspraxia can be recognised, the present writer claims that these characteristics used to design the diagnostic procedure, see p 73, appear to have been appropriate for the task. It is probable that one or two others could have been selected, eg, diadochokinesis was not included per se, due to the revelation throughout the pilot studies that all, or most of, the children in the population of expressive language disorders had difficulty in this area and therefore it was not uniquely a characteristic of developmental articulatory dyspraxia. The same statement could be made of some of the characteristics included, eg, sequencing, but a constellation of symptomatic behaviours had to be selected and it was decided that the ones chosen were commonly found in developmental articulatory dyspraxia. Once again it should

be stated that the similarities existing between all types of expressive language disorders are so great that it is impossible to avoid overlapping.

The other most consequential point to be made with reference to Jaffe's, 1984, comments is the attempt of this study to answer the question posed in 4. It is claimed as the result of this present work, that developmental articulatory dyspraxia is a unique condition manifesting as an articulation disorder solely, but instrumental in disturbing the acquisition and development of phonological systems to the extent that in moderate and severe cases of developmental articulatory dyspraxia, phonological learning disorders co-occur.

Recent writers appear to blur the differences between the articulatory and the phonological problems. Despite the fact that both articulation and phonology, in the context of child production, use the same means by which to express language, there are fundamental differences. The articulatory level is concentrated on the physical ability of the mobile oral mechanism to take up postures which enable the production of different sounds. These sounds, now better described as segments, overflow into the phonological system. The latter is not a simplistic production of segments, however, but a cognitive representation, worked out by the creation of rules to meet the requirements by which the child approximates to adult pronunciation patterns. Phonological output, on the other hand, is tailored by the child to approximate to the adult versions which he/she hears in the environment. A recent consortium of opinions on this subject has been published in which many authorities take issue with contemporary thinking. For example, Panagos & Bobkoff, 1984, view developmental articulatory dyspraxia as a phonological disorder of cognitive origins. They claim that the condition cannot be artificially separated from language, and that it is, in fact, a taxonomic linguistic disorder. It is difficult to understand how they cannot accommodate for an articulatory form of the long-accepted dyspraxias which are recognised in all other voluntary movements. Parsons, 1984, has studied the phonological processes used by developmental articulatory dyspraxic children and

non-dyspraxic phonologically impaired children. No significant differences were revealed between the groups. Unfortunately, he omits several pieces of information such as:-

1. The assessment used with the children to declare that they had developmental articulatory dyspraxia.
2. Whether there were data used which did not appear in the phonological analysis, which was that of Ingram, 1981.

He also uses the Goldman-Fristoe Articulation Test, 1969, of which Grunwell, 1980,, says that considering many of the unsupported claims made for this assessment:-

"It would seem to be extremely difficult to use this procedure to obtain any clinically relevant assessments of child speech." p 193

Furthermore, Parsons, op cit, does not acknowledge immaturity as a possible phonological factor indicating the presence of developmental articulatory dyspraxia.

In the same volume, Bowman, Parsons & Morris, 1984, examine the inconsistency of phonological errors in children with developmental articulatory dyspraxia as factors of linguistic and performance load. Using seven of the thirty children who took part in Williams et al study, 1981, consistency and effects of linguistic task and performance load were investigated. Results revealed that developmental articulatory dyspraxic children used consistent types and frequencies of phonological processes. After study of the results obtained from the phonological analysis, Ingram, 1981, and consideration of the age range of the children, 6;1-7;4, the present author speculates that these were children developing out of immature articulatory praxis.

One of the works included requested a need for description in the study of developmental articulatory dyspraxia. Deputy, 1984, seeks a description in which an

observation could be described, from which a reliable set of characteristics emerge and the process should lead to a scientific explanation. It is claimed that this present study can supply such a description and that the scientific basis for it can be supported. Love & Fitzgerald, 1984, argue for the validity of developmental articulatory dyspraxia. They review some earlier literature then proceed to give a single case study which was conducted longitudinally between the ages of 2;5 and 7;9. The initial intervention, surgery for ankyloglossia, revealed the hitherto unrecognised articulatory dyspraxia characterised by groping, poorly sequenced movements. These writers claim that such movements and poor syllable diadochokinesis, which may or may not be accompanied by disordered non-speech oral acts, define the motor speech aspects of the disorder. They further propose that:-

"this concept of the disorder, without inclusion of specific syndrome features of language disorder, or of perceptual and neurological deficit, provides an operational definition that allows the development of a useful diagnostic subcategory, to be established within the wide array of disabilities encompassed by the term childhood phonologic disorder" p 80

The present writer finds this proposal confusing, as it neither clarifies the condition developmental articulatory dyspraxia as described by these writers, nor the term 'childhood phonologic disorder'. It appears possible that they have a conviction that the articulation disorder does exist, but that it must only be regarded as a facet of the phonological constellation and not as a discrete condition, co-occurring with phonological learning and acting as an aetiological factor to a certain degree, in the disruption of the acquisition of the phonological system.

An early exponent of the existence of developmental articulatory dyspraxia is Chappell who produced a work in 1973 which, at the time, contributed to the understanding and management of the condition, (see literature review). In the volume under discussion he considers what he terms "developmental verbal dyspraxia: the expectant pattern". Firstly, he deplores the fact that now, in the 1980s, researchers have still failed to delineate the symptomology which characterises developmental articulatory dyspraxia. He discusses the following

specific characteristics at length:-

1. Limited early speech imitability and phonological development
2. Prominent phonemic errors
3. Articulatory groping
4. Programming overload
5. Prosodic disturbance

Chappell, op cit, compares the above characteristics in adult acquired dyspraxia as described by Kent & Rosenbek, 1983, with similar characteristics in developmental articulatory dyspraxia. Much of the description Chappell, op cit, gives of dyspraxic speech in children agrees with the experience of the present writer. However, he does not make the leap from the dyspraxic speech to its effect on the acquisition and development on children's phonological systems. Rather, he expresses once again the statement that much of the controversy about developmental articulatory dyspraxia pertains to whether certain phonemic errors and problems of clusters are unique to this condition that unquestionably differentiate it from other varieties of articulation deficit. It is difficult to comprehend the reasons which motivate experts to continue to seek an inexhaustible number of possibilities in the expression of speech. It is the present writer's experience that numerous aetiological factors produce similar speech symptoms, since the human brain and oral mechanism can merely develop a finite number of forms of speech, despite the fact that there is an infinite number of permutations within these forms. Different causative factors act on the cognitive and mechanical mechanisms from different vulnerable areas, but the phonological and phonetic outputs assume similar and repetitive types of simplified productions.

Chappell, 1984, proceeds to discuss related concomitant problems under the headings; concomitant motor problems and concomitant language disorders. The latter are reduced vocabularies, immature lengths of utterance, morphological and syntactic immaturities. The presence of oral dyspraxia, dysarthria and co-ordination problems are judged to be the former.

The conclusion drawn by Chappell is that the dyspraxic features are likely to be embedded in a more complex, multi-component expressive disorder which involves all aspects of language, there being deficits in phonological, semantic, syntactic and pragmatic aspects of language. He states that the developmental articulatory dyspraxia will merely further confound the afflicted child's learning of the overall language system. This final statement closely resembles the claim of the present study, as do many points in Chappell's paper.

Riley, 1984, takes a clinical perspective of developmental articulatory dyspraxia. The point of major interest is the fact that he arrives at similar results to those in this study, but under different conditions and using different terms. He assesses 40 children whom he divides into 3 groups. Group One have little or no syllable production problems, Group Two have moderate syllable production problems and Group Three have severe syllable production problems. (Group One could be compared to the Immature Articulatory Praxic children in the present study.) Riley gives results comparing Groups One and Three as follows:-

	Group One	Group Three
Oral Dyspraxia	9%	60%
Delayed Onset Sentences	9%	47%
Severe Articulation Disorder	9%	40%
Soft Neurological Signs	18%	33%
Familial Diathesis	27%	40%

Riley, op cit, diagnosed moderate to severe developmental articulatory dyspraxia in 72% of the 40 children assessed. The present writer suggests that an appreciable number of the sample had immature articulatory praxis. The claimed incidence of developmental articulatory dyspraxia, per se, appears to be too high.

Riley, op cit, when discussing treatment implications, claims that the high percentage of misarticulations present in the children tested are similar to difficulties in at least half of any group of children with articulation disorders. (Here again, there is the problem of definition of articulation disorders - these are viewed differently in

the USA and the UK.) He avers that if this is the case, specifically designed treatment for oral motor co-ordination should be given prior to direct management. Both Riley and the present writer have the impression that this method of preliminary basic practice is effective although neither has made a specific study of the results. The present writer has empirical evidence that such fundamental treatment prevents the development of phonological learning disorders in the majority of language delayed children included in the program.

A paper of utmost importance is included in the collection being referred to here. Crary & Towne, 1984, put forward arguments which they confess have weaknesses, and which have not been fully substantiated. They submit them as guidelines and clinical hypotheses to be evaluated in individual clinical cases. Their hypothesis is that developmental articulatory dyspraxia may result from temporal inco-ordination which reflects asynergy as structures which should be working together fail to do so in the manner required for unaltered speech production. They suggest that movement asynergy may not be evident in simple motor tasks but may be revealed by tasks which increase the demands placed upon spatial and temporal control in the vocal mechanism. This suggestion is in agreement with clinical observations that children with developmental articulatory dyspraxia fail more frequently on longer productions - "increased struggle with increased complexity". Also it would account for the fact that some children produce some sounds correctly in isolation but not in connected speech,

So far as acoustic properties of speech production are concerned, Crary & Towne, op cit, claim that these represent the results of motor activity within the vocal tract during speech. Thus, one method of assessing motor asynergy in the speech of children with developmental articulatory dyspraxia would be to look at deviations in expected acoustic patterns - a study for further research.

Crary, 1984, suggests that developmental articulatory dyspraxia should

be viewed as a phonological disorder manifest in spatial/temporal control deficits for speech. If this is the case (although the present writer does not accept the situation from this viewpoint) then evidence of vocal tract asynergy in the form of temporal co-ordination deficits would be expected in such children. It seems to the present writer that this may well be an explanation for the presence of developmental articulatory dyspraxia, but it does not alter the fact that the condition is primarily a disorder of articulation which in turn affects the development of child phonologies.

Finally, on similar lines to the work of Williams et al, 1980, a list of behaviours identified by clinicians in South Australia as differentially diagnosing developmental articulatory dyspraxia, is submitted by Murdoch et al, 1984. Using a method which classified frequency of use by signifying 'always', 'sometimes' or 'never', 30 clinicians made the following classification of characteristics which 'always' occur in developmental articulatory dyspraxia.

1. Struggle, groping trial-and-error behaviours on some (or all) phonemes
2. Inability to volitionally produce an isolated phoneme or sequence of phonemes on some, but not all, occasions
3. Failure to achieve isolated and sequenced oral movements on command, while able to achieve them automatically without language intervention
4. Speech development follows a deviant pattern
5. Unable to produce /pətəkə/ on a diadochokinetic task; able to produce each phoneme in isolation
6. Increased articulation errors with increased length of utterance
7. Inconsistent pattern of errors evident in speech.

When compared with the list drawn up by their fellow countrymen, there are similarities and dissimilarities but on the whole a near consensus exists between the two.

The remaining paper in the volume deals with treatment and is irrelevant to this present study.

FACTORS IN DEVELOPMENTAL ARTICULATORY DYSPRAXIA LITERATURE 1984

FACTORS

AUTHORS

- | | |
|---|--|
| 1. Need for definition and delineation of symptoms and characteristics | Jaffe
Deputy
Chappell |
| 2. Neurological aspects | Jaffe
Crary
Crary & Towne
Love & Fitzgerald
Murdoch et al
Riley |
| 3. Pre-speech sensori-motor learning requirement | Chappell
Riley
Jaffe |
| 4. Oral deficits | Jaffe
Love & Fitzgerald
Riley |
| 5. Spatial/temporal implications | Crary
Crary & Towne |
| 6. Developmental articulatory dyspraxia as a facet of a developmental phonological disorder constellation | Panagos & Bobkoff
Deputy
Crary & Towne
Bowman, Parsons & Morris
Parsons
Love & Fitzgerald |

CHAPTER TWO

THE NATURE OF DEVELOPMENTAL ARTICULATORY DYSPRAXIA

No evidence exists to explain the presence of developmental articulatory dyspraxia in some children. However, from the literature, see p 11, and from empirical evidence, three theories may be postulated. (It should be remembered that other aspects, such as spatial and temporal awareness, have a role to play in the condition.)

The three major possibilities are:-

1. The Sensory Feedback Theory
2. The Motor Planning Theory
3. Inherited Theory

1. The Sensory Feedback Theory

To comprehend in greater detail the processes involved in the acquisition of a reliable degree of oro-sensory awareness, it is pertinent to consider the neurophysiological system which is involved.

Labial, lingual, mandibular, palatal, pharyngeal and laryngeal movements are all apparently dependent on precise feedback from the stimuli of proprioception and tactility. Tactility is the sense of touch. Proprioception is concerned with impulses received primarily from muscle spindles and Golgi tendon organs, and conveys information about the position, in relation to the rest of the body, of muscles and joints, Chusid & McDonald, 1981. When impairment occurs in the sensory pathways motor planning will suffer and the response, in the form of muscle and joint movements, will be disrupted. Topognosis, the ability to locate cutaneous stimuli, appears to be affected in some children with developmental articulatory dyspraxia. For example, when a clinician indicates the oral areas to be involved in the production of an articulated segment, eg /b/, by the use of a tongue guide on the lip surfaces, it is not always possible for the child to respond to the tactile stimulus. This inability implies a lack of establishment of reliable feedback along dependable pathways. There is, however, evidence that correct responses are produced on some, but not all, occasions suggesting that a transient dysfunction exists and

not a permanent damage as in, for example, dysarthria. Fawcus, 1971, explains this lack of smooth action by suggesting the presence of 'noise', the opposite of clear signalling. He claims that this 'noise', interferes with the flow of relevant information required by the brain to produce a clear signal. Such 'noise' can be regarded like static on a radio which muffles the message and leads to the production of an inappropriate response. In the case of developmental articulatory dyspraxia this would mean that the disrupted sensory feedback would lead to inaccurate motor planning.

In a later paper, Fawcus, 1980, describes the problems present in a small group of children who acquire articulatory skills more slowly than their peers or who develop their phonology in a deviant form. In this connection, Fawcus, op cit, refers to the role of open- and closed-feedback loop systems. He quotes Smith & Smith, 1966, whose work indicates that tongue movements are capable of internal monitoring by means of tactile and kinaesthetic feedback well before the infant adds auditory feedback to his control system. This raises the question as to whether the child with developmental articulatory dyspraxia may have failed to develop this early internal monitoring system fully.

Subsequently the acquisition of auditory feedback may have been inconsistently affected by the initial failure to monitor tactile and kinaesthetic feedback on every occasion. Fawcus, op cit, also describes the treatment of a girl of 14;0 who was operating normally at all levels except articulation, which was so problematic as to be unintelligible. This could well have been as a result of developmental articulatory dyspraxia. In co-operation with a team from Guy's Hospital Dental School, Fawcus was able to provide a dental plate with fourteen contacts which enabled the girl to provide a feedback system which resulted in a significant improvement in accuracy and intelligibility. The prosthesis enabled the workers to determine the nature of the difficulties which resulted from tongue retraction which prevented the learning of the palatal contacts necessary to produce intelligible speech.

Such evidence adds some credence to the claim that sensory feedback is

a determining factor which initiates the response required to stimulate motor movement.

Berman, 1982, challenges the peripheralist viewpoint, not on the grounds that sensory input plays no role in motor function, but rather that sensory input has attributes that make it difficult for it to control on-going voluntary movements. He refers to "noise" and irrelevant information and suggests that sensory input would have to be filtered before meaningful information could be extracted. Berman, op cit, proposes that there is too limited time for this process to take place and contends that it is more likely that sensory stimuli "trigger" whole, well-rehearsed movement programs which can produce rapid, effortless responses. He concludes that the brain must have a storage bank of movement programs capable of responding to sensory information, much as Lashley, 1951, proposed. Thus it may be that in motor learning, the evolution of a movement may reflect the evolving set of the association areas more than the fine tuning of sensorimotor mechanisms executing the movement. Berman, 1982, claims that, as an intermediate phase between sensory and motor mechanisms, higher cortical centres play a critical role both in transforming sensory input into sensory information and in preparing, selecting and adjusting motor programmes based on the information locked in the sensory input.

Animal experiments used on monkeys, rats and dogs have indicated that deprivation of sensory stimulation disorganises the working of the brain (for example, Windle, 1969; Mason & Berkson, 1975; Levine, 1960). Casler, 1965, studied the effects of tactile stimulation on a group of institutionalised infants and found that those who were handled more often developed better than those who were not. It is true that deprivation of sensory stimulation disorganises normal, adult brains. For example, explorers confined to small cabins in adverse weather condition during Arctic winters, report temporary disturbances in behaviour and personality. Similarly, pilots of jet planes confined to cramped quarters demanding sustained concentration describe short-lived abnormal movements and behaviours on landing. Modern political regimes are accused, in some cases, of using punishments regarded as mentally cruel which result in disorientation

of those submitted to them. As a result of this, and for other experimental purposes, scientists design such conditions by the use of 'sensory deprivation rooms' where tests are carried out to determine both how long it takes to change human behaviour and what forms of disorganisation occur when the brain is deprived of normal sensory experience. These experiments demonstrate the results of overt sensory deprivation on the functioning of sensory processes. This is not, of course, what happens to children with developmental articulatory dyspraxia. They have, in most cases, normal environments and caring parents who provide similar experiences to those of the majority of developing children. It is possible, however, that a form of "internal sensory deprivation" takes place whereby, by some transient defect within the complex system of neurons and synapses involved in the process of information-relay from the external to the internal levels of functioning, full sensory processing is prevented from taking place. In cases where children fail to develop awareness in the different parts of their bodies they find difficulty in directing unfamiliar movements to the required group of muscles to be used to perform an act. Such lack of awareness, or uncertainty of specific areas will arise if the sensory signals do not equate in the children's experience with a specific peripheral area. Even greater confusion may arise when auditory and visual perception is added to tactile, kinaesthetic and proprioceptive input. Integration has to take place between the modalities before accurate sensory input can be relied on to stimulate motor response. Integration at a sensory level enables speakers to 'see' what they 'hear' and 'hear' what they 'see', and to 'feel' all of the information. Thus the child builds his ability to respond to his mother's voice calling his name and saying 'come here'. Even a very young child can respond to the source of sound accurately and select from several possible places where his mother is when she calls him.

If the child has a poorly organised body awareness he will not feel what his body is doing without watching it or touching it. If a child does not have this awareness of his body he will have difficulty with most activities requiring accurate directions to produce movements and bodily placements, including articulation. Articulation depends on sensory motor integration. On the sensory side, two major roles

appear to be played by proprioception:-

- (1) Feedback involving movements of the tongue and lips and variations in jaw opening.
- (2) Extraction of somaesthetic information which occurs when the tongue outlines the form of a bony or muscular surface. This information may eventually allow recognition of an organ, or part of an organ through its outline presentation.

The importance of these proprioceptors to speech production has been demonstrated by studies which disrupted sensory feedback and produced impaired articulation and unintelligible speech (for example, Ringel & Steer, 1963; Schliesser & Coleman, 1968; Putnam & Ringel, 1976) indicating the effect of the sensory input on the motor output - sensory-motor integration. In the Putnam & Ringel study, the behaviour of the lips, tongue and mandible in two subjects talking normally, was altered under the influence of trigeminal nerve-block anaesthesia. Cineradiography was used to observe the changes. Frame-by-frame measurements of lip protrusion, tongue position and jaw placement were taken from the film data for selected stops, glides, fricatives and vowels in the speech sample. The following changes were revealed:-

- "(1) Reduction in context-appropriate lip protrusion and loss of precision in lip closure activity, which was more noticeable for the upper than the lower lip;
- (2) Reduction in precision of tongue articulations, particularly on contacts for lingua-alveolar and lingua-velar consonants, apical retroflexion on glides, and steady state postures for lingua-palatal fricatives and vowels;
- (3) Noticeable alterations in inferior/superior jaw position which was systematically closer to the maxilla for bilabial consonant closures and often reduced or extended in excursion for vowels and other consonants" (p 247)

Despite the fact that this study created a situation of articulation which emulated dysarthria and not articulatory dyspraxia, it clearly indicated that alterations can occur when sensory pathways are

blocked. Putman & Ringel, op cit, suggest that their results "may reflect the disorganised and/or compensatory reactions of normally functioning motor elements in the total physiological response to sensory deprivation" (p 264). However, they also propose that some of the distorted articulation may have occurred as a result of their subjects' attempts to compensate for the reduced feedback. They were reported to make conscious efforts to overshoot to achieve jaw closure, and to use the lips to search out adequate feedback from closure. The unexpected manoeuvres performed by the tongue may also have arisen in the form of overshoot observed in an attempt to increase somaesthetic feedback from the mandible and other extrinsic lingual tissues. This behaviour is much more similar to that evidenced by children with developmental articulatory dyspraxia.

Rourke et al, 1983, emphasise that, unlike adults who have lost skills in the case of acquired articulatory dyspraxia, children with a 'perceptual' deficit or deficiency have never had the benefit of satisfactory information processing capabilities through this particular sensory-perceptual modality. Consequently they have neither the type and amount of stored information with which current, probably adequate, information can be compared, nor do they possess adequate discriminatory criteria by which to judge the validity of the information presented to them by their deficient sensory-perceptual processors.

Further, the suggestion is postulated by Putnam & Ringel, 1976, that the maintenance of intelligible speech in the presence of substantial reduction in oral sensitivity may be interpreted as evidence of some underlying open-loop speech controls, and of the usefulness and use of the remaining oral and auditory senses that support speech via closed-loop systems. Although this cannot be compared directly with developmental articulatory dyspraxic children, a similar type of explanation could account for some of the recognised inconsistency in the speech of the dyspraxic child. Finally, these writers hypothesise that the nerve-block data may be expressing the results of a complex interaction of disorganisation, reorganisation and/or compensation within the speech production mechanism. Again these suggestions help to illumine the possible complex organisational strategies that may be

incorporated into the process which, even in the presence of a specific disturbance, (in this case reduction of sensory awareness) the speaker may occasionally succeed in utilising, to produce target speech. This may be resorted to by children less severely disabled by developmental articulatory dyspraxia.

Crary, Landess & Towne, 1983, indicate in their publication on phonological error in developmental articulatory dyspraxia that six of their ten subjects were receiving 'sensory integration therapy'. Ayres, 1979, in her book on 'Sensory Integration and the Child', describes developmental dyspraxia in detail and defines it as follows:-

"a brain dysfunction that hinders the organisation of tactile, and sometimes vestibular and proprioceptive sensations and interferes with the ability to motor plan"

(p 101)

She advocates sensory integrative therapy as the most important intervention in all types of developmental dyspraxia to increase brain function and make it more effective. The therapy includes strategies to enhance and strengthen integration of the senses so that each can reach its end-product while integrating one with the other to facilitate whole body activity, including speech and language. Ayres, op cit, claims that children with sensory integrative dysfunction are more likely to have greater difficulties with motor planning and fewer problems with reasoning and intellectual pursuits. She also claims that children with language/speech disorders showed improvement after therapy, although the sensory integrative therapy did not include language training. Ayres, 1979, is strongly convinced that overactivity in the vestibular system contributes considerably to such defects as developmental dyspraxia. Her hypothesis is that when the facilitatory and inhibitory forces acting upon the vestibular system are not in balance, disorganisation occurs and, as a result, information from the vestibular receptors fails to flow to all of the locations which require it. Ayres, op cit, considers that the vestibular-reticular level of the brain is a primal force and has inordinate influence over the more recently evolved muscle, joint and complex auditory and visual systems. This, she suggests, is one

reason why therapy involving vestibular stimulation is instrumental in improving spoken language. She refers to perceptual-motor training; spatial-temporal awareness; visuo-auditory integration. It appears that she trains children with learning disabilities to become consciously aware of their sensations at all perceptual levels, with resulting control over their motor responses.

2. The Motor Planning Theory

To understand developmental articulatory dyspraxia better, we have to add to our knowledge of sensory feedback, a detailed knowledge of motor planning and motor skills.

In normal circumstances, there appears to be a programme within the developing brain which provides for the learning of motor planning. The process of motor planning can only be assumed from the observable responses to stimuli. The precise site(s) of motor planning is unclear but the process appears to begin after the semantic response, or intended message, has been selected at the central language level of the brain. The appropriate response has to be externalised by means of the nerves and muscles to the oral mechanism. After lateralisation of language has become established, around the age of 6;0 in normally developing children, Penfield & Roberts, 1959, it would be expected that expressive speech would emanate from the pre-motor cortex of the left hemisphere of the brain, Broca's area. It seems likely that both hemispheres are involved during early development and that there is a diffusion of areas concerned, Rosenbek & Wertz, 1972; Kornse et al, 1981. It seems clear that such programming has to be established to facilitate accurate articulation. It should be noted that although, in the majority of cases, motor planning is set in motion by the central language unit, there are some occasions in which the central language unit is by-passed, for example, in echolalia. It is possible that in such cases the central language unit has become isolated or has been damaged. Darley, Aronson & Brown, 1975, explain this phenomenon by the suggestion that there is a lesion in the posterior part of the temporal cortex, while the mid-temporal convolution, the arcuate fasciculus and the inferior

frontal speech area remain intact. However, whatever explanation is advanced to explain this situation, it is available to normal speakers for the repetition of nonsense words and foreign words without the benefit of meaning. Therefore the motor planner may be activated by auditory or visual, or audio-visual means as an alternative to direction from the central language unit.

In developmental articulatory dyspraxia, there appears to be no permanent damage either to the central language unit, or to any contributory system involved in the activation of the movements for the production of articulation. The condition is sporadic and constantly changing in its detailed form. These factors once again indicate dysfunction rather than damage. In addition, observation of the involuntary performances of the same movements used for both articulation and feeding, clearly indicates that the muscles are intact and that their movements are only affected on some occasions when the child attempts to produce a specific voluntary movement or group of movements.

From the viewpoint of motor skills, each individual has to learn how to become skilful in all movements which enable him/her to relate to his/her environment - external motor skills. Simultaneously, he/she has to learn how to recognise and identify his/her own body and its parts to enable him/her to operate properly as an active participant in the environment. That is individuals have to conform to society's demands by learning how to wash, feed, dress and generally interact in a normal environment - self-help skills. These skills are all dependent on recognition of body parts and their functions. For this degree of expertise, each individual has to conceptualise his/her body so that he/she recognises and can appropriately move all groups of muscles. This is achieved by developing a system of 'programs' which represent areas of movement. For example, the individual has to refer to a learned activity, initiated by and powered with the muscles of the arm and hand and memorised in a motor memory store, to enable him/her to lift a spoon and stir a cup of tea. Repetition and success at an early learning stage makes this whole process automatic.

Perhaps the most complex motor activity demanded of the human body is that of speech. One of the major problems which arises in this area

is the fact that so much of the learning process is dependent on unseen cues, since the basic skill required for articulation is built on learned movements relying on sensory feedback which can only be monitored internally.

To appreciate the complexity of the memories for articulatory action one has to consider pressure, size and the parameters of the movements required, in addition to the current position in relation to the rest of the body, this is most important as articulation is subject to precise breathing and phonation for which other motor memories have to be recalled. The brain instructs the muscles, but only after the sensations from the body instruct the brain. If this concept is related to driving it makes consideration of automatic control easier to contemplate. The driver gets to know every idiosyncrasy of his/her car and eventually can drive it automatically. When he/she starts to drive a new or different car, he/she has to pay attention to, or voluntarily think about, the particular differences now before him. The dyspraxic child frequently suffers from the 'inaccurate concept' which leads to accidents, and which the driver has to learn to avoid. The developmental articulatory dyspraxic child has intermittent difficulty with articulation production associated with his inadequate concept of the muscles of articulation. These muscles of articulation, together with the muscles of the hand and fingers are perhaps the only muscles to be stimulated by tactile input at the highest level of the brain. When one considers the fact that tactile sensation is experienced over the whole surface of body it is clear that these specific areas are heavily involved with all major activities. For example, tactile sensation is aroused by clothing, heating, and pressure at different parts of our bodies but the areas on which we concentrate most are those of finger movements and the movements of the oral cavity mechanisms. This is particularly strongly emphasised after an injection given intra-orally prior to the extraction of a tooth. Until the effect wears off no accurate motor control can be maintained over the area of anaesthesia as no tactile or kinaesthetic messages can be relayed to the area of the brain responsible for the movements of the muscles involved. This is similar to work previously mentioned, eg that of Putnam & Ringel, 1976. The point being made is that if the ingoing information is

vague or distorted so also will be the outgoing directions. As well as tactility being unreliable in children with developmental articulatory dyspraxia, proprioception appears to be similarly affected. Because proprioception feeds back vague or indeterminate information such children rely very strongly on visual feedback. If they cannot see they are lost. They cannot correctly indicate the position of their hands or feet and are much less able to identify where to put their tongues to produce a specific speech unit. To improve the motor planning of children with developmental articulatory dyspraxia, it is therefore necessary to work towards normal, intact motor systems cued by visual, proprioceptive, tactile and auditory feedback. Exponents of the Motor Planning Theory include McKinlay, 1980; Chappell, 1973; Crary, Landess & Towne, 1983; de Ajuriaguerra & Stambak, 1973; Frisch & Handler, 1974; Johnson, 1980; Macaluso-Haynes, 1978. Many authorities, including some of the aforementioned cite the presence of both sensory feedback defects and motor planning deficits in developmental articulatory dyspraxia.

The skill of motor planning is praxis. As had already been claimed, in the event of the development of mature praxis being disrupted, dyspraxia results.

3. The Inherited Theory

The third possible cause of developmental articulatory dyspraxia is that it is genetically transmitted. Morley 1972, Saleeby, 1978, and McLaughlin & Kriegsmann, 1980, all describe families in which several members were affected by developmental articulatory dyspraxia to a greater or lesser degree. Ferry et al, 1975, and Guyette & Diedrich, 1981, also state that there is a strong indication that developmental articulatory dyspraxia may be inherited. The present writer has encountered two children whose families seem to have produced a few members who manifest the condition. It seems likely that there will be others in the numbers of children assessed, whose backgrounds have not been fully investigated, since there is evidence that parents and other close relatives have shown signs of articulatory difficulties. Another possibility which has not been studied, is that there may be

several mentally handicapped children who present with developmental articulatory dyspraxia in whose families the condition is manifested. This would lead to the assumption that developmental articulatory dyspraxia may be a factor in the constellation of factors which appear to contribute to severe learning disorder and low achievement, in some cases.

It is clear that further research has yet to be carried out to discover more about the nature of the condition developmental articulatory dyspraxia.

CHAPTER THREE

THE EXPERIMENT

Introduction

It was decided that the experiment would be carried out on forty children comprised of four groups of ten.

The experimental groups were drawn from two specific populations. The first was entitled the Language Impaired (LI) group. This group was composed of ten severely language impaired children attending a residential school for children with language disorders so severe that they were interfering with the children's ability to learn in a normal school situation. The ten children selected fell within the predetermined age range, 6;6 - 9;6. In the event, it was found that one child selected for the experiment was so severely handicapped that she was unable to respond sufficiently well to be included in the group. This meant that the Language Impaired group had only nine members. The second experimental group was drawn from a school for children with moderate special educational needs (SEN(M)). Again, randomly selected except for age. The age range in both groups was 6;3 - 9;1 years. Mean age in the language impaired group was 7;7 and in the SEN(M) group, 7;2.

Each member of both experimental groups had been assessed on the Reynell Developmental Language Scale (RDLS), Reynell, 1977, and the Edinburgh Articulation Test (EAT), Anthony et al, 1970. Assessments were administered in all cases within 4 months of the present investigation, and carried out by their clinicians including the author. In the case of the SEN(M) group all children showed language delay and articulation delay to a greater or lesser degree. However, all children recorded some developmental improvement over assessments performed at earlier ages. The children in the LI group presented with some language deviance as well as language delay which was severe in seven of the nine cases.

On the basis of the RDLS scores, seven of the nine LI group children tested were off scale for language expression. Of these seven, the ages at time of testing were 6;6, 6;8, 7;10, 8;0, 9;0 and 9;1 years.

These children at the higher age levels were displaying particularly poor abilities with the production of language. In all cases, this difficulty was reflected in the children's schoolwork. The two oldest children and one of the younger ones also scored below the level required for the scale of this assessment (RDLS) in verbal comprehension. See table p 246. The scores achieved by these children on the EAT were markedly low. None of the nine children scored, at Raw Score levels, more than 37 points.

The SEN(M) children, on the other hand, had higher scores than the LI group as a whole, on all the pre-experiment assessments, although some of their standard scores were poor. Their area of deficit on the RDLS was in the verbal comprehension section in which fifty per cent of the group scored so low as to be off scale. This is claimed to be typical of the results of this test scored by children with special educational needs, Mittler, 1973. The EAT results of the SEN(M) children were markedly higher than those of the LI group: each one of them exceeded 'safety' level of 85 on their quantitative test, which is judged to be necessary for normal development of articulatory skills, Anthony et al, op cit. These results, as well as a detailed description of each child included in the experimental groups, will be discussed later, see pp 157-244.

Two validation groups were selected. The first comprised school children aged 6;02 to 7;07, mean age 7;03, N-10, who attend a primary school on a large urban council estate. The second group for validation studies was composed of ten pre-school children who attended a creche on two half-days per week. They were normally developing children from typical suburban homes. Ages ranged from 3;01 to 3;10, mean age 3;05. The only criterion for selection was age.

The school children matched the LI group for age. The pre-school children matched the SEN(M) group for mental age.

Both the LI and SEN(M) groups were tested on the DADDP at six-monthly intervals over a period of eighteen months, ie, on three occasions.

Assessment and Analysis of Results of
Reynell Developmental Language Scales (RDLS)

Each of the nineteen children included in the experiment for this study was assessed on the RDLS. Once again results of note were achieved. The SEN(M) group standard scores in verbal comprehension and expressive language indicated overall, the trend that Mittler, (1973) indicated was a typical result on this test for children with special educational needs, that is, a score on expressive language in excess of that on verbal comprehension. See table p 246.

Comprehension of language can be at a markedly low level, but children may cope reasonably well with expressive speech, within the context of a limited environment. This finding may be yet another indication of the weakness of the expressive language component of the Reynell Assessment, as propounded by some authorities, eg Crystal et al, 1976, who criticise the Expressive Scale for failing to incorporate specific language structures into the assessment in the manner that LARSP does (Language Assessment, Remediation and Screening Procedure). However, the usefulness of the RDLS as a screening of language development and attainment is accepted by many using test batteries to monitor children's development. Silva, Bradshaw and Spears, 1978, assessed 225 children in New Zealand on RDLS and found that the results they achieved supported the concurrent validity of the Revised Scales as a measure of language development. Both verbal comprehension and expressive language scales correlated highly with other measures of verbal ability, although on close scrutiny of the correlations it was noted that the former was more highly correlated than the latter with the other measures. It was further realised, as a result of this study, that the correlations between the RDLS and some non-verbal measures were also moderately high. This suggests that the RDLS taps general mental ability since one of these measures was the Stanford-Binet Intelligence Scale. Silva et al, op cit, interpreted these results as indicating that although the RDLS is primarily a measure of language ability, this ability should not be considered independently of general mental ability. In fact, many of the RDLS and Stanford-Binet Scale items were similar. One of the features of the Stanford-Binet Scale is its predictive validation data, Anastasi,

1961. When further measures were used three years later it was demonstrated that the RDLS was almost as efficient a predictor as the Stanford-Binet Scale, again particularly the verbal comprehension scale which produced an almost identical predictive correlation co-efficient.

For the purpose of this investigation it was decided that RDLS would be a useful assessment tool to employ to discover the developmental ability of the children in the two experimental groups. See table p 246.

The results of the assessment revealed interesting aspects which in themselves would be useful to study more closely. All the children in the SEN(M) group and three of the children in the LI group, S1, S2 and C9, achieved expressive language ratings within normal limits. A wide disparity of verbal comprehension scores was recorded, see p 246. So far as these groups of children are concerned the expressive language results, with which this study is primarily concerned, reflected those found in the results of the EAT and the DADDP.

Assessment and Analysis of Results of Edinburgh Articulation Test (EAT)

All the children included in the experiment were tested on the EAT. On completion of the consideration of the results of the diagnostic procedure for developmental articulatory dyspraxia, the data obtained from the administration of the EAT to all the children participating in the study was examined. Considerable differences were evident in the results of both the quantitative and qualitative assessments of the two groups. See table p 246.

All the children in the SEN(M) group scored above the level regarded as giving cause for concern, ie, standard score 85. One child was only one point above that score. The scores of the LI group on the other hand, were all substantially lower than the 85 standard score. The visual display produced to illustrate the children's responses after classification into the developmental categories of the qualitative analysis shows the striking difference between the two groups. See table p 246.

In the SEN(M) group, the lowest number of 'Adult Form' realisations achieved was 44. The highest number recorded by the LI group in the 'Adult Form' category was 30. Between the two groups differences of a similar order of magnitude were noted throughout. The most appreciable differentiating factor is that the LI group as a whole produced results which cluster towards the 'Very Immature' and 'Atypical' categories while the SEN(M) group produced quite contrary results which cluster into the 'Almost Mature' and 'Immature' categories. See p 72.

It should be noted that the EAT is an assessment of articulation maturation.

Müller, Munro and Code, 1981, indicate that the EAT provides a model of normal articulatory maturation which discriminates children's articulatory maturation. However, the claim made by the authors of the EAT that the test measures phonological maturation is not beyond dispute. This is supported by Grunwell, 1975, who states that:-

"the test results provide no direct information about the phonological contrasts operating in the child's language by comparison with the adult system, nor about the phonetic characteristics of the child's speech"

p 33

In a review of child speech assessments Grunwell, 1980, when discussing the EAT, points out the ambivalence of the term 'Atypical', but she indicates that children with severe speech problems score a preponderance of 'Very Immature' and 'Atypical' realisations at 4;0. See figure p72 .

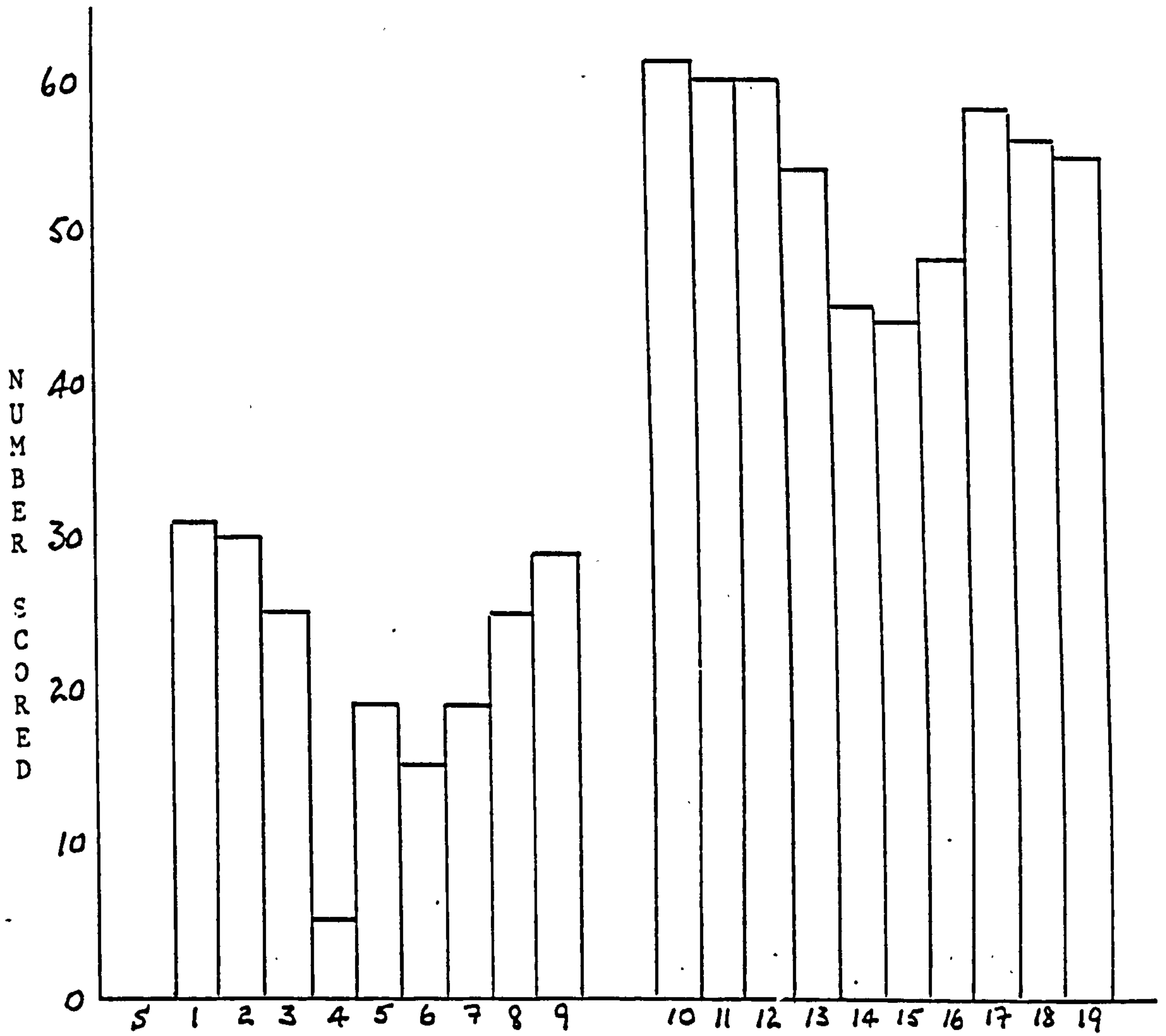


Fig. 1. Comparison of 'Adult Forms'

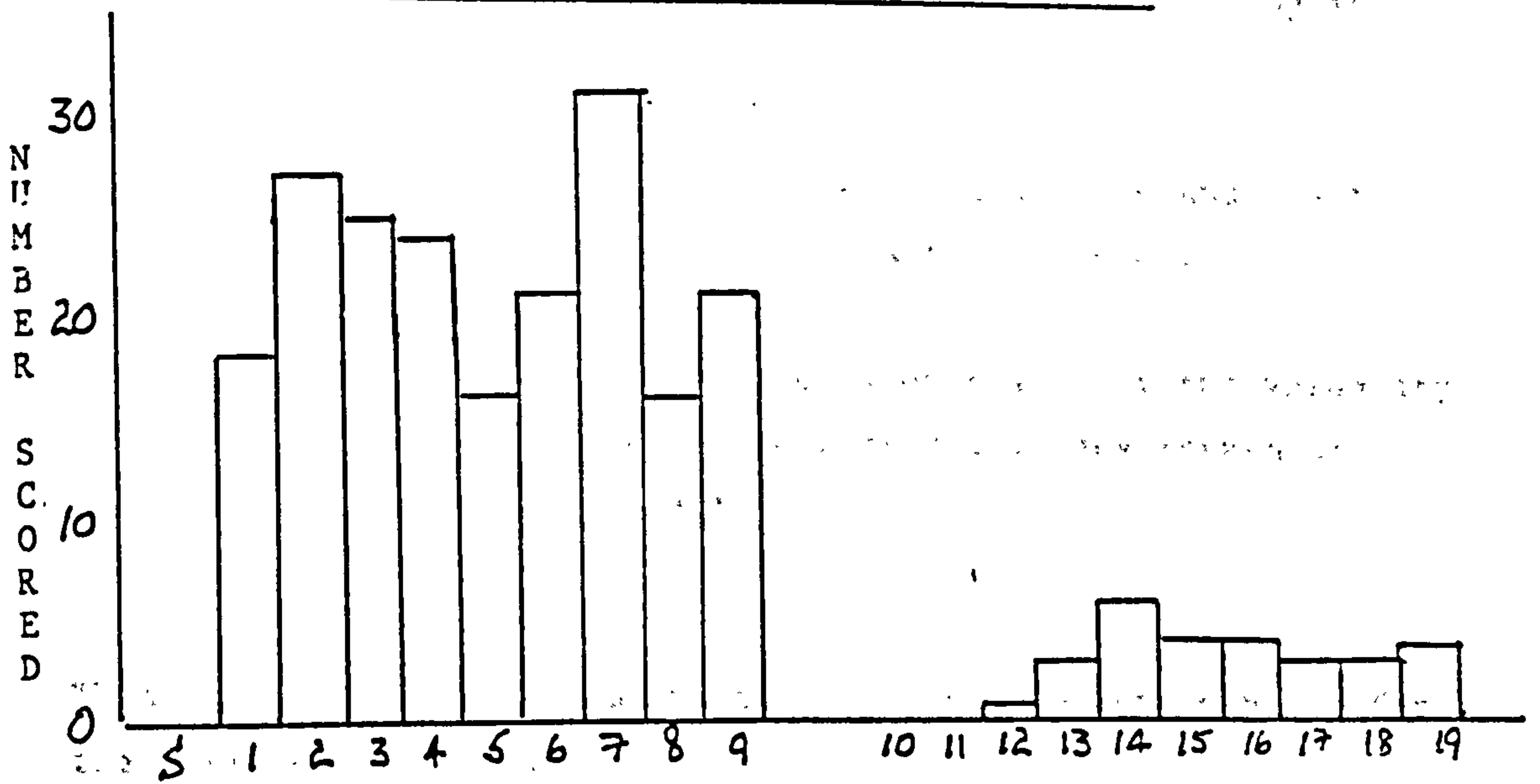


Fig. 2. Comparison of 'Very Immature'

From the literature and from empirical clinical study appropriate characteristics have been selected to delineate the condition developmental articulatory dyspraxia. See p 73a.

- 1 and 2. Inconsistency of articulated production, and groping by trial-and-error for articulation targets, result from inability to develop an adequate motor planning system.
3. Difficulty in imitation also originates from the unreliable programming facility of the motor planner.
4. Difficulty in sequencing not only derives from motor planning problems but also is affected by individual awareness of spatial and temporal constraints.
5. As more complex material becomes available for processing, greater difficulty results. This accounts for the fifth dimension.
6. Rhythm is disrupted where there is spatial and temporal awareness.
7. Prosody will be affected where there are problems of sequencing and rhythm. Intonation may be lacking in signalling variations.
8. The intervention of language instructions appears to exacerbate the difficulties already present.
9. Evidence exists which indicates that only the voluntary movements of muscles are affected in developmental articulatory dyspraxia.

These characteristics form the basis of the subtests devised for the diagnostic procedure.

CHARACTERISTICS OF DEVELOPMENTAL ARTICULATORY DYSPRAXIA

1. Inconsistency in articulated production.
2. Groping by trial and error for articulation targets.
3. Difficulty in imitation of segments, syllables and words.
4. Difficulty in sequencing segments, syllables, words, phrases and sentences.
5. Evidence of increased struggle with increasing complexity of sequences.
6. Evidence of dysrhythmia in articulation.
7. Evidence of restricted range of prosody.
8. Difficulty of production of articulation on command or demonstration.
9. Evidence that only voluntary movements are affected.

TABLE 2.

The Diagnostic Procedure

This procedure had to identify the condition of developmental articulatory dyspraxia, while being sufficiently stimulating and interesting to maintain the motivation of children being tested. It was essential to formulate a procedure to be administered in one session. This requirement resulted from the belief that in a condition in which so many variables are present, it is necessary to assess the child's ability at one session, as inconsistent behaviour contributes to minimal, or sometimes moderate, change from day to day. The author had kept this in mind and therefore ensured that the procedure could be administered within a reasonable period of time with children of chronological ages ranging from 2;06 to 18;00 years. To meet this requirement, performances have to be tested which will be neither too advanced for the very young nor too childish for adolescents.

The age range which was finally selected is 3;00- 14;00.

The diagnostic procedure was devised over a long period during which three different versions were tested on 160 children. The final form of the assessment was, as has been mentioned, see p 8 , constructed in 4 sections.

Section One

This section is designed to:

- a. screen for dyspraxias other than articulatory and oral dyspraxia,
- b. secure a short sample of speech,
- c. test the child's ability to imitate gestures,
- d. elicit behaviours which are indicative of handedness, visuo-spatial abilities and the prerequisites for writing skills,
- e. test co-ordination.

The sub-tests are as follows:

1. A device to elicit speech and put the child at ease by exchanging names.
2. The introduction of four common objects, a comb, a pencil, a key and a toy (a plastic monster-type toy is used by the author). The child is asked to name each one and then to describe and discuss the function of each object. This is designed, primarily, to secure a short sample of connected speech.
3. The child is asked to demonstrate his/her ability to identify and point to parts of the room and the furniture in it, (door, window and chairs). This screens for the presence of ideomotor dyspraxia, Chusid & McDonald, 1981.
4. Demonstration, again on command, of the child's recognition of body schema (point to nose, head, leg, shoulder and chin). This screens for the possible presence of intrapersonal ideomotor dyspraxia. Some degree of co-ordination or the lack of it can also be displayed in this activity.
5. The child is asked to remove and replace his shoes. This exercise elicits several levels of motor, co-ordination and laterality abilities:
 - a. dexterity in fine manual movements
 - b. recognition of right and left
 - c. association of object to appropriate body part
 - d. facility in replacing and refastening shoes thus screening for dyspraxia of dressing, Beaumont, 1983.
- 6 Activities to test for co-ordination as traditionally presented in a neurological examination, McKinlay, 1982. The administrator & takes the child's right hand and, touching the point of child's nose and the blade of the index finger, asks the child to touch
- 7 'there' with 'that'. The instruction is repeated but in this case the child is asked to close his eyes while carrying out the appropriate movements.

- 8 The child is shown four short sticks (cocktail sticks, toothpicks
& or similarly sized pencils) and asked to observe while the
administrator lays them out in the form of a square. The design
9 is then dismantled and the child is asked to reassemble them in
the form of a square. On completion of this stage, the tester
changes the top and bottom sticks forming these sides of the
square, laying them across each other to construct a diagonal
cross. The child watches this action; the tester dismantles the
design and presents the child with the sticks asking him/her to
copy the pattern just made. This test screens for constructional
dyspraxia, Beaumont, op cit.
10. A piece of paper is introduced on which the examiner makes three
dots at the apices of a triangle. The child is asked to join the
dots, thus revealing the triangular figure. Next the child is
requested to write his name underneath the triangle. This subtest
reveals visuo-spatial awareness in completing the figure and
writing the name. Handedness may also be observed. Werner, 1944;
Farnham-Diggory, 1978.
11. This activity involves the imitation of gestures using fine and
gross movements, spatial awareness and laterality. The child is
asked to copy:
- a. With fingers together and pointing upwards, stretch arms and
hold hands, palms forward towards the child.
 - b. Repeat above, keeping left hand open but closing right hand
in a fist.
 - c. Hold left arm outstretched to side at shoulder level and
stretch right arm above head.
 - d. Hold thumbs and index fingers touching each other to form a
diamond shape. Bergès & Lézine, 1963.

Section Two

This section concentrates on identifying the presence of developmental
articulatory dyspraxia, working from complex to more simple material.
All the subtests investigate the child's ability to repeat accurately.

spoken models. This section is the only one of the four which form the assessment, in which scoring is introduced under three headings

1. articulatory precision,
2. consistency,
3. sequencing.

Articulatory precision covers the range of possible segmental errors which can take place such as groping or searching for articulatory placement by trial and error, substitutions, distortions, additions and/or omissions of segments.

Consistency includes the varied forms which may occur in response to models given to be imitated. Consistency, in this context, depends on the child's internal concept of the articulations he/she is attempting to produce. For example, the occurrence of metathesis highlights the confusion which the motor planning deficit imposes on the child's ability to produce a series of similarly produced segments, syllables and words.

Sequencing, at segmental and more complex levels, is also closely observed as strong claims are made by many authorities that this feature identifies developmental articulatory dyspraxia, (eg, Edwards, 1973; McLaughlin et al, 1980; Aram & Horwitz, 1983),

A category key has been devised to represent responses given. This has been deliberately structured to cater for the very fine differences which appear to occur in these children who may be identified as having developmental articulatory dyspraxia. The categories are as follows:-

- 0 - no response has been made
- 1 - a totally incorrect response has been made
- 2 - a poor, but minimally correct response has been made, eg, incomplete; at least 3 errors
- 3 - a fair approximation has been made, eg, two to three errors present
- 4 - a good response has been made, only one or two slight errors are

present

5 - an accurate response has been made.

In pilot studies, scores were experimented with in several different forms and it was decided that they should be presented as percentage of errors. This was as a result of working with the necessarily large numbers which accrue from the use of the category key proposed. Sections One, Three and Four are not scored per se. Instead, examiners are requested to comment on the individual behaviours of each child being tested. This was a further decision taken as a result of the presence of so many variables in the behaviours of this population.

The subtests in Section Two investigate the child's ability to repeat accurately spoken models. They consist of :-

1. Phrases and sentences specifically designed to test consistency and sequencing. The pattern is repeated three times and follows similar lines:-
 - a. preposition article noun, eg, on the bus
 - b. preposition article adjective noun, eg, on the big bus
 - c. preposition article adjective adjective noun, eg, on the big red bus
 - d. article noun verb noun preposition article adjective adjective noun eg, the boy went home on the big red bus.
2. Single multisyllabic words are repeated three times each by the administrator and the child is asked to imitate them three times, eg, aeroplane. This is a further test of all three aspects of the procedure, articulatory precision, consistency and sequencing.
3. This is a repeat of the above, using multisyllabic nonsense words, eg, tabito. /təbɪtəv/
4. Varying articulatory placements and features are presented in the form / bə bə bə də də də gə gə gə / for imitation These are then interchanged thus / bə də gə / and the child is again asked to produce them in this form. Plosives, fricatives and finally combinations of the two are

presented for the child to reproduce.

5. Sequences of vowels are presented in either spoken and sung forms, eg, /eɪ i aɪ əʊ u/ for imitation
6. Counting from 1 to 10 is the final subtest in this section. This exercise is not scored but used to reclaim lost incentive in cases of frequent failures. The child is instructed to count from 1-10.

Section Three

This section determines the presence, if any, of oral dyspraxia, by testing the child's capacity to imitate non-verbal movements of the oral musculature. Subtests one to five inclusive, test the protrusion, elevation, depression, lateral and circular movements of the tongue. The sixth subtest examines the opening and closure of the mouth, while the following three subtests determine the effectiveness of the retraction and protrusion of the lips. The lateral movement of the mandible is assessed by subtest ten while the eleventh subtest ensures whether or not the child utilises a normal bite. Pressure exerted by air held in the oral cavity indicates the degree of flexible movement of the buccal musculature in subtest twelve. The penultimate subtest checks mobility of, and control over, the movements of the vocal folds by the means of throat clearing and coughing. The last exercise is to whistle - many children are unable to do this but the majority make an attempt to do so.

As previously indicated, the administrator notes the performance of all of these movements.

Section Four

Instructions are given to the child to listen to, and follow the instructions given on a tape-recording. Three differing hand

clapping exercises are demonstrated, each repeated three times. The child is expected to imitate each rhythmic sequence three times. These are followed by three tapped sequences each to be repeated three times. Lastly, the sequences are demonstrated as 'la - la'. Once more, three different sequences are presented, three times each and the child is instructed to chant them. Finally, the child is asked to repeat the nursery rhyme 'Baa Baa Black Sheep'.

The purpose of this section is to stimulate rhythmic responses by using an audio-tape for the imitation of clapped, tapped and chanted sequences. This was included because many sources stated that rhythmic abilities were important for consideration in dyspraxia, Edwards, 1973; McLaughlin & Kriegsman, 1980. Standard procedures of rhythmic assessment were used. It is recognised that a test for a childhood communication disorder involving so many variables and co-occurring factors is difficult, or even impossible, to standardise. It is considered adequate for routine clinical applications, for the procedure to be empirically validated. After pilot studies with 160 children validity was achieved with the two selected groups.

Administrators are advised to audio-tape the responses of Section Two particularly. It is beneficial to make a tape recording of the whole test. Inevitably scoring is time-consuming, and to obtain reliable results it is essential to score these results as soon after administration as possible. Experienced administrators rapidly develop an expertise enabling them to become more time-effective.

INTERPRETATION OF RESULTS

Section One

Comments will indicate the presence, if any, of these conditions other than developmental articulatory dyspraxia which are known to co-occur with developmental articulatory dyspraxia, as described

in subtests one to eleven.

Section Two

This section is critical for diagnostic purposes and the results will be interpreted as follows:-

- a. where ratings indicating 'accurate' or 'good' occur most frequently the results should be considered to be within normal limits;
- b. in the case of ratings designated 'fair' occurring most often, persisting immature articulatory praxis will be judged to be present; (in rare cases, a problem of mild developmental articulatory dyspraxia can be present, in which one or two specific areas give rise to perpetual errors which cannot be resolved or do not improve with maturation;)
- c. the frequent occurrence of 'poor' responses will be construed as identifying a moderate degree of either developmental articulatory dyspraxia or a moderate degree of articulatory praxis;
- d. numerous 'failed', ie, inaccurate responses, indicate a severe degree of developmental articulatory dyspraxia;
- e. where 'no response' recurs, assessment by other means will be considered.

The reliability of the DADDP depends on the test/retest factor. A confident diagnosis cannot finally be made until the procedure has been administered on at least three occasions at four- to

six- monthly intervals. This involves at most one year, with assessment at the beginning, six months later and, finally, twelve months after the initial assessment, or at least eight months with assessment at the beginning, four months later and, finally, eight months after the initial assessment. The claim is made that early intervention, careful differential diagnosis and positive diagnosis cannot be completed until repeated assessments have been carried out in this manner. Ferry et al, 1975, and others claim that inefficacy of speech therapy is an indication of the presence of developmental articulatory dyspraxia. It is herein postulated that careful assessment will save time overall and provide clearer objectives for therapy as a result.

After the third assessment it is possible to detect the presence or not, of improvement in articulation. It is this evidence of improvement which differentiates the two conditions. Children with persisting immature articulatory praxis will show clear evidence of improvement. Children with developmental articulatory dyspraxia will continue to show a repeated pattern of failure, see Appendix 6, pp XX, XXI.

Section Three

Comments will reveal whether or not oral dyspraxia is present and, if so, which areas of the oral mechanism are involved.

Section Four

The presence and types of rhythmic difficulties present, if any, will be identifiable from the comments recorded.

CHAPTER FOUR

RESULTS OF THE EXPERIMENT

LI GROUP N-9 Age Range 6;6-9;1

Section 1

In Subtest Two the child is asked to describe, name and generally discuss four common objects, a comb, a pencil, a key and a toy which took the form of a plastic monster-type object. Most children had little to say about any of the objects and required prompting from the administrator. One word responses were common. The results of this exercise indicated immediately both lack of conversational ease and lack of sociolinguistic skills. Subtests Three and Four, pointing to objects of furniture in the room then pointing to body parts was reasonably well carried out by all the children tested. Awareness of chairs other than that on which the child was sitting and any which were particularly obvious was poor in some instances. The part of body which created the greatest amount of difficulty in recognition and location was the chin. Subtest Five, which necessitates the removal and replacement of the child's shoes, caused the expected difficulty with those children with right-left confusion as well as those with uncertain manual dexterity. The Subtests which assessed co-ordination of movement, Six and Seven, were predictably failed by the children with difficulties in these skills. Subtests Eight and Nine which assess constructional skills were performed well on the whole. Five children completed the triangle in Subtest Ten. Each of the remaining four omitted one side of the figure usually the basal side. The same four children had some difficulty in writing their names. Spatial and sequencing difficulties were evident in each case.

Those who succeeded in producing fair facsimiles included two boys with the same forename who had had to learn to write forename and surname in full to alleviate confusion. Both produced clear productions and stimulated the assumption that adults impose certain requirements on some children which prove that the children have the

capacity to do better than they are expected to when necessity demands.

In the final imitation of gesture Subtest, the results were better than anticipated in most cases. Right-left confusion was again the greatest problem.

Section Two

Since no marked improvement has been recorded on re-assessing the nine children from this group on the diagnostic procedure, it is assumed that they present with developmental articulatory dyspraxia, although three of the children appear to have the condition in a much milder form than the others and may have immature articulatory praxis.

Distribution of percentage of errors is as follows:-

Subject	Articulatory Precision	Consistency	Sequencing
1	11	9	9
2	29	26	26
3	38	23	18
4	58	48	46
5	53	43	26
6	53	25	41
7	48	16	17
8	30	42	38
9	10	15	5

Section Three

The children in the LI group included two with no trace of oral dyspraxia. One child presented with a mild degree and two with a severe degree of this problem, while the remaining four children demonstrated the presence of a moderate amount of oral dyspraxia. Six of the seven children affected had the greatest amount of oral dyspraxia in the muscles of the tongue. One had severe dyspraxia in the tongue, the lips and all other muscles involved. Another child had a similar involvement of oral muscles but to a moderate degree of severity.

Section Four

Consideration of rhythm in Section Four produced the following results. One child displayed normal rhythmic abilities. Four children had moderate, and the remaining four, severe difficulties, in reproducing the types of rhythmic activities demanded by the assessment. The greatest degree of difficulty for all the children was in holding the memory of the rhythm. In the simple beats, imitation was possible but with the introduction of more complex forms the children could not repeat the timing accurately. As has been suggested, see p 28, the rhythmic and timing difficulties experienced by children with both expressive and receptive language disorders requires further research.

SEN(M) GROUP N-10 Age Range 6;3 to 8;4

Section One

Results achieved by the children in this group in Section One are as follows. Some conversation was elicited in Subtest Two although much of it was in the form of one word comments, and a great deal was inappropriate to the material handled. In the remaining Subtests, the most remarkable errors were either of right-left confusion or inco-ordination both to mild degrees. The most important difference in this group is the high incidence of left-handedness. Seven of the ten children displayed left-hand preference for writing and construction. None of the LI group children used the left hand. Whether this factor in itself has any direct bearing on the problem or not is neither clear nor relevant here, but it is worth noting that four children had severe writing problems of sequencing, production and spatial reality. Not all of these children had correlated constructional problems but some did.

Section Two

All ten children displayed some degree of difficulty in each of the

three categories, articulatory precision, consistency and sequencing. It has been ascertained by re-testing eighteen months after the initial assessment, that improvement is recorded in all cases. This outcome suggests that the children all presented originally with degrees of immature praxis. The distribution of percentages of errors is as follows:-

Subject	Articulatory Precision	Consistency	Sequencing
10	8	0	4
11	17	11	7
12	14	3	6
13	23	17	11
14	13	0	4
15	20	5	9
16	14	3	6
17	15	3	9
18	13	0	2
19	19	4	8

Section Three

Four children in the SEN(M) group had no oral dyspraxia present. Of the six who presented with oral dyspraxia, three had a mild degree and three a moderate degree of severity. The latter three showed the greatest amount of involvement in the muscles of the tongue and lips.

Section Four

In the rhythmic activity area the SEN(M) group again showed greater ability than the LI group. One child had normal rhythm, four had a mild degree of difficulty and the remaining five had moderate problems. As with the LI group the memory trace for the rhythm presented appeared to disappear quickly and second and third attempts were more difficult to reproduce.

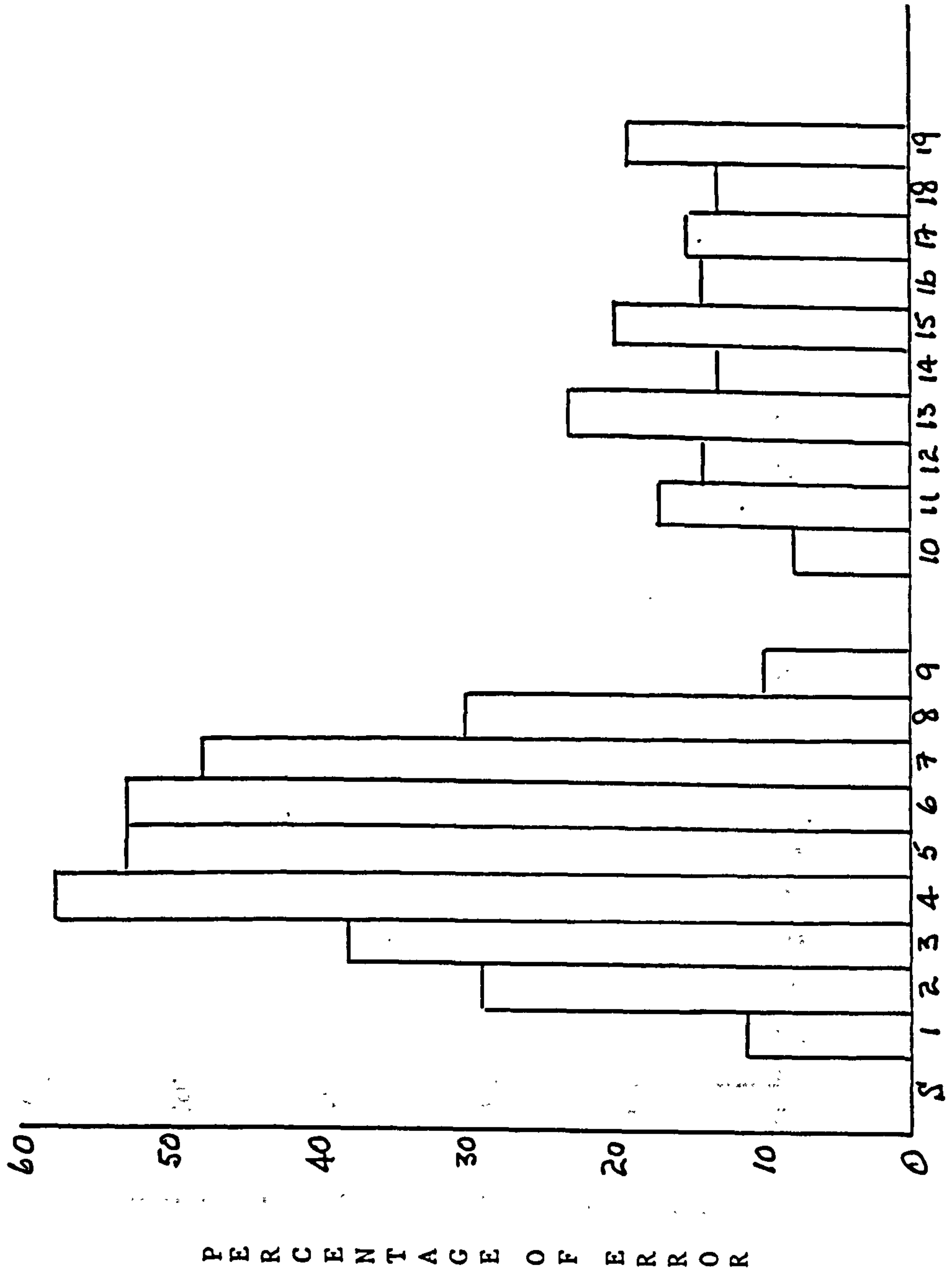


Fig. 3, Comparison of 'Articulatory Precision'

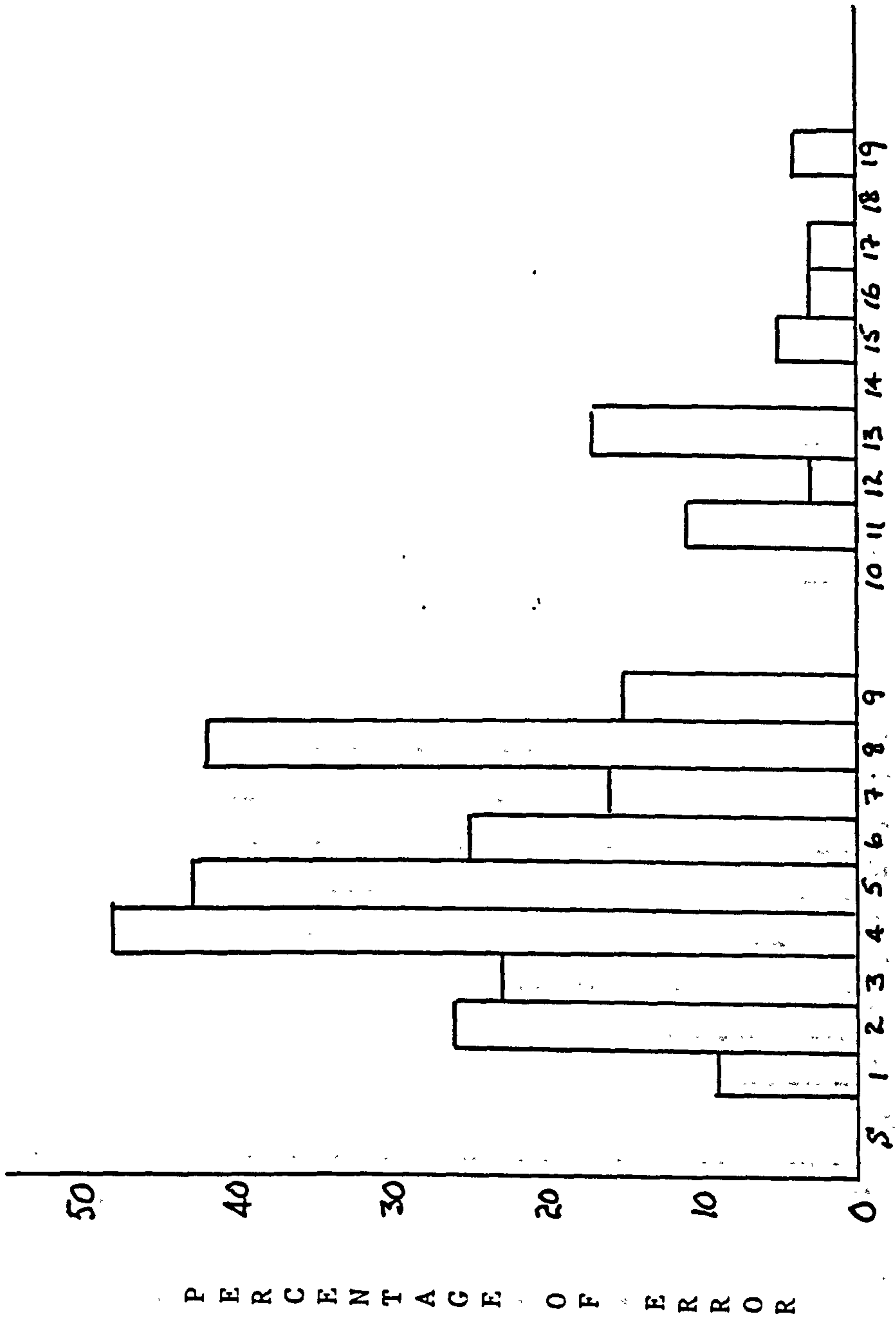


Fig. 4. Comparison of 'Consistency'

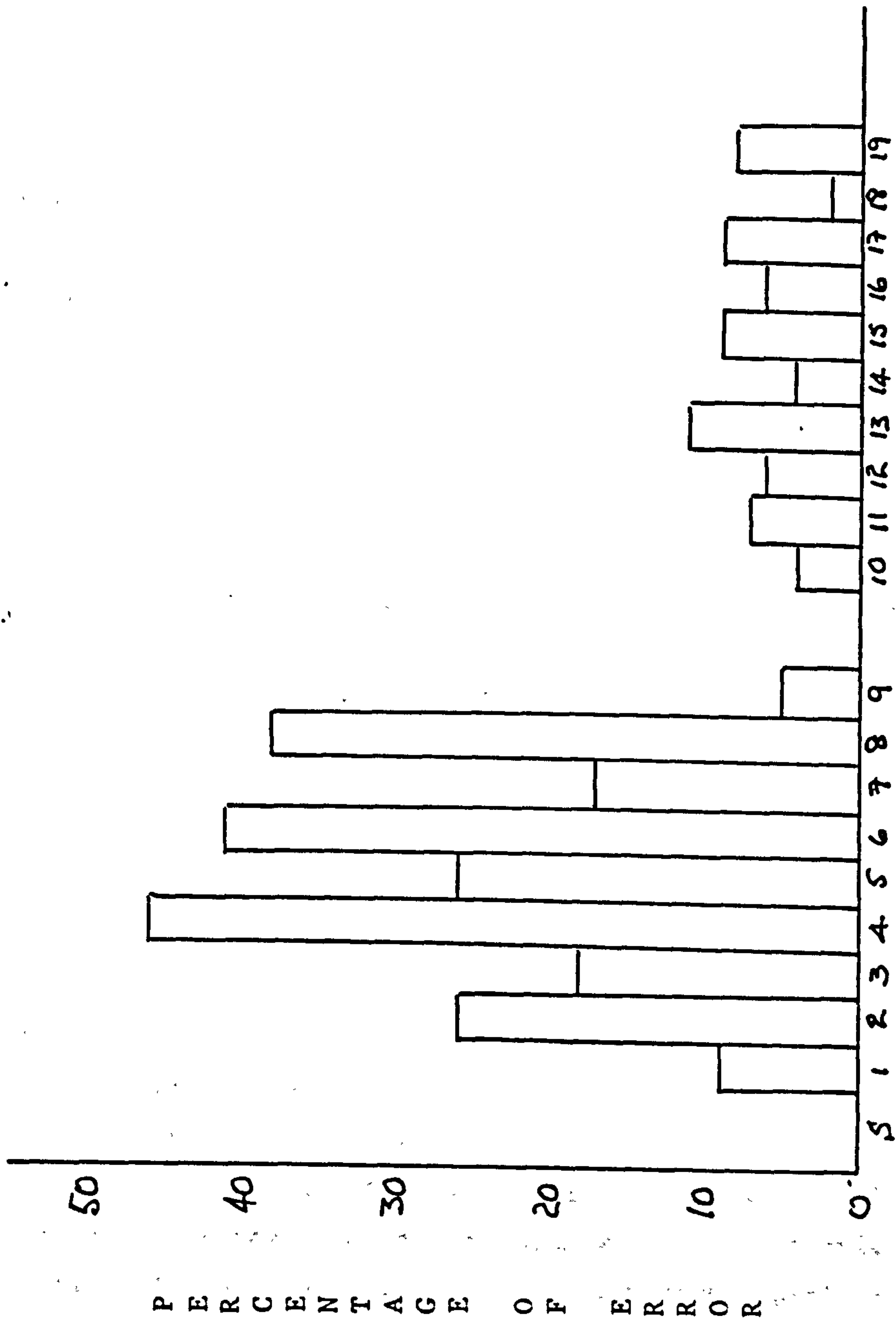


Fig. 5. Comparison of 'Sequencing'

Statistical Analysis of the Results of the Diagnostic Procedure on the Language Impaired (LI) Group and the Special Educational Needs (Moderate) (SEN(M)) Group

It was predicted that developmental articulatory dyspraxia was the factor which would determine the differences observed in the speech of the LI group and not observed in the speech of the SEN(M) group. To support this prediction that there was good reason to specify the direction of the means, Miller, 1975, one-tailed t-tests were applied to both sets of data.

On a scale 0 to 1, where 0 means that an event never occurs and 1 means that it always occurs, the findings of this experiment indicate a $p < 0.001$ significance level. In the controversial subject of the existence of developmental articulatory dyspraxia, this is a reasonable outcome. Inspection of the data suggests that one group, the LI group, is more variable than the other, the SEN(M) group. However, F-tests to test for homogeneity of variance proved non-significant. Therefore the assumption underlying the use of t-tests is not violated, Robson, 1973; Ferguson, 1976. The differences in the groups, although not significant for the sample size used in this study, indicate that the results reflect the greater number of factors that contribute to articulatory performance in the LI group. However, the robust significance recorded in each component tested, (articulatory precision, consistency and sequencing) $p < 0.001$, indicates that developmental articulatory dyspraxia continues to have a marked effect on the children's speech despite their individual differences. See Table 3, p 91.

The subsections of the diagnostic procedure other than those dealing directly with developmental articulatory dyspraxia were tested on the Mann Whitney test. These subsections include - oral dyspraxia; rhythm; visual perception; self-monitoring; ideational dyspraxia; ideomotor dyspraxia; constructional dyspraxia; co-ordination and writing. All of these are screened at a very superficial level by the diagnostic procedure, except oral dyspraxia and rhythm, each of which has a section of the assessment devoted to it.

In the case of rhythm, a significant level was recorded $p < 0.05$. This low probability could mean that the null hypothesis, that the results recorded by the children were purely random, can be rejected. Therefore, the alternate hypothesis, that the independent variable, developmental articulatory dyspraxia, has produced a difference in the levels of performance of the two groups, is accepted.

Evidence exists that rhythm is disrupted in many children who present with language and/or speech disorders, Morley, 1972; Perkins, 1977; Crystal, 1980. Therefore, it is not possible to claim that developmental articulatory dyspraxia is the sole causal factor. Notwithstanding, the fact that the LI group is significantly more dysrhythmic than the SEN(M) group, in which there is no incidence of developmental articulatory dyspraxia, should be noted.

COMPONENT	LI GROUP	SEN(M) GROUP
Articulatory Precision	N	9
	Mean	63.332
	Variance	324
	t=3.601	p < 0.001
Consistency	N	9
	Mean	72.556
	Variance	191.278
	t=4.836	p < 0.001
Sequencing	N	9
	Mean	74.889
	Variance	204.611
	t=4.023	p < 0.001

Results of One-Tailed t-tests

Table 3

THE VALIDATION STUDIES

Validation Study One - The School Children

N - 10 Males 5 Females 5 Age range 6;02 to 7;07 Mean age 7;03

No child in this group presented with developmental articulatory dyspraxia, according to their performance on the DADDP.

In Section One several children showed some degree of immaturity. Appreciable differences in levels of development were noted. Some children showed greater overall ability while others illustrated areas of strength and weakness. All the children used their right hands to write and to manipulate the sticks in the construction exercise. Three children, one female and two males, showed some right-left confusion both with shoes and with the imitation of gestures. All the males and one female indicated minimal to mild immature visuo-spatial awareness. This was demonstrated in completing the dots to form the triangle and in writing names. Four females completed the triangle correctly while the remaining 6 children failed to do this. Five of them omitted the bottom line. One male repeated, in miniature, the three dots alongside the original three and when the instruction was repeated to join them up, he drew a separate line above his highest dot. His attempt to write his name, which had eight letters, resulted in the production of four letters - the first two were correct, the third was not one included in the spelling of his name, and the fourth, which appeared later in his name, was misplaced. It was noted that this particular child appeared depressed and lethargic. Another male produced a poor performance of a different nature. He manifested both an immature grasp and constant tongue thrust.

In Section Two it was clear that the females were more competent with pragmatic language and offered considerably more structured responses than the males did, except for one, Buffery & Gray, 1972. The most overall linguistic child was a male who invariably used logical steps and cues, in response to meaningless items. In Section One and Two it was clear that some children, particularly four of the males, exhibited

immature articulatory praxis. Four of the females presented with immature use of some fricatives particularly /s/. One male produced accurate connected speech, but found difficulty when asked to produce segmental fragments of articulation. This was very mild but appeared to be connected with a mild timing problem which surprised the child himself.

Another of the males had some immature articulatory praxis which affected labial sounds a little. Two of the males and one female had minimal problems with sequencing which all of them were able to self-correct.

Section Three on oral dyspraxia was completed without error by eight of the ten children. The remaining two indicated mild immature oral praxis. One child of each sex had a little difficulty, the female in elevating the tongue and the male in producing circular movements with his tongue. The latter also found difficulty in protruding his lips and insisted on retracting them on each of the three trials allowed.

As regards Section Four, the rhythmic section, each of the five males, and one of the females, had mild difficulties. Four of them indicated poor timing while the fifth displayed a sequencing error which caused him to become somewhat confused.

In toto, none of these problems were other than minimal and, except for the writing difficulties, did not interfere in these children's ability to communicate.

Validation Study Two - The Pre-school Children

N - 10 Males 5 Females 5 Age Range 3;01 - 3;10 Mean Age 3;05

These children attended a crèche bi-weekly. They were middle-class children whose parents wished them to experience mixing with contemporaries before starting school.

Eight of the group were very willing to co-operate in the exercise, but one female and one male were less prepared to collaborate.

The results indicated that none of the children has developmental articulatory dyspraxia, although there were signs of both oral and articulatory immature praxis in several of the children. This is what would be expected in a group of this age..

In Section One it appeared that four females and two males had established right hand use. The remaining one female and three males were giving signs of being uncertain, and using both left and right hand on different tasks.

One female could write the first letter of her name, while a second wrote her whole name with ease and speed, but completely in reverse. Two females completed the triangle with no difficulty. Two males copied the dots presented. The remainder of the children did not attempt to join up the dots and complete the triangle. Construction of the sticks was difficult for eight of the children, the other two managed the task with ease, one was a male and one a female.

Two children had some problem in the co-ordination exercise. One male used the other hand, after having the index finger of his right hand selected to touch the tip of his nose. One female, although she succeeded in the task when her eyes were open, could not touch her nose with her eyes closed. McKinlay, 1982, claims that this is a predictive factor for inco-ordination. Two children were not fully aware of the names for their body parts. One, however, was Asian and may well have bilingual naming problems, as is often the case with even the most able speaker.

Section Two results indicated that six children, two females and four males, had not reached the level of mature praxis and were perpetuating some immature forms. One female was accurate on every count. All other females lacked the use of the target phoneme / θ / and were mostly replacing it with their sound [ʃ]. The unwilling male appeared to have the greatest skill with articulation but he had to be cajoled into performing. Two males presented with a degree of immature phonology in the form of cluster reduction and fronting.

In Section Three, signs of immature oral praxis were detected in all but two of this group of children. The movements most frequently affected were the circular movements of the tongue, which broke down at the level of the lower lip in several cases. With persistence, all the children could successfully manipulate their tongues and lips after two trials. None of these children could whistle. This achievement develops later than this age, normally between 4;0 and 6;0.

In Section Four rhythm was successfully acquired by three females and two males in this group. The female who was unwilling to co-operate was adamant about this activity only. It was felt that she would probably have been successful had she understood the requirements fully, as she was one of the best performers in all other areas. One male was markedly dysrhythmic and failed in each task. All the others were somewhat lacking in rhythm, but obviously were acquiring the skill.

Most of these younger children were interested in the activities and in pointing out their abilities to perform in related areas, for example, in singing, dancing, saying poems and generally in demonstrating a facility for all motor movements including articulation. These ten children were, by comparison, the most able children tested. Their normal development was seen to be notably in advance of the performances of all the children in the groups, including the school children. The only known difference was the socio-economic status of the children in the pre-school group. They are probably all from families in which the fathers are in middle-management, teaching, computer-based employment and such-like professions. In several cases, quite spontaneously, the children proffered the information that the mother was working while the child was in the pre-school group. The three professions mentioned were teaching, nursing and physiotherapy.

Apart from one child in the school children's group, four of the pre-schoolers enquired about their performance in the assessment, and two questioned the administrator as to the purpose of the exercise, and whether there would be further need for their co-operation.

VALIDITY AND RELIABILITY

Validity was established by fifteen speech therapists in different clinical situations, eg child development units; children's hospitals; schools for the language impaired and language assessment units. Each speech therapist administered the diagnostic procedure to three children identified by the following classifications:-

1. Presenting with developmental articulatory dyspraxia as described by the speech therapist's own criteria;
2. Having no presence of developmental articulatory dyspraxia as described by the speech therapist's own criteria;
3. Presenting with symptoms which indicated either developmental dysarthria and/or developmental articulatory dyspraxia, as described by the speech therapist's own criteria.

Across the board agreement was reached by the fifteen therapists as a result of administering the diagnostic procedure on the forty-five children.

Reliability was achieved by inter-rater methods in which fifteen speech therapists were asked to view two videotapes. One displayed a young child with developmental articulatory dyspraxia and the second showed an adolescent with developmental articulatory dyspraxia. The speech therapists were required to score the diagnostic procedure's Section Two on each of these children. Results confirmed the reliability of the diagnostic procedure. Differences were minimal and the general consensus was that the procedure identified the condition.

Immature Articulatory Praxis (IAP) Developmental Articulatory Dyspraxia (DAD)

Comparison of Contributory Factors

IAP

DAD

- | IAP | DAD |
|---|---|
| 1. Imprecise production of phonetic segments | 1. Imprecise production of phonetic segments |
| 2. Omission of some target phonetic segments | 2. Omission of many target phonetic segments |
| 3. Production of a target phonetic inventory covering a full range of phonetic features and ability to realise a target inventory | 3. Production of an inadequate phonetic inventory restricted to plosives and nasals |
| 4. Mispronunciations of some target phonemes | 4. Mispronunciation of many target phonemes |
| 5. Occasional inconsistency of production | 5. Occasional inconsistency of production |
| 6. Usually able to correct production on command easily | 6. Occasionally able - usually by reducing rate - to correct production on command |
| 7. Occasional disruption of sequencing of phonetic segments | 7. Regular disruption of sequencing of phonetic segments |

Table 2

Explanation of Distinguishing Factors between Immature Articulatory Praxis and Developmental Articulatory Dyspraxia

In essence, immature articulatory praxis first appears as a mild degree of developmental articulatory dyspraxia. This probably accounts for the fact that some authorities have expressed surprise at the sudden improvement in cases of developmental articulatory dyspraxia, Fawcus, 1971,; Morley, 1972; Ferry et al, 1975. In this present study, it was only after several, (three in most cases), applications of the diagnostic procedure at six-monthly intervals that it became clear that those children first considered as having mild developmental articulatory dyspraxia, were showing marked improvement. Their phonetic inventories which were initially restricted, showed signs of reaching the target phonetic inventory covering a full range of phonetic features. After similar re-assessments the children in the developmental articulatory dyspraxia group, who originally were regarded as moderately and severely dyspraxic in their articulation, were found to be continuing to present with moderate to severe degrees of developmental articulatory dyspraxia. In fact, it became clear that two different groups were being observed, one performing at a much more disordered level than the other, and showing little or no improvement with maturation and practice. Each of the stipulated factors (see p 97) affected to a greater degree those children in the LI group who were then identified as the developmental articulatory dyspraxic group. By the end of the testing period, the children with what then had been identified as immature articulatory praxis, were, without exception, showing the acquisition of a target phonetic inventory. The age of these children at that time was between 7;6 and 9;6. Prognostic implications were then seen to be different for the two groups. The hypothesis for the children with immature articulatory praxis was as follows: that some adverse effect on phonological development would result from the slower development of praxis, but, this could be overcome by good linguistic input and, if necessary, the intervention of speech therapy. Alternatively, the prognoses of the children in the group presenting with developmental articulatory dyspraxia could be expected to be poor and the result would be a more disordered development of phonology.

CHAPTER FIVE

Immature Articulatory Praxis

Articulatory praxis has already been defined in this investigation as:-

The ability in the developing child to maintain a consistent production of precisely formed articulatory movements voluntarily.

This assumes that the skilled motor system develops in time as maturation and growth proceed. It is now accepted as the result of study and observation in addition to the assessment of children's progress in the first six or seven years of life that, as with general motor development, different stages of articulatory maturity can be identified. A group of children were recognised as being immature in the development of articulatory praxis. This necessitated the consideration of a definition of this state. The following has been selected:-

Immature articulatory praxis results in cases where children's ability to develop a consistent production of precisely formed articulation movements voluntarily is retarded in some respect, in the absence of any neuro-physiological disorder.

This definition concurs with the finding of Kools & Tweedie, 1975, who devised a study to trace the development of praxis. They define praxis as the ability to perform skilled movements on command or demonstration. Eighty-seven males between 1;0 and 6;0 were assessed on oral praxis command, oral praxis demonstration; limb praxis command and limb praxis demonstration. Results showed an orderly emergence of praxis in all measures beginning about 1;0 and becoming nearly perfect by 6;0. These authors, Kools & Tweedie, op cit, found that there was a relatively high correlation between oral command and limb command and oral demonstration and limb demonstration at all age intervals. According to Ferry et al, 1975, two-thirds of all children have difficulty with articulation in the early stages of speech development, but by the age of 5;0 only 14 per cent have persisting articulation deficits. Fawcus, 1980, discusses the differences in the patterns of movement in firstly, catching a ball, and secondly, speaking, employed by 5-year olds. He describes 'ball catching' as

involving immature 'slow motion' movements which are controlled by the 'open-loop' system which in turn relies on visuo-manual skills required to assess the speed, and judge the direction from which the ball is propelled, by an outside agent. In contrast, according to Fawcus, op cit, their speech production performance is almost identical with the adult model although it involves a much more complex series of activities and is dependent on more intricate skill. The skill, in this latter case, is learned by means of 'closed-loop technology'. This leads him to emphasise the greater ease with which the child learns skills dependent on an intrapersonal system.

In the present study, speech behaviours of 120 children were observed during pilot studies and it quickly became clear that many of the younger children were using inconsistent and immature patterns. It was decided to re-assess one of the original pre-school groups after allowing an interval of two and a half years. Seven of the original ten children were available for retesting at ages between 5;2 and 5;11. In each case a marked improvement had taken place in the maturity with which the child performed complex articulatory motor movements. All the children reached adult targets.

This result supports Anthony & McIsaac, 1970, in their discussion of the Edinburgh Articulation Test qualitative assessment sheet, which revealed that speech-retarded children follow normal patterns, but at a slower rate than normally developing children. In fact Anthony & McIsaac, op cit, rank maturity on a 3-point scale - almost mature, immature and very immature. Their test records were available from 2;5 to 6;0 years, on numerous children all of whom were tested on more than one occasion. The writer has further evidence of the development of articulatory praxis in a group of pre-school children with apparent learning disorders in an assessment unit attached to a school for children with special educational needs. EAT qualitative results over a period of three years indicate a normal acquisition of articulatory precision proceeding at a markedly slower rate than that of normally developing children. None of these children has any sign of developmental articulatory dyspraxia. Within the group of 20 children, 17 have given evidence of some degree of immature

articulatory praxis, from mild to very severe.

These findings solved several problems. They provided a possible explanation for some of the hitherto confusing articulation errors which, over a period, appeared to be both non-pathological and resolvable.

Based on the findings of the author's study, immature articulatory praxis affecting articulation is apparently more prevalent than developmental articulatory dyspraxia. Immature articulatory praxis appeared, to a limited degree, among the normal pre-school group and the school children. In the SEN(M) group several children presented with immature articulatory praxis. Having identified the occurrence of immature praxis, the only true cases of developmental articulatory dyspraxia occurred in the LI group of children.

These will be described in detail later.

Incidence of Developmental Articulatory Dyspraxia
and Immature Articulatory Praxis

Analysis of the results of the experiment carried out to identify the presence of developmental articulatory dyspraxia produced supportive evidence for the existence of developmental articulatory dyspraxia. However, the incidence of the condition in the populations tested is confined to the children who comprised the Language Impairment (LI) group. The condition of immature articulatory praxis accounts for the greater number of children with articulation errors, in the pre-school group and the SEN(M) group. This is substantiated by the results of the qualitative section of the Edinburgh Articulation Test (EAT). See table no. 6, p 246.

The LI children's errors were strongly represented in the 'Very Immature' and 'Atypical' sections, whereas errors recorded by the SEN(M) group were concentrated in the 'Almost Mature' and 'Immature' sections. A large number of the latter children scored high results in the adult form section. Six LI group children presented with developmental articulatory dyspraxia while the majority of SEN(M) children had immature articulatory praxis which was resolving. The effectiveness of the diagnostic procedure in the differentiation of these two similar conditions has been demonstrated. The results of children with LI vary little on successive six-monthly testings. A small amount of improvement can be observed, possibly as the result of speech therapy but the overall performance on speech production tasks remains unchanged. In the case of successive assessments of the SEN(M) children over the same period, marked improvement is noted on these tasks. This results in normal articulatory production around the age of five to six years in normally developing pre-school children and six to eight years in SEN(M) children. These findings indicate two different conditions, developmental articulatory dyspraxia and immature articulatory praxis. See Appendix 5. Thus developmental articulatory dyspraxia is an identifiable, but rare, clinical condition which usually affects articulation to a severely crippling degree. Immature articulatory praxis is a common developmental condition of delayed articulation, which becomes resolved, and from which normal praxis develops, depending on the rate

of development and general ability of the child. The minimal level of this condition, immature articulatory praxis, observed in pre-school children appears to resolve by six years of age. This fact has been recognised by several authorities, but has not been investigated until now. See literature review p 17. Children with co-occurring disabilities both mental and physical, eg, mild to moderate degrees of mental retardation and mild to moderate degrees of cerebral palsy, apparently take longer to develop normal articulatory praxis, but most seem to attain normal praxis around seven or eight years of age.

Consideration of the Major Components in the Diagnostic Procedure -
Articulatory Precision; Consistency and Sequencing

As a result of this experiment it is now possible to examine the involvement of these components considered most likely to break down in developmental articulatory dyspraxia.

Articulatory Precision

It was predicted in Chapter 1 that this would be the area in which most errors would occur and this was the case. The ten children taking part in the experiment from the SEN(M) group produced the following results in percentage of errors:-

<u>No of children</u>	<u>Percentage of errors</u>
1	8
2	13
2	14
1	15
1	17
1	19
1	20
1	23

The range of results produced by the nine children in the LI group was much greater.

<u>No of children</u>	<u>Percentage of errors</u>
1	11
1	29
2	30
1	38
1	48
2	53
1	58

When these two sets of results are compared with the Edinburgh Articulation Test Qualitative Results the following is found:-

1. The children in the SEN(M) group perform better than those in the LI group.
2. The children in the SEN(M) group produce results which cluster within the 'Almost Mature', 'Immature' and 'Very Immature' areas. The highest frequency is in the 'Immature' area.
3. The children in the LI group produce results which cluster within the 'Very Immature' and 'Atypical' areas. The highest frequency is in the 'Atypical' area.

This finding also appeared when children thought to be presenting with developmental articulatory dyspraxia were compared on their qualitative results of the EAT with those thought to be presenting with immature articulatory praxis. That is, the SEN(M) group of children demonstrate immature or delayed development of articulatory skills while the LI group of children show the presence of developmental articulatory dyspraxia.

Consistency

In the same way, SEN(M) children performed better than LI children when the two groups of results on consistency were compared.

The SEN(M) children recorded the following percentages of errors:-

<u>No of children</u>	<u>Percentage of errors</u>
3	0
3	3
1	4
1	5
1	11

No of children Percentage of errors

1 17

The LF group of children produced the following results in consistency:-

No of children Percentage of errors

1 9
1 15
1 16
1 23
1 25
1 26
1 42
1 43
1 48

Again a marked discrepancy can be seen in these results between the two groups.

Sequencing

When comparing both sets of results in this connection the following results were produced:-

No of children SEN(M) Percentage of Errors

1 2
2 4
2 6
1 7
1 8
2 9
1 11

No of children LI Percentage of errors

1	5
1	9
1	17
1	18
2	26
1	38
1	41
1	46

The statistical analyses of these results in each of the three areas articulatory precision, consistency and sequencing showed that each was significant at $p < 0.01$, despite the fact that articulatory precision showed the greatest breakdown capacity in each group. The means for the three components are as follows:-

Articulatory Precision	SEN(M) 15.6	LI 38.8
Consistency	SEN(M) 4.6	LI 27.5
Sequencing	SEN(M) 6.6	LI 26.2

These results show a slight deflection of agreement for the first time. The results of the articulatory precision tests indicate the greatest difficulty in both groups although they are 100% more severe in LI than in the SEN(M) group. However, the LI group have their next greatest difficulty in consistency while the SEN(M) group find sequencing more difficult. It can be assumed that this reflects the greater learning difficulties across the spectrum of cognitive abilities that the SEN(M) group have.

A great deal of work has been done in the area of the sequences of action required to learn all types of skills, Lashley, 1951; Piaget & Inhelder, 1963; Gordon & McKinlay, 1980. Study of the signatures of the children in the SEN(M) group bears out the contention that they may have generalised sequencing difficulties. Six of the ten showed misordering of letters as well as reversals. See p XVI. This was true of only two of the LI group. Of the ten children in the SEN(M) group, seven were left-handed. All the LI children were right-handed. Yoss

& Darley, 1974, found no evidence of left-handedness in the group they termed developmental articulatory dyspraxic. It would be interesting to study the whole situation more closely, but this area has not been pursued in the present investigation.

RHYTHM

Consideration of timing and the rhythm of speech opens up numerous possible arguments which it is neither appropriate nor possible to deal with in depth in this investigation. Suffice it to say that there is a tangential relationship between developmental articulatory dyspraxia and rhythm which requires further study. Frequent examples of lags and failures in the timing and rhythm of produced responses in children in both the LI and SEN(M) groups can be balanced against Lashley's, 1951, claim that:

"The skilled extemporaneous speaker rounds his phrases and speaks with a definite though not regular rhythm" (p 127)

Lenneberg, 1967, suggests that four aspects, delayed feedback, signal switching between right and left ear, rate of interruptions and rate of syllable production appear to be closely related from the point of view of rhythmicity. He concludes that this fact lends credence to the hypothesis of a fundamental speech rhythm. Lenneberg, op cit, goes on to discuss speech rhythm with psychological and neurological correlates. He avers that psychological trains of events appear to move at rhythmic rates similar to seen motor events, eg tapping a finger on the table or saying la-la-la at a fast but still comfortable speed. Although he acknowledges that much has still to be learned about the origin, nature and significance of brain waves as produced on the electro-encephalogram, when he first extended these views he felt able to claim that rhythmic activity is a fundamental property of the vertebrate brain. Beaumont, 1983, when discussing right and left hemisphere contribution to rhythm and musical perception, describes studies which show that both cerebral hemispheres appear to be involved. For example a left ear advantage for random note sequences was found by Johnson et al, 1977, Zatorre, 1979, Gordon, 1980. Meanwhile Gates and Bradshaw, 1977, emphasized that different strategies adopted by subjects and familiarity of the type of material employed made it appear that both cerebral hemispheres made contributions to musical perception.

When describing Luria's Neuropsychological Investigation, Christensen,

1974, indicated the site of lesions according to the correctness of a patient's performance. For example, in motor performance of rhythmic groups, using the four tests of rhythmic reproduction suggested, a right temporal lesion is indicated if the patient does not realise fully the incorrectness of his performance. Alternatively, a lesion of the frontotemporal area of the cortex is indicated if the patient exhibits marked incoordination in all tests.

Lea, 1980, maintains that the child's first attempts at rhythmic expression are subjective and related to the fundamental pulsation such as the heart beat. Three rhythmic tests were used by Lea, op cit, in a study in which it was principally hypothesised that poor rhythmic ability is a correlate of severe disorders of speech and language.

Three subsidiary hypotheses were as follows:-

1. Correlations between rhythmic ability and chronological age and rhythmic ability and motor development would not be significant.
2. The correlation between rhythmic ability and auditory memory would be significant.
3. The correlation between rhythmic ability and intelligence would be positive but not significant.

48 children, 39 male and 9 female were tested. Age range 9;8 - 16;5

The language tests used were:-

1. Illinois Test of Psycho-linguistic Abilities, 1961
 - (a) Auditory sequencing
 - (b) Grammatical closure
2. Sentence repetition test based on sentences from Terman-Merrill forms L & M, 1960.

The tests of rhythm were as follows:-

1. The change test, in which subjects had to indicate the point of change in stimulus time patterns.
2. The synchronisation test in which subject had to join in with and synchronise as closely as possible with stimulus sequences.
3. The imitation test, in which the subject had to imitate as closely as possible a stimulus pattern after the second time of presentation.

Results showed support for the main hypothesis. Highly significant correlations were found between the three rhythm tests and the three language tests. Subsidiary hypothesis one was upheld, that no significance would be found between rhythmic ability and both motor ability and chronological age.

Similarly the outcome supported the hypothesis that correlations between rhythmic ability and auditory memory were significant. The third subsidiary hypothesis however, was proved not only positive but significant, that the correlation between intelligence and rhythmic ability would be positive but not significantly so.

Interesting as this study is, the question arises, as it did in the case of the appropriateness of the rhythmic activities in Section Four of the diagnostic procedure in this study, as to whether the most relevant levels of rhythmic ability are being assessed. The rhythmic quality implicit in speech production, which emphasises the peaks and troughs of syllables, words and more complex spoken forms is not necessarily closely correlated to the motor activities of clapping and tapping. It may be and so appears, more concerned with the appreciation of spatial and temporal correlations, and the abstract awareness of the integration of spatial and temporal qualities. A great deal more research is required in this area.

Further Examination of the Selected Characteristics of
Developmental Articulatory Dyspraxia

Those characteristics which were selected for use in this study, meet two specific investigatory requirements:-

1. The clarification of the behaviours which, it is believed, constitute the symptomatology of developmental articulatory dyspraxia.
2. The basis for the sub-tests within the definitive section of the diagnostic procedure which endeavours to identify, or not, the presence of developmental articulatory dyspraxia.

The operational definition which has been formulated is also based on these characteristics which are as follows:-

1. Inconsistency in articulated speech production
2. Groping by trial and error for articulation targets
3. Difficulty in imitation of segments, syllables and words
4. Difficulty in sequencing segments, syllables, words, phrases and sentences
5. Evidence of increasing struggle with increasing complexity of sequences
6. Evidence of dysrhythmia in articulation
7. Evidence of restricted range of prosody
8. Difficulty in production of articulation on command and demonstration.
9. Evidence that only voluntary motor movements are affected.

1. Inconsistency in articulated speech production

The claim is advanced that children with developmental articulatory dyspraxia evidence, more than their normal peers, a tendency to change the character of an articulated production by several means, from one trial to another, in the attempt to produce a target realisation. For example, in the word 'buttercup' a child may respond by using, in the first repetition, a close approximation in which he

labialises the alveolar and velar segments thus producing [bʌbəpʌp]. In a second imitation he may use a similar response which on this occasion is voiced throughout, [bʌbəbʌb], and on a third attempt produce [bʌbədʌ]. This inconsistency in production is found in the speech of several children but there is strong evidence from the results of the diagnostic procedure in this study, that the incidence of this characteristic is less frequent than was expected. This supports the findings of Yoss & Darley, 1974. Similarly, the experiment revealed that children presenting with immature articulatory praxis were also frequently consistent in production. Those children who proved to be most inconsistent were those who were most severely affected by developmental articulatory dyspraxia. They were also less able to self-monitor, suggesting that sensory-motor and auditory feedback loops may all be involved in the maintenance of consistency from one speech production to the next in cases where repetitions are demanded.

Several authorities include 'inconsistency' as a feature indicative of the presence of the specific articulation disorder here termed developmental articulatory dyspraxia (eg, Chappell, 1973; Rosenbek & Wertz, 1973; Ferry et al, 1975; Williams et al, 1980; McLaughlin & Kriegsman, 1980). Guyette & Diedrich, 1981, do not accept that consistency of error is helpful in the differential diagnosis of developmental articulatory dyspraxia.

2. Groping by trial and error for articulation targets.

This characteristic was evidenced in terms of the occurrence of articulatory imprecision. The oral behaviour, in the act of articulation, of many of the children signified the loss of ability to organise and plan the movements, particularly of the lips and tongue which are so important to the intelligibility of speech. In the more severe cases, this particular difficulty could be instrumental in preventing consistency of response as each attempt imposes so much struggle for movement that it is obvious that there is difficulty in achieving approximately identical positioning from one attempt to another. This is strong evidence for the claim that developmental articulatory dyspraxia prevents the establishment of automaticity in

articulatory movements. Accompanying the direct problem of organisation of the required muscle groupings, is the apparent lack of support from visual and auditory cues to facilitate the action by watching and/or listening. The repeated failures and the frustrations which ensue, appear to interfere so much with the child's overall performance that he/she eventually ceases trying to produce the desired response. If the experience has been particularly disastrous and the results unacceptable, the child may lose motivation completely and refuse to continue trying to respond. In many children, other forms of dyspraxia, eg ideomotor, ideational, are also present and additional frustration can be noted in the futility felt in trying to make suitable signed responses. Where signing is viable, total behaviour changes have resulted from the use of this means of communication. It is unfortunately sometimes the case that the basic problem is undiagnosed, and the child may be completely misunderstood at all levels. This is mentioned in this context, since there is occasionally a rather unacceptable degree of mouthing and facial contortion due to groping for placements, which causes uninitiated observers to misconstrue the child's difficulty as a sign of mental subnormality or psychological upset.

3. Difficulty in imitation of segments, syllables and/or words

It may appear that this is an alternative means of describing groping for articulation targets. In fact, this is a discrete area of difficulty which further illustrates what may be going wrong with the underpinnings of articulation. Morley, 1972, defined articulation as follows:-

"Articulation is a learned neuromuscular skill associated with neurological maturation, although acquired at a time in infancy before conscious imitation is involved to any great extent."
p 280)

The neuromuscular aspect of articulation is, as has been previously suggested, the motor action, or response, made possible by the sensory feedback, to a degree of reliable automaticity. The sensory feedback includes particularly proprioceptive and tactile systems associated with auditory stimuli conducted along sensory pathways to the cortex

of the brain. To facilitate imitation, the sensations conveyed as stimuli must be reliable; the motor planning set in motion as a result of the brain receiving these stimuli must be reliable; and the movement set up in the muscles to meet the requirements of imitation of a particular segment or group of segments, must be reliable. This degree of reliability at each of these levels depends on previous stimulation, previous practice sufficient to reach an automatic level of motor planning and motor performance. It is the learned automatic factor on which imitation appears to depend most. This level of function is one which is not necessarily reliant on involvement of the central language unit, as has already been noted. Echolalia, and the repetition of foreign or nonsense segments, illustrate how accurate imitation can be in the absence of meaning. The children diagnosed as having developmental articulatory dyspraxia do not have this reliable accuracy in their sensory motor systems. They find marked difficulty in imitation. The difficulty is compounded in instances when the required response is longer than a word, and demands a phrase or sentence. This appears to be the result of failures in attempts to automatise and produce a string of differing segments requiring precise flexibility of muscle movement at speed. Although this difficulty is present in most of the speech production which the child with developmental articulatory dyspraxia attempts to produce, it is sometimes more obvious as the material to be imitated increases in length.

4. Difficulty in sequencing segments. syllables, words, phrases and sentences

Another feature of developmental articulatory dyspraxia which has been widely acclaimed as an identifying factor is sequencing. It is not difficult to appreciate that if a child finds problems with forming the articulatory units required for building words at the level of fundamental placements and approximations of his/her oral mechanism, he/she is going to present with marked inability to sequence. There is a tendency to 'run over' from one ill-defined segment to the next and so to scramble the segments into and over each other. There is a recognisable presentation of omissions in which whole syllables and/or individual segments are left out. When a child persists in his/her

attempt to produce a correctly structured sequence and fails in many respects, as he does so, the overall sequence of the produced speech will be disturbed. Aram & Horwitz, 1983, devised a study to ascertain the sequential and non-speech praxic abilities in children with developmental articulatory dyspraxia. Conclusions indicated two major findings, which were:-

1. In at least some dyspraxic children sequential deficits may be confined to verbal sequential tasks.
2. No study (including Aram & Horwitz's) demonstrates that dyspraxic children have greater verbal sequential difficulty than do other children with developmental speech and language disorders.

Results from the present study point to less evidence of sequential problems than consistency problems in Language Impaired children, although both were much less frequent than problems of articulatory precision. See p246.

5. Evidence of increasing struggle with increasing complexity of sequences

Allusion has already been made to the predilection in children with developmental articulatory dyspraxia to become less able to produce intelligible speech in the presence of increasingly complex language forms. This was clearly supported in Subtest 1, Section Two of the diagnostic procedure. See p76 . The greater the demands put on the muscles of articulation, the greater the difficulty the child has producing fluent speech, and the less likely he/she is to continue to sustain control over his articulatory movements. To avoid future refusal to attempt increasingly difficult tasks, it is advisable to accept failure and proceed to a different task.

There are some children who appear well able to increase their ability to reproduce more complex forms, but who fail lamentably on much simpler tasks, such as repeating isolated segments. These idiosyncratic differences in individuals to complete and/or succeed in producing different levels of speech production, serve to confuse the issues even more when considering aetiological and management factors.

In the case of a child failing more noticeably and more frequently as he/she attempts to produce more complex speech forms it could be assumed that the basic deficit, in either the proprioceptive/tactile, or the auditory-proprioceptive-tactile feedback systems which fails to implement the motor organisation and planning, is becoming less able to deal with the more complex productions. This is a logical consequence of overloading a defective system, and can be understood in that context, Fawcus, 1971; Edwards, 1973. On the other hand, it is much more difficult to account for a problem which does not affect complex programming and production, but only manifests itself at certain, apparently simple, levels. Several explanations may account for this. Firstly, there may be a very specific neuromuscular involvement whereby only limited areas of production will be affected. For example, one child tested in the course of pilot studies, succeeded at all levels of Section Two of the diagnostic procedure until he was asked to produce isolated segments. This proved almost impossible for him. When asked to say / bə bəbə dədədə gəgəgə / he repeated the consonant / b / throughout and could not copy the other two consonants in this context in any of the permitted three attempts to do so. When the voiceless equivalents replaced / b /, / d /, / g / this child repeated his first performance and succeeded in the first consonant only, repeating it in place of the other two. This pattern was repeated throughout. / f / was used to represent / s / and / θ /. On completion of the assessment, this child was asked to produce / bə də gə / and his response was [də də də] Similarly he responded to rearranged fricatives by repeating the first sound presented in each case. When requested to say fin, sin, and thin the child produced each one correctly with no hesitation. The response did not depend upon being meaningful, as this boy had correctly reproduced all the nonsense words presented to him in the previous Subtest. Only the segments with 'schwa' presented difficulty. This could be accounted for as a learned response, an articulation disorder at this level caused by poor auditory feedback. No sign of the problem was noted in the child's connected speech. He was considered to be of higher than average ability and could read and write without difficulty. No studies are available which describe similar cases. This could be accounted for by the fact that segments are not recognised as separate entities. Normally, they are "squashed together", Liberman & Prince,

1977. If this is taken to its logical conclusion it could be that some speakers are so unaccustomed to hearing "unsquashed" segments in isolation that they cannot discriminate between any three similar-sounding ones such as

/bɑ dɑ gɑ/ and /fɑ sɑ θθ /. This particular aspect of language information may not have been learned at any earlier stage by this child and so was unavailable to him. If such is the case, the situation is rare. It is much more common for children to fail more frequently as the demands for production become more complex.

7. Evidence of dysrhythmia in articulation

There is a paucity of information regarding speech rhythm. It is strongly evidenced that rhythm is located in the right hemisphere of the brain but the question arises as to whether it is the same rhythmic skill which enables us beat time to music, give the precise amount of stress to dance steps and generally move in a rhythmical fashion, as that which we use in speech-flow to maintain fluency in speech production. Beaumont, 1983, reviews the work of certain authorities and suggests that:-

"As 'musical' stimuli become more and more simplified, they are less and less distinct from simplified speech sounds, and it becomes more likely that subjects will process them as if they were speech sounds. This is supported by two pieces of evidence: that, by and large, the right hemisphere advantage is found more readily with structured musical passages, and that characteristics of the subjects themselves can have a profound effect on the lateral advantage observed."

p 213

(for reviews see Craig, 1979; Damasio & Damasio, 1977; Gates & Bradshaw, 1977; and Wyke, 1977).

One contingency on which a flow of meaningful language is dependent is rhythm, which Allen, 1975, defines as "the structure of a sequence". This determines that as a type of structure, rhythm plays an organising role in speech. One regular recurrence in developmental articulatory dyspraxia is the fragmentation of stresses either by pause or omission. Long pausing will break the rhythmic patterns

required to convey meaningful 'chunks' of language. Similarly, omitting segments or series of segments will detract from the recognisable, acceptable, expected rhythmic formations on which the understanding of spoken language relies, in the ear of the listener.

Crystal, 1969, emphasises that recognition of the general nature of English rhythm is superfluous to the acceptance of rhythmicality. He includes rhythmicality in his group of prosodic systems and asserts that it

"accounts for those linguistic contrasts
attributable to our perception of regularly
occurring peaks of prominence in utterance"

p 161

Crystal, op cit, when referring to arhythmicality, which he claims is very rare, suggests that irregularly rhythmic utterance can be accounted for by variation in tempo in the production of syllable and by hesitation phenomena. With reference to the level of linguistic value on a scale of prosodic features, Crystal places rhythmicality, with several other features, at the most linguistic end. In the same volume, Crystal, op cit, reviews past work on prosodic features, including rhythm and notes that as early as 1775, Steele anticipated current experimental work with remarkable perceptiveness. He maintained that a perfect regularity is imposed on speech, though he had to admit that 'bad' speakers were sometimes inconsistent. Crystal, 1969, suggests that once the phonetic basis of the perceived regularity, which is rhythm, has been determined experimentally, a more reliable description of the principles underpinning this prosodic feature will be available. A small amount of clarification may arise from this present study.

If rhythm plays an organising role in speech, other claims previously made can be better understood. For example the contention made by Wallon & Denjean, 1958, that in the presence of an intact neurophysiological system the child with a motor programming difficulty does not know what to do to set the motor system in motion, to produce the correct speech production, may be accounted for by the lack of control of rhythm. The present writer perceives rhythm in

this context, as the interaction of spatial and temporal awareness required to initiate the structure of sequences.

A subtest in the diagnostic procedure in the present study is specifically designed to test rhythmic abilities in temporal patterning of body movements and CV production. This has been described in detail, see p 109. However, the original decision to include the subtest was based on empirical observations and on studies of other authors who claim strong associations between language and rhythmic abilities. No-one has more recently described this better than Lashley, 1951, who suggests that rhythm is basic to language since the latter is comprised of a pattern of sounds organised in time. He claims that there are parallels in speech with the recurring patterns at certain intervals in music. A skilled speaker uses a definite though not regular rhythm. Lashley, op cit, describes how he envisages the neurological organisation of elaborate systems of interrelated neurones which impose certain types of integration upon a large number of widely spaced effector elements. He claims that in one case these systems transmit temporally spaced waves of facilitative excitation, while on the other hand, they impart a directional polarisation to both receptor and effector elements. These systems are in constant action and form a type of substratum upon which other activity is based. They contribute to every perception and every integrated movement. If this is the case, it can be postulated that the result of a disorganisation at a basic level which disrupts the underpinnings of motor speech production, includes rhythm.

Lea, 1980, in a study already referred to, see p 110, describes the association of rhythmic ability and language ability in a sample of 48 children in Moor House School. Of that number, 15 cases were classed as having primary articulation disorder. These children were found to have better rhythmic ability than those with greater language difficulties. No evidence was given of the amount of rhythmic disruption which was present in the articulatory disabled group. This finding is supported by the results of the experiment in the present study, in which it was found that the children in the Language

Impaired group had the greatest rhythmic difficulties. The majority of children in the SEN(M) group, some of whom presented with primary articulation disorders had also rhythmic difficulties but to a much lesser degree.

Griffiths, 1972, found that the sharpest division which occurred in the comparison of normal children with aphasic children was the repetition of rhythms.

Lenneberg, 1967, goes so far as to propose that a rhythm exists in speech which serves as an organising principle and perhaps a timing device for articulation. He states that

"the interdigitation phenomenon poses a problem of timing owing to the fast rate of sound production. . . . muscles must be activated at such rapid succession that a neuronal firing order must be assumed that functions with an accuracy of milliseconds. This can be accomplished only by automatisms consisting of intricate time-patterns. . . . The hypothesis is advanced that the temporal patterns on which the neuromuscular automatisms are based have at their roots a physiological rhythm. . . . Indirect evidence is cited that articulation itself reflects such a basic rhythm." p 120

This is again reflecting the neurological basis for the development of an automatic system which is necessary to produce articulated segments, but further, it is postulated that the whole system is based on a series of physiological rhythms.

7. Evidence of restricted range of prosody

Apart from rhythm, which itself is regarded as a prosodic system, other prosodic aspects appear to be involved in the speech of children with developmental articulatory dyspraxia. The other

prosodic systems include: stress, pitch, loudness, pause, and intonation. Intonation, it should be noted, is a combination of all the others. Briefly, the definitions derived from Crystal, 1969, are as follows:

1. Stress - referable to variations in the loudness parameter, perceived by increase in loudness accompanied by unmarked pitch movement.
2. Pitch - dependent on:
 - (i) the level of intensity at which judgments are made; it is necessary to specify a standard level of loudness for any judgment of comparative pitch;
 - (ii) the type of listener involved;
 - (iii) time, in terms of fundamental frequency and its related harmonics.
3. Loudness - the perceptual correlate of variation in amplitude of sound-wave vibration, which in physical terms, is the correlate of physiological intensity of utterance.
4. Pause - two types described:
 - (i) structural, closely tied to breathing and almost totally predictable in grammatical contexts;
 - (ii) hesitation, less predictable grammatically.

The presence of developmental articulatory dyspraxia with its deficits in production, affects many prosodic features and this in turn further diminishes the intelligibility of speech. Although major prosodic disorders are not so commonly occurring as those in dysarthria, there is an overall flattening of intonation; an increase in pause: less normality in volume, sometimes too loud, sometimes too soft: fewer

changes in pitch; less indications of stress and a marked irregularity in rhythm.

8. Difficulty in production of articulation on command

As has been mentioned in various contexts previously, a strong factor in the disruption of speech production that manifests developmental articulatory dyspraxia is the mediation of instructive language. It is this separate factor which points the present writer to some involvement of brain dominance, to indications for cortical participation, and to the acknowledgement of two systems of production one voluntary, personalised and dependent on a degree of automaticity and the second more closely associated with socialised repetition, wholly dependent on automaticity but stemming from a different centre in the brain. The former, the voluntary system, is activated by instruction, either internal - from the individual, or external - from another person. It involves using a memory store dependent on sensory feedback which is unreliable and which has enabled the individual to make an automatic response to some, but not all, of the stimuli utilising that particular sensory feedback route. On the other hand, the latter, involuntary, system draws on a store which does not emanate from the same source but which operates at a lower level of cognition and from which the individual can produce "learned", often "musical", "rote" material which has become automatic. This dichotomy does not exist in every child with developmental articulatory dyspraxia. The most severe cases are apraxic - that is totally unable to produce speech due to the failure of the child's system to develop praxis of these muscles necessary for speech.

There are, however, some children who present with language which apparently falls into these categories. Consequently, on some occasions when rote or melodic features accompany the language used, there is fluency of production. If they are instructed to respond to, or attempt to initiate speech on their own behalf, the resultant production is non-fluent and liable to contain some or all of the descriptive features listed as characterising developmental articulatory dyspraxia. In minimally affected cases, minor interruptions in the clarity of articulation may be the sole problem

and it can be so slight as to warrant little attention.

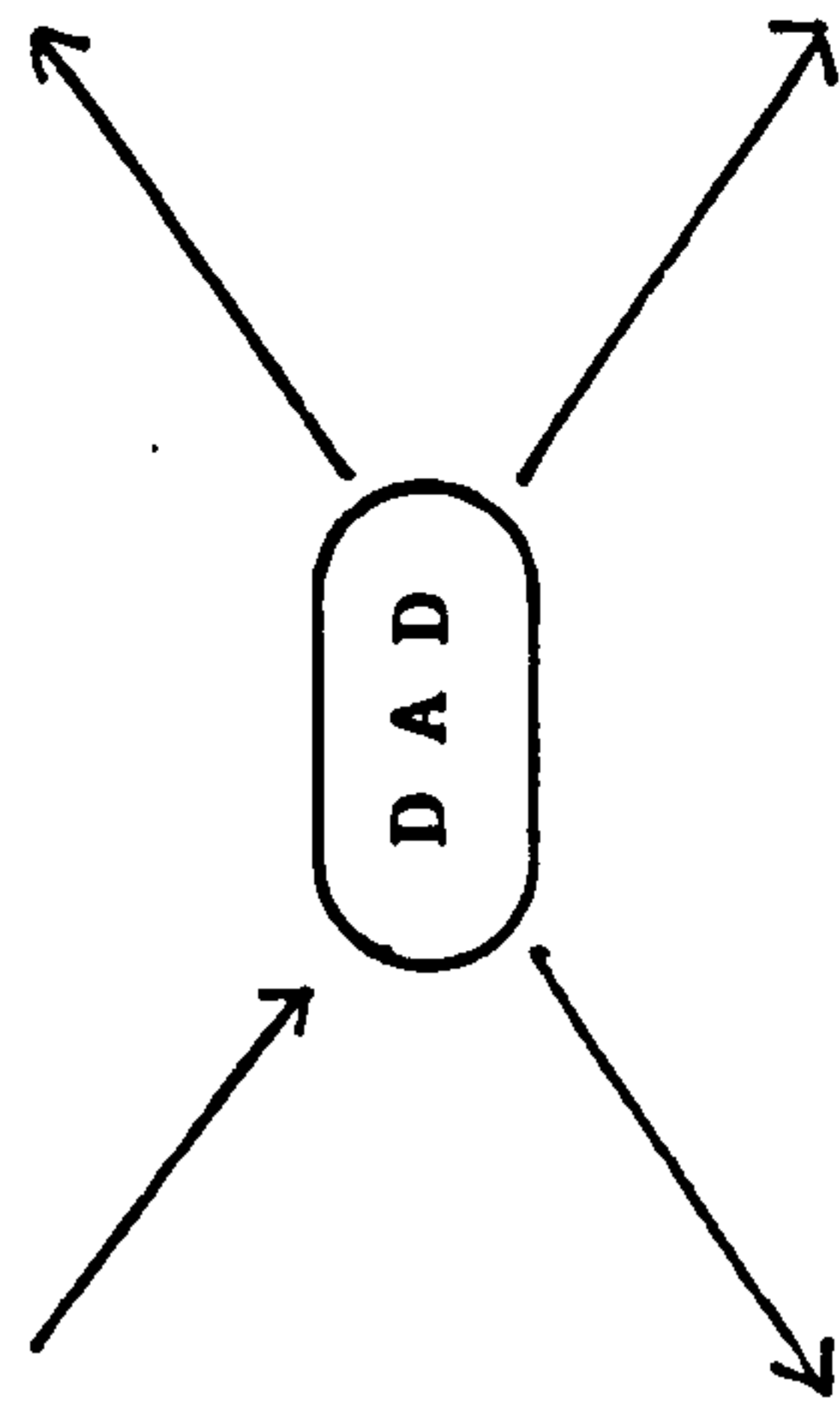
9. Evidence that only voluntary motor movements are affected

Following on the last feature but with regard to the production of movement rather than fluent speech, evidence exists, and can be tested in most cases, for the involvement of only voluntary motor movements for articulation in developmental articulatory dyspraxia. For example, a child who, on demonstration of the placement of /f/ for example, (demonstration rather than 'on command' instruction should be utilised in this checking process) is unable to place the lower lip under the upper teeth to produce the desired sound, but he/she may be able to assume exactly that posture in order to diminish an "itch" on his lower lip. This action indicates that normal muscle movement is present. Only the 'voluntary' aspect of movement is dysfunctioning.

At this stage, on completion of the experiment, it seems possible that the most vital characteristics were included and were found to be viable, but that does not mean that only children presenting with these characteristics have the condition, nor that these characteristics are the only ones regularly presenting in the condition. At this stage they appear to account for the majority of the articulatory behaviours observed in the condition, developmental articulatory dyspraxia. It is however, appreciated that other characteristics may be identified in future.

CONTRIBUTORY FACTORS

1. Familial diathesis
2. Sensory feedback and/or motor planning deficits
3. Intrapersonal auditory perceptual feedback loop system deficiencies



CO-OCCURRING CONDITIONS

1. Speech and Language
 - a. Phonatory difficulties
 - b. Prosodic disturbances
 - c. Dysarthria
 - d. Semantic Pragmatic, or Specific Developmental Language Disorders
 - e. Reading and/or writing problems
2. Others
 - a. Dyspraxias
 - b. Clumsiness
 - c. Spatial and/or temporal deficits
 - d. Visual perceptual problems
 - e. Learning disorders

IDENTIFYING CHARACTERISTICS

1. Articulation disorder
2. Reduced intelligibility of speech
3. Inability to demonstrate cognitive ability by means of expressive speech

IMPLICATIONS FOR THE ACQUISITION AND DEVELOPMENT OF PHONOLOGY

1. Disruption of the perceptual input from faulty intrapersonal feedback
2. Difficulty in finding strategies to produce adult forms due to imprecision, inconsistency and sequential problems in articulation
3. Probability that normal phonological development will be adversely affected.

MODEL FOR DEVELOPMENTAL ARTICULATORY DYSPRAXIA (DAD)

Table 3

THE RELATIONSHIP BETWEEN DEVELOPMENTAL ARTICULATORY DYSPRAXIA AND PHONOLOGICAL DEVELOPMENT

A model is presented which attempts to account for developmental articulatory dyspraxia and its relationship to and implications for phonological development. See Table 5, p 125.

It is postulated that developmental articulatory dyspraxia results from three major factors.

1. Inherited diathesis
2. Sensory feedback and motor planning deficits
3. Inefficient self-monitoring

1. Inherited diathesis, in which a predisposition exists which results in the manifestation of a form of neuropsychological expressive speech problem, eg, specific expressive developmental language disorder; stuttering; developmental articulatory dyspraxia. This occurs in different forms according to the individual. Dyspraxia can be found in different or similar forms in families, see p 17.

2. Sensory feedback and motor planning deficits are contributing factors, see pp 54 and 61.

3. Inefficient self-monitoring confounds the situation making the child less able to establish acceptable forms of speech production. It should be noted that this is by no means specific to developmental articulatory dyspraxia; many children with disorders of both comprehension of language and production of language also appear to have problems of faulty feedback.

It is postulated that these specific areas are involved to different degrees in different individuals, in the manifestation of developmental articulatory dyspraxia. The children with Language Impairment produced results on the diagnostic procedure which will be discussed later in the light of this account of developmental articulatory dyspraxia.

Developmental articulatory dyspraxia having been established as an articulation disorder usually present to a marked degree, a short list

of the identifying characteristics of the condition is as follows:-

1. Articulation disorder
2. Reduced intelligibility of speech
3. Inability to demonstrate cognitive ability by means of expressive speech.

1. Articulation disorder

This designation indicates a disorder arising from a defect in the mechanism of speech production, ie the oral cavity, its organs and its functions for articulation. In the instance of developmental articulatory dyspraxia the structure of the oral cavity is usually normal with intact bony parts, the different organs in proportion to each other and normal muscle action. The specific articulatory defects arise from the intermittent alterations of function in voluntary movements which, on the occasions on which they occur, disrupt articulatory movements. Thus speech production is affected by a neuropsychological dysfunction. As a result of the articulation disorder there is :-

2. Reduced intelligibility of speech

Thus, although the disorder is articulatory in nature, it affects spoken language, in particular the phonological dimension of spoken language. The listener is prevented from understanding fully, words, phrases and sentences of expressive language, due to reduction in intelligibility, which is manifested in phonetic and phonemic production. In turn this situation exacerbates the ability to learn precise articulation for the production of speech. This leads to the third problematic area.

3. Inability to demonstrate cognitive ability by means of expressive speech

In the most severe cases, children with developmental articulatory dyspraxia may be unable to demonstrate their intellectual ability through the spoken word, and, even more handicapping, where reading

and writing affected. This may be confounded by the listener's inability to understand and therefore failure to provide feedback to the child. Such children have been regarded as mentally retarded or simply as behaving 'awkwardly', as a result of their inability to find a means by which to communicate their intentions. These children have co-existing difficulties which exacerbate the situation.

Conditions which co-occur with developmental articulatory dyspraxia include the following:-

1. Speech and Language

- a. Phonatory difficulties occasionally present, resulting in inability to initiate vocalisation.
- b. Prosodic disturbances in which
 - (i) intonation may be affected by reduced variations in pitch range;
 - (ii) rate can be disrupted and pauses protracted;
 - (iii) the difference between stressed and unstressed syllables may be reduced to the point of syllable-timed speech.
- c. Dysarthria may be present making both diagnosis and treatment difficult. Dysarthria is consistent and the reduction of movement resulting from its presence can prevent progress. When the dysarthria is mild to moderate in degree and the developmental articulatory dyspraxia is severe, it is easier to differentiate one from the other and plan management.
- d. It has been observed that in severe cases of developmental articulatory dyspraxia, semantic pragmatic disorders may be present and severe language learning disorders may occur.
- e. Reading and writing may both be affected - see 'other' co-occurring conditions.

2. Other Co-occurring Conditions

- a. Dyspraxias other than articulatory dyspraxia may be present, eg, oral, constructional, ideomotor, ideational, dressing, ocular. All or some of these may co-exist with developmental articulatory dyspraxia. Oral dyspraxia may not co-occur invariably.
- b. Clumsiness of movements appears to be frequently associated with developmental articulatory dyspraxia. This takes the form of either hand/eye and/or hand/foot inco-ordination; fine motor skills' difficulties or general dysrhythmia.
- c. Spatial and temporal deficits in the form of visual perceptual problems such as figure-background awareness are common. This is also observed occasionally in the linguistic dimension as difficulties in the appreciation of deixis.
- d. Visual perceptual problems of constancy have also been noted in children with developmental articulatory dyspraxia. Also the appreciation of right and left is often uncertain.
- e. General learning disorders consequent upon the types of problems described above, are frequently found in children with moderate to severe degrees of developmental articulatory dyspraxia. These can affect the ability to concentrate, to learn to read and write and to acquire numeracy skills.

Expressive speech is comprised of two major aspects, phonetic and

phonemic. Having demonstrated the existence of developmental articulatory dyspraxia, the phonetic dimension of speech production has been considered. The acquisition of phonology, which runs concurrently with the acquisition of articulation, will now be considered. It is hypothesised that the presence of disordered articulation will have a deteriorating influence on the development of the child's phonological system. Research into the child's developing phonology and how he/she creates his/her own system, reveals perpetual changes as the system becomes more closely related to the adult targets, Ferguson & Macken, 1980; Locke, 1980.

A phonological analysis, Grunwell, 1985b, is being applied to the data samples resulting from the assessment for developmental articulatory dyspraxia and the results of the Edinburgh Articulation Test. The data is limited in the most severe cases but it is possible that it will provide sufficient information to make judgments on the effect of the articulation disorder, developmental articulatory dyspraxia, on the acquisition of the phonological component of language.

CHAPTER SIX

THE HYPOTHESIS

It is hypothesised that the presence of developmental articulatory dyspraxia will have an adverse affect on the development of a normal phonological system.

The major points that are to be considered in the discussion of this claim are as follows:-

1. The relationship between an identified articulation disorder and the formulation of the rules required for acquisition and development of a phonological system.
2. The relationship of the known deficit of sensory/motor feedback in developmental articulatory dyspraxia, to sensory/motor feedback in the development and maintenance of the phonological system.
3. The relationship between interpersonal and intrapersonal auditory feedback mechanisms, and their role in the development of the phonological system. The effect of the presence of developmental articulatory dyspraxia on these systems will be discussed.
4. Implications of developmental articulatory dyspraxia for current theories of phonological system development.
5. Developmental articulatory dyspraxia considered in the context of motor programming deficit and its specific implications for developmental articulatory dyspraxia and the development of phonology.

1. The relationship between an identified articulation disorder and the formulation of the rules required for acquisition and development of a phonological system
 - a. It is claimed that a disorder or dysfunction of motor programming results in the presence of developmental articulatory dyspraxia. The role of speech motor programming is to position the speech musculature and to sequence muscle movements for the volitional production of articulated segments of speech, (see Darley, Aronson & Brown, 1975). Dysfunction of the motor programmer is often associated with alterations which particularly affect the initiation of segments, syllables and words. Primarily, articulatory dyspraxia is an articulation disorder, which results in the production of disturbed articulation, ie observed as pronunciation difficulties.

It is hypothesised that a consequence of these faulty productions will result in the children experiencing difficulty in devising an 'internal map' which enables them to use their developing experiences of speech productions on which to base a formula for dealing with future use of segments, syllables and words. Memory traces based on the recognition of visual, auditory, tactile and kinaesthetic feedback dependent on reliable input will not be properly established. Several authorities claim that articulatory dyspraxia results from an inability in organisation which prevents children memorising the patterns of movement required to carry out the purposive movements of speech, eg Gordon & McKinlay, 1980.

A major factor in the consideration of this problem is the intentionality of the speaker. Where children have a clear abstract intention to produce a particular segment, but are prevented from doing so by a neurophysiological dysfunction, the intention remains the same, only the output is distorted. Hewlett, 1985, proposes the following definition:-

"a phonetic distortion is one
in which the correct phoneme is
incorrectly realised" p5

- b. This articulatory disturbance will affect the development of a normal phonological system. To clarify this point it is necessary to be clear what is meant by a phonological system. Grunwell, 1981a, following Halliday, defines a phonological system as follows:-

"a finite inventory of sound
elements, which are both
interdependent in their functioning
as contrastive units, and which
also interact with each other in
combining to form larger units." p12

Thus the acquisition of this system of contrasts and combinations will be affected by the disrupted and inconsistent articulation and sequencing that occurs in developmental articulatory dyspraxia. It is contended that this in turn will result in a phonological disorder. Hewlett, 1985, defines a phonological

disorder as follows:-

"a disorder involving the phonological representation of words in the speaker's brain, or the mental processes used in the conversion of phonological forms into phonetic forms"

p 8

It is claimed that children with developmental articulatory dyspraxia attempting to create the rule-dependent output of their normally developing contemporaries, are unable to produce all the contrastive units and phonotactic possibilities necessary as a result of the articulation disturbance created by their dyspraxia. Similarly, the sequencing disruption present in developmental articulatory dyspraxia, will affect the combinations of segments in longer sequences. In addition to the articulatory imprecision, the lack of consistency of output will further disrupt the phonetic output on which the phonological system is dependent. Hewlett, op cit, disputes the fact that linguistics precludes phonetics. In the light of the close relationship of phonetics to phonological output, this seems to be a cogent point. Hewlett, op cit, also suggests that a dichotomy should be considered between the term phonetics and articulation when referring to disorders. He proposes that 'phonetic disorder' should only be used in the case of dyspraxia, leaving 'articulatory disorders' to describe structural deviations of the vocal tract resulting in disrupted articulation. This is an interesting point as it suggests a potentially useful distinction between articulatory, phonetic and phonological disorders. This needs further consideration with regard to the implications for clinical terminology, differential diagnosis and the explanation of speech disorders. However, it cannot be discussed further in this investigation. Thus, it is proposed that developmental articulatory dyspraxia adversely affects the normal development of a phonological system.

- c. Hypotheses can be formed to account for the restricted articulation and its affect on the developing child phonologies.
- (1) That the articulation disturbances permit only restricted phonological forms to develop, such as 'favourite articulation', by which the children adopt repetitive use

of a particular, but possible, form of output which gives them fewer problems of production. For example, a frequent expected type of articulation may be constituted by the use of a front, plosive consonant followed by a vowel.

- (ii) That the children with developmental articulatory dyspraxia, persist in attempting to produce patterns which equate to adult targets, but continually fail and produce variable attempts at output, resulting in highly inconsistent performances, and thus moderate to severe variability in phonological realisations.
- (iii) That the phonotactic possibilities are likely to be reduced to consonant (C) followed by vowel (V), or vice versa, and sequences of CV at the simplest levels, in the case of children with developmental articulatory dyspraxia. Any more complex sequences present too much difficulty in placement and sequencing.
- (iv) That the frequent incidence of sequential errors prevents the correctly ordered production of segments necessary in normal phonological realisations.
- (v) That interaction between this disrupted articulatory performance and phonological organisation has implications for disorders in both.

Sensory feedback is required to regulate and control movement, However, although it is essential for all future control of movement, this plays only a minor part in the whole process after the earliest stages of development when this control was learned, Lashley, 1951.

When sensory feedback is affected, as in the case of developmental articulatory dyspraxia, disruption must take place at a very early stage of development. The defect resulting will become established before the stage of automaticity has been reached. No further opportunity arises in the course of development during which this situation can be changed or adjusted, thus it would appear that the condition would be immutable.

2. The relationship of the known deficit of sensory/motor feedback in developmental articulatory dyspraxia, to sensory/motor feedback in the phonological system

To develop a normal phonological system it has been argued that

there is a close interface between articulatory and phonological learning, Ingram, 1979; Menn, 1980; Grunwell, 1981a, 1982a, 1985a. In developmental articulatory dyspraxia, the role of a deficiency in sensory/motor feedback is acknowledged as important, see p 54. As a result of the activation of the motor programmer, movement of the requisite groups of muscles required to produce an articulated segment is set in motion. This movement involves sensory and motor areas of nerve pathways. Hardcastle, 1976, describes two classes of feedback, exteroceptive and proprioceptive. Exteroceptive is conducted through the auditory and tactile channels, while proprioceptive feedback supplies information to the brain regarding the movement and position of different parts of the vocal tract. In the productive aspects of developmental articulatory dyspraxia, the latter, the proprioceptive loop, is the feedback channel most involved. The unreliable movements resulting from the disruption of the motor programmer, will be instrumental in feeding back faulty information to the sensory feedback system which in turn will 'learn' a faulty program. This will lead to the establishment of dyspraxic characteristics.

Stark, 1980, acknowledges future need to study infants' developing speech-production skills in relation to their communicative use of these skills. In the meantime, she describes stages of speech development during which infants learn to control laryngeal and articulatory gestures above the larynx. She indicates the importance of the combination and recombination of features, the increasing control of speech musculature, and the interaction between the two. Stark, op cit, describes in her Stage 4, reduplicated babbling, 31-50 weeks, the first resemblance to speech in the characterisation of CV syllables, each closely similar to each other. In addition, this production resembles speech much more than any previous stage in its timing. It could be as early as this stage that children with developmental articulatory dyspraxia fail to learn, by means of reliable sensory feedback, the consonantal, and in some cases, vowel productions which are built into series of productions to signal verbal communication. At the same time, the development of stress

patterns and timing may be interrupted. This failure could predict disturbances in the development of both phonetics and phonology and further have implications for both an articulation disorder and a phonological disorder. Such findings imply a relationship between babbling and phonological universals, as they describe the segments which the infants are capable of producing at the end of the prespeech period, as the segments most likely to be found in adult phonological systems (see Cruttenden, 1970; Dore et al, 1976; Oller et al, 1976).

3. The relationship between interpersonal and intrapersonal auditory feedback systems, and their role in the development of phonological systems. Discussion of the effect of the presence of developmental articulatory praxis on these systems

It could be postulated that the presence of developmental articulatory dyspraxia disrupts children's ability to learn to discriminate due to the unreliable intrapersonal feedback it produces. Children learn to perceive and discriminate language input by means of two input systems - that from the environment around them by which, indirectly, they receive auditory input carrying information concerning the language used by adults and others. This is available via acoustic airwaves. The second is that received by bone-conduction and by direct means from the children's own output which is decoded for monitoring and any necessary correction, as it is simultaneously encoded for other listeners.

In this connection, Grunwell, 1981a, refers to Winitz, 1969, who proposes that it is the speech problem that 'causes' the auditory failures. He hypothesises that, if for some reason, the discrimination ability does not develop early, then the children's own immature speech production will provide negative auditory feedback which will eventually 'drown out' the later potential to discriminate intrapersonally, and in some instances, possibly interpersonally. This is the logical follow-up to the contention that children, such as those with disrupted output of

developmental articulatory dyspraxia, do not develop, by means of their proprioceptive feedback loop system the automatic postures necessary for adult-targetted pronunciation patterns. The involvement of the exteroceptive feedback loop system described by Hardcastle, 1976, which is conducted through auditory and tactile channels, added to the existing confusion of children with developmental articulatory dyspraxia, could be expected to increase their difficulties. Different aspects of learning will be affected as a result of the interaction of these two feedback loop systems. Evidence exists which indicates that various features can be differentiated by definition into auditory and articulatory, Lieberman, 1970; Ladefoged, 1971. For example, some primary auditory features are voice onset, stop and sibilance while glottalicness, articulatory place and backness are examples of articulatory features, Ladefoged, op cit.

MacNeilage, 1980, shows existent relatively invariant acoustic correlates, but no invariant neuromuscular ones for auditory features. Similarly, for articulatory features there exist relatively invariant neuromuscular correlates but no invariant acoustic ones, Studdert-Kennedy, 1976. It seems possible that the variability fed back through dyspraxic children's intrapersonal self-monitoring systems will create confusion which will influence their reception of interpersonal auditory feedback from adults. Straight, 1980, speculates that normally developing children have a developing perceptual representation for their own speech based on their intrapersonal feedback which differs from that with which they perceive adult speech.

This theory can be applied with slight modifications to developmental articulatory dyspraxia and its effect on phonological system development. Following Straight, op cit, we can assume that children's underlying perceptual forms are very different from adults'. The presence of developmental articulatory dyspraxia will, of course, affect the speech

production of the children further distancing their output from the adult target. Straight, op cit, in pointing out that children exhibit a high degree of variability from word to word in the amount of specificity of their articulatory targets, highlights further the different perceptual representation of their own speech. Referring to this subject he says:-

"The phenomenon of perceiving one's own speech less well than others' strikes me as a possible crucial phenomenon for the study of phonological deviance." p 65

How much more could the same phenomenon influence the phonological development of the children with developmental articulatory dyspraxia whose perceptual representation is additionally disrupted by their uncontrolled and highly variable productive performances. It appears that children with developmental articulatory dyspraxia may develop two phonological systems, one which is perceived auditorily and by which the speech of others is understood, and the second, their own defective systems which are used in speech output. This latter system has a perceptual input from the children's own auditory feedback mechanism. The children may not, of course, be conscious of this input as demonstrated by the 'fis' phenomenon. However, evidence exists that children may become aware of their problems in production and may elect to avoid difficult pronunciation patterns. The case for avoidance is strengthened if it can be proved that children understand a fair sample of words containing the avoided segment(s) by means of interpersonal auditory feedback, Ferguson & Farwell, 1975; Menn, 1976. Several children with developmental articulatory dyspraxia have been observed to practise avoidance.

4. Implications of developmental articulatory dyspraxia for current theories of phonological system development
- a. To learn a phonological system, children require several perceptual and productive abilities. Initially they must be able to hear what is happening around them. From heard input they must be able to select out speech sounds. To use the input in a meaningful way they have to be able to discriminate at various levels, the segmental, syllabic, word-level and so on. In addition they have to learn to recognise distinguishing features, both segmental and non-segmental. Using all the detailed features available they have to learn to perceive the contrastive segments, then to produce these segmental contrasts, and finally to combine them to form more complex and different units. All of the received signals have to be processed cognitively and committed to memory. The memories stored are multi-modal in form, including visual, auditory, proprioceptive and tactile. To allow for the considerable number of contrasts and combinations required to be converted into production, rules have to be created by which recognition, classification, recall and retrieval can be utilised to formulate groups of these features into forms which will equate to those used by others in the environment. Phonological features have to be acquired and numerous permutations have to be practised to adapt them for meaningful use. The whole process is, arguably, a cognitive one by which interpersonal and intrapersonal information is received and correctly selected. This information is then probably processed through a central language area and used to organise and activate the productive system. (There is evidence that an automatic but inappropriate system can be learned by human beings which appears to be stored in a separate area and not connected with the central language area, ie echolalia, see Darley, Aronson & Brown, 1975.)
- b. Ferguson & Macken, 1980, emphasised the cognitive nature of phonological system development. They suggested that children form hypotheses by which they experiment with different methods of approach when attempting to create their individual rules for use in the development of the system. For example, the onset of

systematicity is increasingly viewed as evidence that children have 'invented' a rule. Similarly, irregular segments that have been produced accurately, may lose accuracy when a 'rule' appears in the children's systems. The evidence for changing hypotheses is to be found in the situations in which children replace one systematic rule with another equally systematic rule which has just been learned, and over-generalisation of this new rule sometimes occurs.

Ferguson & Macken, op cit, claim that another aspect observable in acquisition is selectiveness which is one of the first indications of the active role of the child in acquisition (see, Ferguson & Farwell, 1975). Active selection and/or avoidance of words with a particular structure is not uncommon.

The third aspect mentioned is creativity in children's production. For example, some of the words used by children are not present in the adult language, but are permissible since they obey the children's existing rule system, eg 'vocables', Ferguson, 1976; 'protowords', Menyuk & Menn, 1979. The dynamic nature of the system reflects the constant creativity used by children in their gradual move towards adult forms, Hsieh Hsin, 1972.

Further evidence of children's active participation in the formulation of rules is the indication that in the early stages, data analysis is carried out at a very low, perhaps individual syllable/word basis. Thence the production of 'protowords', signalling some meaning. By 1;0 - 2;0 further learning and acquisition of rules enables the children to expand their phonological repertoire.

Menyuk & Menn, 1979, propose that children's processing takes place by means of analysis by synthesis, at a very basic, possibly distinctive feature level. Ferguson, 1976, contends that basic analysis is done at a word level. Straight, 1980, states categorically that analysis occurs by analysis and synthesis occurs by synthesis.

- c. Every child appears to be born with a facility to simplify speech consistently.

The majority of children develop a phonological system apparently by the gradual loss of these simplifying processes until their words match adult models, see Stampe, 1969. Considerable speculation remains regarding the acquisition of phonological systems by children. Menn, 1980, states:-

"a theory devised to account economically for an adult behaviour cannot generally account for the acquisition of that behaviour. The relation between adult and child is, among other things, the relation between skilled and unskilled performer. If the adult produces no unskilled acts, the central theory is unlikely to have a way of modelling the production of unskilled acts. And if it cannot model unskilled acts it cannot model the child's acts. Therefore, the child cannot be modelled merely as one who possesses a subset of the capacities of the adult"

p 27

Discussing 'rules', Menn, op cit, advises careful approaches to the subject. She strongly asserts that the claim that ordered rules are unlearnable makes no sense. The rules themselves are never in evidence, only patterns. The exceptions to a pattern may form a less general pattern, claims Menn. This could be what is taking place in the cases of children with developmental articulatory dyspraxia. The children can still formulate rules, but the disruptions in both their perceptual ability and production facility may be interacting to prevent them from progressively formulating and reformulating patterns of speech acceptable as developing adult forms. This does not mean that these children cannot produce rules for pronunciation patterns. It does mean that the motor programming fault which affects their sensory motor feedback will militate against them producing patterns which, in themselves, will equate to adult targets. For different reasons, other children with learning problems possibly of a cognitive nature, may be unable to create rules to facilitate

the development of phonological systems. It appears that there is, within all children, a facility to create the rules which each individual will apply to the production of pronunciation patterns. Numerous problems can arise which may prevent some children from acquiring and developing an acceptable system. These children will be seen to have a developmental phonological disorder.

The presence of developmental articulatory dyspraxia in children learning to acquire and develop phonologies will have serious effects for the following reasons:-

1. The motor programming disorder will interfere with the production of acceptable patterns.

2. By means of the intrapersonal auditory feedback loop system, disrupted output will be received by the children. Thus the data to be used for the selection and creativity of rules will be faulty from the outset. The contention is made that to some degree, the interpersonal auditory feedback loop system input is sufficiently intact for comprehension of the message it carries, but it is not sufficiently strong to influence the effect of the disrupted, 'direct', bone-conducted, auditory input on which the children appear to operate their rules. Thus the children resort to creating rules which can only approximate to the productions required for output.

3. In developing their phonological systems, children form hypotheses, or create rules. These rules are frequently changed. Such changes are seen to reflect the changing hypotheses which are formulated by children to achieve increasingly more complex and 'acceptable' pronunciation patterns. The presence of developmental articulatory dyspraxia will further disrupt children's attempts to create these rules. In fact, there is probably a circular situation existing, as the whole process will be exacerbated by the unreliable self-monitored feedback received by such children via their intrapersonal auditory feedback mechanism.
4. Pronunciation patterns produced by children with developmental articulatory dyspraxia may consist almost entirely of 'favourite articulations'. These result in simplified forms, eg, glottal replacements, which the children can use successfully for all types of pronunciations.
5. These reduced forms of production will simplify phonological patterns at the same time, thus resulting in a phonological disorder co-occurring with the original articulation disorder.

The interdependence of articulatory and phonological systems is clearly demonstrated in this explanation and it is hypothesised that the existence of the articulation disorder will severely disrupt the acquisition and development of an acceptable phonological system.

5. Motor programming deficit and its specific implications for developmental articulatory dyspraxia

It is being claimed that the deficit in the neuromuscular system acting as the main aetiological factor in the condition of developmental articulatory dyspraxia is that of the motor programmer. It is possible to see this claim as providing a cycle of circumstances with numerous extensive implications. The inability to form the correct positions from which to operate the speech musculature and to sequence muscle movements can be seen as the trigger of a series of breakdowns in motor speech production. The following are affected:-

1. The immediate production patterns.
2. The sequence of segments used to signal specific meanings.
3. The intrapersonal feedback via bone-conduction to the middle ear.
4. The acoustic signals by which the features of the intended segments and sequences of segments are delineated.
5. The creation of rules to apply to the segments and sequences of segments whereby they can be
 - (i) stored in the perceptual memory banks,
 - (ii) formulated into appropriate signals to motivate the motor programmer to initiate the desired production.
6. The pronunciation patterns produced.

Every stage of the cycle is affected by the initial deficits within the motor programmer.

It has been further contended that every moderate to severe case of developmental articulatory dyspraxia will interfere with the acquisition and development of a normal phonological system.

It is pertinent to point out, moreover, that on the basis of the performance of the population studied in this research, a further apposite claim can be made at this stage. This finding is largely derived from the results of the Edinburgh Articulation Test. It is that in all the cases of immature articulatory praxis identified, no occurrence of a developmental phonological problem resulted. Exceptions have to be made in the three cases of children with immature articulatory praxis from the LI group. In one case, the issue was complicated by the presence of severe articulation disorders related to post-operative cleft palate, in which just sufficient tissue remained to enable the child, S1, Mary, eventually to produce acceptable pronunciation patterns. Hearing loss had also been present intermittently during the second to fourth years of this child's development.

S2, Kerry, had either severe immature articulatory praxis or mild developmental articulatory dyspraxia. It was extremely difficult to be certain which was present, but whichever it was, by age 8;1 this child was still presenting with an articulation age of 3.75, that is, nine months behind the age of 4;6 which Grunwell, 1982, claims to be the age at which normal children have acquired a normal phonological system. Reports of her early assessments indicate the presence of a severe developmental phonological disorder now almost completely resolved.

S9, Philip, presented on EAT with articulation age 3.75 at CA 8;0. He had initially been referred to the special placement as the result of a severe phonological and general language disorder.

Thus the assertion can be made that, in the absence of any other language implications, immature articulatory praxis does not lead to a developmental phonological disorder. It now remains to be seen whether the application of Phonological Analysis of Child Speech (PACS) Grunwell, 1985b, to the data resulting from the EAT and the diagnostic procedure will support the claim here made.

If developmental articulatory dyspraxia is present it is predicted that PACS will reveal the following types of simplification:-

1. 'Favourite Articulation' - repetitive use of a particular form of production which the children find easiest to produce, eg, front plosive consonant followed by a vowel.
2. Highly variable phonological realisations, resulting from trial-and-error attempts to equate to adult targets.
3. Reduced phonotactic possibilities, usually CV, possibly CVCV and occasionally CVCVCV or similar sequence, ie, CR, FCD and GR.
4. Sequential errors such as metathesis.
5. Overall disruption of the phonological system.

CHAPTER SEVEN

Grunwell, 1985b, has produced PACS to enable those working with children displaying degrees of unintelligible speech, to discover the particular areas of development which are specifically affected. The aim is to facilitate diagnosis and thus afford the means to direct the plans for clinical management.

In its present state PACS is comprehensive, in that it can pinpoint most areas in which children are making simplifications and modifications which differ from the target adult realisations, see Grunwell, op cit.

To test the hypothesis presented - that the presence of developmental articulatory dyspraxia has an adverse effect on the acquisition and development of a normal phonological system, it is necessary to study in detail the results of PACS. For this comprehensive study only the subjects deemed to have moderate or severe developmental articulatory dyspraxia will be included in the scrutiny. These are S3, S4, S5, S6, S7 and S8. The three apparently most severely affected children are S4, S5 and S6. S4, Andrew, and S6, Phillip, were both just over 9;0 at the time they were assessed on the DADDP. S5, Graham, was 6;6 so it is possible that he may eventually gain more ground than the other two. Of the six children selected, the ratio of male to female is 5:1. The mean age is 7;7.

In the first place it is necessary to note the ages when normal children attain the different processes which characterise adult representations. By 2;0 years, consonant contrasts emerge in a basic form as follows:-

nasal/oral

obstruent/sonorant

labial/lingual

stop/fricative

voiced/voiceless (stops)

Grunwell 1982

By 3;0-3;6 years, Grunwell, op cit, claims that in the elaboration of

structural patterns the following tend to occur:-

- a. harmony and reduplication rules disappear early;
- b. syllable final consonants appear;
- c. consonant clusters, especially in the initial position, begin to appear;
- d. unstressed syllables are used in all contexts by 3;6.

Expansion of the systemic contrasts occurs in the following order:-

- a. velar consonants and a lateral are used by 3;0;
- b. palato-alveolar voiceless fricative and both affricates appear between 3;0 and 4;0.
- c. voicing of fricatives is used by 4;0;
- d. dental slit fricatives and / / are not used until 5;0 or later.

Bearing this information in mind, consideration is given to PACS. PACS can be adapted for clinical and research use. For the purpose of this investigation the following aspects of the procedure have been used:-

1. A data sheet on which is recorded
 - a. Orthographic Gloss
 - b. Adult Phonemic Representation
 - c. Adult Syllabic Structure
 - d. Child's Pronunciation
 - e. Child Syllabic Structure
2. Phoneme Realisations divided into
 - a. Syllable Initial Word Initial - SIWI
 - b. Syllable Initial Within Word - SIWW
 - c. Syllable Final Within Word - SFWW
 - d. Syllable Final Word Final - SFWF
3. Cluster realisations in all possible positions

4. Phonetic Inventory and Phonetic Distribution

5. Phonological Process Analysis

6. Developmental Assessment

S3, Neil, age 7;1 (see p168) produced pronunciations which contained a number of both structural and systemic simplifications. Included in these were some pronunciation patterns which are not only idiosyncratic, but also somewhat difficult to account for, eg

$/tʌθbrʌʃ/ \rightarrow [rɛz];$ $/ðat/ [zə].$

In the EAT, Neil produced six atypicalities which mirrored his problem in finding an approximate realisation to represent the adult target in some instances. One of the six atypicalities was realised as [tʃ] and one as [tʂ] and one as [ʂ] showing a tendency to affrication and friction. The tendency towards gliding, of which there are eight examples, five /r/ and three /l/, in this relatively small data sample indicates not only 'favourite articulation', Ingram 1976, but selection of a facile choice, supporting the strong use of fronting. This child has little or no elevation of the tongue tip either in articulation or oral movement. He uses jaw movement in a supportive vertical fashion to a marked degree. This may be a compensatory movement to augment the poor tongue elevation. In the case of the inexplicable selections made in a few instances, eg, for 'toothbrush' and 'that', it may be that control of the outgoing production was totally lost and the production became arbitrary. Confusion exists in the attempts to use affrication - the ability is demonstrated, eg, the final pronunciation pattern in 'garage' and 'bridge' is correctly realised. The tendency to affricate /kʌ/, /gʌ/ and /sʌ/ to [tʃ], [dʒ] and [tʃw] occurs on four occasions. This is an unusual, but not unknown, pronunciation, which once again may result from the tongue's inability to move sufficiently quickly between the back elevation and the more indeterminate approximant placement, in two of the three examples. Overall the approximants are most frequently represented by [w] which is the approximant requiring tongue movement to velum. It is a fact that /t/ and /d/ can be produced with minimum tongue movement and across a wide area of the blade of the tongue. These

pronunciations also occur in immature development, but indications from the results of both DAD and EAT suggest that the problem in this case is connected with the moderate degree of developmental articulatory dyspraxia which is present, as evidenced by 38% of articulatory precision errors.

S4, Andrew, age 9;0 (see p175) This child manifested the greatest amount of expressive language difficulty of the total number, ie 160, children observed in the course of this investigation, with the exception of the institutionalised children seen. Each assessment produced poor results and evidence is available of major phonetic, phonological and general linguistic problems. The number of adult forms produced in the EAT was the lowest recorded on any occasion by the present author, these were: /m/, /p/, /t/, /d/ and /r/. Not one word was realised in adult form. Only consonant harmony simplifications were not recorded in the structural simplifications. The majority of simplifications were consonant deletions mostly occurring in the final position but also noted in SIWI, SIWW and SFWW positions. The maximum number of cluster reductions possible in the data were recorded. Systemic simplifications included 17 instances of glottal replacement. It was noted that on frequent occasions when a closer approximation to adult target proved impossible, Andrew produced glottal replacements. In one polysyllabic word he produced them in three positions, SIWI, SFWW and SFWF. Vowels were also distorted. Gliding was the only form of systemic simplification which was not evidenced. One of nine possible /l/s was realised. The remainder were deleted. Of 12 possible /r/ realisations, one was realised and 11 deleted. Intelligibility of speech was severely reduced and it was also almost impossible for this child to communicate by facial expression or any type of prosodic means as his generalised dyspraxia made every effort subject to disruption and/or distortion. School reports indicate that Andrew has managed to produce some words by means of Paget Gorman signed speech but these too are limited and inaccurate, only proving helpful when the listener requires additional cues to aid intelligibility.

It seems possible that this child is a member of the small proportion of the population who have cognitive ability which they are unable to

exploit due to the severe amount of dyspraxia affecting all voluntary movements and the movements of articulation in particular.

S5, Graham, aged 6;6(see p 184). This child was one of the three most severely articulation-handicapped in the LI group. His difficulties were found to be concentrated in articulatory precision and consistency in the diagnostic procedure although sequencing also proved to be a problem. His structural simplifications in PACS indicated not only severe immaturity but also a marked degree of idiosyncratic productions. Some of these showed signs of reduction in phonotactic terms, in instances of polysyllabic words. However, metathesis was also present, eg, [mat] for /stamps/ in some, and metathesis and constant harmony, eg, [mem] for /m'breɪb/. This may have arisen due to a total inability to create strategies to deal with this rather unusual cluster of segments which are also produced in a differently accented form from the majority of words in English, ie, second rather than first syllable stressing. The child appears to have perseverated on the first consonant and been unable to find a means to approximate the remainder of the word to the adult target. Consonant deletion, both WF and SFWW, was present affecting around 30% of the productions, while consonant harmony was also noted in several instances. In the case of cluster reductions, more were recorded in the categories of /st/, /sp/, /sm/, /str/ and /fl/ than in /gʌ/, /br/ etc. This is an indication that slow development of phonological realisations is taking place. Although developmental articulatory dyspraxia is present it may not have such a disruptive effect on this child's speech as on one or two others as he is younger and obviously still developing rules to help him produce closer-to-adult forms. The same tendency is seen in the types of systemic simplifications produced. These were confined to instances of immature productions with no evidence of more deviant forms. The types of error recorded under the heading of 'others' indicated unsystematic use of friction, and unawareness in placement between the front, middle and back of the oral cavity. With the high degree of inconsistency recorded and the observed tendency to grope for articulation placement, a clear picture results which indicates the effect of the developmental articulatory dyspraxic disorder on the development of the phonological system.

S6. Phillip, age 9;1 (see p191) This is a child whose productions evidenced the second greatest degree of difficulty in the LI group. Like Andrew, this child is over nine years of age and the expressive language available to him is extremely limited. He uses Paget Gorman signed speech to a marked degree and has none of the accompanying dyspraxias other than those affecting the oral cavity, articulatory and oral. Once again, problems were identified in areas of major complexity and the phonological system evidenced the majority of problems occurring in the number of structural simplifications produced. In each example of a polysyllabic word, one syllable was deleted indicating inability to handle more than two syllables at any time. This is further evidence that children with developmental articulatory dyspraxia have the greatest amount of difficulty working out means by which to program the movement sequences of their oral musculature to enable them to perform the actions required to produce the fine, rapid movements of normally produced pronunciation patterns.

One example of vocalisation and consonant harmony and two of reduplication were present. Every example of clusters in the data was reduced. Here is further proof of the manipulative difficulty experienced by this child in attempting to direct the movements of his articulators.

Fewer systemic simplifications occurred. However, each possible type was represented with the exception of context-sensitive voicing. Fronting constituted the most frequent process and all except one were velars fronted to the alveolar position. Deaffrication was the other process noted on three occasions. Not only does this child present with the second greatest number of difficulties in the diagnostic procedure for DAD and in the analysis of phonology, he also produces the second greatest number of atypical realisations in the EAT. Once more this indicates the amount of difficulty Phillip has in his attempts to equate pronunciation patterns to those of the adults around him.

S7, Michael, age 7;10 (see p198) Here is a child whose difficulty is limited to the area of formulating rules to enable him to realise

pronunciation patterns equivalent to adult realisations. He realises the correct number of syllables in the majority of words but cannot group their constituent segments into mature sequences. He appears to have difficulty in devising a system by which he can utilise the parts of his oral cavity behind his alveolar ridge. This is supported by the fact that the majority of the simplifications used are examples of fronting. Seventeen of twenty-three possible realisations of fronting contained consonants which had been fronted, thirteen velar and four palato-alveolar. All other systemic simplifications were represented to a minimum degree particularly gliding and glottal replacement in both of which five examples occurred.

Structural simplifications included three examples of weak syllable deletion. Consonant deletion was recorded in seven final positions, one SIWW position, and three SFWW positions. The only other category of structural simplifications in which Michael evinced difficulty was cluster reduction, in which fifteen of seventeen possible responses were affected. The correctly produced cluster was SIWW. One contradictory realisation appeared when the SFWW /S/ was palatised to [ʃ] in the word 'Christmas'.. Otherwise a clearly discernible pattern appears which leads to the assumption that for this child the presence of developmental articulatory dyspraxia affects the development of the phonological system particularly in the areas of velar production and the realisation of clusters.

S8, Joanne, age 6;8 (see p205) Apart from the fact that this is the only female with developmental articulatory dyspraxia in the nineteen children from the experimental groups, this child evinces greater difficulty in consistency and in sequencing than in articulatory precision. She has, on the diagnostic procedure nevertheless, indicated by her responses that a striking degree of immaturity is present. Structural simplifications reveal final consonant deletion in thirty per cent of possible examples. Three occurrences of vocalisation and four of consonant harmony are recorded. The most frequently realised simplification occurs in the category of cluster reduction in which only four instances in the possible twenty were acceptably realised.

In the simplifications recorded in the systemic processes, a few were

noted in each section with most affecting context-sensitive voicing.

Other simplifications not classified as normal included deaffrication, denasalisation and assimilation, epenthesis, metathesis and lenition of stop. The variations occurring between such realisations suggest the amount of struggle taking place in an attempt to produce acceptable pronunciation patterns to match those perceived. It is evident that this child has additional problems of a spatial/temporal nature. Her inconsistencies are reflected in the metathesis and epenthesis present, which highlight the sequential difficulties in her production.

The developmental articulatory dyspraxia present, which is showing its influence on this child's productive ability, is resulting in a marked degree of unintelligibility of speech.

Comparison of Errors within PACS and between PACS, DADDP, EAT and RDLS in children presenting with developmental articulatory dyspraxia

Six children S3, S4, S5, S6, S7 and S8 have been deemed to have developmental articulatory dyspraxia to either a moderate or a severe degree on the basis of the diagnostic procedure. Each of the six present with more structural simplifications than systemic simplifications. Consonant deletion, mostly final, and cluster reduction account for the greatest number of difficulties. This indicates a particular difficulty in the closure of words and in coping with two or more consonants occurring together, for children struggling to signal all the segments required to produce intelligible speech. Children with other problems of expression, for example, developmental phonological learning disorders, also have difficulty in these areas, however; thus it cannot be claimed that developmental articulatory dyspraxia accounts for these simplifications entirely. What can perhaps be judged to result from the presence of developmental articulatory dyspraxia, particularly in the cases of the severe form, ie, in S4 Andrew, S5 Graham and S6 Phillip, is the fact that so few strategies can be utilised and so few rules can be created to program the output that the resulting pronunciation patterns are very immature. When compared with the results of the diagnostic procedure it is interesting to note that the three children with the most severe degree of developmental articulatory dyspraxia, are the three with the most numerous simplifications in PACS. For example, S4 Andrew, the child most severely affected in articulatory precision, consistency and sequencing, has some structural simplifications in all areas except consonant harmony. Instances of deletion, including syllable deletion, and cluster reduction still account for the greatest amount of simplifications. S4 Andrew, also has a high number of systemic simplifications. These are increased by the presence of 17 glottal replacements. The latter form is resorted to whenever it is impossible to produce a 'closer-to-target' realisation. This child also presented with the greatest number of 'other' simplifications not classified as normal indicating that he is trying various means to reach the desired target. He is using idiosyncratic strategies in an attempt to create acceptable patterns. This child who has

several forms of dyspraxia, in fact all his voluntary movements are poor, had he not been diagnosed early enough, might have been mistaken for a mentally handicapped child.

A surprising result was recorded by S3, Neil. He instanced a high number of structural simplifications again widely different including each category with the exception of reduplication. The highest incidence of simplification was revealed in Consonant Deletion, mostly final, and six instances of Weak Syllable Deletion were present. He had the lowest number of Cluster Reductions recorded by any of the nine children whose speech was analysed, including the two children deemed to have immature articulatory praxis. On the other hand, he recorded the highest number of systemic simplifications, including those of S4, Andrew. The category in which most simplifications were present was 'Fronting', in which he simplified 18 of the possible 21 realisations. He also presented with more instances of 'Gliding' than any of his peers. So far as this analysis compared with the results of the other assessments is concerned, he does appear to have a mild to moderate degree of developmental articulatory dyspraxia. However, consideration of the results of PACS leads one to assume that a developmental phonological learning disorder may also exist . autonomously. It is, however, possible to speculate that the presence of the former will have some disadvantageous effect on the latter and that there is interaction between the two.

S5, Graham is interesting for different reasons. This is the youngest child in the group and, unlike S4 and S6, was referred for special speech therapy and educational intervention at an earlier age. The results of his assessment on the diagnostic procedure showed considerable difficulty with both articulatory precision and consistency. His sequencing ability was less severely affected. These results were supported by those of the EAT. At the same time the RDLS results indicate a considerable language problem which may be accounted for by extreme immaturity, or some amount of language deviance. Although there are still some important indications of the simplifications recorded as the result of the PACS, there are also signs that could be interpreted as the effect of intervention. This child again presents with most structural simplifications in final

consonant deletions and cluster reductions. However, there are fewer examples of both, particularly in the case of cluster reductions. Systemic simplifications are realised by all but glottal replacements and the simplifications grouped under 'others' include metathesis which it is claimed, eg Johnson, 1980, is a characteristic of developmental articulatory dyspraxia.

S6, Phillip, an older child of similar age to S4, Andrew, once again indicates that the presence of severe developmental articulatory dyspraxia has interrupted the normal development of a phonological system. The structural simplifications point to the implication of the more complex categories Consonant Deletion, mostly final, and Cluster Reduction. There are fewer systemic simplifications once more and in this case, fewer simplifications of any other type. Again the overall picture is of a marked reduction in mature forms following, in the presence of developmental articulatory dyspraxia, an inability to achieve the necessary amount of creativity to establish the rules required in the formation of a reliable phonological system. This child unlike most of the others in the LI group, has a literacy facility by which he has learned reading and writing. He has also been able to communicate by means of Paget Gorman signed speech.

So far as the other assessments are concerned S6, Phillip, has produced results which support the presence of developmental articulatory dyspraxia, eg EAT. The RDLS results indicate little expressive language difficulty emphasising the mechanical nature of the problem.

S7, Michael, produces results which indicate a marked disparity in the characteristics of developmental articulatory dyspraxia, which disrupt his speech. There are considerably fewer difficulties with both consistency and sequencing than there are with articulatory precision. In PACS the expected format is followed once more. The majority of structural simplifications take the form of Final Consonant Deletion, and Cluster Reduction. Each category in systemic realisation is simplified but the majority of simplifications are to be found in 'Fronting' in which there were 17 instances out of a possible 23. Fewer other forms of simplification were noted. This child had the

greatest number of 'Very Immature' responses in the EAT of all the children in the experimental groups. It seems likely that the presence of developmental articulatory dyspraxia and the extreme immaturity recorded, combined to affect the acquisition and development of a viable phonological system.

Finally, S8, Joanne, The only female of the three in the LI group who evidenced developmental articulatory dyspraxia. Once again the greater number of structural simplifications were to be found in Final Consonant Deletion and Cluster Reduction. Examples of each type of systemic simplification were also present and also a variety of other forms each realised by one or two examples. This child has an unusual distribution of characteristics of developmental articulatory dyspraxia, in which most difficulty is experienced with consistency, with sequencing in close pursuit and the least number of errors arising in articulatory precision. There is no indication from the results of PACS that this form of problem has had any different effect on the types of phonological disturbances ensuing. There are examples of Epenthesis and Metathesis, the serial order problems, but neither occur sufficiently frequently to influence any simplifications in either the structure or the system, more than in the other children's results. The fact remains that these children with the greatest amount of developmental articulatory dyspraxia, have the most 'Very Immature' and 'Atypical' examples in the EAT and present with the most disrupted developing phonological systems.

See analyses of results in following pages :- 157-245.

S1

Age 7;10 - 8;0 (at dates of final assessments)

Sex F

Status Attends school for L.I.

Assessments of Language and Speech

<u>RDLS:</u>	VC - Equivalent Age	7;0	C.A. 7;10
	Standard Score	0.7	
	EL - Equivalent Age	7;0	
	Standard Score	1.2	
<u>EAT:</u>	Quantitative - Raw Score	37	C.A. 7:10
	Standard Score	64	
	Qualitative - Adult Forms	31	
	Minor Variations	2	
	Almost Mature	4	
	Immature	9	
	Very immature	18	
	Atypical	1	
	Articulation Age	3.75	
<u>DADDP:</u>	Articulatory Precision Errors	11%	C.A. 8;0
	Consistency Errors	9%	
	Sequencing Errors	9%	
<u>PACS:</u>	<u>Structural Simplifications</u>		
	Final Consonant Deletion	7	
	SIWW Consonant Deletion	3	
	SFWW Consonant Deletion	2	
	Reduplication	1	
	Cluster Reduction	11	

Systemic Simplifications

Fronting	6
Stopping	2
Gliding	4
Glottal Replacement	2

Others

Back Assimilation	1
Insertion of Stop	1
Devoicing	1
Liquid Simplification	1

Evaluation of Assessments

RDLS Both components of this test showed results within normal limits.

EAT The results are clustering in the direction of normal although there remains a group of very immature responses.

DADDP The small amount of errors supported by the results of the EAT lead to the suggestion that this child displayed immature articulatory praxis which is well on the way to being resolved.

Results from other sections revealed normal responses except for a small amount of inco-ordination.

This child has some degree of developmental phonological disorder due to factors other than immature articulatory praxis. She was born with a cleft palate which was surgically repaired at an early stage. Conductive deafness was identified around 3;0 after chronic otitis was diagnosed. Grommets were fitted as a result of this.

PACS

No of tokens No possible

STRUCTURAL SIMPLIFICATIONS

1. Final Consonant Deletion

plosives

2 5 /ðæt/ → [ðə]; /ləɪk/ → [ləɪ]

fricatives

2 9 /'krɪsməs/ → ['krɪspə]; /hɒs/ → [p]

clusters: -1

3 6 /mɪlk/ → [mɪk]; /desk/ → [des]

/ləst/ → [ləs]

2. SIWW Consonant Deletion

3 /'ɛrəpleɪn/ → [ɛəpeɪn]; /'tɪmɪ/ → ['tɪmə]

/'brɪndʒ/ → ['brɪndʒ]

3. SFWW Consonant Deletion

2 /'bɪrθde/ → ['bɪdeɪ]; /ʌm'brɛlə/ → [ɛ'bleɪə]

4. Reduplication No of tokens No possible

partial 1 - /'jɛləv/ → ['jɛjəv]

5. Cluster Reduction

plosive + approximant 6 10 /'ɛrəpleɪn/ → ['zəpeɪn]; /klaʊdz/ → [kaʊnds]

/'tʌbbrʌʃ/ → ['tʌfbʌʃ]; /brɪdʒ/ → [brɪdʒ]

/blu/ → [bʌ]; /braʊn/ → [braʊn]

fricative + approximant 2 2 /'flaʊə/ → ['faʊə]; /θri/ → [fi]

/s/ + plosive 1 2 /stæmps/ → [tæmps]

/s/ + approximant 1 1 /'slɪpɪŋ/ → [sɪpən]

/s/ + plosive + approximant 1 1 /striŋ/ → [twɪŋt]

SYSTEMIC SIMPLIFICATIONS

	No of tokens	No possible
1. <u>Fronting</u>		
velars	2	15
palato-alveolars	4	10
		/'mʌŋkɪ/ → ['mʌnkɪ]; /wɪŋz/ → [wɪnz]
		/brɪdʒ/ → [brɪdz]; /fɪs/ → [fɪs]
		/'gɑrɪdʒ/ → ['gɑwɪdz]; /'sɜːldʒə/ → ['sɜːrdzə]
2. <u>Stopping</u>		
/tʃ/	2	3
		/'tʃɪmɪ/ → ['tɪmɪ]; /'mɑːtʃɪz/ → ['mɑːtɪz]
3. <u>Gliding</u>		
	4	15
		/'krɪsməs/ → ['krɪspə]; /'gɑrɪdʒ/ → ['gɑwɪdz]
		/strɪŋ/ → [tʰwɪŋt]; /'rɑːtə/ → [wɑːtə]

4. Glottal Replacement

WV replacement	1	/ʌm'brɛlə/ → [ɛ'blɛɹə]
WF insertion	1	/'sɔɹldʒə/ → [ʃɔɹdzəɹ]

OTHERS

1. <u>Back Assimilation</u>	1	/bɒtɫ/ → [ˈbɒkɫ]
2. <u>Insertion of Nasal</u>	1	/klɔɹdz/ → [kɔɹndz]
3. <u>Devoicing</u>	1	/glʌv/ → [glʌf]
4. <u>Liquid Simplification</u>	1	/ʌm'brɛlə/ → [ɛ'blɛɹə]

S2

Age 7;10 - 8;1 (at dates of final assessments)

Sex F

Status Attends school for L.I.

Assessment of Language and Speech

RDLS: VC - Equivalent age 5;02 C.A. 6;0
Standard Score -1.0
EL - Equivalent Age 4;09
Standard Score -1.0

EAT: Quantitative - Raw Score 36 C.A. 7;10
Standard Score 60
Qualitative - Adult Forms 29
Almost Mature 3
Immature 6
Very Immature 27
Articulation Age 3.75

DADDP: Articulatory precision Errors 29% C.A. 8;1
Consistency Errors 26%
Sequencing Errors 26%

PACS: Structural Simplifications
Weak Syllable Deletion 2
Final Consonant Deletion 7
Reduplication 1
Cluster Reduction 16

Systemic Simplifications
Fronting 8
Stopping 2
Glottal Replacement 1

<u>Others</u>	
Deaffrication	2
Devoicing	1
Vocalisation of Lateral	1

Evaluation of Assessments

RDLS

Both verbal comprehension and expressive language are just within normal limits being recorded in each case at minus one standard deviation from the mean. This level can be problematic as there are no extra resources to facilitate learning which is stretched to the limit, and because the child gives evidence of coping with linguistic situations across the board, adult expectations are high and resulting constraints may be imposed.

EAT

A considerable amount of very immature articulation is still present. This child would be regarded as 'at risk' of learning an improved articulatory system with this score at her age.

DADDP

Over a quarter of this child's ability with articulatory precision, consistency and sequencing can be regarded as failing to meet normal developmental requirements. This again is at a level where appearances and productions will belie ability.

In the other sections of the DAD procedure the following were revealed:-

- a. A mild right/left confusion.
- b. Mild oral dyspraxia particularly affecting the tongue.
- c. Rapid fading of rhythm trace after first imitation.

PACS

No of tokens No possible

STRUCTURAL SIMPLIFICATION

1. Weak Syllable Deletion

posttonic	2	27	/ɛləfənt/ → [ɛfənt]; /ɛrəpleɪn/ → [ɛpeɪn]
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2. Final Consonant Deletion

nasals	1	8	/ˈslɪpɪŋ/ → [ˈsɪpə]
plosives	2	8	/bəˈsɑ:d/ → [bəˈsɑ:ɪ]; /bɪg/ → [bɪ]
fricatives	2	13	/wɪθ/ → [wɪ] ; /ˈkrɪsməs/ → [ˈkrɪsmə]
cluster:-1	1	-	/kɔ:lɑ:dz/ → [kɔ:z]

3. Reduplication

	1	-	/ˈɪndʒən/ → [ɪnɪnɪn]
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4. Cluster Reduction No of tokens No possible

plosive + approximant 9 10
 /ɛrəpleɪn/ → [s peɪn]; /krɪsməs/ → [krɪsmə]; /klaʊdz/ → [kaʊz]
 /kreɪn/ → [teɪn]; /glʌv/ → [tʌb]; /drɔ/ → [dɔ]
 /blu/ → [bu] ; /ʌm'brɛlə/ → [ʌm'beɪə]; /brɪdʒ/ → [brɪz]

fricative + approximant 1 2
 /'flaʊə/ → [fəvə]

/S/ + plosive 3 3
 /spun/ → [pʌn]; /stamps/ → [tʌmp]; /mɒnstə/ → [mɒntə]

/S/ + nasal 1 1
 /smɒnsk/ → [mɒnk]

/S/ + approximant 1 1
 /'slɪpɪŋ/ → ['sɪpə]

/S/ + plosive + approximant 1 1
 /strɪŋ/ → [tʌɪŋ]

SYSTEMIC SIMPLIFICATIONS

1. Fronting

velars 2 11
 /glʌv/ → [tʌb]; /gærɪdʒ/ → ['dæɪzəz]

/fɪ/ → [fɪs]; /ʃɜrgə/ → [sɜrgə]; /wɒtʃ/ → [wɒts]

palato-alveolars 6 9
 /mætʃəz/ → [mætseɪz]; /gærɪdʒ/ → ['dæɪzəz]; /brɪdʒ/ → [brɪz]

2. Stopping No of tokens . No possible

/v/ 1 1
 /glʌv/ → [tʌb]
/dʒ/ 1 4
 /'sɔ:sdʒə/ → ['sɔ:sdə]
 /'gɑ:rdʒ/ → ['dɑ:zəz]

3. Glottal Replacement 1 -

OTHERS

1. Deaffrication 2 7

 /brɪdʒ/ → [brɪz]
 /'gɑ:rdʒ/ → ['dɑ:zəz]

2. Devoicing 1 -

 /glʌv/ → [tʌb]

3. Vocalisation of Lateral 1

 /'sɔ:rdʒə/ → ['sɔ:sdə]

Several very immature instances of persisting forms

suggest that a mild to moderate amount of immature

articulatory praxis is present in this child's speech,

and it is affecting articulation production

system.

Age 7;1 - 7;6 (at dates of final assessments)

Sex M

Status Attends school for L.I.

Assessment of Language and Speech

RDLs: VC - Equivalent Age 5;0 - 5;2 C.A. 7;5
Standard Score -2.6

EL - Equivalent Age 4;10 - 4;11
Standard Score -1.5

EAT: Quantitative - Raw Score 24 C.A. 7.5
Standard Score 44

Qualitative - Adult forms 25
Minor Variations 1
Almost Mature 1
Immature 7
Very Immature 25
Atypical 6
Articulation Age 3.25

DADDP: Articulatory Precision Errors 38% C.A. 7;1
Consistency Errors 23%
Sequencing Errors 18%

PACS: Structural Simplifications
Weak Syllable Deletion 4
Strong Syllable Deletion 1
Final Consonant Deletion 15
Word Initial C D 1
Vocalisation 4
Consonant Harmony 4

Cluster Reduction	6
<u>Systemic Simplifications</u>	
Fronting	17
Stopping	7
Gliding	8
Glottal Replacement	4
<u>Others</u>	
Affrication	4
Deaffrication	1
Insertion of Stop	3
Devoicing	2
Voicing	1
Reduplication	1
Liquid Simplification	1
Metathesis	1

Evaluation of Assessments

RDLS The results of this assessment indicate that this child has more capability in expression than he uses. It also appears that he is less able in language comprehension than in expressive language.

EAT The profile presented by these results indicate major difficulties created by both delay and deviance, although the immaturity factor is stronger.

DADDP Considerable difficulty is evidenced in articulatory precision, with less in consistency and much less in sequencing in this case. Results from the other sections showed some inco-ordination of movement and some visuo-spatial immaturity. Oral dyspraxia is present in the movements of the tongue. Very little rhythmic ability is present within the parameters tested.

PACS

STRUCTURAL SIMPLIFICATIONS	No. of Tokens	No. of Possible
1. <u>Weak Syllable Deletion</u>		
post tonic	4	28
		/ɛrəpleɪn/ → [jəpweɪn]; /ɪndɪʃən/ → [ənən]
		'krɒkədɑɪl/ → ['tɒ?taɪl]; /'æspən/ → [əsp]
2. <u>Strong Syllable Deletion</u>	1	-
		/'tʌθbrʌʃ/ → [rɛz]
3. <u>Final Consonant Deletion</u>		
nasals	3	14
		/'dɪnətəɪm/ → ['dɪnətɑɪ]; /həʊm/ → [əvə]; /leɪn/ → [we]
plosives	3	9
		/eɪt/ → [ɛ]; /ɪt/ → [ɪ]; /ʒat/ → [zə]
fricatives	3	15
		/ɪz/ → [ɪ]; /jes/ → [jə]; /faɪv/ → [faɪ]
clusters: -l	4	6
		/tɛnt/ → [tɛn]; /desk/ → [des]; /wɪŋz/ → [wɪŋ]; /bɑgz/ → [bɑd]
-2+	1	1
		/sɪks/ → [tə]

4. Vocalisations

/ʌ/	3	/fʌl/ → [frə]; /teɪbl/ → [tɛɪpɹ]; /'pɛnsɪl/ → [pɛnsəʊ]
others	1	/hæsm/ → [əvə]

5. Consonant Harmony

alveolar	2	/'sɔɪldʒə/ → ['sɔɪɹʒə]; /'krɪsməs/ → ['krɪʃɪfəs]
others	2	/'ɛləfənt/ → ['hɛhəfənt]; /'jɛləʊ/ → ['wɛwəʊ]
<u>6. Reduplication</u>	1	/'jɛləʊ/ → [wɛwəʊ]

7. Cluster Reduction

plosive + approximant	3	/klaɪdʒ/ → [tʃaɪz]; /krɒkədɑɪl/ → [tɒɹtɑɪl]; /glɪv/ → [dʒɪvz]
fricative + approximant	1	/'flaʊə/ → [fəvə]
/S/ + plosive	1	/stamps/ → [samps]
/S/ + plosive + approx	1	/strɪŋ/ → [swɪŋ]

SYSTEMIC SIMPLIFICATIONS

1. Fronting
- | | | |
|----|----|--|
| 17 | 21 | /'krɪsməs/ → ['ʃwɪsɪʃ]; /klaɪdɪz/ → [tʃaɪdɪz]; /'fɪŋɡə/ → ['fɪndə] |
| | | /kəʊm/ → [təʊm]; /ɡaɪdɪʒ/ → ['daɪdɪʒ]; /ɡlʌv/ → [dʒʌvz] |
| | | /mɪlk/ → [mɛld]; /bɑːz/ → [bɑd]; /bɪɡ/ → [brɪd] |
| | | /'mʌŋkɪ/ → [mʌntə]; /kwɪn/ → [twɪn]; /ɛɡ/ → [ɛd] |
| | | /'krɒkədəɪl/ → [tɒpɪtəɪl]; /ɡəʊ/ → [dəʊ]; /ki/ → [ti] |
| | | /ɡɒt/ → [dɒt]; /sməʊk/ → [sməʊt] |

2. Stopping

- | | | | |
|-----|---|----|---|
| /v/ | 1 | 1 | /'sevən/ → [tədən] |
| /θ/ | 2 | 4 | /tɪθ/ → [tɪt]; /θɪ/ → [tɪ] |
| /ð/ | 1 | 3 | /'fɛðə/ → [fɛdə] |
| /s/ | 3 | 13 | /'sætədɪ/ → [tətɪdɪ]; /'sevən/ → [tədən]; /sɪks/ → [tə] |

3. Gliding

/r/	4	19	/strɪŋ/ → [swɪŋ] ; /brɪdʒ/ → [brɪdʒ]
			/θri/ → [fwi] ; /treɪn/ → [tweɪn]
			/ˈjɛləʊz/ → [ˈweɪwəʊd] ; /ˈslɪpɪŋ/ → [ˈtʃwɪsɪŋ]
/l/	4	18	/ʌmˈbrɛlə/ → [bʌmˈbɛjə] ; /leɪn/ → [wɛ]

4. Glottal Replacement

ww	2	-	/ˈkrɒkədəɪl/ → [ˈkrɒʔtəɪl] ; /ˈsɪzəz/ → [ˈsɪʔəz]
wf	2	-	/lɒk/ → [pʔ] ; /gɒt/ → [dɒʔ]

OTHER

1. Affrication

	4	-	/ˈkrɪsməs/ → [ˈtʃwɪʃɪs] ; /klaʊndz/ → [tʃaʊnz]
			/glʌv/ → [dʒʌvz] ; /ˈslɪpɪŋ/ → [ˈtʃwɪsɪŋ]

- | | | | | |
|----|------------------------------|---|---|---|
| 2. | <u>Deaffrication</u> | 1 | - | /'matʃəz/ → ['masʃəs] |
| 3. | <u>Insertion of Stop</u> | 1 | - | /ʌm'brɛlə/ → [bʌm'brɛlə] |
| 4. | <u>Devoicing</u> | 2 | - | /'matʃəz/ → ['masʃəs]; /teɪbɫ/ → [tɛɪpʊs] |
| 5. | <u>Voicing</u> | 1 | - | /reɪs/ → [reɪz] |
| 6. | <u>Liquid Simplification</u> | 1 | - | /'gɑɪdɪz/ → ['dɑɪdɪz] |
| 7. | <u>Fricative Preference</u> | 1 | - | /'slɪpɪŋ/ → ['tʃwɪsɪŋ] |

S4

Age 8;9 - 9;0 (at dates of final assessments)

Sex M

Status Attends school for L.I.

Assessment of Language and Speech

RDLS: VC - Equivalent Age 4;01 C.A. 8;9
Standard Score Off Scale

EL - Equivalent Age 2;07
Standard Score Off Scale

EAT: Quantitative - Raw Score 6 C.A. 9;0
Standard Score Off Scale

Qualitative - Adult Forms 5
Minor Variations 1
Almost Mature 1
Immature 1
Very Immature 24
Atypical 31
Articulation Age 3.00

DADDP: Articulatory precision Errors 58% C.A. 9;0
Consistency Errors 48%
Sequencing Errors 46%

Evidence that all voluntary movements are affected, eg, cannot close eyes on command.
Oral dyspraxia of tongue and possibly laryngeal muscles.

Almost total lack of rhythm.

<u>PACS:</u>	<u>Structural Simplifications</u>	
	Weak Syllable Deletion	5
	Final Consonant Deletion	21
	SFWW Consonant Deletion	3
	SIWI Consonant Deletion	1
	SIWW Consonant Deletion	2
	Vocalisation	1
	Cluster Reduction	18
	<u>Systemic Simplifications</u>	
	Fronting	6
	Stopping	8
	Context-Sensitive Voicing	1
	Glottal Replacement	17
	<u>Others</u>	
	Palatalisation	4
	Insertion of Stop	1
	Devoicing	1
	SIWW CD+Metathesis & /θ/→ [f]	1

Evaluation of Assessments

RDLS

It is difficult to determine whether this child's comprehension of language is affected by his greater problem in expression. His general behaviour does not signify such a learning delay in other areas.

EAT

A minimal number of adult forms appear in this child's articulation and his major difficulty is with atypicalities.

DADDP

Very high proportions of precision, consistency and sequencing of articulation are affected by the severe dyspraxia present.

The presence of dyspraxia is discernible in all voluntary movements attempted by this child. he is unable to close his eyes on command, and can only perform these manual movements which he has learned, apparently with great difficulty.

PACS

STRUCTURAL SIMPLIFICATIONS

No of tokens No possible

1. Weak syllable Deletion

posttonic 5 19 /ʌmbrelə/ → [ə'b2ə]; /'ɛrəpleɪn/ → [ˈɛpeɪ]

/ɪsɪmni/ → [tə]; /'pɛnsɪl/ → [pɛr]; /'souldʒə/ → [tɔr]

2. Final Consonant Deletion

nasals 4 8 /'ɛrəpleɪn/ → [ˈɛpeɪ]; /θʌm/ → [fʌ]

/treɪn/ → [teɪ]; /kəʊm/ → [kəʊ]

plosives 2 2 /red/ → [re]; /sməʊk/ → [məʊ]

fricatives 6 9 /gʌv/ → [dʌ]; /'mɔ:fəz/ → [ˈmɔtə]; /'sɪzəz/ → [ˈɪsə]

/fɪʃ/ → [tə]; /'tvɒbrɪʃ/ → [ˈtvɔfə]; /tɪθ/ → [tɪ]

affricates 2 2 /wɒtʃ/ → [bɔp]; /'gɑrɪdʒ/ → [ˈdɑ2ə]

	No of tokens	No possible
clusters: -1	6	6
		/bɒtl/ → [bɒʔ] ; /desk/ → [dɛʔ]
		/mɪlk/ → [mɪʔ] ; /ɛləfənt/ → [ɛləʔəʔ]
		/tɛnt/ → [tɛʔ] ; /wɪŋz/ → [wɛʔ]
	1	/stamps/ → [təʔ]
SFWW Consonant Deletion	3	9
		/ʌm'brɛlə/ → [ə'bɛʔə] ; /fɪŋgə/ → [fɪdə]
		/'mʌŋkɪ/ → ['mətə]
SIWI Consonant Deletion	3	12
		/fɛʒə/ → ['ɛbə] ; /fɪʃ/ → [ə]
		/'sɪzəz/ → ['ɪsə]
SIWW Consonant Deletion	1	8
		/'ʃʊgə/ → ['təə]
<u>3. Vocalisation</u>		
others	1	1
		/braʊn/ → ['bɔvə]

No of tokens No possible

4. Cluster Reduction

plosive + approximant	12	12	/ɛrəpleɪn/ → ['ɛpeɪ]; /brɪdʒ/ → [bæʒ]; /glaʊ/ → [dʌ]
			/'krɪsməs/ → [ʔoʔməʒ]; /blu/ → [bu]; /drɔ/ → [dɔ]
			/klaʊdz/ → [taʊʔ]; /braʊn/ → [baʊə]; /treɪn/ → [teɪ]
			/kwɪn/ → [gɪs]; /ʌm'brelə/ → [ə'bɪʔə]; /tʁəʊbrʌʃ/ → [tʁʊfə]
fricative + approximant	2	2	/'flaʊə/ → [pɑ]; /θri/ → [pi]; [si]
/S/ + plosive	2	2	/spun/ → [pʊʔ]; /stamps/ → [təʔ]
/S/ + nasal	1	1	/sməʊk/ → [məʊ]
/S/ + plosive + approx.	1	1	/striŋ/ → [təʔ]

No of tokens No possible

SYSTEMIC SIMPLIFICATIONS

1. Fronting 6 13
- /klaʊdz/ → [kʌʊz]; /'fɪŋgə/ → ['pɪdə]
- /'gɑ:ɪdʒ/ → ['dɑ:zə]; /gʌv/ → [dʌ]
- /'mʌŋkɪ / → ['mætə]; /ki / → [ti]

2. Stopping

- | | | | |
|------|---|---|--------------------------------------|
| /f/ | 2 | 5 | /'fɪŋgə/ → ['pɪdə]; /'flaʊə/ → [pə] |
| /θ/ | 1 | 5 | /θri/ → [pi] |
| /ð/ | 1 | 7 | /'fɛðə/ → ['ɛbə] |
| /s/ | 1 | 1 | /'səʊldʒə/ → [təʊ] |
| /ʃ/ | 1 | 3 | /'ʃʊgə/ → ['təə] |
| /tʃ/ | 2 | 3 | /'tʃɪmɪ/ → [tə]; /'mætʃəz/ → ['mætə] |

3. Context-Sensitive Voicing

- WI 1
- /kwɪn/ → [gɪs]

4. Glottal Replacement

WI	1	/krisməs/ → [ˈkɹɪzməɪ]
WW	4	/krisməs/ → [ˈkɹɪzməɪ] ; /ʌmˈbrɛlə/ → [əˈbɪlə]
WF	12	/ˈɛləfənt/ → [ˈɛləɪəɪ] ; /ˈgærɪdʒ/ → [ˈdærəɪ] /bɒtl/ → [bɒɪ] ; /brɪdʒ/ → [bɒɪ] /krisməs/ → [ˈkɹɪzməɪ] ; /klaɪdʒ/ → [ˈtærɪ] /desk/ → [dɛɪ] ; /ˈɛləfənt/ → [ˈɛləɪəɪ] /mɪlk/ → [mɪɪ] ; /spʌn/ → [pʌɪ] /stamps/ → [təɪ] ; /stɹɪŋ/ → [təɪ] /tɛnt/ → [tɛɪ] ; /wɪŋz/ → [wɛɪ] /θrɪ/ → [sɪ] ; /brɪθdə/ → [ˈbəsə] /kwɪn/ → [gɪs] ; /ˈsɪzəz/ → [ˈɪsə]

OTHERS

1. Palatalisation

S5

Age 6;0 - 6;6 (at dates of final assessments)

Sex M

Status Attends school for L.I.

Assessment of Language and Speech

RDLS: VC - Equivalent Age 4;07 C.A. 6;6
Standard Score Off Scale

EL - Equivalent Age 3;07
Standard Score Off Scale

EAT: Quantitative - Raw Score 20 C.A. 6;4
Standard Score 40

Qualitative - Adult Forms 19
Almost Mature 3
Immature 8
Very Immature 16
Atypical 19
Articulation Age 3.00

DADDP: Articulatory Precision Errors 53% C.A. 6;6
Consistency Errors 43%
Sequencing Errors 26%

PACS: Structural Simplifications
Weak Syllable Deletion 7
Final Consonant Deletion 11
SFWW Consonant Deletion 3
Consonant Harmony 3
Reduplication partial 2

Cluster Reduction 8

Systemic Simplifications

Fronting 7

Stopping 10

Gliding 2

Context-Sensitive Voicing 2

Others

Liquid Simplification 4

Backing 1

Palatalisation 1

Lateral Replacement 1

Insertion of Stop 1

Metathesis 2

Evaluation of Assessments

RDLS

Both verbal comprehension and expressive language are off scale in standard scores. This indicates a striking delay in the development of both major components of language. However, this child is the youngest in the LI group and it is possible that further development will take place.

EAT

Not only is there a prominent delay in the learning of articulation, there are a conspicuous number of atypical usages.

DADDP

More than half this child's attempts at pronunciation are imprecise and there is, in addition, a very high proportion of inconsistency present in his speech. Although the errors in sequencing recorded are fewer, there is still a high proportion of difficulty in this area.

In Sections 1, 3 and 4 in the diagnostic procedure, it was noted that:-

1. Poor co-ordination and spatio-visual ability were recorded.
2. Oral dyspraxia is present in the tongue. Breath control is poor. Moderate to severe difficulty was experienced in attempting to copy rhythmic patterns.

PACS

No of tokens No possible

STRUCTURAL SIMPLIFICATIONS

1. Weak Syllable Deletion

pretonic	1	1	/ʌm'brɛlə / → [mɛm]
posttonic	6	27	/'ɛrəpleɪn / → ['ɛleɪ] ; /'ɔspən / → [ɔp] ; /sɔv'dʒə / → [ɛd] ; /'ɪndɪʒən / → ['ɪnɪsɪn] ; /'dæməs / → ['dæzɔv] ;

2. Final consonant Deletion

nasals	2	11	/'ɛrəpleɪn / → ['ɛleɪ] ; /dɔvən / → [dɔv]
plosives	1	3	/'pɪknɪk / → ['pɪknɪ]
fricatives	1	10	/'krɪsməs / → ['krɪsmə]
clusters: -1	3	3	/klaʊdz / → [klaʊd] ; /'brɪndʒ / → [brɪdʒ]
			/desk / → [des]
			/stamps / → [mat]
			/'mɒnstə / → ['mɒstə] ; /'mʌŋkɪ / → [mʌtə]
SWFF Consonant Deletion	3		/'bɜrðdeɪ / → ['bɜrbə]

No of tokens No possible

3. Consonant Harmony

palatal	1	-	/gɑɪdɪ / → ['jɑɪdɪ]
alveolar	2	-	/smɑ:k / → [dɑ:t] ; /ɛləfənt / → ['ɛlələp]

4. Cluster Reduction

plosive + approximant	3	8	/'krɪsmɑs / → ['kɪs mɑ]; /kwɪn / → [kɪn]; /ɛrəpleɪn / → ['ɛlələp]
fricative + approximant	1	2	/'flɑ:və / → ['lɑ:və]
/s / + plosive	2	3	/stɑmp / → [mɑt]; /spʌn / → [pʌn]
/s / + nasal	1	1	/smɑ:k / → [dɑ:t]
/s / + plosive + approx.	1	1	/strɪŋ / → [kɪŋ]

5. Reduplication partial

	2	-	/'bɑ:ðdeɪ / → ['bɑ:bə]; /'pɛnsɪl / → ['pɛntɛn]
--	---	---	--

SYSTEMIC SIMPLIFICATIONS

	No of tokens	No possible
1. <u>Fronting</u>		
velars	3	16
		/mɪlk/ → [mɪlt]; /mɔŋkɪ/ → [ˈmɔtə]; /gəʊ/ → [dəʊ]
palato-alveolars	4	12
		/fɪʃ/ → [fɪs]; /smɔŋk/ → [dɔst]
		/'tʊəbrɔʃ/ → ['tʊəbrɔs]; /'gærɪdʒ/ → ['jæjədʒ]
2. <u>Stopping</u>		
/θ/	1	5
		/θɔm / → [pɔm]
/ð/	1	2
		/ ðə / → [də]
/s/ + /z/ *	4+1*	10
		/'pensɪl/ → ['pentɪn]; /stɛmp/ → [mɔt]; /slɪpɪŋ/ → [plɪtɪŋ]; /smɔŋk/ → [dɔnt]
/tʃ/	2	3
		/'mɔʃəz/ → ['mɔtəz]; /wɔʃ/ → [wɔt] */'sɪzəz/ → ['sɪtəz]
/r/	1	12
		/ rɛd / → [dɛd]
3. <u>Gliding</u>		
/r/	2	9
		/'gærɪdʒ/ → ['jæjədʒ]; /brɪdʒ/ → [bjɪdʒ]

4. Context-Sensitive Voicing

- Devoicing WW 1
Devoicing WF 1

OTHERS

1. Liquid Simplification 4
/'tʁθbrʌʃ / → ['tʁθblʌs]; /t'reɪn / → [kleɪn]
/'brɪndɪŋ / → ['brɪdɪŋ] ; /st'reɪŋ / → [kleɪŋ]
/t'reɪn / → [kleɪn]
2. Backing 1
/'krɪsməs / → ['kɪsmɛ]
3. Palatalisation 1
/'tʃɪmni / → ['tʃɪmpni]
4. Insertion of Stop 1
/stamps / → [mat] ; /'slɪpɪŋ / → ['plɪtən]
5. Metathesis 2
/'tʃɪmni / → ['tʃɪmpni]
6. Lateral Replacement 1

The pronunciation patterns in this sample are strikingly idiosyncratic with the occurrence of many irregularities which will be discussed later showing interaction between the two. Strong evidence of developmental articulatory dyspraxia is present and the adverse effect it has on phonological development, showing interaction between the two.

Age 9;0 - 9;1 (at dates of final assessments)

Sex M

Status Attends school for L.I.

Assessments of Language and Speech

RDLS: VC - Equivalent Age 6;0 - 6;5 C.A. 9;1
Standard Score -0.6

EL - Equivalent Age 3;01
Standard Score Off Scale

EAT: Quantitative - Raw Score 15 C.A. 9;0
Standard Score Off Scale

Qualitative - Adult Forms 15
Almost Mature 1
Immature 2
Very Immature 21
Atypical 25
Articulation Age 3.00

DADDP: Articulatory Precision Errors 53% C.A. 9;1
Consistency Errors 25%
Sequencing Errors 41%

PACS: Structural Simplifications
Weak Syllable Deletion 4
Strong Syllable Deletion 1
Final Consonant Deletion 19
SFWW Consonant Deletion 5
SIWW Consonant Deletion 3
SIWI Consonant Deletion 2
Reduplication 2

Consonant Harmony	1
Cluster Reduction	17
Vocalisation	1
<u>Systemic Simplifications</u>	
Fronting	8
Stopping	3
Gliding	1
Glottal Replacement	3
<u>Others</u>	
Deaffrication	2
Fricative Preference+	
Metathesis	4

Evaluation of Assessments

RDLS Verbal comprehension is within normal limits. Expressive language is very retarded.

EAT The results of this test indicate extreme immaturity of articulation. The category with the highest error score is 'Atypical' indicating that many idiosyncratic forms are being used. Taken in conjunction with the DAD scores this result is considerably important.

DADDP Over half of the pronunciation patterns produced are imprecise. One quarter of all segments produced are inconsistent and almost half are out of sequence. There is a considerable degree of unintelligibility present in the speech sample tested.

Results from Sections 1, 3 and 4 of DAD evidence the presence of some inco-ordination in this child's movements. Oral dyspraxia was present in tongue, lip and some laryngeal muscle movements. Severe difficulties in rhythm were noted in all categories screened. Writing was good and design normal.

PACS

No of tokens No possible

STRUCTURAL SIMPLIFICATIONS

1. Weak Syllable Deletion

posttonic	4	22	/ʌm'breɪlə /→ ['əbəl]; /'ɛrəpleɪn /→ ['ɛpəl] /'mʌŋkɪ /→ [mʌ] ; /'ɛləfənt /→ ['ɛbəl] /'slɪpɪŋ /→ [pə]
strong syllable deletion	1	15	

2. Final Consonant Deletion

nasals	7	10	/'ɛrəpleɪn /→ ['ɛpəl]; /kəʊm /→ [təʊ]; /'slɪpɪŋ /→ [pə] /kwaɪn /→ [wɪ]; /'treɪn /→ [teɪ]; /brʌʊn /→ [bʌʊ]; /θʌm /→ [fʌ]
plosives	3	4	/smɑːk /→ [mɑː]; /ʃʌt /→ [ət]; /raɪt /→ [waɪ]
fricatives	3	9	/'mɑːʃəz /→ ['mɑːtə]; /'saɪzəz /→ ['saɪə]; /tɪθ /→ [tɪ]

No of tokens No possible

affricates	1	3	/gɑɪdɪ/ → [ˈgɑə] /ˈɛləfənt/ → [ˈɛbə]; /tɛnt/ → [tə]; /stæmps/ → [tə] /wɪŋz/ → [wɪ];
clusters: -2+	4	-	/ʃɑt/ → [ə]; /kwɪn/ → [w]
SIWI Consonant Deletion	2	-	/ˈkrɪsməs/ → [ˈtɪsəs]; /sɑʊldɪə/ → [ˈsəʊlə]; /gɑɪdɪ/ → [gɑə]
SIWW Consonant Deletion	3	18	/ˈtʃɪmni/ → [ˈtɪzə]; /ʌmˈbrɛlə/ → [ˈəbə]; /ˈtʌbrɪz/ → [ˈtʌbrɪz]
SFWW Consonant Deletion	5	9	/ˈpɛnsɪl/ → [ˈpɛpə]; [ˈpɛpəp]
3. <u>Vocalisation</u>	1	3	/bɒtl/ → [ˈbɒbə]
4. <u>Reduplication</u>	2	-	/ˈpɛnsɪl/ → [ˈpɛpəp]; /bɒtl/ → [ˈbɒbə]
5. <u>Consonant Harmony</u>	1	-	/fɪf/ → [fɪf]
labio-dental	1	-	
6. <u>Cluster Reduction</u>			
plosive + approximant	11	11	/ˈɛrəpleɪn/ → [ˈɛpə]; /brɪdɪ/ → [brɪ]; /klaʊdɪz/ → [tɑʊdɪz] /glɑv/ → [dɑz]; /ˈtʌbrɪz/ → [ˈtʌbrɪz]; /kreɪn/ → [kreɪn] /blu/ → [bu]; /kwɪn/ → [w]; /brɑʊn/ → [brɑʊn] /ʌmˈbrɛlə/ → [ˈəbə]; /ˈkrɪsməs/ → [ˈtɪsəs]

No of tokens No possible

fricative +approximant	2	2	/flavə/ → [ˈfave]; /θri/ → [fi]
/S/ + plosive	2	2	/spun/ → [puz]; /stamps/ → [ta]
/S/ + nasal	1	1	/sməsk/ → [mən]
/S/ + plosive + approx.	1	1	/strɪŋ/ → [tɪn]

SYSTEMIC SIMPLIFICATIONS

1. Fronting

velars	7	14	/klandz/ → [təndz]; /glɒv/ → [dɒz]; /ki/ → [ti]
			/mɪlk/ → [mɪt]; /kəʊm/ → [təʊ]; /krɪsməs/ → [tɪsəs]
			/strɪŋ/ → [tɪn]
palato-alveolar	1		/tʃɒbrɪʃ/ → [ˈtʃɒbz]

Age 7;7 - 7;10 (at dates of final assessments)

Sex M

Status Attends school for L.I.

Assessments of Language and Speech

RDLs: VC - Equivalent Age 5;00 - 5;02 C.A. 7;7
Standard Score -2.4

EL - Equivalent Age 3;10
Standard Score Off Scale

EAT: Quantitative - Raw Score 23 C.A. 7;10
Standard Score Off Scale

Qualitative - Adult Form 19
Almost Mature 2
Immature 8
Very Immature 31
Atypical 4
Articulation Age 3.00

DADDP: Articulatory Precision Errors 48% C.A. 7;10
Consistency Errors 16%
Sequencing Errors 17%

PACS: Structural Simplifications
Weak Syllable Deletion 3
Final Consonant Deletions 7
SIWW Consonant Deletions 1
SFWW Consonant Deletions 3
Cluster Reductions 15

Systemic Simplifications

Fronting	17
Stopping	2
Gliding	5
Context-Sensitive Voicing	2
Glottal Replacement	5

Others

Deaffrication	2
Palatalisation	1

Evaluation of Assessments

RDLS The verbal comprehension result indicates that this child is almost one-and-a-half deviations below normal. The expressive language result indicates severe difficulties as it is completely off the scale.

EAT The results of this test indicate extreme articulation immaturity and some idiosyncratic representations. The highest error score achieved by this child is in the 'Very Immature' category.

DADDP Articulatory precision presented the greatest difficulty with almost 50% loss in this category. Consistency and sequencing both indicated a significant amount of difficulty, but at a greatly reduced level from articulatory precision.

Results from the other Sections of the DAD diagnostic procedure indicate some spatial and visual unawareness, and a right-left confusion. Oral dyspraxia may be present in the lingual muscles - it was clear that inconsistency of movement was present. Rhythm was almost totally absent in this child's performance.

PACS

No of tokens No possible

STRUCTURAL SIMPLIFICATIONS

1. Weak Syllable Deletion

post-tonic	3	25	/ɪndɪjən/ → [ɪnda]; /pɛnsɪl/ → [pɛsɪ] ^A ; /ɔrpən/ → [ɔrp]
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2. Final Consonant Deletion

fricatives	1	11	/faɪv/ → [fa]
approximants	1	2	/pɛnsɪl/ → [pɛsə] ^B
clusters: -1	4	6	/mɪlk/ → [mɪt]; /dɔvnt/ → [dɔvn]
			/dɛsk/ → [dɛs]; /stæmp/ → [tæmp]

-2+	1	1	/sɪks/ → [sɪ]
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SIWW Consonant Deletion	1	22	/tʃɪmni/ → [tɪmə]
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SFWW Consonant Deletion	3	11	/tʊbrɪʃ/ → [tʊbrɪʃ]; /mɒnstə/ → [mɒstə]; /pɛnsɪl/ → [pɛsɪ] ^A ; [pɛsə] ^B
-------------------------	---	----	--

No of tokens No possible

3. Cluster Reduction

plosive + approximant	9	9	/'hɛəbrʌʃ/ → ['ɛɪbʌʃ]; /tɹeɪn/ → [tɹeɪn]; /kwɪn/ → [tɪn]
			/gɪv/ → [dʌv]; /krɪsməs/ → [tɹɪsməʔ]; /'tʌðbrʌʃ/ → [tʌvʌʃ]
			/klaʊdz/ → [tʌvʔ]; /brɪdʒ/ → [brɪz]; /'ɛrəpleɪn/ → ['ɛɪjəpeɪn]

fricative + approximant	1	2	/θrɪ/ → [ə]
/S/ + plosive	2	3	/stamps/ → [tʌmp]; /spʌn/ → [pʌn]
/S/ + nasal	1	1	/smɔːk/ → [mɔːt]
/S/ + approximant	1	1	/'slɪpɪŋ/ → ['dɪpən]
/S/ + plosive + approx.	1	1	/stɹɪŋ/ → [tɹɪnt]

No of tokens No possible

SYSTEMIC SIMPLIFICATIONS

1. Fronting

velars	13	14	/kwɪn/ → [tɪn]; /'krɪsməs/ → ['tɪsməʃ]; /klændz/ → [tændʒ]
			/'gærɪdʒ/ → ['dɛjəz]; /glʌv/ → [dʌv]; /'mʌŋkɪ/ → ['mʌtə]
			/ki/ → [ti]; /kəʊm/ → [təʊm]; /sməʊk/ → [məʊt]
			/mɪlk/ → [mɪt]; /strɪŋ/ → [tɪnt]; /ʃʊgə/ → ['sʊdə]
			/wɪŋz/ → [wɪnz]

palato-alveolars	4	9	/'mætʃəz/ → ['mætseʒ]; /ʃʊgə/ → ['sʊdə]
			/wɒtʃ/ → [wɒts]; /'gærɪdʒ/ → ['dɛjəz]

2. Stopping

/s/	1	7	/'slɪpɪŋ/ → ['dɪpən]
/tʃ/	1	3	/'tʃɪmni/ → ['tɪmə]

There are indications of severe immaturity in this sample of data. Evidence of a striking inability to both formulate and produce near-target realisations is present throughout. The 'Atypical' representations (see EAT) are all "favourite articulations". This speech production is typical of severe developmental articulatory dyspraxia.

Age 6;8 - 6;11 (at dates of final assessments)

Sex F

Status Attends school for L.I.

Assessment of Language and Speech

RDLS: VC - Equivalent Age 4;08 - 4;11 C.A. 6;8
Standard Score -3.0

EL - Equivalent Age 3;11 - 4;00
Standard Score -2.9

EAT: Quantitative - Raw Score 28 C.A. 6;11
Standard Score 51

Qualitative - Total 63
Adult Forms 25
Minor Variations 3
Almost Mature 5
Immature 10
Very Immature 15
Atypical 4
Articulation Age 3.00

DADDP: Articulatory Precision Errors 30% C.A. 6;8
Consistency Errors 42%
Sequencing Errors 38%

PACS: Phonological Process Analysis
Structural Simplifications
Final Consonant Deletion 12
SIWW Consonant Deletion 1
Vocalisation 3
Consonant Harmony 4
SI Cluster Reduction 16

Systemic Simplifications

Fronting	4
Stopping	2
Gliding	2
Context-Sensitive Voicing	9
Glottal Replacement	2

Others

Deaffrication	2
Denasalisation + assimilation	2
Epenthesis	3
Metathesis	2
Lenition of Stop	1
Palatalisation	3

Evaluation of Assessments

RDLS

Although indicating a marked delay in development of both verbal comprehension and expressive language, there is a normal presentation of results in that the comprehension is in advance of the expression.

EAT

Evidence of substantial immaturity in the development of articulation is clear in the results of this assessment. Slightly more than 25% of the results are categorised 'Very Immature'.

DADDP

Imprecisions are scored throughout the assessment but it appears that increased complexity leads to increased difficulty as the greatest number of articulatory imprecisions are scored in the polysyllabic word categories. There is equal difficulty with nonsense as with meaningful words. In this case even greater difficulty is experienced in sequencing and the greatest amount is in consistency. These factors indicate the presence of a moderate problem in articulatory precision, a moderate to severe disruption of sequencing and a severe degree of inconsistency. The interaction of these three conditions leads to unintelligibility of speech. The question now arises as to whether these circumstances have a direct relationship to the child's acquisition and development of phonology.

Performance in Section One revealed some mild-moderate constructional dyspraxia.

Similarly some mild oral dyspraxia confined to labial and buccal muscles was recorded.

Rhythmic ability was poor and there was an immature reproduction of rhyme.

PACS

No of tokens No possible

STRUCTURAL SIMPLIFICATIONS

1. Final Consonant Deletion

nasals	3	10	/ɛrəpleɪn/ → [ɛrɪəbɛɪ]; /spʊn/ → [pʊ]
			/braʊn/ → [bɑʊ]
plosives	2	5	/traɪt/ → [raɪ]; /glʌv/ → [kʁʌv]
fricatives	2	11	/'krɪsməs/ → ['krɪstɑɪ] ^A ; /'sɪzəz/ → ['sɪzə]
affricates	1	3	/wɒtʃ/ → [wɒə]
clusters: -1	3	6	/tɛnt/ → [pɛn]; /dɛsk/ → [kɛs]; /mɪlk/ → [mɪʊ]
approximants	1	5	/'kɒtənwʊl/ → ['cɒtəwʊ]
SIWW Consonant Deletion	1	24	/'krɪsməs/ → ['krɪsɪs] ^B
SFWW Consonant Deletion		11	/'sɛntəkɒbz/ → ['sɛkɪkɒz]; /'kɒtənwʊl/ → ['cɒtəwʊ]
2. <u>Vocalisation</u>	3	-	/mɪlk/ → [mɪʊ]; /wɒtʃ/ → [wɒə]; /'pɛnsɪl/ → [pɛnsə]

No of tokens No possible

3. Consonant Harmony

velar	2	-	/striŋ /→ [kɹɪŋ] ; /'santəkɒbz /→ ['sɒkɪkɒz]
alveolar	2	-	/'ɪndəʒɪn /→ ['ɪndɪdən] ; /ɛləfənt /→ [ɛlənənt]

4. Cluster Reductions

plosive + approximant	9	12	/'santəkɒbz /→ ['sɒkɪkɒz] ; /ʌm'brɛlə /→ [ɒnə'pɛlə] ; /blu /→ [bu]
			/ɛrəpleɪn /→ [ɛrəbeɪ] ; /braʊn /→ [baʊ] ; /treɪn /→ [keɪn]
			/drɔ /→ [dɔ] ; /'ɪvəbrɪʃ /→ ['tɪpɒs] ; /brɪdʒ /→ [brɪʃ]
fricative + approximant	1	2	/'flaʊə /→ ['fauə]
/S / + plosive	3	3	/'mɒnstə /→ ['mɒntə] ; /stæmp /→ ['mæsɪs] ; /spʌn /→ [pu]
/S / + nasal	1	1	/smɔ:k /→ [mɔ:k]
/S / + approximant	1	1	/'slɪpɪŋ /→ ['sɪpən] ; ['sɪpəŋ]
/S / + plosive + approx.	1	1	/striŋ /→ [kɹɪŋ]

SYSTEMIC SIMPLIFICATIONS

No of tokens No possible

1. <u>Fronting</u>			
velar	1	18	/kɔtənwrɪ/ → [ˈcɔtəwrɪ]
palato-alveolar	3	9	/fɪʃ/ → [fɛz]; /ˈtʌθbrʌʃ/ → [ˈtʌpsɔz]; /ˈmʌtʃəz/ → [ˈmʌtsəz]
2. <u>Stopping</u>			
/tʃ/	1	4	/ˈtʃɪmɪ/ → [ˈtɪmbə]
/dʒ/	1	3	/ˈsɑʊdʒə/ → [fɔldə]
3. <u>Gliding</u>			
/r/	2	15	/red/ → [wɛt]; /θri/ → [fwi]
4. <u>Context-Sensitive Voicing</u>			
Voicing WI	1	-	/kwɪn/ → [gwɪn]
Devoicing WI	1	-	/glʌ/ → [kʌ'lʌ]
Voicing WW	1	-	/ɛrəpleɪn/ → [ˈɛrəbɛ]
Devoicing WW	2	-	/ˈʌmˈbrɛlə/ → [ɔnəˈpɛlə]; /ˈtʌθbrʌʃ/ → [tʌˈpsɔz]

Age 7;6 - 8;0 (at dates of final assessments)

Sex M

Status Attends school for L.I.

Assessments of Language and Speech

RDLS: VC - Equivalent Age 7;00 C.A. 8;5

Standard Score 1.1

EL - Equivalent Age 5;03 - 5;05

Standard Score -1.0

EAT: Quantitative - Raw Score 36 C.A. 7;6

Standard Score 60

Qualitative - Total 64

Adult Forms 29

Almost Mature 3

Immature 6

Very Immature 21

Atypical 5

Articulation Age 3.75

DADDP: Articulatory Precision Errors 20% C.A. 7;11

Consistency Errors 15%

Sequencing Errors 5%

PACS: Phonological Process Analysis

Structural Simplifications

Final Consonant Deletion 1

Reduplication (partial) 1

SI Cluster Reduction 12

Systemic Simplifications

Fronting	2
Stopping	4
Gliding	6
Context-Sensitive Voicing	6

Others

Back Assimilation	1
Assimilation	
/r/ → [r]	1
/ɹ/ → [m]	1
Metathesis	2

Evaluation of Assessments

RDLS

A discrepancy in the direction of expressive language which is being produced at the lowest level of normal acceptance, minus one standard deviation. Verbal comprehension is within normal limits.

EAT

The indications from the results of this assessment are that there is a persisting retardation of articulation development. A considerable number of errors are very immature. Approximately one-eighth of the mispronunciations are 'Atypical'. This result will be considered in conjunction with those of the DAD procedure.

DADDP

The greatest amount of difficulty experienced by this child was concentrated in the areas of polysyllabic words both meaningful and nonsense. The less complex words in Subtest One created considerably less difficulty. There were fewer imitated errors than spontaneous errors of an 'Atypical' nature as noted in the EAT.

Factors, other than articulatory praxis have contributed to this child's phonological disorder. A significant aspect of this child's history is of recorded lowered threshold of hearing between 3;0 and 5;0. Tonsillectomy, adenoidectomy and bilateral myringotomies were carried out at age five, by which time expressive language was unintelligible. In both DAD and PACS a timing fault was also recognised which may be affecting voice onset time (VOT). This child is of normal intelligence and right-handed. He appears to have some moderate difficulty with co-ordination and rhythm, while ideomotor dyspraxia and self-monitoring problems may be present to a mild degree.

PACS

No of tokens No possible

STRUCTURAL SIMPLIFICATIONS

1. <u>Final Consonant Deletion</u>	1	14	/ʃʌtɪŋ/ → [ʃʌtə]
2. <u>SIWI Consonant Deletion</u>	1	-	/'jɛləʊr/ → [ɛwəʊ]
3. <u>Partial Reduplication</u>	1	-	/'fɪŋgə/ → [wɪwə]
4. <u>Cluster Reduction</u>			
plosive + approximant	6	7	/'ɛrəpleɪn/ → [ɛjəpeɪn]; /'krɪsməs/ → [kɪtməs]
			/klaʊdz/ → [kaʊz]; /brɪdʒ/ → [prɪdʒ]
			/'tʌbbrɪʃ/ → ['tʌb-bʃ]; /ʌm'bɹeɪlə/ → [ʌmpɹɛjə]
fricative + approximant	1	2	/θri/ → [fi]
/S/ + plosive	2	2	/spʌn/ → [pʌn]; /stʌmps/ → [tʌmbz]
/S/ + nasal	1	1	/sməʊk/ → [mɛʊk]
/S/ + approximant	1	1	/'slɪpɪŋ/ → ['sɪpən]
/S/ + plosive + approx.	1	1	/strɪŋ/ → [tɪm]
5. <u>Vocalisation</u>	1	-	/'pɛnsɪl/ → ['pɛntə]

No of tokens No possible

SYSTEMIC SIMPLIFICATIONS

1. Fronting

palato-alveolars	1	9	/ʃurʒə/ → [ˈsɜrʒə]
velar	1	-	/wɪŋz/ → [wɪnz]

2. Stopping

/f/	1	5	/ˈɛləfənt/ → [ˈɛləpənt]
/θ/	1	4	/ˈtʁθbrʌʃ/ → [ˈtʁʊb-brʌʃ]
/s/	2	9	/ˈkrɪsməs/ → [ˈkrɪtməs]; /ˈpɛnsɪl/ → [ˈpɛntə]

3. Gliding

/l/	4	11	/ˈlɒkɪŋ/ → [ˈjɒkɪŋ]; /ʌmˈbrɛlə/ → [ʌmˈpɛjə]
/f/ & /ð/	2	-	/ˈjɛləʊr/ → [ˈɛwər]; /ˈflaʊə/ → [ˈfwaʊə]
			/ˈfrɪŋʒə/ → [ˈwɪwə]; /ˈfɛðə/ → [ˈfɛwə]

4. Context-Sensitive Voicing

WF	1	-	/rɑɪt/ → [raɪd]
WW	2	-	/stʌmps/ → [tʌmbs]; /ˈtʁθbrʌʃ/ → [ˈtʁʊb-brʌʃ]
Devoicing WW	1	-	/ʌmˈbrɛlə/ → [ʌmˈpɛjə]
WI	2	-	/ˈdaɪnəs/ → [ˈtʰaɪnəs]; /brɪdʒ/ → [pɪdʒ]

OTHERS

1. Back Assimilation. 1 /bɒtl/ → [bɒkl]
2. Metathesis 2 /desk/ → [deks]; /kwin/ → [wkin]
3. /r/ to [ŋ] 1 /'brɪndy/ → ['bɪndɪŋ]
4. /ŋ/ to [m] 1 /strɪŋ/ → [tɪm]

The majority of simplifications used by this child are evidence of immature development and of persisting early forms. However, a timing problem may exist in the form of voice onset time unreliability, and also difficulty in co-ordinating phonation, resonance and articulation. This is a borderline case in which it is difficult to be certain whether there is mild developmental articulatory dyspraxia or persisting immature articulatory praxis. There is evidence of the presence of a moderate amount of developmental phonological disorder, for which this child was first referred to the school for language impaired children.

Age 8;3 - 8;6 (at dates of final assessments)

Sex M

Status Attends SEN(M) school

Assessment of Language and Speech

RDLS: VC - Equivalent Age 5;03 - 5;05 C.A. '8;6
Standard Score - -2.0

EL - Equivalent Age 7;00
Standard Score - 0.9

EAT: Quantitative - Raw Score 73 C.A. 8;6
Standard Score 122

Qualitative - 61 Adult Forms
4 Minor Variations
Articulation Age 6.00

DADDP: Articulatory Precision Errors 8% C.A. 8;3
Consistency Errors 0
Sequencing Errors 4%

PACS: Full battery unnecessary

Comments: Difficulties in DADDP were confined to subtests 4 and 5 in Section Two. Errors resulted from metathesis of /t/, /k/ and /d/ & /g/ in imitation of segments. There was some minor confusion with vowels. This child is left-handed. Visual perception is mildly disordered.

Conclusion: Phonology developed over a longer than normal period but is well in advance of comprehension of language and is within normal limits.

S11

Age 7;8 - 8;1 (at dates of final assessments)

Sex F

Status Attending SEN(M) school

Assessment of Language and Speech

RDLS: VC - Equivalent Age 4;05 C.A. 7;8
Standard Score - off-scale

EL - Equivalent Age 7;00
Standard Score 0.7

EAT: Quantitative - Raw Score 72 C.A. 8;1
Standard Score 122
Qualitative - 60 Adult Forms
2 Minor Variations
2 Almost Mature
1 Immature
Articulation Age 6.00

DADDP: Articulatory Precision Errors 17% C.A. 7;10
Consistency Errors 11%
Sequencing Errors 7%

PACS: Full battery unnecessary

Comments: Major problem areas in DADDP were Subtest 3 in Section Two - nonsense words, in which consistency was not maintained in 3 of the 7 trials, and Subtest 4 where two second tries were required and two sequences were failed - the first and the fourth -

In Subtest 5(a) the final two vowels were omitted.

Moderate difficulty was experienced with rhythm.

There was evidence of both constructional dyspraxia and incoordination in addition to some visual perceptual difficulty. This child is left-handed, and has a marked attention problem and some anxiety.

Conclusion: Despite several other learning disabilities this child has developed a phonological system within normal limits.

S12

Age 7;7 - 7;10 (at dates of final assessments)

Sex M

Status Attends SEN(M) school

Assessment of Language and Speech

RDLS: VC Equivalent Age 5;09 - 5;11 C.A. 7;9
Standard Score -1.1

EL Equivalent Age 7;00
Standard Score 1.5

EAT: Quantitative - Raw Score 71 C.A. 7;10
Standard Score 122

Qualitative 60 Adult Forms
3 Almost Mature
1 Immature
1 Very Immature

Articulation Age 6.00

DADDP: Articulatory Precision Errors 14% C.A. 7;7
Consistency Errors 3%
Sequencing Errors 6%

PACS: Full battery unnecessary

Comments: Language comprehension level is considerably lower than expressive language and not commensurate with chronological age. Omissions on sequencing in DADDP were of articles and adjectives.

Some difficulty was experienced in repetition of vowel

sequences in subtest 5(a) and (c).

This child has mild visual perceptual and self-monitoring difficulties and moderate problems with both rhythm and co-ordination. He is left handed.

Conclusion: After initial phonological delay which included immature articulatory praxis, expressive speech is now within normal limits.

Age 6;7 - 6;11 (at dates of final assessments)

Sex F

Status Attends SEN(M) school

Assessment of Language and Speech

RDLS: VC - Equivalent Age 3;10 - 3;11 C.A. 6;11
Standard Score Off-scale

EL - Equivalent Age 4;10 - 4;11
Standard Score -0.2

EAT: Quantitative - Raw Score 68 C.A. 6;10
Standard Score 122

Qualitative - 54 Adult Forms
4 Almost Mature
4 Immature
3 Very Immature

Articulation Age 6.00

DADDP: Articulatory Precision Errors 23% C.A. 6;7
Consistency Errors 17%
Sequencing Errors 11%

PACS: Full battery unnecessary

Comments: Some persisting immaturities in expressive speech but for the most part within normal limits. Evidence of ideomotor and oral dyspraxia to a mild degree. Rhythm and self-monitoring are also mildly affected. Constructional and ideational dyspraxia are present to a moderate degree

while a moderate amount of inco-ordination is also recorded. This child is left handed and presents with a major writing problem. Whole word omissions as sequences become more complex are found in DADDP Section Two Subtest One.

Conclusion: Despite numerous mild to moderate learning disorders, this child has acquired phonology to a useful level marginally below normal limits.

S14

Age 7;11 - 8;3 (at dates of final assessments)

Sex F

Status Attending SEN(M) school

Assessment of Language and Speech

RDLS: VC - Equivalent Age 6;06 - 7;00 C.A. 8;2
Standard Score -0.6

EL - Equivalent Age 7;00
Standard Score 0.1

EAT: Quantitative - Raw Score 53 C.A. 8;3
Standard Score 86

Qualitative - Total 65
Adult Forms 45
Minor Variations 3
Almost Mature 4
Immature 7
Very Immature 6
Atypical 0
Articulation Age 5.00

DADDP: Articulatory Precision Errors 13% C.A. 7;11
Consistency Errors 0
Sequencing Errors 4%

PACS: Phonological Process Analysis

1. Structural Simplifications
Final Consonant Deletion 7
Vocalisation 2
Cluster Reduction (SI) 9

2.	<u>Systemic Simplifications</u>	
	Fronting	7
	Stopping	2
	Gliding	7
	Context-Sensitive Voicing	3
3.	<u>Others</u>	
	Affrication	3
	Tetism	1
	/θ/ → [f]	4
	/θ/ → [v]	1

Another factor which has to be taken into account in analysing the speech of this child is the possibility that a mild degree of dysarthria is present. There is buccal and labial rigidity of muscles and some evidence of sensory unawareness in the buccal and oral muscles. This has been treated and only a mild degree remains.

This child is right-handed.

The non-verbal, non-linguistic aspects screened by the DAD diagnostic procedure indicated that visual perception, ideational dyspraxia constructional dyspraxia and oral dyspraxia are all present to a moderate degree. Rhythm is moderately poor as is writing ability. There is also a mild degree of difficulty with self-monitoring.

Factors other than immature articulatory praxis contribute to this child's phonological disorder.

PACS

STRUCTURAL SIMPLIFICATIONS

No of tokens No possible

1. Final Consonant Deletion

nasal	1	15	/kəʊm/ → [kəʊ]
fricatives	1	12	/faɪv/ → [faɪ]
clusters: -1	2	4	/dɛsk/ → [dɛs] ; /kəʊld/ → [kəʊl]
-2+	1	4	/raʊnd/ → [raʊ]

2. SFWW Consonant Deletion

	1	4	/'tʌbbrʌʃ/ → ['tʌbrʌʃ]
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3. SIWW Consonant Deletion

	1	1	/'wɪslɪŋ/ → ['wɛslɪn]
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4. Vocalisation

	2	5	/(h)əʊlɪz/ → [kəʊz] ; /bɔ:l/ → [bəʊ]
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Cluster Reductions No of tokens No possible

Plosive + approximant 5 8
/brɪdʒ/ → [brɪdʒ]; /blu/ → [bu]

/tʃɪldrən/ → [ʃɪltən]; /brʌʃ/ → [brʌʃ]

/tʃrɑːŋɡl/ → [tʃrɑːŋɡl]

Fricative + approximant 2 2
/flaʊə/ → [flaʊə]; /θrɪ/ → [frɪ]

/S/ + approximant 1 1
/slɪpɪŋ/ → [sɪpən]

/S/ + plosive + approx. 1 2
/skwɛə/ → [kwɛɪj]

SYSTEMIC SIMPLIFICATIONS

No of tokens No possible.

Fronting

Velars	3	25	/wɪŋz/ → [wɪnts]; /ki/ → [tɪ]; /sɪks/ → [sɪts]
Palato-alveolars	5	9	/'gɑ:ɪdʒ/ → ['gɑ:ɪz]; /mɑ:ʃəz/ → ['mɑ:tsəz] /wɒtʃ/ → [wɒts]; /wɪŋz/ → [wɪnts] /'tɪʃu/ → ['tɪtsu]
<u>Stopping</u>			
/v/	1	2	/'sevən/ → ['sɪtən]
/h/	1	14	/(h)əʊlɪz/ → [kəʊz]

In the first example the resultant production may be arrived at by the following route:-

/v/ devoiced to [f], [f] to [t] by tetism

No of tokens No possible

Gliding

/r/	3	12	/rɛd/ → [wɛd]; /grɪn/ → [gwin]
			/ʌm'brɛlə/ → [ʌm'bjɛjə]
/l/	4	10	/glʌv/ → [gwʌv]; /klaʊdz/ → [kwʌɪdz]
			/ɛləfənt/ → [ɛjəfənt]; /ʌm'brɛlə/ → [ʌm'bjɛjə]
<u>Context-Sensitive Voicing</u>	3	-	/'mʌtʃəz/ → ['mʌtsəs]; /sɪzəz/ → ['sɪtsəs]
			/wɪŋz/ → [wɪnts]

Others

Affrication	3	'tʃu / → ['tʃu] ; /wɪŋz / → [wɪnts] /stamps / → [stʌmpts]
Tetism	1	'sevən / → ['sɪtən]
/θ /	4	/tɪθ / → [tɪf]; /θrɪ / → [fɹɪ]; [fi] /θʌm / → [fʌm]
/ð /	1	'feɪð / → [fevə]

Age 7;4 - 7;7 (at dates of final assessments)

Sex M

Status Attends SEN(M) school

Assessment of Language and Speech

RDLS: VC - Equivalent Age 4;08 - 4;09 C.A. 7;7
Standard Score -3.3

EL - Equivalent Age 6;06 - 7;00
Standard Score 1.2

EAT: Quantitative - Raw Score 54 C.A. 7;7
Standard Score 88

Qualitative - Total 65
Adult Forms 44
Minor Variations 2
Almost Mature 5
Immature 10
Very Immature 4
Articulation Age 5.00

DADDP: Articulatory Precision Errors 20% C.A. 7;4
Consistency Errors 5%
Sequencing Errors 9%

PACS: Phonological Process Analysis
1. Structural Simplifications
Vocalisation 1
Consonant Vowel Harmony 1
SI Cluster Reduction 3

2.	<u>Systemic Simplifications</u>	
	Fronting	2
	Palato-alveolars	2
3.	<u>Others</u>	
	Epenthesis & Voicing	1

Evaluation of Assessments

RCLS

A marked disparity in the development of verbal comprehension and expressive language is again noted. Expressive ability is recorded at a near normal level while verbal comprehension is over three standard deviations from the mean.

EAT

A standard score of 88 on the quantitative scale is only marginally above the 'danger level'. The qualitative score revealed almost 75% of adult forms being used. Errors were confined to immaturities, four of which were persisting 'Very Immature' forms. These results indicate delayed development of articulation skills.

DADDP

Included in the imprecisely articulated samples were once again indicating a possible regional bias. Other forms wrongly realised suggested immaturity rather than deviance. The difficulties with both consistency and sequencing are mostly apparent in the nonsense word section. Sequencing of vowel sounds proved difficult and attempts to interchange these vowels are replaced by repetition of the first occurring vowel in each section. The child displays moderate difficulty with visual perception and rhythm. His writing ability is very poor. A mild degree of oral dyspraxia is present mainly affecting retraction of the lips and jaw movement. This child is physically large with spade-like fingers and heavy features. These factors appear to affect his co-ordination, and fine motor skills. A minimal amount of self-monitoring unreliability is present. This child is right-handed.

STRUCTURAL SIMPLIFICATIONS

<u>Vocalisation</u>	No of token	No possible
/ʌ/	1	2
		/bɔɫ/ → [bɔʊ]

Consonant Vowel Harmony

dental	1	/tɪθ/ → [tɪç]
--------	---	---------------

(/ʃ/ → [ç] ; /θ/ → [ç] under the influence of a close front vowel)

Cluster Reductions

/s/ + nasal	1	No possible	/sməʊk/ → [məʊk]
/s/ + approximant	1	1	/slɪpɪŋ/ → [lɪpɪŋ]
/s/ + plosive + approx	1	1	/strɪŋ/ → [tʁɪŋ]

SYSTEMIC SIMPLIFICATIONS

Fronting

Palato-alveolars 2 10 /brɪdʒ/ → [brɪdz] ; /'ʃʊgə/ → ['sʊgə]

Age 8;4 - 8-7 (at dates of final assessment)

Sex M

Status Attending SEN(M) school

Assessment of Language and Speech

RDLs: VC - Equivalent Age 7;00 C.A. 8;4
Standard Score -0.6

EL - Equivalent Age 7;00
Standard Scale 0.7

EAT: Quantitative - Raw Score 65 C.A. 8;7
Standard Score 122

Qualitative - Total 65
Adult Forms 53
Almost Mature 3
Immature 5
Very Immature 4
Articulation Age 6.00

DADDP: Articulatory Precision Errors 14% C.A. 8;4
Consistency Errors 3%
Sequencing Errors 6%

PACS: Full battery unnecessary

Evaluation of Assessments

RDLs, EAT, DADDP and PACS all show near normal results for this child's performance. Some articulatory problems may have been the

result of a marked overshoot of the maxilla leading to a malocclusion of the bite, and difficulty in maintaining lip closure.

In DADDP the majority of failures were scored in the nonsense word category and the subtests in Section Two, 4, concerned with /s/, /f/ and /θ/ productions.

The non-language/speech aspects of DAD indicated a mild degree of ideational dyspraxia, oral dyspraxia and rhythm. A more moderate involvement of visual imperception was suggested.

This child is left handed and has very poor writing ability.

S17

Age 6;3 - 6; (at dates of final assessments)

Sex F

Status Attending SEN(M) school

Assessment of Language and Speech

RDLs: VC - Equivalent Age 5;03 - 5;06 C.A. 6;6
Standard Score -1.5

EL - Equivalent Age 5;06 - 5;10
Standard Score -0.4

EAT: Quantitative - Raw Score 69 C.A. 6;6
Standard Score 122

Qualitative - Total 65
Adult Forms 58
Minor Variations 2
Almost Mature 1
Immature 1
Very Immature 3
Articulation Age 6.00

DADDP: Articulatory precision Errors 15% C.A. 6;3
Consistency Errors 3%
Sequencing Errors 9%

PACS: Full battery unnecessary

Evaluation of Assessments

RCLS, EAT, DADDP and PACS all register results at the low average end of normal.

The majority of production errors in DADDP clustered around fricatives particularly in nonsense words. In the non-verbal sections of the procedure this child produced scores which indicated mild problems with rhythm, co-ordination and self-monitoring. More moderate involvement was noted in the area of visual imperception and there was a most severe difficulty in writing. This child is left-handed and presents with a marked difficulty in timing which affects processing and responses.

Age 6;10 - 7;1 (at dates of final assessments)

Sex M

Status Attends SEN(M) School

Assessment of Language and Speech

RDLS: VC - Equivalent Age 5;09 - 5;11 C.A. 6;10
Standard Score -0.9

EL - Equivalent Age 7;00
Standard Score 1.2

EAT: Quantitative - Raw Score 68 C.A. 7;1
Standard Score 122

Qualitative - Total 65
Adult Forms 56
Almost Mature 4
Immature 2
Very Immature 3
Articulation Age 6.00

DADDP: Articulatory precision Errors 13% C.A. 6;10
Consistency Errors 0
Sequencing Errors 2%

PACS: Full battery unnecessary

Evaluation of Assessments

RDLs

Typical presentation of verbal comprehension recording as lower than expressive language in children with special educational needs. Expressive language is within normal limits commensurate with age.

EAT

Evidence of continuing small degree of delay in articulatory development.

DADDP

Similar delay recorded as above.

This child presented with mild degrees of difficulty with self-monitoring, constructional dyspraxia and co-ordination.

More moderate amounts of oral dyspraxia, dysrhythmia and visual imperception were also recorded while writing was the skill apparently presenting the greatest amount of difficulty.

This child is right handed.

Age 6;11 - 7;2 (at dates of final assessment)

Sex F

Status Attends SEN(M) school

Assessment of Language and Speech

RDLS: VC - Equivalent Age 7;00 C.A. 7;2
Standard Score -0.6

EL - Equivalent Age 7;00
Standard Score 1.8

EAT: Quantitative - Raw Score 66 C.A. 7;2
Standard Score 122

Qualitative - Total 65
Adult Forms 55
Minor Variations 1
Almost Mature 3
Immature 2
Very Immature 4
Articulation Age 6.00

DADDP: Articulatory Precision Errors 19% C.A. 6;11
Consistency Errors 4%
Sequencing Errors 8%

PACS: Full battery unnecessary

Evaluation of Assessments

RDLS: Yet another example of a result which indicates a more normal development of expressive language than of verbal comprehension, frequently found in SEN(M) children.

EAT: Almost normal results for age.

DADDP: The majority of errors were recorded in the subtests which incorporate /f / and /θ/. Confusion between the two again suggests that the regional use is ambivalent. Consistency and sequencing difficulties are minimal and the results on the whole from Section Two are within normal limits.

Rhythm, co-ordination and self-monitoring all appear to be minimally affected. Oral, constructional and ideational dyspraxia would seem to be present to a moderate degree as is visual imperception. Yet again a severe difficulty with writing is noted. This child is left-handed.

TABLE OF RESULTS OF ALL ASSESSMENTS ADMINISTERED IN THE COURSE OF THE INVESTIGATION

SUBJECT AGE	R D L S STD SC		E A T							DADDP ZERROR				P A C S						COMMENT							
	VC	EL	QN	AF	MV	AM	I	VI	A	ARTIC AGE	AP	C	S	WSD	FCD	VOC	RED	CH	CR		FR	SYSTEMIC ST GL C-SV GR	OTHER				
LI																											
1	8;0	+0.7	+1.2	37	31	2	4	9	18	1	3.75	11	9	9	///	7	///	1	///	11	6	2	4	///	2	9	
2	8;1	-1.0	-1.0	36	29	0	3	6	27	0	3.75	29	26	26	2	6	///	1	///	16	8	2	///	///	1	4	
3	7;1	-2.6	-1.5	24	25	1	1	7	25	6	3.25	38	23	18	4	14	4	1	4	6	17	7	8	///	4	12	
4	9;0	o/s	o/s	6	5	1	1	1	24	31	>3.00	58	48	46	5	21	1	///	///	18	6	8	///	1	17	14	
5	6;6	o/s	o/s	20	19	0	3	8	16	19	>3.00	53	43	26	7	8	///	2	3	8	7	10	2	2	///	13	
6	9;1	-0.6	o/s	15	15	0	1	2	21	25	>3.00	53	25	41	5	18	1	2	1	17	8	3	1	///	3	16	
7	7;10	-2.4	o/s	23	19	0	2	8	31	4	3.00	48	16	17	3	7	///	///	///	15	17	2	4	2	5	7	
8	6;8	o/s	-3.2	28	25	3	5	10	16	3	3.00	30	42	38	///	12	3	///	4	16	4	2	2	10	2	16	
9	8;0	-1.1	-1.0	36	29	0	3	6	21	5	3.75	10	15	5	///	1	1	1	///	12	2	4	6	6	///	6	
SEN(M)																											
10	8;3	-2.0	+0.9	73	61	4	0	0	0	0	<6.00	8	0	4	///	///	///	///	///	///	///	///	///	///	///	///	-
11	7;10	o/s	+0.7	72	60	2	2	1	0	0	<6.00	17	11	7	///	///	///	///	///	///	///	///	///	///	///	///	-
12	7;7	-1.1	+1.5	71	60	0	3	1	1	0	<6.00	14	3	6	///	///	///	///	///	///	///	///	///	///	///	///	-
13	6;5	o/s	-0.2	68	54	0	4	4	3	0	<6.00	23	17	11	///	///	///	///	///	///	///	///	///	///	///	///	-
14	8;0	-0.6	+0.1	53	45	3	4	7	6	0	5.00	13	0	4	///	5	2	///	///	9	8	2	7	3	///	11	
15	7;4	-3.3	+1.2	54	44	2	5	10	4	0	5.00	20	5	9	///	///	1	///	1	3	2	///	///	///	///	-	
16	8;4	-0.6	+0.7	65	53	0	3	5	4	0	<6.00	14	3	6	///	///	///	///	///	///	///	///	///	///	///	///	-
17	6;3	-1.5	-0.4	69	58	2	1	1	3	0	<6.00	15	3	9	///	///	///	///	///	///	///	///	///	///	///	///	-
18	6;10	-0.9	+1.2	68	56	0	4	2	3	0	<6.00	13	0	2	///	///	///	///	///	///	///	///	///	///	///	///	-
19	6;11	-0.6	+1.8	66	55	1	3	2	4	0	<6.00	19	4	8	///	///	///	///	///	///	///	///	///	///	///	///	-

KEY

LI: Language Impaired
 SEN(M): Special Educational Needs (Moderate)
 RDLS: Reynell Development Language Scale
 EAT: Edinburgh Articulation Test
 DADDP: Developmental Articulatory Dyspraxia Diagnostic Procedure
 PACS: Phonological Analysis of Child Speech

RDLS: Standard
 STD SC: Score
 VC: Verbal
 EL: Comprehension
 Expressive
 Language
 EAT: QN: Quantitative Raw Score
 AF: Adult Form
 MV: Minor Variation
 AM: Almost Mature
 I: Immature
 VI: Very Immature
 A: Atypical
 Artic: Articulation
 DADDP: AP: Articulation
 Precision
 C: Consistency
 S: Sequencing

PACS: SIMPLIFICATIONS-
 STRUCTURAL:
 WSD: Weak Syllable Deletion
 FCD: Final Consonant Deletion
 VOC: Vocalisation
 RED: Reduplication
 CH: Consonant Harmony
 CR: Cluster Reduction
 SYSTEMIC:
 FR: Fronting
 ST: Stopping
 GL: Gliding
 C-SV: Context-Sensitive Voicing
 GR: Glottal Replacement
 OTHER includes:
 Velarisation
 Palatalisation
 Affrication
 Deaffrication
 Devoicing
 Epenthesis
 Metathesis
 Lenition of Stop
 Substitutions
 Consonant Deletion

The results of PACS on the data provided by DADDP and EAT have proved both of the following:-

1. The hypothesis that the presence of developmental articulatory dyspraxia would have an adverse affect on the development of a normal phonological system.
2. The predictions for the types of simplifications (See p 144):
 - a. 'Favourite Articulations'.
 - b. Highly variable phonological realisations.
 - c. Reduced phonotactic possibilities, eg, CR, FCD and GR.
 - d. Sequential errors such as metathesis.
 - e. Overall disruption of the phonological system.

Therefore it is claimed that developmental articulatory

dyspraxia will always co-occur with a developmental phonological

disorder.

The results of PACS on the data provided by DADDP and EAT have proved both of the following:

1. The hypothesis that the presence of developmental articulatory dyspraxia would have an adverse effect on the development of a normal phonological system.
2. The predictions for the types of simplifications, see p 144:
 - a. 'Favourite Articulations', or systematic sound preferences are the phonological phenomena consequent upon children's habitual use of a simple movement pattern. This characteristic suggests that the children have a difficulty diversifying, in a systematic way, the movement patterns used in speech; their development of articulatory motor skills is thus shown to be restricted. This restriction is also shown in the results of the DADDP in which the performance in articulatory precision, consistency and sequencing was largely due to the presence of developmental articulatory dyspraxia, see p 91. This suggests that there is a major disruption of motor skills development, resultant on a motor programming deficit which also interferes with the normal development of sensori-feedback loop systems. Thus the limited phonological performance is the eventual consequence of a series of events which appear to follow the initial neuro-physiological dysfunction.
 - b. Highly variable phonological realisations resulting from the presence of developmental articulatory dyspraxia, highlight the inconsistency factor and the difficulties with sequencing which these children experience and which was recorded in their DADDP results. The 'hit or miss' attempts to produce repeatedly the same or similar segments and sequences of segments evidenced both in their spontaneous speech and language and in their responses on

DADDP are a further indication of the lack of motor organisation resulting from the deficient motor programmer. Two major developmental problems arise as a result of this neurophysiological dysfunction: (i) articulatory and (ii) phonological.

(i) Articulatory Maturation.

The neurophysiological difficulty is manifested in the inability to acquire motor skills for articulation commensurate with age and other levels of development. No reliable programme of articulatory placements or practising of such placements can be depended upon by the organs of articulation. This is alleged to be the result of inconsistent programme planning which fails to ascertain that the same or very similar movements are called into action each time a specific movement has to be performed. Thus automaticity of voluntary movements for articulation does not become established.

(ii) Phonological Maturation

Consequent upon the neurophysiological difficulty and the resultant inability to achieve articulatory automaticity these children cannot systematically develop a phonological system. This results from their inability, associated with lack of control of articulatory movements, to depend on a reliable 'internal map' by which to create and change, in an acceptable form, the rules or patterns necessary to develop phonological realisations equivalent to adult targets, see p 140. Their attempts to do this produce the highly variable pronunciation patterns evidenced in the results of PACS on their data samples.

c. Reduced phonotactic possibilities, eg, CR, FCD and GR reflect an inability to produce the co-occurring segments which constitute clusters and, among other forms, the final segment(s) which create closure in CVC and more complex word forms. These are structural simplifications found in all developing children, but persisting in children such as those with developmental articulatory dyspraxia, whose motor skills are underdeveloped and prevent them from performing the movements necessary to produce those more complicated patterns. In turn this reduction of phonotactic possibilities interferes with overall intelligibility of these children's speech and places them at a further disadvantage socially and educationally. It should be noted that the normal desire to signal the presence of co-occurring segments, clusters and/or final consonants frequently leads these children to use a glottal replacement in positions where they fail to produce a more acceptable pattern of pronunciation. Similar restrictions are evidenced on DADDP especially in the sequencing difficulties.

d. Sequential errors such as metathesis. This is another problem which is found occasionally in normal development but more frequently in children presenting with developmental articulatory dyspraxia. Grunwell, 1982, observes the rarity of the occurrence of metathesis. She describes it as a 'permutation of ordering of segments in children's speech', p 149. Metathesis is thus concerned with sequencing, and results when the considerable precision required for the integration of different speech mechanisms fails to develop normally, Lenneberg, 1967. Metathesis, in the cases of children with developmental articulatory dyspraxia in this present study, appeared to co-occur with marked syllabic and other reduction, eg, /ʌm'bjɛlɔ/ → [mɛm]. Thus it appears that metathesis provides further evidence of a motor programming deficit

which constrains these children's attempts to approximate to an acceptable, ordered sequence of segments.

- e. Overall disruption of the phonological system. It can be seen that the foundations of a normal phonological system are appreciably disrupted and distorted in the cases of children with developmental articulatory dyspraxia. In the absence of a reliable neurophysiological system, both for motor programming and for sensori-motor feedback, these children are unable to develop either articulatory motor skills or an adequate memory for the movement of articulation. Furthermore, the deviant pronunciation and the variability in the children's attempts to articulate do not provide any experience of systematic speech patterns. It must be assumed that these are necessary to create the rules and formulate the strategies by which children acquire and develop a phonological system which, with maturation eventually equates to the adult system, Ferguson and Macken, 1980.

Therefore it is claimed that developmental articulatory dyspraxia will always co-occur with a developmental phonological disorder.

CONCLUSIONS

As a result of carrying out this investigation, the following claims are made:

1. That the condition developmental articulatory dyspraxia exists.
2. That the condition developmental articulatory dyspraxia is of rare occurrence.
3. That developmental articulatory dyspraxia has an adverse effect on the acquisition and development of child phonologies.
4. That a condition of maturation, herein designated immature articulatory praxis, exists.
5. That immature articulatory praxis does not affect the normal acquisition and development of child phonologies.

1. That the condition developmental articulatory dyspraxia exists.

- a. To establish the existence of the condition developmental articulatory dyspraxia, a diagnostic procedure was devised which successfully identified the defined condition.
- b. It was noted that degrees of severity could be applied to the condition.

(i) In cases of severe developmental articulatory dyspraxia children showed evidence of marked productive difficulties of a sensori-motor nature indicating disruption and consequent inadequate control in the production of skilled movement patterns for speech in this area. This affected articulatory precision, consistency of articulation

and sequencing of articulation.

Motor skills were under-developed, or, in some cases, undeveloped, leading to reduced intelligibility in expressive language, which is indicative of phonological involvement. 'Favourite articulations' were produced indicating the limitations of the motor performance on the one hand, and leading to a considerable amount of homophony (homonymy) on the other.

- (ii) There was evidence of somewhat greater control over the sensori-motor system in the cases of moderate developmental articulatory dyspraxia. Here the greater development of articulatory motor skills, in turn, enabled the children to formulate and to practise, with greater reliability, more contrastive segments and thus to establish a more highly developed phonological system. Nevertheless the children's phonological systems were still markedly delayed and, in all cases, deviant. They showed restrictions in structural patterns, eg, consonant clusters and the more complex segmental contrasts, eg, CVCCV, VCCVCV. In addition, consistency and sequencing were noticeably disrupted, compounding the overall difficulties.
- (iii) Where there appeared to be a mild degree of developmental articulatory dyspraxia present, it was observed that either only the more complex forms of articulatory production were affected, eg, three-place clusters, long and complex sentences, or a specific group of movements were persistently involved, eg, tongue to velum movements. Thus only a few contrasts or combinations were affected but, on re-testing, these errors were found to be persisting.

2. That the condition developmental articulatory dyspraxia is of rare occurrence.

From a total of 39 children, 10 in the pre-school group, 10 in the group of schoolchildren, 10 in the SEN(M) group and 9 in the LI group, six children had characteristics of speech which indicated the presence of developmental articulatory dyspraxia. The claim can now be advanced that the occurrence of developmental articulatory dyspraxia is likely to be higher among the population of children regarded as having language impairments. All of the children with developmental articulatory dyspraxia had been extracted from normal schools and placed in an environment where there is a similar amount of speech therapy and educational input. It was expected at the outset of this study that incidences of developmental articulatory dyspraxia would occur in the SEN(M) population, but this did not prove to be so. The fact that so few cases of the condition exist, supports the claims of some authorities, particularly Guyette and Diedrich, 1981, who refer to the rarity of the condition.

The 15 speech therapists who acted as testers in the inter-tester reliability assessments on the diagnostic procedure, also report a small incidence of the condition. Seven of the 45 children assessed had developmental articulatory dyspraxia. These tests took place at scattered points throughout Central England indicating that the rarity claim can be supported across the board.

Children identified as having developmental articulatory dyspraxia are usually to be found in the case loads of speech therapists in child-development units, paediatric assessment units and hospitals for children with severe disorders. Many speech therapists are having difficulty in differentially diagnosing developmental articulatory dyspraxia. The definition, delineation of characteristics and awareness of the condition of delayed maturation, immature articulatory praxis, all of which result from this investigation, may improve the situation.

3. That developmental articulatory dyspraxia has an adverse effect on the acquisition and development of child phonologies.

This investigation has enabled the claim to be made that developmental articulatory dyspraxia results from the unreliability of the motor programmer and the consequent effect on the establishment of the sensory feedback loop systems, see pp 54-65. The unreliability of both of these systems leads to an inability to develop automaticity for the voluntary articulatory movement sequences which are required for adequate and competent mastery of speech production patterns. Kent, 1984, has advanced a theory which he describes as follows:

"This theory would be couched more in terms of musculoskeletal and neural maturation than in terms of linguistic contrasts.....[it] would describe speech development not with the hard, inflexible categories of linguistic phonetics but with a descriptive system designed to reflect articulatory movements and the changeable vocal tract anatomy from which they are formed during the period of infancy and childhood. One way of viewing language development is as an aspect of autoorganisation in human systems."

p R893

Kent, op cit, concludes that:

"The autoorganisation theory is compatible with the fact that most children acquire speech and language without deliberate instruction from care givers."

p R893

This theory highlights the fact that despite a large number of variables which can influence autoorganisation of speech most children become proficient at a reasonably early age, around 3;0 to 4;6 years. Those who fail to reach this level of proficiency appear to do so because of early influences over which they have little or no control, eg, structural deviations such as cleft palate, neuromuscular deviations such as dysarthria, or neurophysiological dysfunctions such as developmental articulatory dyspraxia.

Oller, Wieman, Doyle and Ross, 1976, claimed that children establish basic articulatory skills in the course of prelinguistic vocalisations during the later stages of babbling. This is described by Grunwell, 1985a, in the following terms:

".....speech is a continuously changing flow of sound resulting from continually varying articulatory movements. From their basic articulatory repertoire children proceed to develop new patterns of movement sequences as their pronunciation becomes more practised (that is, more automatic) and mature."

p 67

In their different ways, all of these authorities are describing the establishment of a controlled articulatory movement mechanism by means of the development of sensori-motor feedback patterns which in turn are dependent on reliable motor programming. Developmental articulatory dyspraxia can be assumed to be present from birth. Consequently the establishment of these basic skills will not take place in a normal way.

This account thus accords with Harris and Cottam's, 1985, use of the term 'natural' in the context of clinical phonology. Their discussion considers the extent to which the occurrence of phonological phenomena depend on external factors to be found in the natural world rather than in language. They thus use 'natural' in this context independently of 'normal'. When this concept is applied to the present study, it appears that the existence of the condition developmental articulatory dyspraxia would be the natural basis from which the developmental phonological disorder results. Thus the motor skill dysfunction leads to the articulation disorder which, in turn, disrupts the development of phonology. This explanation satisfies the aims of the model devised in the present study, where it is claimed that the identifying characteristics will have implications for the acquisition and development of phonology, see p 125.

4. That immature articulatory praxis exists.

The present study produces evidence that this condition can be identified and that it is of a maturational nature, see pp 98-101. The existence of such a condition has been alluded to in the literature, eg, Fawcus. 1971, Yoss and Darley, 1974, Ferry et al, 1975, although it has not been specifically identified until now. Further indirect references hint at such a condition. For example, Kent, 1984, presents seven basic principles on which a theory of speech development should be formed. These include the following:

"1. Vocal tract anatomy changes markedly in the first year of life and continues to be gradually remodeled over the first few years of life.

p R888

2. There is with maturation a progressively ascending level of central nervous system control over vocalisation and other behaviours.

p R889

3. Stages of speech-language acquisition are poorly defined, and at least some of them may not be applicable outside the normal maturational pattern.

p R890

4. Production and perception capabilities that ultimately lead to speech are initially largely separate, but they begin to be co-ordinated (integrated) within the first few months of life.

p R890

5. Rhythmic or cyclic patterns are a natural basis for the organisation of movement systems and may contribute to the acquisition of skilled co-ordinated movements in speech and perhaps even to conversational turn-taking.

p R891

6. Units of phonological contrast are larger for the young child in the early stages of language acquisition than for the adult language user.

p R892

7. Acquisition of phonology interacts with the acquisition of motor control for speech."

p R892

If, as seems possible, speech development does reflect articulatory motor skill development and control as Kent suggests, this theory strongly supports the existence of immature articulatory praxis. Stages 1, 2, 4 and 5 all have some bearing on maturing motor and, therefore, articulatory skills. Stages 6 and 7 specifically indicate interaction of speech motor control and phonology at the acquisitional stages.

Kent's theory has its basis in infancy and early childhood. To consider later developmental changes, Sharkey and Folkins, 1985, hypothesize that different developmental motor processes affect the variability of speech movements at early, intermediate and older ages. In their study the development of speech motor skills was investigated by measuring the variability of lower lip and jaw movements. Groups of 5 adults and children at ages 4;0, 7;0 and 10;0 produced [bæ] and [mæ] 20 times each. The only significant finding was in the variability of lower lip displacement which decreased between the 4;0 and 7;0 year olds but not between any other age groups. These results are based on lip and jaw movements but it seems likely that similar developmental motor processes affect other articulatory organs. If this is found to be the case there would be still further evidence for different degrees of praxis ability during the years of child development.

Hawkins in her extremely detailed study, 1973, and follow-up study, 1979, reveals that more mature speakers impose more organisation upon the segments of consonant clusters. Two child groups aged from 4;0 to 7;0 were compared with an adult group and it appears that the older group of children resembled each of the other groups almost equally, while the younger group

of children resembled the adult group less than the older group did. The children generally appeared to change gradually towards the adult norm with age. Thus more evidence is available to suggest that articulatory praxis matures with age, as the present study claims. Working in a similar area, Gilbert and Purves, 1977, carried out a study which revealed that children aged 5;0 - 7;0 can be roughly separated from older children and adults on the basis of absolute duration of consonants. This appears to imply that the timing programme used by children to achieve cluster control is different from that of adults. This finding leads further support to the existence of immature articulatory praxis.

Recent literature indicates that there may be a much later ceiling for the maturity of articulatory praxis than was first suggested, but, at the same time, the same literature supports the claim that immature articulation would be expected during the development of praxis. Repeated administrations of DADDP at six-monthly intervals reveal the reduction of the condition with maturity.

5. That immature articulatory praxis does not affect the normal acquisition and development of child phonologies.

- a. None of the children with immature articulatory praxis revealed by the DADDP, but with no other contributory factors, presented with a developmental phonological disorder.
- b. All children have immature articulatory praxis in the early stages of development of speech, Waterson, 1971, 1978; Hawkins, 1973, 1979; Menyuk and Klatt, 1975; Menn, 1976, 1980; Gilbert, 1977; Eilers, Wilson and Moore, 1979; Macken and Barton, 1980; Klein, 1985; Hewlett, 1985; Hewlett and Howell, 1985. Thus early speech patterns are attributable to developmentally immature performance skills, ie, the interaction between cognitive and motor skills, as proposed by Menn, 1980.

The effect of the immature articulatory praxis experienced by some children is frequently evidenced in the acquisition of consonant clusters and more complex combinations of syllables, and of the voicing contrasts. In regard to the latter, Macken and Barton, 1980, report a study which provided data giving evidence of 3 general stages of acquisition. They recorded longitudinally the acquisition of voicing contrast as measured by voice onset time. Four children were recorded at 2-week intervals from about 1;6. The three general stages of development considered are:

1. no contrast:
2. contrast minimal, possibly occurring in one of a pair of phonemes (usually voiced) and thus not perceptible to adults;
3. a contrast resembling the adult contrast.

Thus it was found that the appropriate phonological contrast for voicing may occur as early as 1;5. However, the authors pointed out that some children take much longer than others to acquire sufficient articulatory skill to produce adult-like voicing consistently.

The studies discussed in Section 4 immediately preceding demonstrate the existence of immature articulatory praxis and the fact that normal phonology develops in its presence. This supports the findings of this present study. The SEN(M) group, all of whom evidenced immature articulatory praxis in the first instance, showed proof of a normally developing phonological system. Some of these children did of course develop their systems later than normal, but these systems were delayed in development, not deviant and all had reached a normal developmental level before the completion of the study.

c. The Edinburgh Articulation Test (EAT) was used to screen the articulation ability of all the children in the LI and SEN(M) groups. An unexpected equivalence of results was recorded when those of the EAT were compared with those of the DADDP, see p 72. The qualitative classifications of the EAT are in 6 developmental categories: Adult Forms (AF), Minor Variations (MV), Almost Mature (AM), Immature (I), Very Immature (VI), and Atypical (A), see p 246. A remarkable disparity was recorded between the results of the LI group and the SEN(M) group. The latter results clustered around AM, MV and AF while the former produced classifications with a preponderance of VI and A and some I. Only the A and VI classifications on the EAT indicate the presence of a restricted phonological system. Since the EAT is an assessment of maturation, these results clearly indicate a degree of immaturity persisting in several of the children in the two experimental groups. Immature articulatory praxis is a normal condition which most children outgrow, given time, therefore it does not have an effect on the normal development of phonology.

General Observations

- (i) The operational definition selected at the outset of the investigation was as follows:

developmental articulatory dyspraxia is the inability, in the developing child, to execute, on command or by imitation, on some but not all occasions, the volitional movements required to produce articulation in the absence of any detectable major neurophysiological or neuromuscular disability.

This definition has met all the requirements detectable in the children who are now known to have developmental articulatory dyspraxia. Thus there is no reason to change it and it now becomes the definition considered

most appropriate for the condition.

- (ii) No example of developmental articulatory dyspraxia was found in which it could be said that no other factor(s) was involved. It was usually the case that language delay or language deviance or both were detectable. Observation of several children with developmental articulatory dyspraxia led to the conclusion that in its severe form this condition is a whole-person disability. It precludes children from social intercourse, and strongly affects learning skills, both cognitive and physical. Behaviour is disorganised and many aspects are affected including gait, posture and manual skills.
- (iii) The results of a questionnaire distributed to the parents of the LI group (see appendix 4) disclosed that six of the seven parents who returned the questionnaire claimed that their children did not babble. While aware of the unreliability of parents' responses to questions concerning their children's early development, this is a high proportion of agreement. Several authorities discuss the babbling stage, and suggest that it is a basic requirement for the development of the articulatory movements of speech, eg, Ferguson, 1976; Oller et al, 1976; Aram and Glasson, 1979; Ferguson and Macken, 1980; Grunwell, 1984.
- (iv) Finally, all the children with developmental articulatory dyspraxia were right-handed. Seven of the ten SEN(M) children were left-handed. This fact could be investigated further.

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APPENDICES

APPENDIX ONE

Additional Observations Resulting from this Investigation

Several points are made by Guyette & Diedrich, 1981, with which the present author concurs as a result of this study. They include the following:-

1. That there is a strong indication of a genetic factor in developmental articulatory dyspraxia. The present writer has observed that this condition can occur as one of a constellation of conditions forming a familial diathesis, in which varying types of speech and/or language disorder may occur.
2. That the preponderance of children presenting with developmental articulatory dyspraxia is male.

Guyette & Diedrich, op cit, contended that neither struggling for articulatory placement, nor inconsistency of errors, nor poor sequencing of segments were found more frequently in children with developmental articulatory dyspraxia than in children with other articulation disorders. The present study negates this statement. The diagnostic procedure produced results which clearly revealed a greater number of errors in all three of these categories in children with developmental articulatory dyspraxia than in children with other forms of expressive language disorder. On the other hand agreement is reached by both studies regarding the fact that cognitive deficits are not critical to the identification of the condition.

This present study did find, however, unlike Guyette & Diedrich, that oral dyspraxia co-occurs with developmental articulatory dyspraxia in every instance. Guyette & Diedrich, op cit, commented particularly on progress in developmental articulatory dyspraxia, indicating that while some children presenting with the condition never learn to speak, others apparently outgrow the condition spontaneously. Fawcus, 1971, and Ferry et al, 1975, made similar observations all of which support the dichotomy between developmental articulatory dyspraxia and immature articulatory praxis.

Two further important issues were raised by Guyette & Diedrich, op cit. Firstly, in discussing the selection of groups of children to be

assessed for the presence of developmental articulatory dyspraxia, they point out that some were selected on the basis of oral movement skills, Yoss & Darley, 1974; some had previously been diagnosed as having developmental articulatory dyspraxia by unknown assessment, Rosenbek & Wertz, 1973; and some had made insignificant progress in therapy, Ferry, Hall & Hicks, 1975. It is important to note that all the groups selected in the present investigation were based on age. The schoolchildren, SEN(M) and LI groups were each a random sample from children aged between 6;0 and 9;0 attending specific schools. The pre-school group was also a random sample of children selected entirely by age - between 3;0 and 4;0.

Finally, Guyette & Diedrich, op cit, suggested that it may be likely that some form of language disorder accompanies developmental articulatory dyspraxia, In fact, they postulated that the suggestion made by Greene, 1967, may be upheld, that all children with developmental articulatory dyspraxia have a language disorder. This study has been able to prove that this is the case so far as the phonological component of language is concerned.

A clarification of the symptoms of developmental articulatory dyspraxia and their implications can be claimed. Jaffe, 1984, commenting on earlier American findings, criticises the fact that developmental articulatory dyspraxia is defined as comprising a constellation of symptoms all of which need not be present in each case. He regards this as an unsatisfactory basis for diagnosis. The important point is that the cluster of symptoms can be reduced to individual possibilities which may or may not co-occur in each case. Articulatory imprecision, inconsistency of production and deficits in sequencing of segments and syllables were present to some degree in each of the six children diagnosed as having developmental articulatory dyspraxia. A similar situation exists in the case of phonological simplifications. Every possible example does not, nor need not, occur in each child's realisations. In addition, Jaffe, op cit, points out that the symptoms are not exclusive to developmental articulatory dyspraxia. It has to be acknowledged that there is a finite number of possibilities which can occur in expressive language. The co-occurrence, on a greater number of

occasions than can normally be expected, of several abnormal characteristics of articulation, indicates that a specific type of condition, described to take such a form, is being manifested.

Consideration of the case of S4, Andrew, in the LI group may help to clarify several issues which motivated the present writer to undertake this study. The initial intention was to attempt to discover whether, as was the present writer's contention, adolescent and adult patients presenting with developmental articulatory dyspraxia at an earlier stage in their lives, had been misdiagnosed as mentally handicapped and hospitalised as unable to manage in the community. In the event, after several pilot studies, it proved impossible to assess such people due to the degrees of institutionalised behaviour with which they presented. The original contention remains. S4, Andrew, who was diagnosed as a child with a severe language disorder at age 4;6 and who was selected for placement in the school for language impaired children at age 6;4 could have become such a case. His speech is almost entirely unintelligible. He has generalised dyspraxia of all voluntary movements. Visual imperception, spatio-temporal unawareness and dysrhythmia are all present. He also has an intrapersonal auditory feedback loop difficulty and a specific timing problem. But there is evidence that he is capable of learning and organising his behaviour. His severe problems demand much specialised help, but he has a range of cognitive ability and can concentrate well, obtaining some success in all classroom activities. (He can also participate in social and domestic domains.) A brother, three years his junior, and presenting with almost identical deficits has recently been referred to the same school. A second brother is mentally handicapped. This also provides further support to the claim that the condition is inherited in at least some, if not all, cases. A medical diagnosis has now been decided upon in the case of Andrew and his brothers. The Renpenning Syndrome has been identified. This condition is defined as an X-linked mental retardation without physical abnormalities. Although profound retardation can be present, mild to moderate is most common, Renpenning et al, 1962, (see McLaughlin & Kriegsman, 1980).

The use of the diagnostic procedure devised for this investigation appears to be of value. It is cumbersome to some degree due to the

need to account for all the possible variables, which may arise in this condition. This fact, in turn, means that it is not easy to score, but it is important to be as precise as possible in scoring. Reconsideration of the section on rhythm may be necessary. Observations made in the course of this investigation indicate that research is required into both rhythm in normally developing language and rhythm in developmental articulatory dyspraxia.

Data from the results of the diagnostic procedure have been studied and the following conclusions drawn:-

1. Oral Dyspraxia. All the children with developmental articulatory dyspraxia had signs of oral dyspraxia. Of the remaining thirteen children, seven showed evidence of oral dyspraxia and six had none whatsoever. Each of the seven in which the condition was present had previously had immature articulatory praxis.
2. Inco-ordination. In the six children with developmental articulatory dyspraxia, one had inco-ordination of movements to a marked degree, the remaining five had mild indications of inco-ordination. Three of the thirteen remaining children had no signs of inco-ordination and the remainder had mild signs. None of the total number of children appeared to be incapacitated by this problem.
3. Rhythm. All the children presenting with developmental articulatory dyspraxia had a major problem with rhythm. Only one child in the LI group had normal rhythmic awareness as had only one in the SEN(M) group. All other children had some degree of difficulty with general rhythmic forms as well as the specific ones tested in the diagnostic procedure. The major problem with rhythm appeared to be retaining the memory of the rhythmic activity demonstrated. In many of the children the memory trace faded after the first attempt of the required three.
4. Spatial-visual problems. Four of the six children with developmental articulatory dyspraxia displayed problems in this area. Two of the three most severely affected developmental

articulatory dyspraxic children were adequate on the spatial-visual skills. The elder of the two is already benefitting from being able to write, draw and design. An interesting point to note is that seven of the ten SEN(M) children are left-handed. All of the LI children are right-handed.

5. Right-left confusion. One of the group of six with developmental articulatory dyspraxia evinced this difficulty. Nine of the remainder had some confusion. This problem can interfere with the cognitive ability to appreciate directional movements, particularly in reading and writing, which, in English, are dependent on an established Left to Right scanning system.

It could be claimed from this study that the children with developmental articulatory dyspraxia have a left cerebral dominance, whereas those with special educational learning disorders are right hemisphere dominant or unestablished. Gordon & McKinlay, 1980, suggest that it is the establishment of dominance that is important and not the rightness or leftness. Bryant, 1980, claims that with clumsy, low achieving children handedness should be taught to avoid confusion in learning.

6. Writing. An extremely small sample of writing was expected, but from the little tested it soon became clear that all but two of the SEN(M) children have severe to very severe writing problems, see p XV. It was interesting to note that in several of these cases, no indications of this were seen in either spatial-visual awareness, nor right-left confusion. Four of the six children with developmental articulatory dyspraxia had pronounced writing difficulties and the remaining two evidenced very immature writing patterns. These were composed of excessively large symbols which were printed, not written, in an idiosyncratic style.

It is possible that several allied abilities remain to be assessed. In the pilot studies, sensory awareness of oral and manual dimensions were tested and rejected as the majority of children succeeded with them with no difficulty.

7. Comparison of frequency of errors of consistency and sequencing resulted as follows:-

LI group

Children with more sequencing than consistency errors	2
Children with the same sequencing as consistency errors	2
Children with fewer sequencing than consistency errors	5

SEN(M) group

Children with more sequencing than consistency errors	8
Children with fewer sequencing than consistency errors	2

This could indicate that these results relate to cognitive ability. More children with learning disabilities have sequencing difficulties than normally developing children, Lashley, 1951; Farnham-Diggory, 1978.

8. Of the six children presenting with developmental articulatory dyspraxia, all showed some signs of general clumsiness in behaviour. Gordon & McKinlay, 1980, indicate that some clumsy children have developmental articulatory dyspraxia. There is a general lack of organisation of movements, activities and performance which singles these children out from their peers. It was interesting to observe that this disorganised behaviour closely paralleled that of children who 'clutter', Weiss, 1964.

9. Rosenbek, 1980, considers the relationship of stuttering and articulatory dyspraxia. It may be that with further research a clearer understanding will emerge of these three conditions and their interrelationships, if any.

As stated, it is apparent that the diagnosed dyspraxic group in this study had difficulties extending beyond articulation. In fact, all peripheral muscular movements were affected so that a disorganised, dysrhythmic movement pattern of a general nature was observed. This affects personal skills such as washing, dressing and feeding. It

also interferes with the development of motor skills required to participate in sports and games, rhythmic and musical activities and other associated leisure pursuits. In fact, it imposes severe restrictions on children affected in this manner.

11. Spatial-temporal development appears to be invariably disturbed in this population. Some children with developmental articulatory dyspraxia seem unaware of the spatial dimensions of their oral cavities having no 'mental image' of front, middle and back and find great difficulty in performing precise tongue movements. This is a motor programming deficit in which spatial awareness is also involved. Similarly, the dimension of time appears to create difficulties. This takes many forms from protracted initiation of tongue movements, voice onset time delays to more complex linguistic considerations, such as deixis, see Wales, 1979.

APPENDIX TWO

CLINICAL IMPLICATIONS

1. Assessment

Developmental articulatory dyspraxia, by definition and description, is a rare disorder affecting a small percentage of children referred for speech therapy. It is characterised by impaired ability to program, produce and sequence the elements of speech. Recognition has been claimed for a maturational dysfunction which is similar in many ways to the mild/moderate forms of developmental articulatory dyspraxia. Only by assessment and re-assessment with the use of a diagnostic procedure such as that devised and tested in this investigation, is it possible for speech therapists to be certain of the problem existing. More superficial indications are discernible by careful study of the factors in each case. For example, where an older child is referred for assessment and treatment with a profound difficulty in articulation, it can be assumed that the problem is possibly that of developmental articulatory dyspraxia. On no account should a clinician proceed to planning management without first assessing the situation by using several procedures to ascertain the areas of disorder and the degrees of severity. Recommendation, as a result of this study, is made for the use of the EAT and the DADDP. Both have been proved to be capable of completion by the most severely articulation-handicapped children. The results of these tests should then be analysed by the use of PACS. The final assessment results will indicate the presence or not of developmental articulatory dyspraxia, the degree of articulatory immaturity or atypicality present and the result of these conditions on the acquisition and development of the child's phonological system. It is advisable to administer the diagnostic procedure for developmental articulatory dyspraxia with as much speed as the child can manage. Tardy presentation of such procedures discourages failing children. The format is such that it can be completed with rapid certainty after the clinician has become familiar with it. In the course of the investigation it became clear that numerous factors were being tested, eg spatial-temporal awareness. In the course of management, as opposed to investigation,

many of these factors could be adjusted either by the clinician's or some other adult's intervention, eg the teacher or parent. The symptom constellation which is dyspraxia is represented by the presence of different variables in each individual, but it is now claimed that specific areas will always be affected - articulatory precision, consistency and sequencing. Since, as has been previously indicated, these criteria can also be affected in other speech disorders, it is essential to assess the degree of severity present and to re-assess for attainment or not at four-to-six-monthly intervals. This is particularly important since there must be no confusion in the mind of the clinician regarding the presence of an articulation disorder, a phonological disorder, or both.

2. Management

Different management programs and techniques are required for each type of problem. Consequently, careful assessment and differential diagnosis will obviate any confusion which could arise with respect to the true diagnosis. The disclosure that developmental articulatory dyspraxia affects child phonologies is invaluable in planning management. The explanation of the circular nature of the causes of developmental articulatory dyspraxia is also fundamental to planning treatment as it is pertinent to intervene in all areas, sensory/perceptually, cognitively and motor/productively.

3. Immature Articulatory Praxis

The incidence of immature articulatory praxis occurring in children of 6;0 and older requires to be investigated. It could be predicted from this study that the majority of such children will be located in schools for children with special educational needs of a moderate nature. However, it is accepted that a percentage of children in mainstream schools have special educational needs. Furthermore, it is recommended that some of these children should continue to be educated in mainstream schools, Warnock, 1979. Clinicians responsible for such populations should work closely with teachers to assist such children in the greater awareness of the sound system and of their own equivalent productions, to enable them to learn to read. It is an

accepted fact that children with articulatory deficits find difficulty in integrating phonetic and written symbols, Cotterell, 1969. This awareness is necessary for learning to read and write. Teacher training in this area is improving, but greater co-operation between teachers and speech therapists is required in many school populations - see Reid, 1966; Downing, 1970, 1975; Pidgeon, 1976; Donaldson, 1978. The lack of articulatory permanence present in immature articulatory praxis appears to affect the written and read language skills more severely than the expressive language one. Clinical observation.

4. Self-Monitoring

The exclusively intrapersonal nature of the experience of self-monitoring one's own spoken output precludes direct analysis by others. Each of the six children with developmental articulatory dyspraxia in this study presented evidence of a self-monitoring difficulty. The importance of this component for the acquisition of a viable phonological system cannot be ignored.

Hutchinson, 1967, attempted to test children's self-monitoring abilities by the use of a 'repeat measures' type of statistical comparison. Although she appeared to achieve some results, neither this method nor the assessment which she later produced, could be used on such severely articulation disordered children as those with developmental articulatory dyspraxia, 1978.

Fawcus, 1980, when discussing self-monitoring mentions feedback drills and, at the same time, indicates the limited information which these supply. However, he points out that they can be used by young or severely handicapped children. He also refers to the successful use of spectrographic analysis with some subjects, for example children and adults with palatal problems, hearing loss and lack of lingual control. It is the present writer's experience that this approach can be most successful with children with either dysarthria or auditory discrimination problems, inter- or intrapersonal. Two children with developmental articulatory dyspraxia did not benefit however, as their attempts to meet the correct visual form increased their struggle to produce the target-articulations. It may be the case that less

severely affected children could benefit if their greatest problem was not that of searching for articulation placement.

Hardcastle & Morgan, 1982, describe the advantages of instrumental techniques of electropalatography and pneumotachography in the analyses of three articulatory disordered children. They claim indications for therapy from their results. Similarly the previously reported technique used by Heath & Fawcus, see p 55 indicates the significance of devices adapted for clinical use.

5. Reduced Intelligibility

The inadequacies experienced by the speaker who is unable to produce clear speech have far-reaching consequences. Social intercourse becomes impossible. The embarrassment created in the child and in his/her listener eventually leads to the child withdrawing from the situation, so far as attempts at communication are concerned.

In some contexts, and with children whose fingers are free of dyspraxia, a shared signing system may replace attempts at speech. To avoid the inevitable behaviour problems which are likely to result in a child unable to express his/her feelings and opinions, it is essential to provide some form of communicative facility. Clinical experiments can be run with different means to discover the most suitable for each individual. The awareness of the use of eye-contact, eye-pointing and all non-segmental forms should be heightened. Use of typewriters, calculators and microprocessors should be considered. Children with developmental articulatory dyspraxia are usually most successful in the visual modality, which is frequently intact. Grunwell, 1981^a describes 'unintelligible speech' as 'the major deviance' that identifies the disability "communicative inadequacy of the phonological system" p 167. All six children described as having developmental articulatory dyspraxia have unintelligible speech. This is reported in all situations: school, leisure and home. The plans of management formulated for these children have to account for intelligibility, variability, sequencing and the processes

established. By any methods the former will depend on the control and development of the other three.

6. Treatment

There has been some agreement about the most satisfactory treatment approaches for this condition, see Chappell, 1973; Rosenbek et al, 1974; Yoss & Darley, 1974; Johnson, 1980; Jaffe, 1984. Each of these authorities has a favoured approach but most agree that the following areas have to be included in any treatment plan.

1. Program to be tailored to individual.
2. Articulation therapy
3. Sensori-motor skill exercises.
4. Reduced rate.
5. Key word learning.
6. Imitation exercises.
7. Self-monitoring awareness.
8. Rhythm, intonation, stress.

An example of a less common technique applied to the treatment of developmental articulatory dyspraxia is that of melodic intonation therapy, Helfrich-Miller, 1980. No details will be presented of any of these techniques as this investigation is not concerned with previous treatment aspects of the condition, developmental articulatory dyspraxia.

One important factor of pre-treatment management is however suggested. As the underpinning of any program of treatment designed to facilitate better articulation at the basic, phonetic or phonological levels, it is recommended that oral awareness should be heightened, in conjunction with a raised level of spatio-temporal skills, Fraser & Blockley, 1973. It is the experience of the present writer that pre-school children with either pathological or maturational articulation disorders have either had little or no practical experience of experimenting with their sound production systems. If this stage has been missed it is vital to teach it, before expecting such children to proceed to more complex language development, as it

is essential for strategy building and rule formation. In the presence of inadequate intrapersonal motor-planning, external means have to be used to attempt to establish some sensory feedback loop systems on which to build production.

The direction taken by the present study will result in consideration of different treatment approaches from those previously advised for children with developmental articulatory dyspraxia. Not only must provision be made to alleviate the articulation disorder, but the resultant phonological disorder requires attention. The articulation disorder is claimed to contribute to the phonological disorder. Logically it could be proposed that resolution of the articulation disorder would lead to remediation of the phonological disorder. However, it is not a case of a simple scheme for improvement creating a beneficial outcome for the co-existing disorders. In the first place, developmental articulatory dyspraxia is claimed to be due to a neurological dysfunction for which there is no known treatment. Thus the situation is immutable and compensatory treatment strategies have to be sought.

7. The Multidisciplinary Team

These children present with a wider problem than an expressive language disorder. The articulation disorder/phonological disorder co-occurring, will constitute the basis for a learning disorder which will certainly disrupt language-linked learning and may also involve numeracy. Of the six children with developmental articulatory dyspraxia identified in this investigation, two could produce recognisable signatures and one of these two had problems of space and size, see p XV. Only one child wrote clearly and within normal dimensions. Severe spatial and visual representational problems were present in the other five. These signs indicate the major learning problems experienced by the group. Teachers and speech therapists co-operate closely in the school which these children attend where one teacher and one therapist are responsible for ten children. This is almost an ideal situation. The school is residential so it is vital that the care staff are also aware of each child's learning problems and individual difficulties. Many children are able to perform better

to a care assistant in a personal situation, eg hair shampooing, than in front of their peers in a classroom situation.

Parents have to be involved in children's management even when the children are in a residential school. Some find it difficult, either due to guilt, lack of understanding or feelings of inadequacy, to contribute towards the education of their children, but the other members of the team have to involve them as much as possible.

Visiting is restricted, but lines of communication are open at all times and where special help is required, home visits are made and information and advice are made available.

APPENDIX THREE

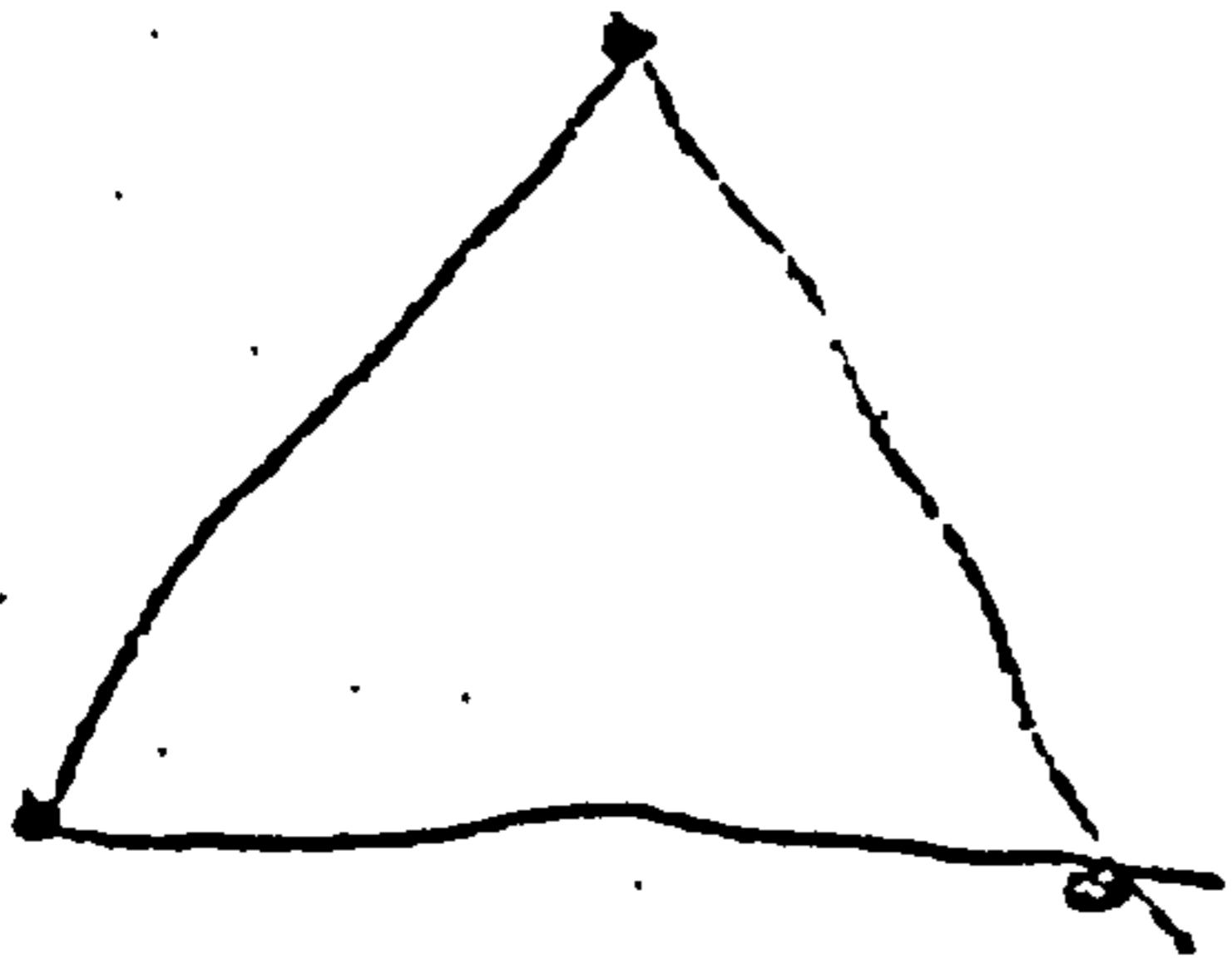
ABBREVIATIONS USED IN THIS STUDY

A	Atypical
AF	Adult Form
AM	Almost Mature
AP	Articulatory Precision
C	Consistency
CA	Chronological Age
CH	Consonant Harmony
CR	Cluster Reduction
CSV	Context-Sensitive Voicing
CV	Consonant Vowel
DAD	Developmental Articulatory Dyspraxia
DADDP	Developmental Articulatory Dyspraxia Diagnostic Procedure
EAT	Edinburgh Articulation Test
EL	Expressive Language
F	Female
FCD	Final Consonant Deletion
FR	Fronting
GL	Gliding
GR	Glottal Replacement
I	Immature
IAP	Immature Articulation Praxis
ITPA	Illinois Test of Psycholinguistic Abilities
LARSP	Language Assessment, Remediation and Screening
LI	Language Impaired
M	Male
MV	Minor Variations
PACS	Phonological Analysis/Assessment of Child Speech
RDLS	Reynell Developmental Language Scales
RED	Reduplication
S	Sequencing
SEN(M)	Special Educational Needs (Moderate)
SFWF	Syllable Final Word Final

SFWW	Syllable Final Within Word
SIWI	Syllable Initial Word Initial
SIWW	Syllable Initial Within Word
ST	Stopping
VC	Verbal Comprehension
VI	Very Immature
VOC	Vocalisation
WF	Word Final
WISC	Weschler Intelligence Scale for Children
WPPSI	Weschler Preschool and Primary Scale of Intelligence
WSD	Weak Syllable Deletion
WW	Within Word

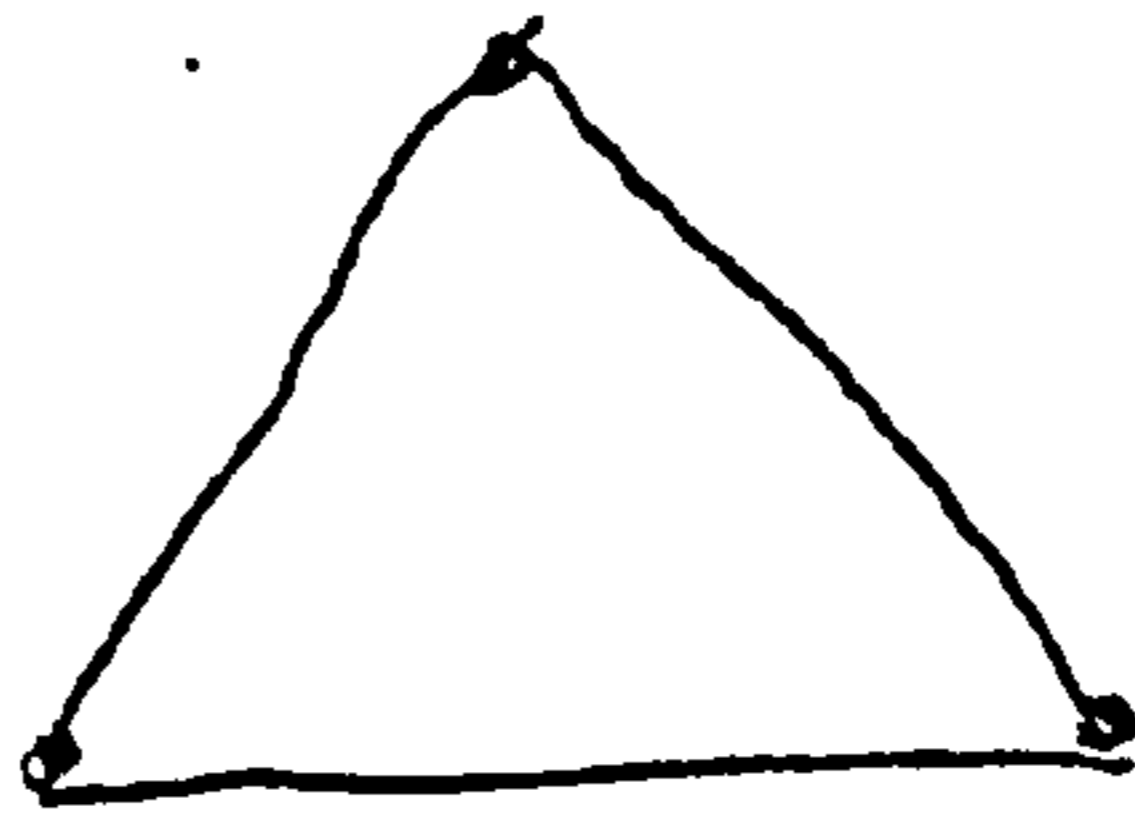
APPENDIX FOUR

APPENDIX FIVE

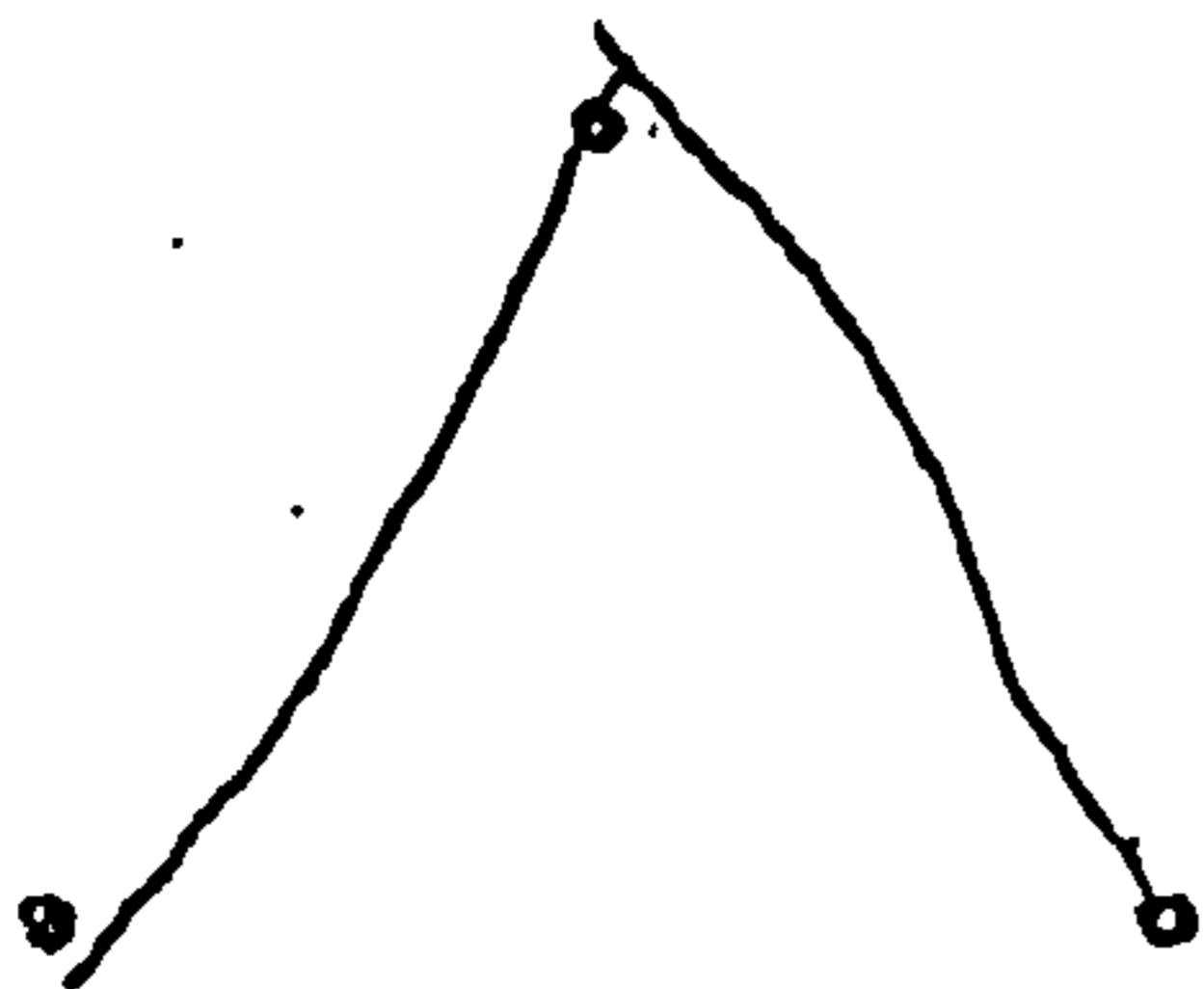


Mary

S1 MARY



S2 KERRY
KERRY



S3 NEIL

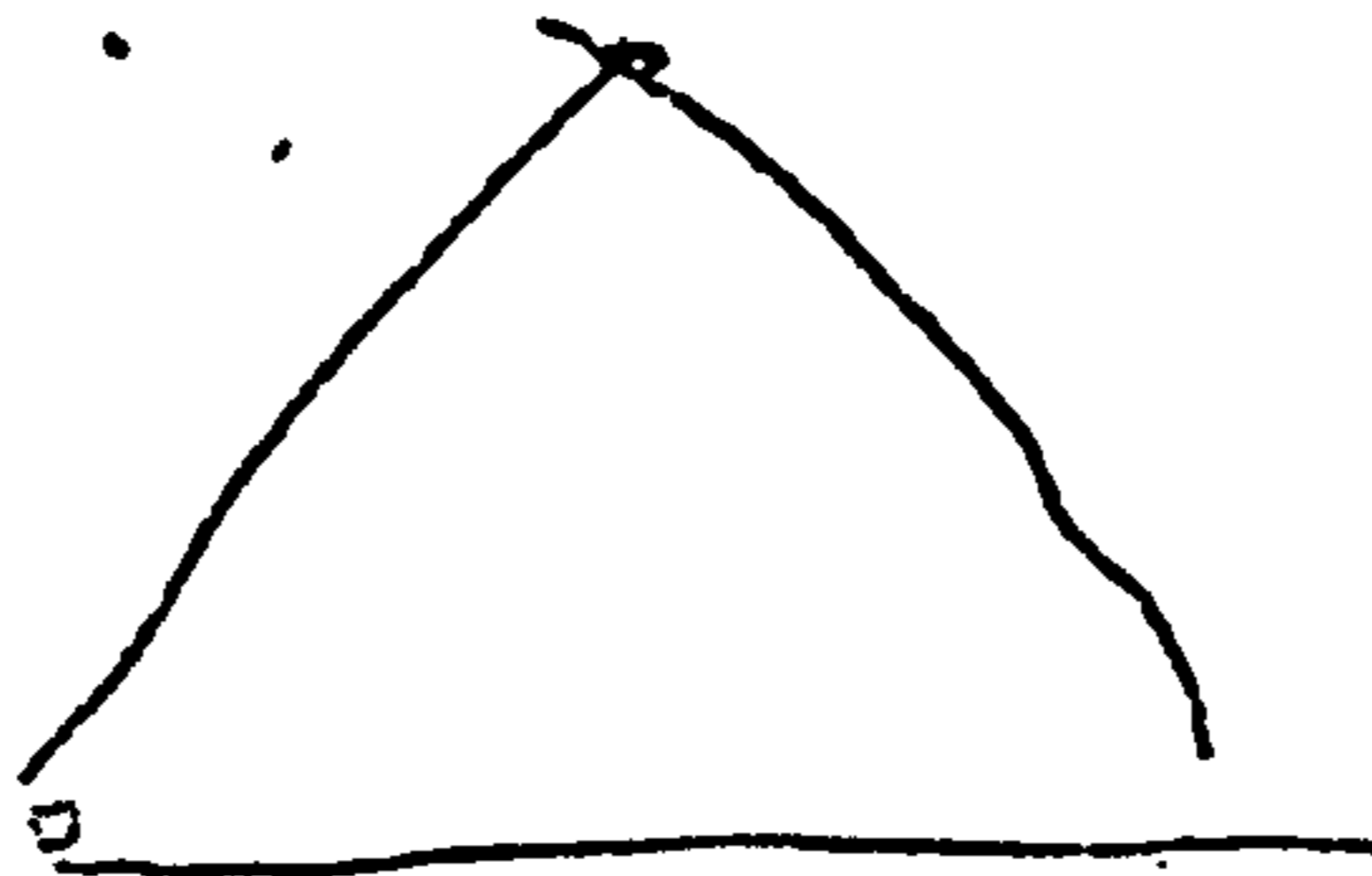
Neil



S4 ANDREW

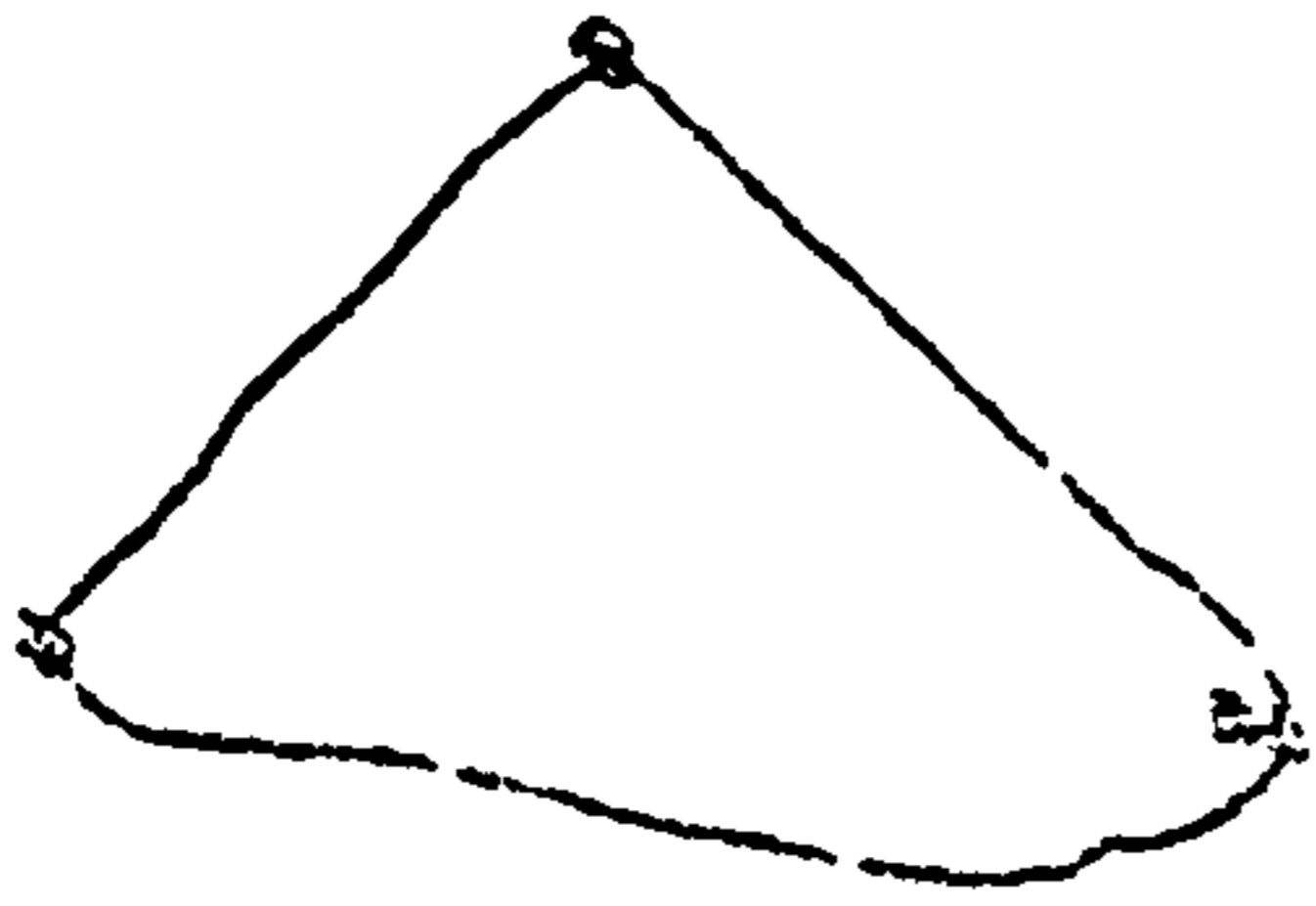
ANDREW

en



GRAHAM

S5 GRAHAM



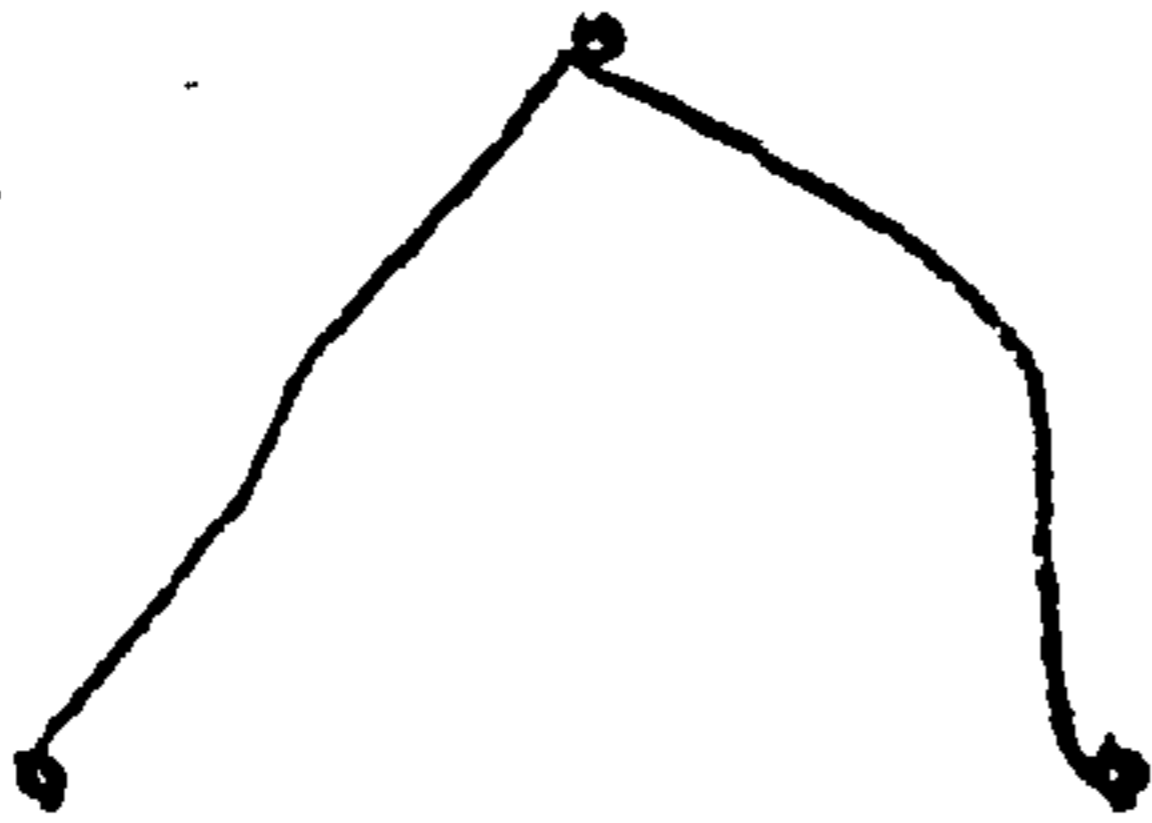
Phillip

S6 PHILLIP

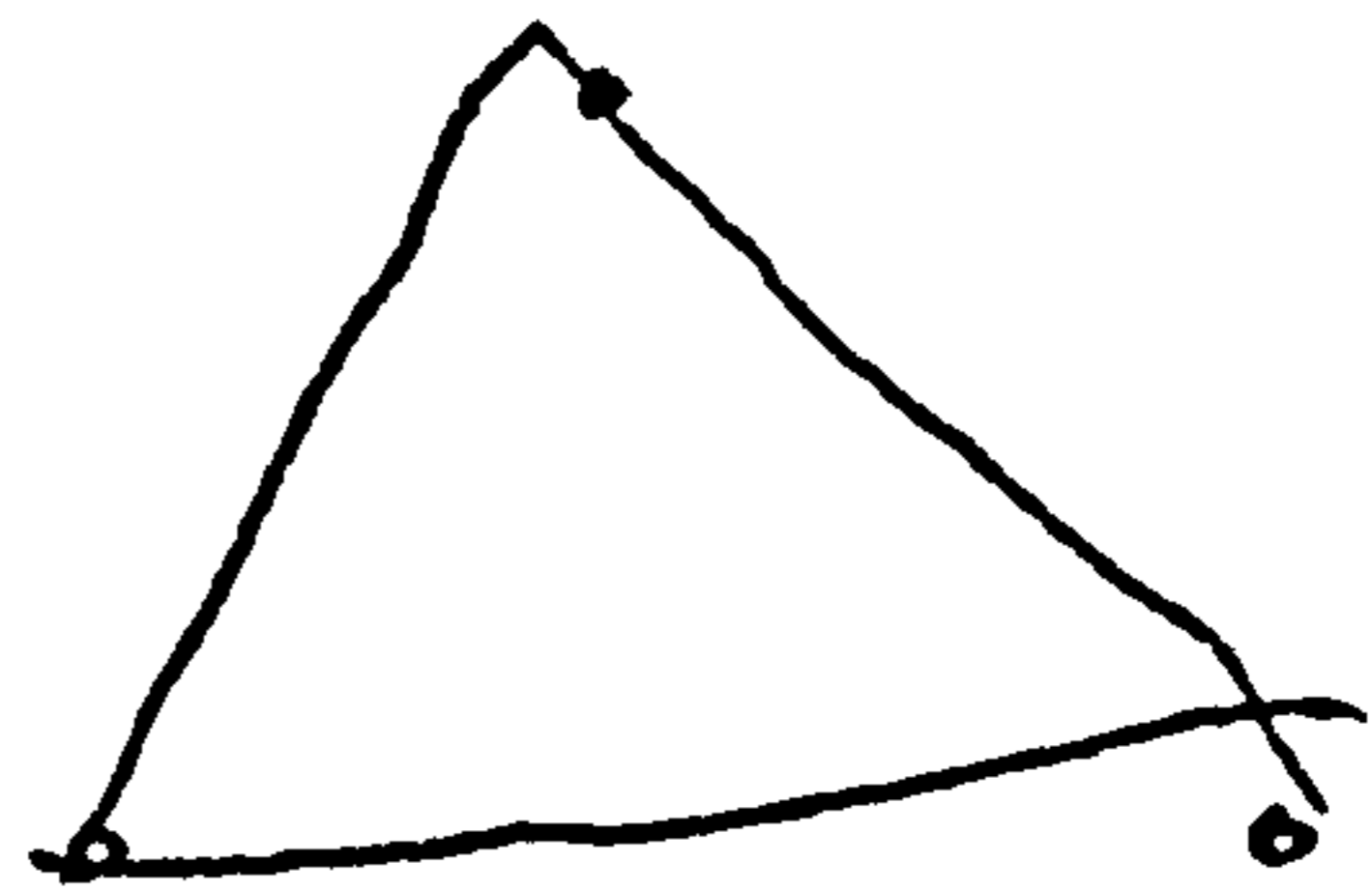


Minaret et al

S7 MICHAEL



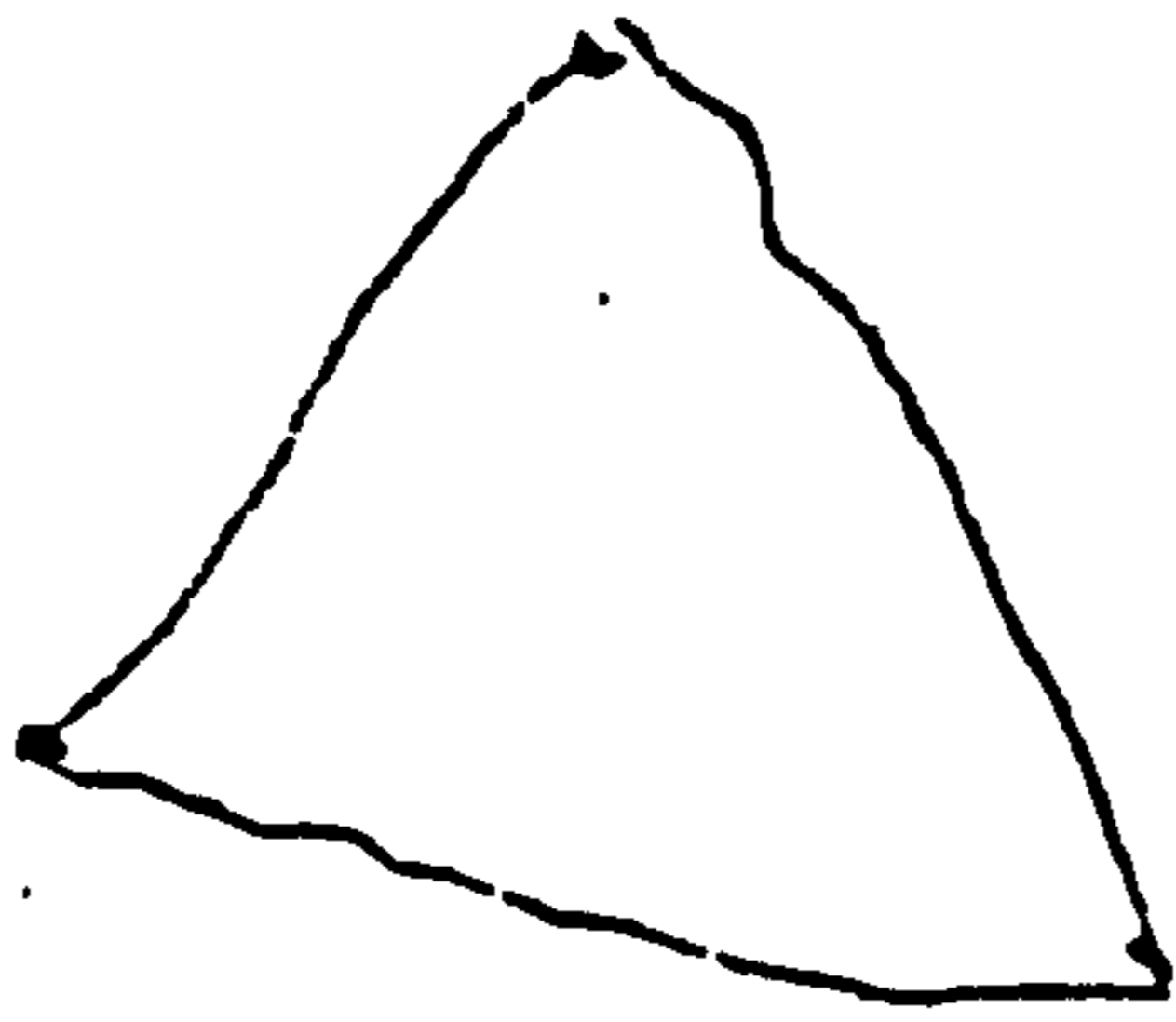
S8 JOANNE



Philip

S9 PHILIP G

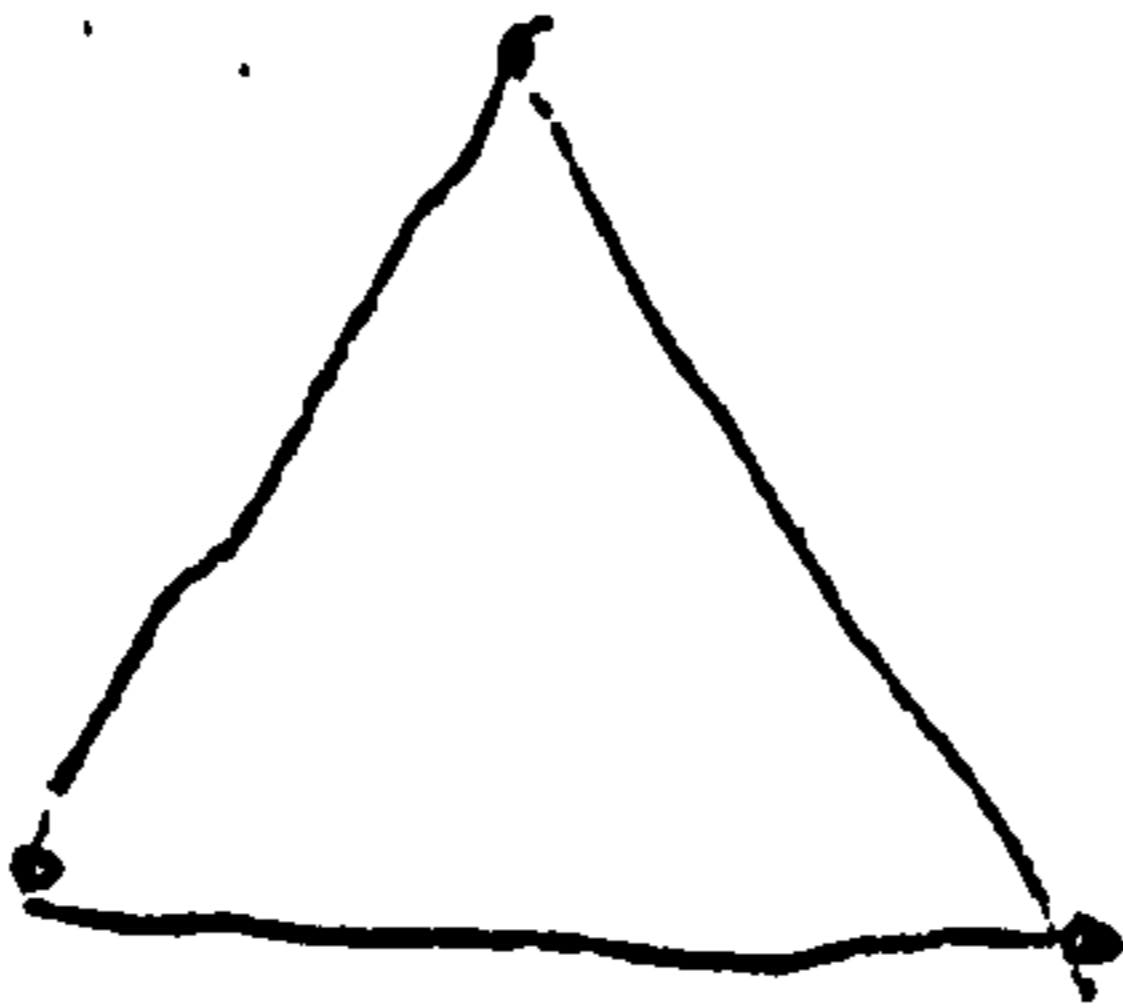
Joanne



Mort y n.
S10 MARTYN

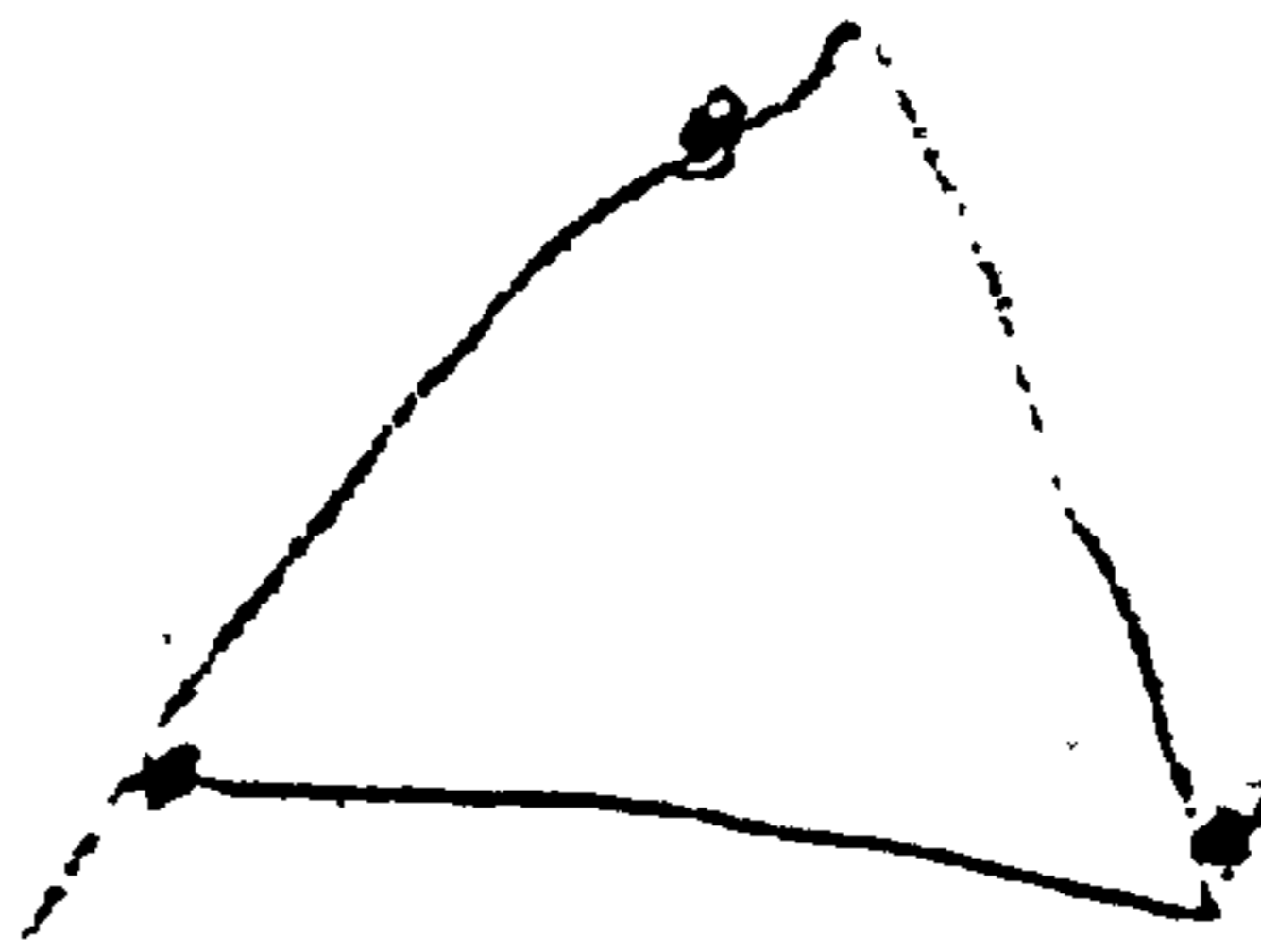


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Lesley



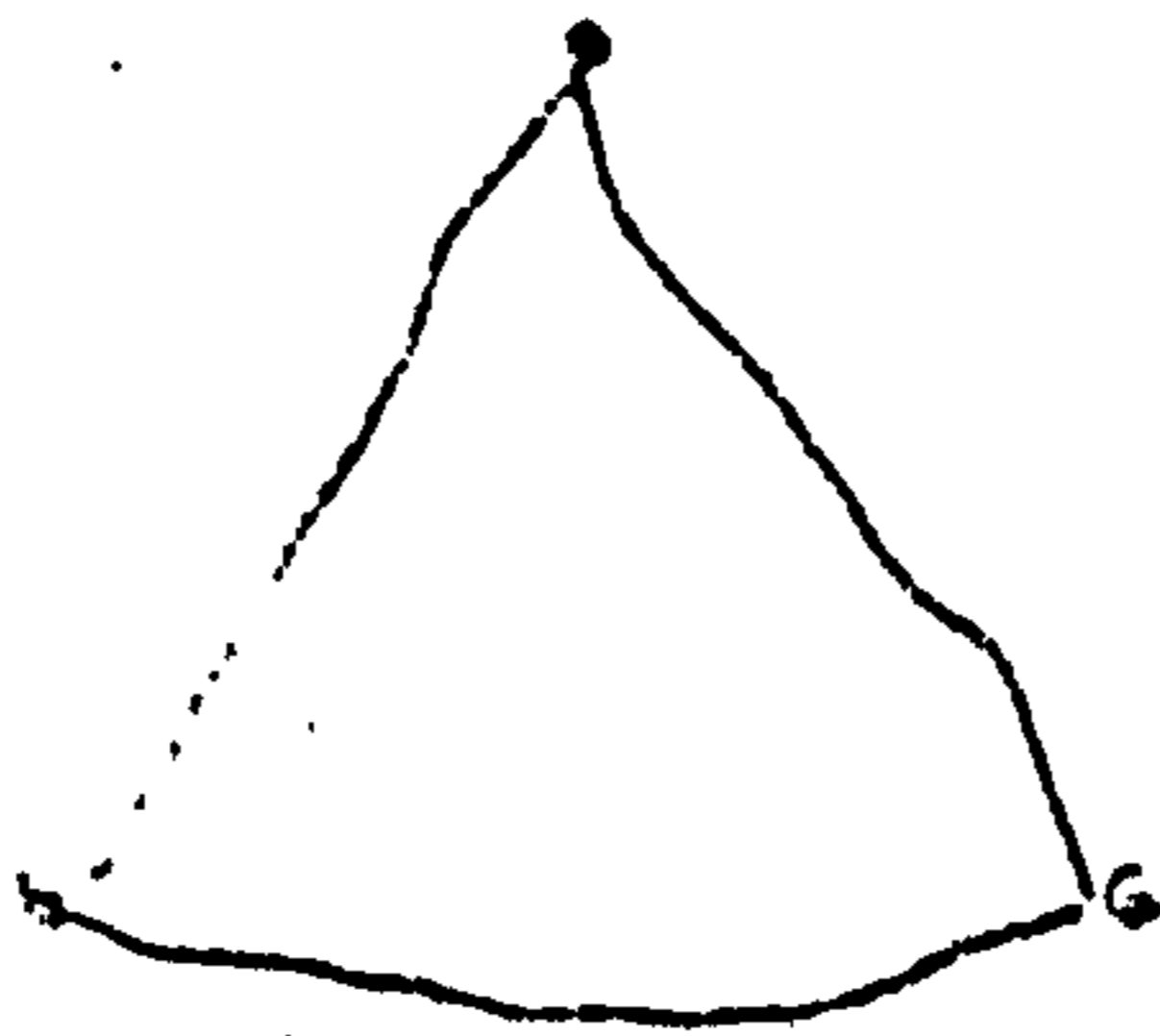
S12 JASON

Jason



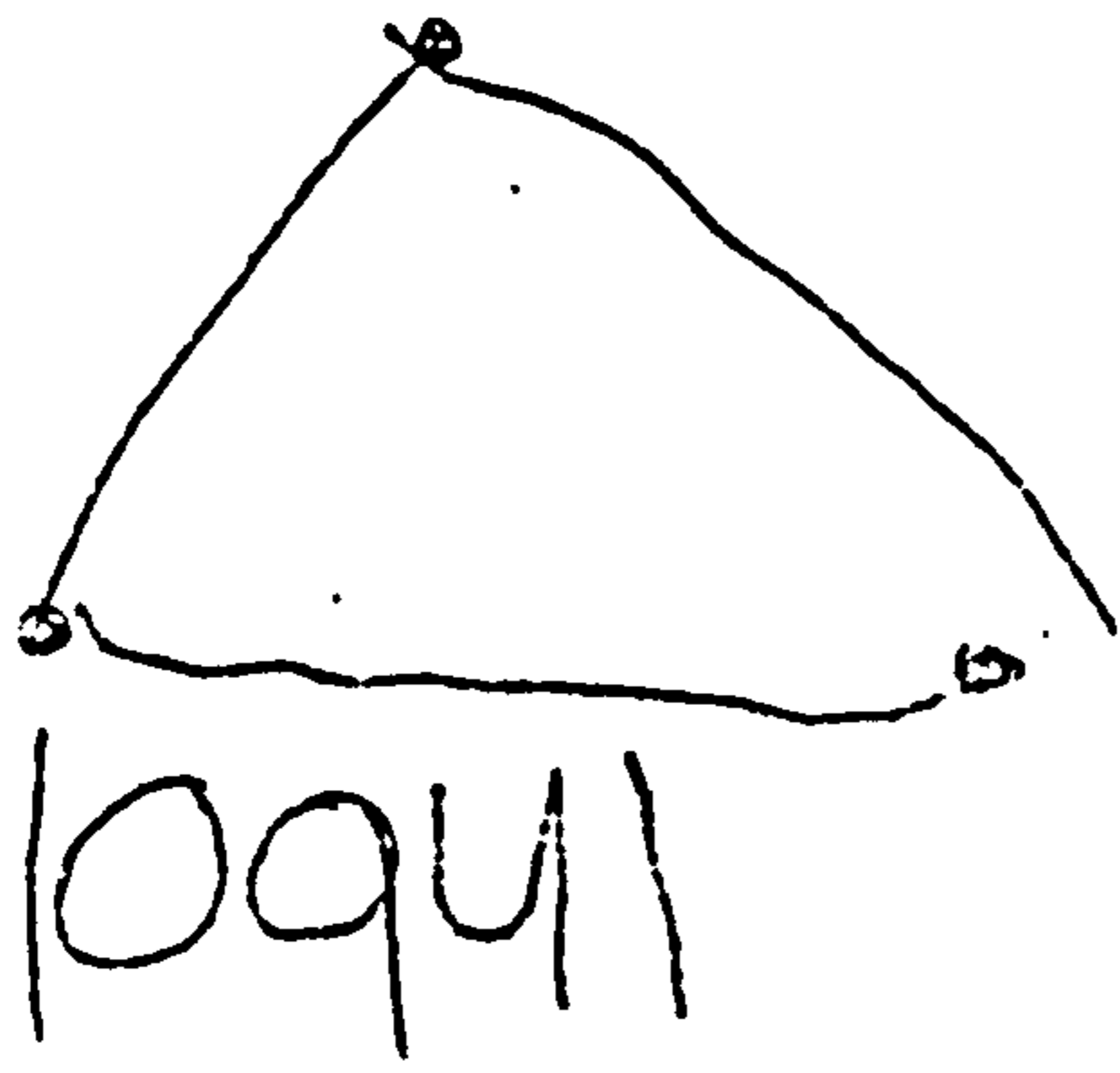
SAREA

S13 SAREA



Jacqueline

S14 JACQUELINE



S15 PAUL



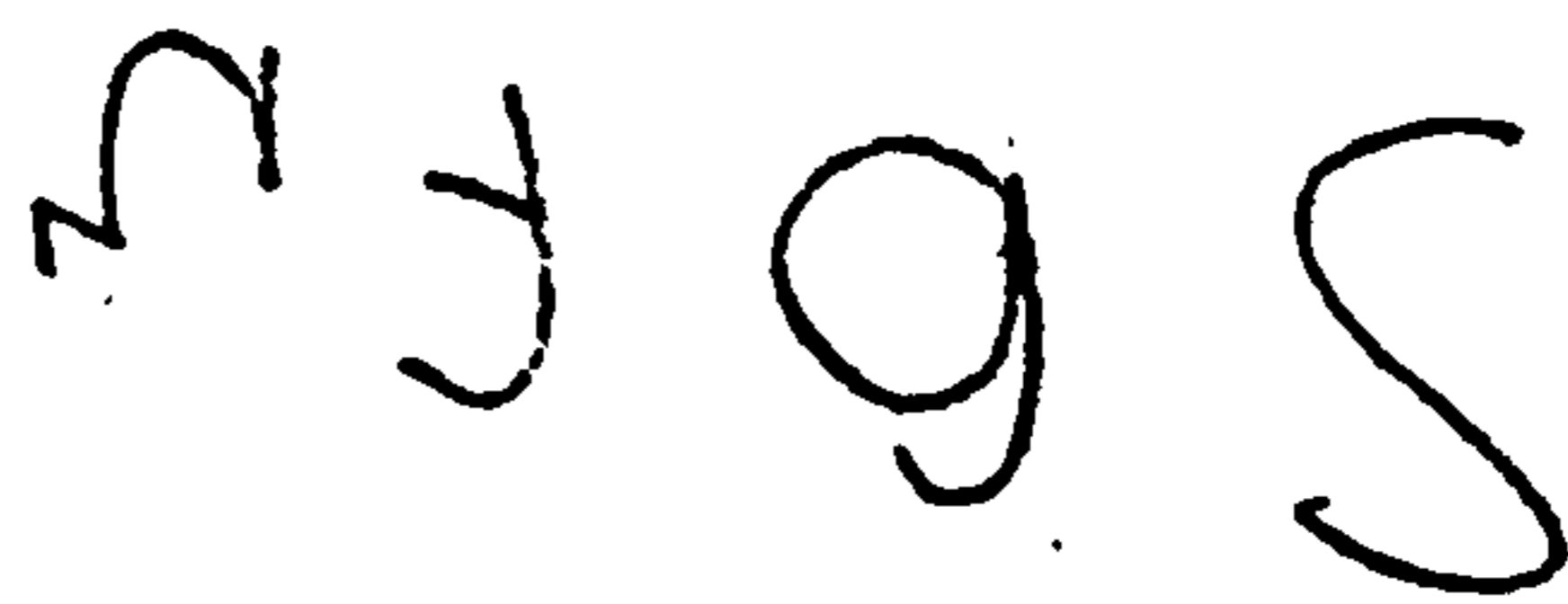
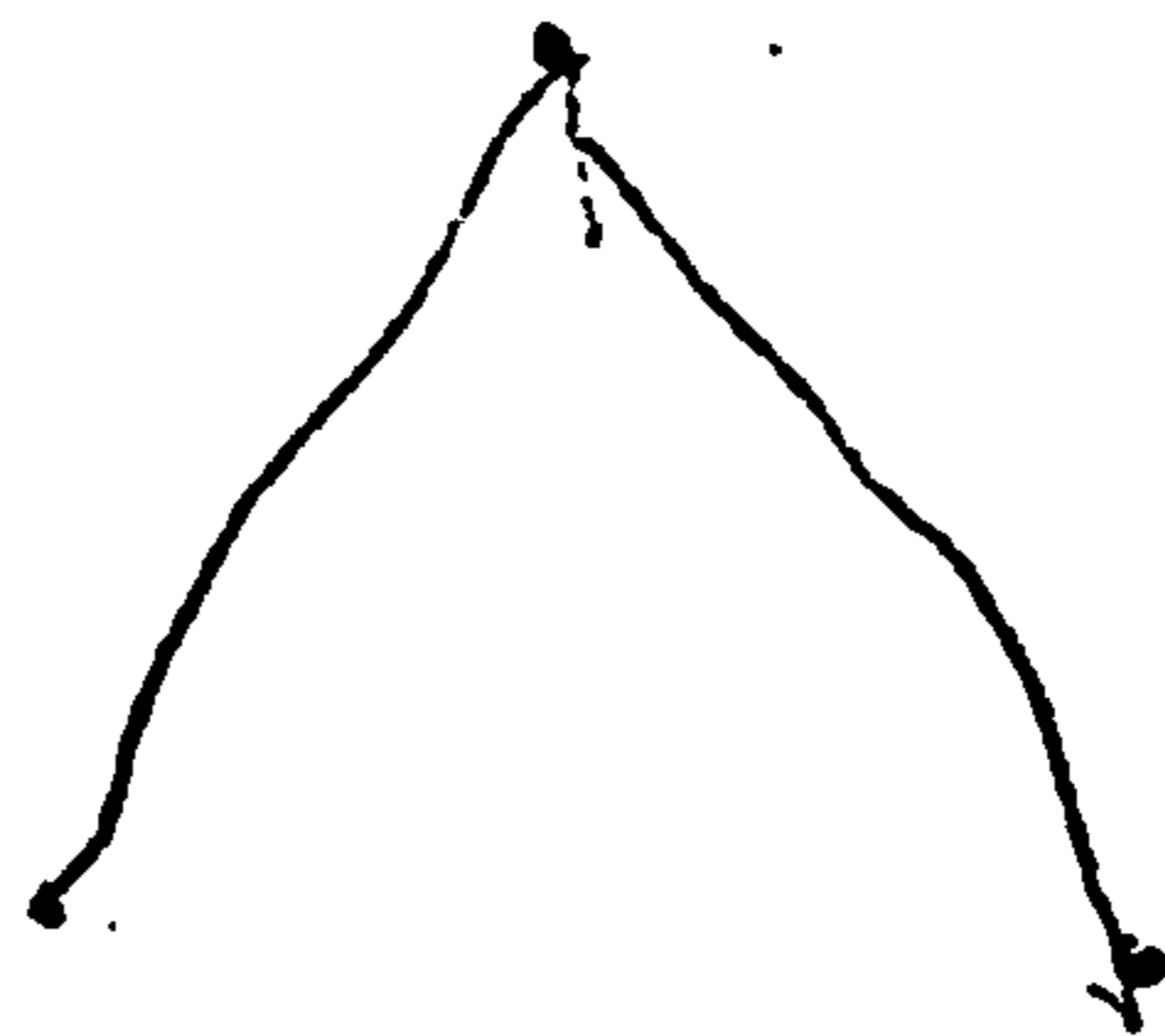
S16 ADRIAN



S17 SABRINA



S18 LESLIE



S19 SAMANTHA

APPENDIX SIX

TO LI AND SEN(M) GROUPS

S	A P	C	S	A P	C	S	A P	C	S
LI									
1	29	21	18	15	15	13	11	9	9
2	41	38	33	34	30	33	29	26	26
3	41	24	20	40	22	17	38	23	18
4	60	49	44	57	49	46	58	48	46
5	-	-	-	54	42	26	53	43	26
6	55	24	40	53	26	40	53	25	41
7	42	20	18	44	16	18	43	16	18
8	-	-	-	30	47	40	30	42	38
9	17	17	17	12	15	10	10	15	5
SEN(M)									
10	25	6	10	17	2	10	8	0	4
11	24	14	10	19	10	8	17	11	7
12	24	7	12	15	5	10	14	3	6
13	30	27	20	28	22	20	23	17	1
14	29	10	12	17	3	4	13	0	4
15	31	17	23	25	11	18	20	5	9
16	19	5	15	17	4	8	14	3	6
17	27	11	13	18	7	11	15	3	9
18	29	4	8	21	0	10	13	0	2
19	28	8	19	23	6	10	19	4	8

COMMENTS

1. Little or no improvement is recorded over the three administrations in the DAD group S3, 4, 5, 6, 7 and 8.
2. Progressive improvement is observed in A.P., C. and S. in all cases of I.A.P. S.S. 1, 2, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19 over the three administrations. The Cut-off score for normal praxis appears to be around 30 for A.P. Considerably more fluctuation appears to be present in the results for C. and S.

ADMINISTRATION OF DADDP MARCH 1982 AND SEPTEMBER 1983

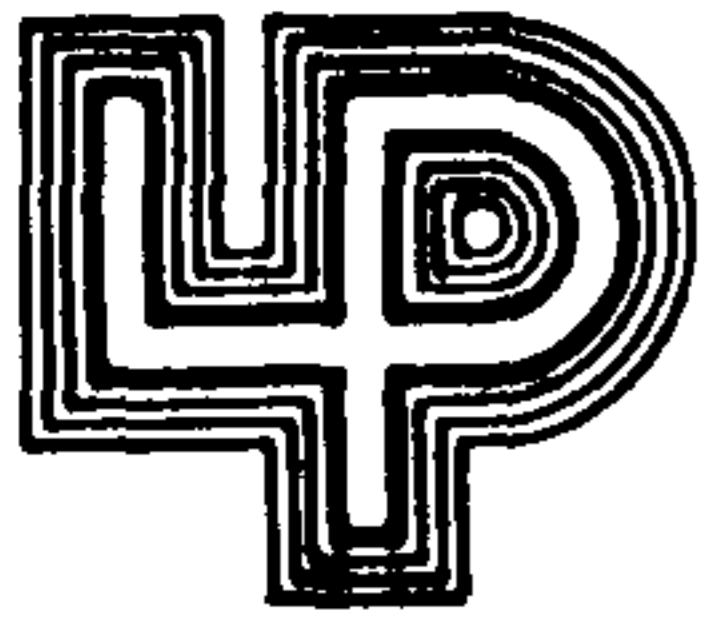
PRE-SCHOOL GROUP

S	A	P	C	S	A	P	C	S
1	9		2	2	2		0	0
2	17		8	0	3		2	0
3	5		3	1	0		0	0
4	6		2	2	1		0	0
5	7		3	0	2		0	0
6	9		1	2	1		1	1
7	4		0	0	0		0	0

Of 10 children originally assessed in March 1982 only 7 were available for re-assessment in September 1983.

The results in each case show progression towards the norm.

APPENDIX SEVEN



Leicester Polytechnic

Developmental Articulatory Dyspraxia

A Diagnostic Procedure

**devised by Nancy R. Milloy ©
School of Speech Pathology**

Name:

Date of Birth

Clinic/School:

Date tested:

Age

Date tested:

Age

Date tested:

Age

Administered by:

Section One

1. Tell child your name and ask him/her to tell you his/hers.
2. Show objects, one at a time: comb, key, pencil, monster. Ask child to name and describe each object and demonstrate its function.
3. Ask child to point to the door, the window, all the chairs in the room.
4. Ask child to point to his/her nose, head, leg, shoulder and chin in that order.
5. Ask child to remove shoes. Turn the shoes so that they are on the wrong sides and facing each other toe-to-toe; ask child to put shoes on.
6. Ask child to give you his/her hand. Indicate, by touching it, the point of his/her nose. Likewise by touch, indicate the point of his/her right index finger. Ask child to touch one with the other without naming them. ie., touch there (nose) with that (finger).
7. Ask child to close eyes and repeat No. 6.
8. With four toothpicks make a square. After dismantling your square. ask child to make one.
9. Re-form the square. Now leave sides as before and move top and bottom toothpicks to form a diagonal cross. Dismantle your design and ask child to make a similar one.
10. Give child a piece of paper on which have been drawn three dots which can be joined to form a triangle. Ask child to join the dots with a pencil. When child has finished, ask him/her to write name underneath the triangle.
11. Ask child to watch you closely and copy each step after you:
 - (i) With fingers closed and pointing upwards, hold hands - palms forward - towards child.
 - (ii) Repeat above, but hold left hand open and right hand closed in a fist.
 - (iii) Hold left arm outstretched to side at shoulder level and right arm above head.
 - (iv) Hold thumbs and index fingers touching each other to form a diamond shape.

Comments

mita

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- 8.
- 9.
10. part
11.
 - (i)
 - (ii)
 - (iii)
 - (iv)

Section Two

Tape record the WHOLE of this section

1. Listen carefully and say after me:

(a) On the bus

On the big bus

On the big red bus

The boy went home on the big red bus

(b) Up the hill

Up the steep hill

Up the long, steep, hill

The sheep climbed up the long, steep, hill.

(c) Under the car

Under the new car

Under the new, blue, car

The ball rolled under the new, blue car (and out on to the road).

2. I shall say each of these words three times; wait until I finish, then you say them:

(a) buttercup buttercup buttercup

(b) lollipop lollipop lollipop

(c) crocodile crocodile crocodile

(d) aeroplane aeroplane aeroplane

(e) fisherman fisherman fisherman

(f) sewing machine sewing machine sewing machine

(g) superstructure superstructure superstructure

CATEGORY KEY

Responses 0 No response 3 Fair
1 Failed 4 Good
2 Poor 5 Accurate

Articulatory Precision

Consistency

Sequencing

1

2

3. Now, here are some funny words; say them three times after me.

- (a) ['tabətəu 'tabətəu 'tabətəu] 'tábito'
(b) ['səkənəf 'səkənəf 'səkənəf] 'sáckinif'
(c) [bɪ'tanəg bɪ'tanəg bɪ'tanəg] 'bitánig'
(d) [xɪlɪ'tʃɔʃ xɪlɪ'tʃɔʃ xɪlɪ'tʃɔʃ] 'rilichósh'
(e) [lə'θɪʃəp lə'θɪʃəp lə'θɪʃəp] 'lithíship'
(f) [plɔsə'dɪɪn plɔsə'dɪɪn plɔsə'dɪɪn] 'plawsidreén'
(g) ['skɪəməwɒt 'skɪəməwɒt 'skɪəməwɒt] 'scrámiwot'

4. I shall say some sounds; you say them after me.

- (a) [bəbəbə dədədə gəgəgə]

Now put them together

- (b) [bədəgə bədəgə bədəgə]

No noise this time. (Voiceless consonant, whispered vowel).

- (c) [fəfəfə səsəsə θəθəθə]

Together now

- (d) [fəsəθə fəsəθə fəsəθə]

Again, no noise.

- (e) [pəpəpə fəfəfə tətətə səsəsə kəkəkə]

Together again

- (f) [pəfətəsəkə pəfətəsəkə pəfətəsəkə]

5. Try these sounds. Let's sing the first ones like this: Produce a continuous note.

- (a) [a əv u ɛɪ i a əv u ɛɪ i a əv u ɛɪ i]

This time, say them after me non-continuous.

- (b) [a əv u a əv u a əv u]

The same way again

- (c) [u ɛɪ i u ɛɪ i u ɛɪ i]

Singing again (continuous note).

- (d) [u a u a u a u a u a u a u a u a]

6. Ask child to count to ten

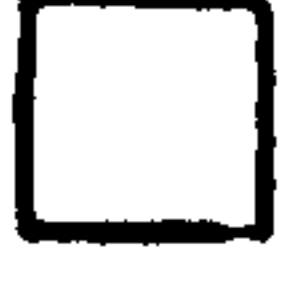
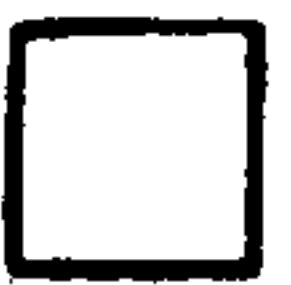
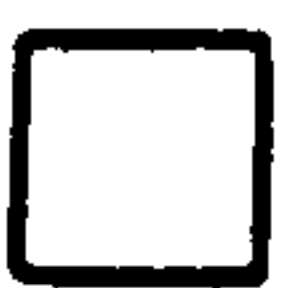
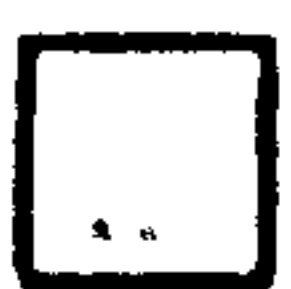
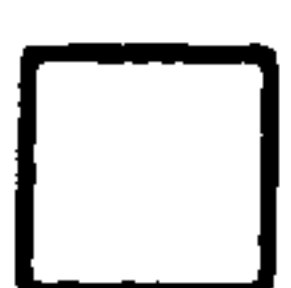
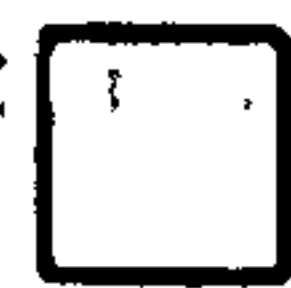
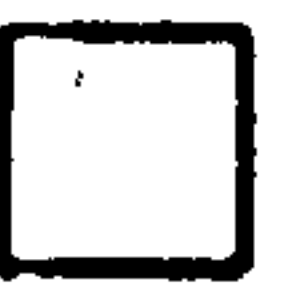
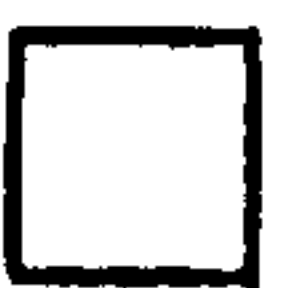
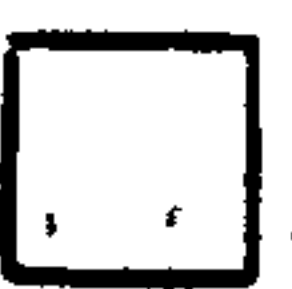
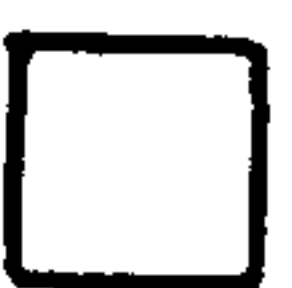
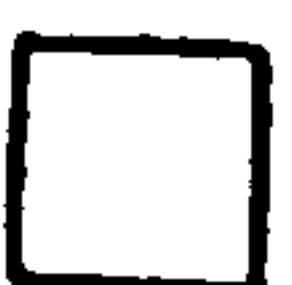
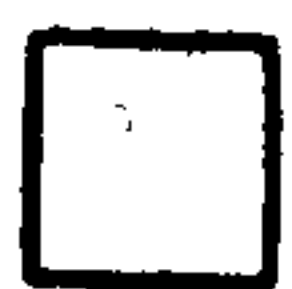
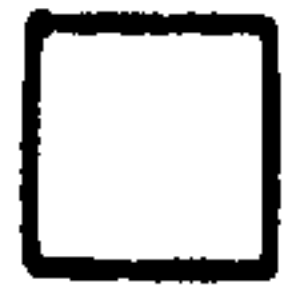
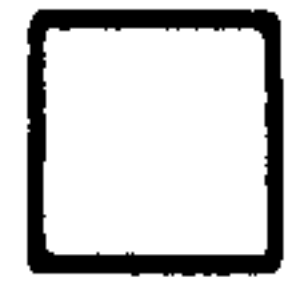
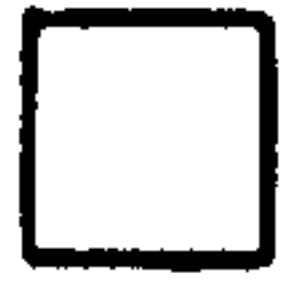
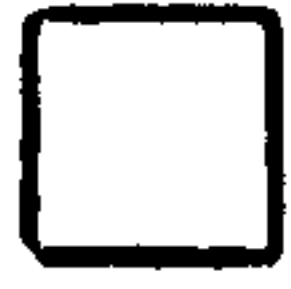
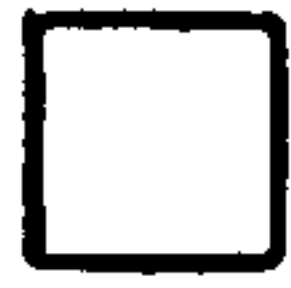
CATEGORY KEY

Responses 0 No response 3 Fair
1 Failed 4 Good
2 Poor 5 Accurate

Articulatory Precision

Consistency

Sequencing



Section Three

Instruct child to copy your movements. Give no further verbal instructions. Allow three attempts per movement.

1. Stick out tongue.
2. Turn tongue up to touch nose.
3. Turn tongue down to touch chin.
4. Move tongue from one corner of mouth to the other several times.
5. Move tongue right round total lip surface several times.
6. Open mouth wide; close mouth - three times.
7. With lips closed, smile - three times.
8. Purse lips to form kissing position - three times.
9. With lips open, smile - three times
10. With mouth open, wiggle jaw from side to side several times.
11. Make normal bite several times.
12. With mouth closed, blow out cheeks. With fists, release breath.
13. Clear throat, cough, several times.
14. Whistle.

Comments

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Section Four

Now listen to the sounds on this tape recording.

The first exercise is hand clapping. Each group of claps will be done 3 times. Listen carefully, then you do it 3 times.

Next, the sounds are made by tapping one finger on the edge of the table. Listen to it being done, 3 times for each group, then you do it 3 times.

Lastly, the sounds are made by saying lah-lah, sometimes slowly, sometimes quickly.

Each exercise will be done 3 times. Listen and then you do it 3 times.

Finally, say the nursery rhyme Baa-baa black sheep.