RESEARCH THESIS SUBMITTED AS PART OF THE

COURSE WORK FOR THE DEGREE OF M. PHIL

IN THE UNIVERSITY OF ASTON IN BIRMINGHAM

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1st October 1975

S U M M A R Y

After initial definitions, the first part of the study compares the amount of time spent on various activities by E.S.N.(s) children in day school with time spent on the activities of a Doman-Delacato home programme. There follows a review of some approaches to the acceleration of the progress of E.S.N.(s) children, in particular that of G. Doman and C. Delacato.

The experiment which forms the main research item is one based on experimental and control groups, pre and post tested, of E.S.N.(s) children in a day school, the experimental group performing some activities from Doman and Delacato. The results are analysed and suggest in a qualified way, that this particular approach has some merit in the day school situation. A follow up study four months after the experiment suggests that the gains made by the experimental group remain after the cessation of their special activities.

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Doman - Delacato Methods In The Education of Severely Educationally Subnormal Children in Day School

C O N T E N T S

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LIST OF TABLES

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LIST OF DIAGRAMS

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I N T R O D U C T I O N

As in the past different authorities from different parts of the world have used different concepts of mental subnormality it is well to attempt to define standards in order to identify the subjects of this study. It is in fact easier to identify the severely handicapped because of their obvious difficulty in adapting themselves to the physical and social environment. Less severely handicapped persons only become obvious when "the complexity of society advances above the limit of their spontaneous competence". (Clarke 1966).

The World Health Organisation refer to Mental subnormality as "incomplete or insufficient general development of the mental capacities".(W.H.O.Bulletin 1954). The American Association of Mental Deficiency adopted the following basic definition of mental retardation in May 1960.

"Mental retardation refers to sub average general intellectual functioning which originated during the developmental period and is associated with impairment in adaptive behaviour". (Heber 1961).

A propos this definition, the upper age limit of the developmental period is considered to be at approximately 16 years, and sub average general intellectual ability is more than 1 Standard Deviation below the population mean. Adaptive behaviour is considered to show itself through three main elements - maturation, learning and social adjustment.

The British Mental Health Act (1959) defined subnormality as "A state of arrested or incomplete development of mind which includes subnormality of intelligence and is of a nature or degree which requires or is susceptible to medical treatment or other special care or training of the patient". Furthermore, in the same Act, severe subnormality is seen as the inability "to live an independent life or guard against serious exploitation".

The American Association for Mental Deficiency and the British Mental Health Act definitions both note the existence of two main deficits in the subnormal - in general intellectual functioning and in adaptive behaviour. Both also exclude any reference to causes - the emphasis is on symptoms, not aetiology.

The diagnosis of mental subnormality does not necessarily, therefore, imply that the retarded person will always be incapable of either average intellectual functioning or unimpaired adaptive behaviour. This last point is of significance when the Doman - Delacato rationale of brain damage is considered later.

The generally accepted classification of subnormal persons is a behavioural one emphasising measured deficits in intelligence and adaptive behaviour, the former carrying perhaps the more weight. Intellectual performance is measured in the United Kingdom by using one of the widely used intelligence tests like the Stanford Binet 1960 Revision, or the Weschler Intelligence Scale for Children. Adaptive behaviour is often measured using the Vineland Social Maturity Scale (Doll 1953), or Gesell Developmental Schedules (Gesell and Armatruda 1947). In both areas, classification is expressed in Standard Deviation units and verbal descriptions. (Tables 1 and 2).

TABLE 1 LEVELS OF MEASURED INTELLIGENCE

Word Description of Retardation in Measured Intelligence	Level of Deviation in Measured Intelligence	Range in Standard Deviation Value		Corresponding IQ Range	
				Stanford Binet S.D.=16	Weschler S.D.=15
Borderline	-1	-1.01	2.00	68 - 83	70 - 84
Mild	-2	-2.01	3.00	52 - 67	55 - 69
Moderate	-3	-3.01	4.00	36 - 51	40 - 54
Severe	-4	-4.01	5.00	20 - 35	25 - 39
Profound	-5	-5.01		Below 20	Below 25

(After A.A. Baumeister)

TABLE 2 LEVELS OF ADAPTIVE BEHAVIOUR

Mild	-1
Moderate	-2
Severe	-3
Profound	-4

(After A.A. Baumeister)

The children who are the subjects of this study are all classified as moderately to profoundly retarded, or severely educationally subnormal, (ESN(s)) all having measured IQ's of less than 50 on the Stanford Binet (1960) Test. In the United Kingdom, before April 1971, such children were deemed unsuitable for education in school, and attended either Day Training Centres or Mental Hospitals. Since April 1971, when the education of severely educationally subnormal pupils became the responsibility of the Department of Education and Science and not the Department of Health, the Training Centres (Junior) have become Day Special Schools, and the institutionalised children have attended Hospital Schools.

Limiting consideration to the Day Special Schools, what kind of education is evolving for these pupils? Much of it is based on what might be termed "nursery school" practice, where sensory motor elements are very important. These include gross to fine motor co-ordination, auditory, visual and early language skills. Much of the time is also spent on personal/social elements such as toilet training, self help in general, establishing "acceptable" standards of social behaviour and interpersonal relationships. While this type of content for the school day may be appropriate to the level of development reached by the children, however advanced their chronological age may be, there are some important considerations that relate to the methods used in handling and applying this content. In the nursery school, a wide variety of tactile, visual and auditory stimuli are made available, with an equal variety of apparatus for developing motor skills. The children have a large degree of freedom to choose their activity, and have an ability to learn almost incidentally from the activities. The time is unstructured basically, while the space may be quite strongly structured.

The ESN (S) child, by definition, has a severe "impairment in adaptive behaviour" (Heber 1961) - he cannot easily relate to his environment.

He cannot, therefore, learn "incidentally" with the facility of the normal child from the activities, however rich the stimuli, that are put in his way. In other words, while the space needs to be structured as with the nursery class, so does the time. Freedom to learn is inappropriate for ESN (s) children, who quickly resort to what might be called negative behaviour for long periods. Research at the Hester Adrian Research Centre, Manchester, suggests the following elements in the effective teaching of S.S.N. pupils. (Cunningham 1971).

(a) Any skill needs to be broken down into simpler skills, and taught in the correct sequence only when each stage has been mastered.

(b) The child needs to overlearn.

(c) The child needs all the individual teaching time he can get.

(d) The child needs to succeed frequently and to be rewarded in some way.

Of these elements, (c) is the one that receives the least real attention in the Day Special School for a variety of reasons.

(a) Shortage of staff to allow individual attention for any length of time.

(b) Inappropriately trained staff, many of whom are nurses, or trained for normal Primary School children.

(c) The perpetuation of the nursery school ethos.

In summary, however rich and imaginative the classroom environment, and however well cared for the children may be, the E.S.N.(s) child cannot gain sufficiently from it unless he receives individual attention from the staff to help him for a large part of the day, during which time his activities should be quite rigidly programmed.

THE DURATION OF INDIVIDUAL ATTENTION

If the lengthof contact time between an individual ESN(s) pupil and the teacher or assistant is of importance in the progress of the pupil, how much time is spent in this way in the Day Special School? A simple observation was undertaken in such a school which involved the rather laborious exercise of observing one child (Female - Chronological Age 5.5) over one school week of five days. The child's activities were noted down and timed throughout each day, the detailed timetable being set out in Diagram 1. The schedule of times spent in each separate activity is shown in Table 3, from which it is apparent that only 20 minutes in the day were devoted to individual attention. This is 5.22% of the child's total school time, in a class of eleven pupils with one teacher (trained as an infant teacher in normal school) and one classroom assistant.

Whether 5.22% is a sufficient proportion of the school day to be given to individual attention with nursery or infant children of normal ability is a debatable point. It seems totally inadequate for severely subnormal children. At the Hester Adrian Research Centre in Manchester, the parents of E.S.N.(s) children are seen as a potential pool of labour to increase this proportion (Cunningham and Jeffree 1971, 1974). The Centre holds parent orientation

DIAGRAM 1 TIMETABLE OF ACTIVITIES FOR ONE CHILD IN A DAY SPECIAL SCHOOL.

(Summer Term)

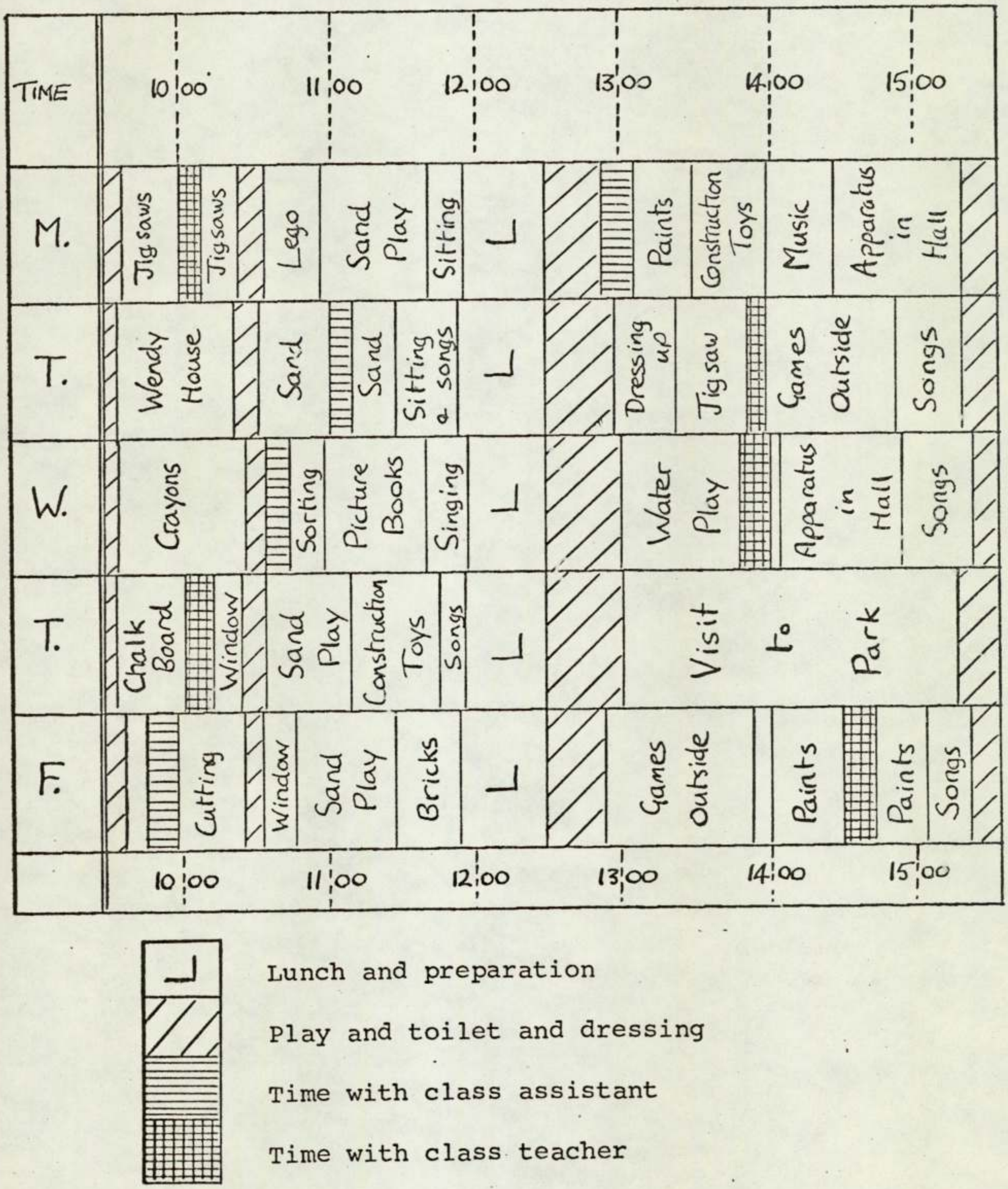


TABLE 3 CONSOLIDATION RESULTS FOR DAY SPECIAL SCHOOL

TIMES IN WHOLE MINUTES

Activity	M.	T.	W.	TH.	F.	Mean Daily Time	Mean % Daily Time
Self Help	56	52	48	40	56	50.4	13.10
Indiv.Attn.	21	22	22	10	25	20.0	5.22
Manual Competence	68	18	42	54	42	44.8	11.68
Tactile Stimulus	42	48	42	30	24	37.2	9.67
Imaginative Play	0	60	0	20	10	18.0	4.68
Books and Reading	0	0	30	0	18	9.6	2.51
Sorting Objects and Pictures	0	0	20	0	0	4.0	1.03
Music Activities	30	20	15	6	6	15.4	3.98
Creative Painting	24	0	0	0	45	13.8	3.63
Motor Skills	30	0	45	0	0	15.0	3.85
Eating and Drinking	42	44	40	42	42	42.0	10.53
Transport*	60	60	60	60	60	60.0	15.39
Outside Play	20	62	20	120	62	56.8	14.73
TOTALS	393	386	384	382	390	387	100.00

* P. 13. (Top)

courses to interest parents in co-operating with the school and even attending the school to help. In itself this is an interesting field for research, the benefits of giving parents assistance to work positively with their handicapped child must be considerable. However, since about 1969 some parents in the United Kingdom have turned to the Doman - Delacato Programme of treatment for their handicapped children. Having felt dissatisfied with medical advice and educational facilities in this country, and perhaps easily attracted by the press publicity given to the Doman Delacato treatment, they have undertaken what is a most rigorous and time consuming programme with their children. The rationale and application of the Doman - Delacato approach are developed in the following chapter, but it is relevant at this point to investigate the amount of time devoted to individual attention from the "teacher", on such a home programme.

The subject of the obversation is the writer's child (Male - Chronological Age 106 months). The period of observation was a school week of five days. Monday to Friday, from 09.00 until 16.00. These are the equivalent times between which a school child is away from home, although the programme of the child in question extends considerably beyond these times at both ends of the day.

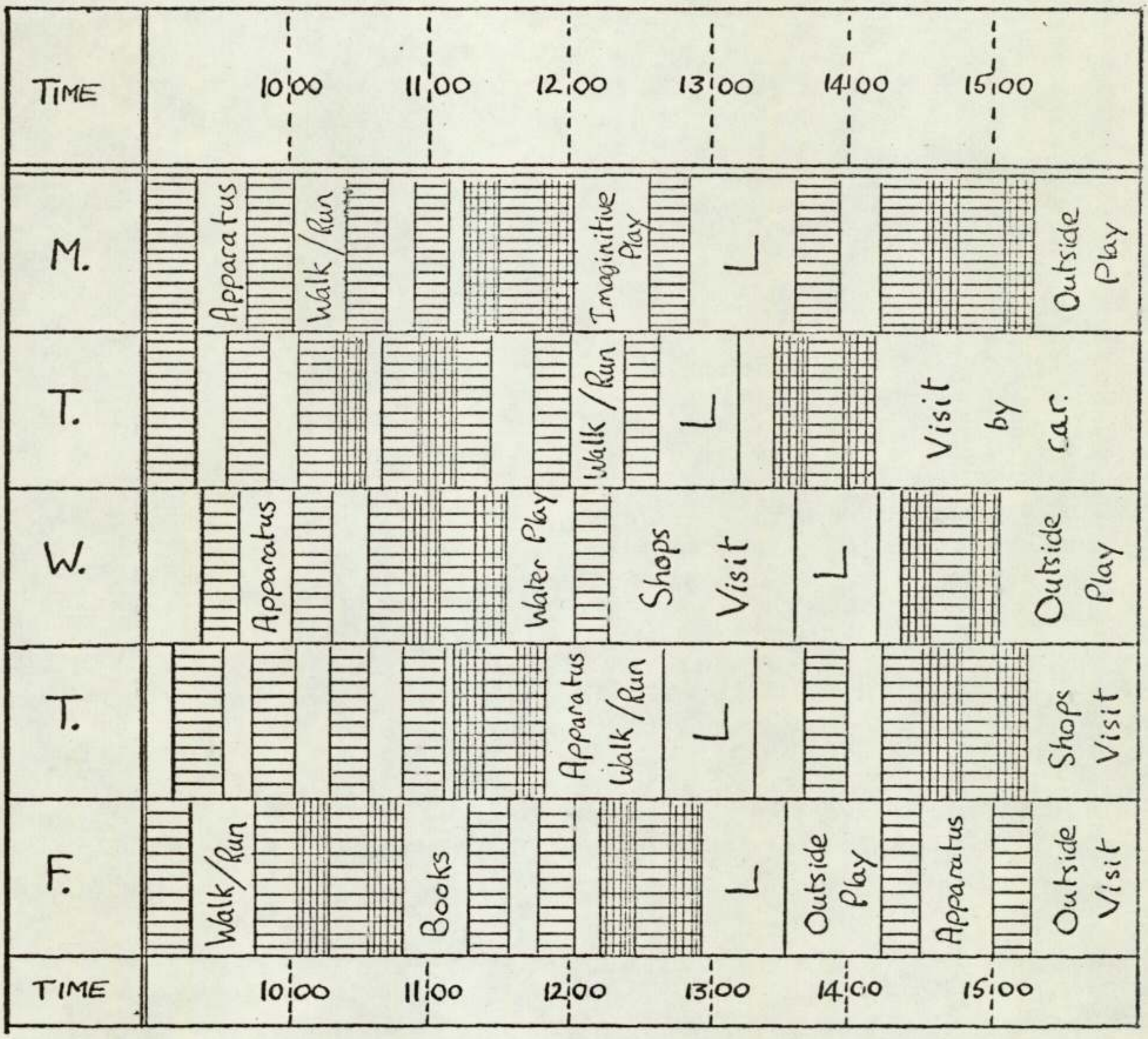
* Transport time for the particular child - 30 mins. each journey between home and school. Some children less, others even longer; most travel by chartered bus.

The detailed timetable is set out in Diagram 2, the schedule of time spent in each activity is shown in Table 4. This shows that a mean of 164 minutes per day were devoted to individual attention, or 39.05% of the child's time. A further 53 minutes each day were devoted to the mobility exercises which for most of the time are under the close supervision and frequent assistance of an adult and could be included with the "individual attention" activities. This would give a mean total of 217 minutes per day or 51.67% of the time given to individual attention, compared with the 5.22% of the Day Special School, a factor of approximately ten times.

Regardless of the Doman - Delacato rationale, such an amount of attention should produce more rapid progress than is possible in the conventional special school classroom, and gives the opportunity for the overlearning which seems necessary for E.S.N.(s) children to succeed in mastering a skill (Cunningham '71). The extra time on individual attention is gained at the expense of time spent on transport, free manual competence exercises, free tactile play, creative play and music.

DIAGRAM 2 TIMETABLE OF ACTIVITIES FOR ONE CHILD ON A DOMAN DELACATO HOME PROGRAMME BETWEEN 09.00 AND 16.00.

(4th - 8th JUNE 1973)



"Sequence" of:-

1. Masking.
2. Brachiation on overhead ladder.
3. Masking & "basic vision".
4. Suspended inverted-dynamic.
5. Reading single words.
6. Write a word.
7. Creep.
8. Masking.
9. Crawl.
10. Masking.
11. Tactile exercise.

"Patterning" of:-

4X (5mins. Cross
Daily (Patterning
(5mins. Creeping
(5mins. Crawling

Cross patterning preceded by brushing of limbs.

Lunch.

TABLE 4 CONSOLIDATED RESULTS FOR A DOMAN - DELACATO HOME PROGRAMME 09.00 TO 16.00

TIMES IN WHOLE MINUTES

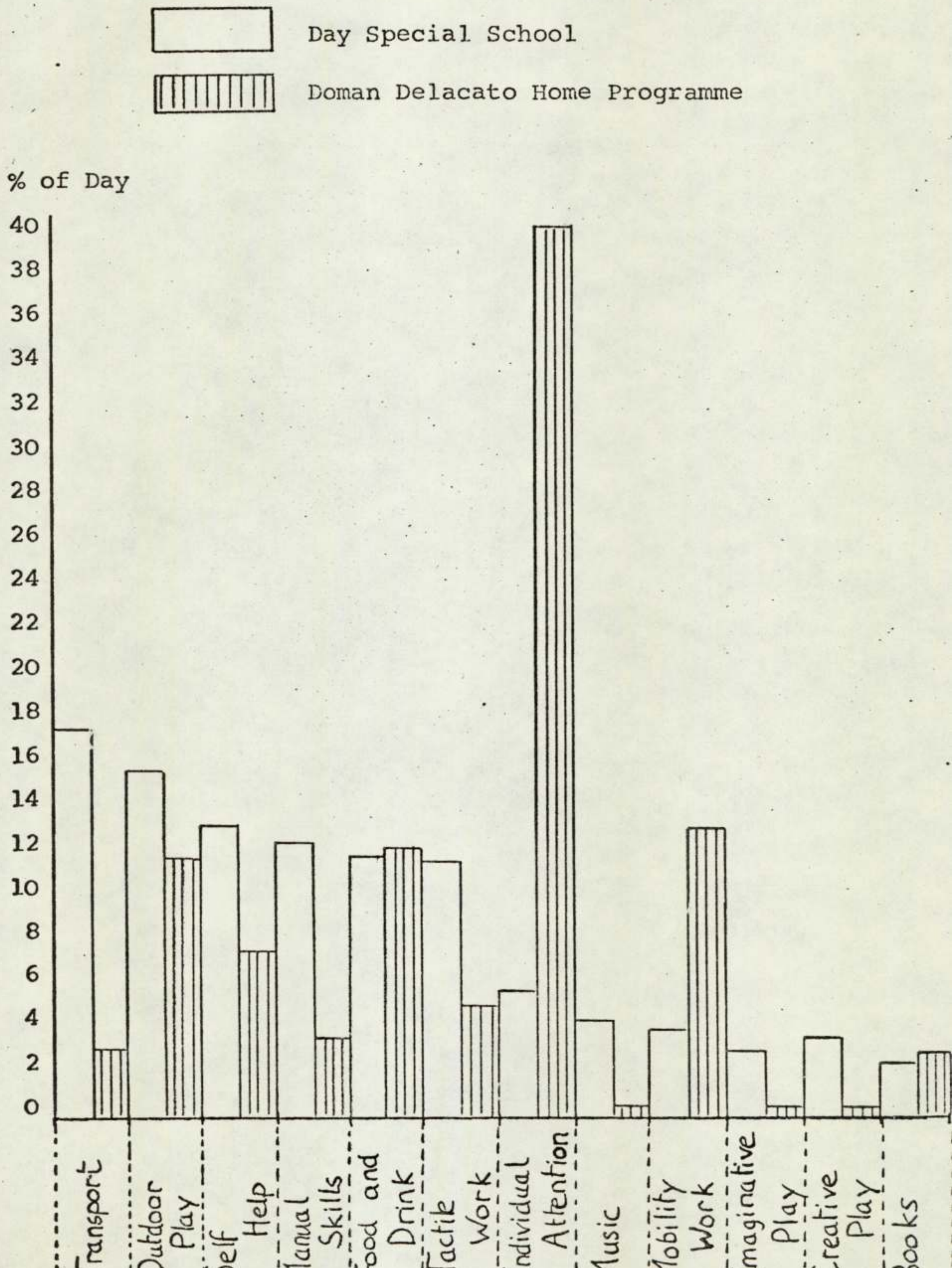
Activity	M.	T.	W.	TH.	F.	Mean Daily Time	Mean % Daily Time
Self Help	30	25	25	20	45	29.0	6.90
Indiv.Attn.	170	170	150	175	155	164.0	39.05
Manual Competence	15	10	15	20	15	15.0	3.58
Tactile Stimului	20	0	25	30	15	18.0	4.28
Imaginative Play	20	10	20	10	15	15.0	3.58
Books on own	15	15	15	25	20	18.0	4.28
Motor & mobility with help	60	45	50	60	50	53.0	12.62
Eating and Drinking	60	40	45	45	40	46.0	10.96
Transport*	0	20	15	15	15	13.0	3.09
Outside Play	30	85	60	20	50	49.0	11.66
TOTALS	420	420	420	420	420	420.0	100.00

* Transport here is time in a car to the shops, friends, special places etc., in the near locality.

Cf. Table 4 - Creative painting, music activities, and sorting activities are omitted. These activities often take place, but outside the 09.00 - 16.00 time period.

However, there are 10 minutes per day manual skills and 9 minutes per day tactile differentiation skills grouped under the heading of individual attention in Table 4, and a considerable amount of time is given to music and creative play in the home programme outside the "normal school day". Diagram 3 shows the comparison between the day school and the Doman - Delacato home programme 09.00 - 16.00 in respect of porportions of the time spent in the various activities. The element that is missing in this simple investigation is the social element. Much of the time spent in the classroom is in contact with the other children: in the home programme there is little of this, and one major criticism of the Doman - Delacato schemes is just this point, and is considered in Chapter 4.

DIAGRAM 3 COMPARISON BETWEEN DAY SPECIAL SCHOOL AND DOMAN-DELACATO HOME PROGRAMME IN RESPECT OF PERCENTAGE TIMES SPENT IN EACH ACTIVITY.



III

THE AIMS OF THE STUDY

The Doman - Delacato methods of treatment are based on a highly structured programme of activities, the frequency, intensity and duration of which accelerate the progress of the child compared with his progress prior to beginning the programme. It is susceptible to major criticisms which will be elaborated subsequently, but the chief of which are:-

(a) The child is at home and is therefore deprived of the social benefits of the company of his peers. It should however be noted that at Special School the "company of his peers" is of a very highly selected group, ie, other E.S.N.(s) children.

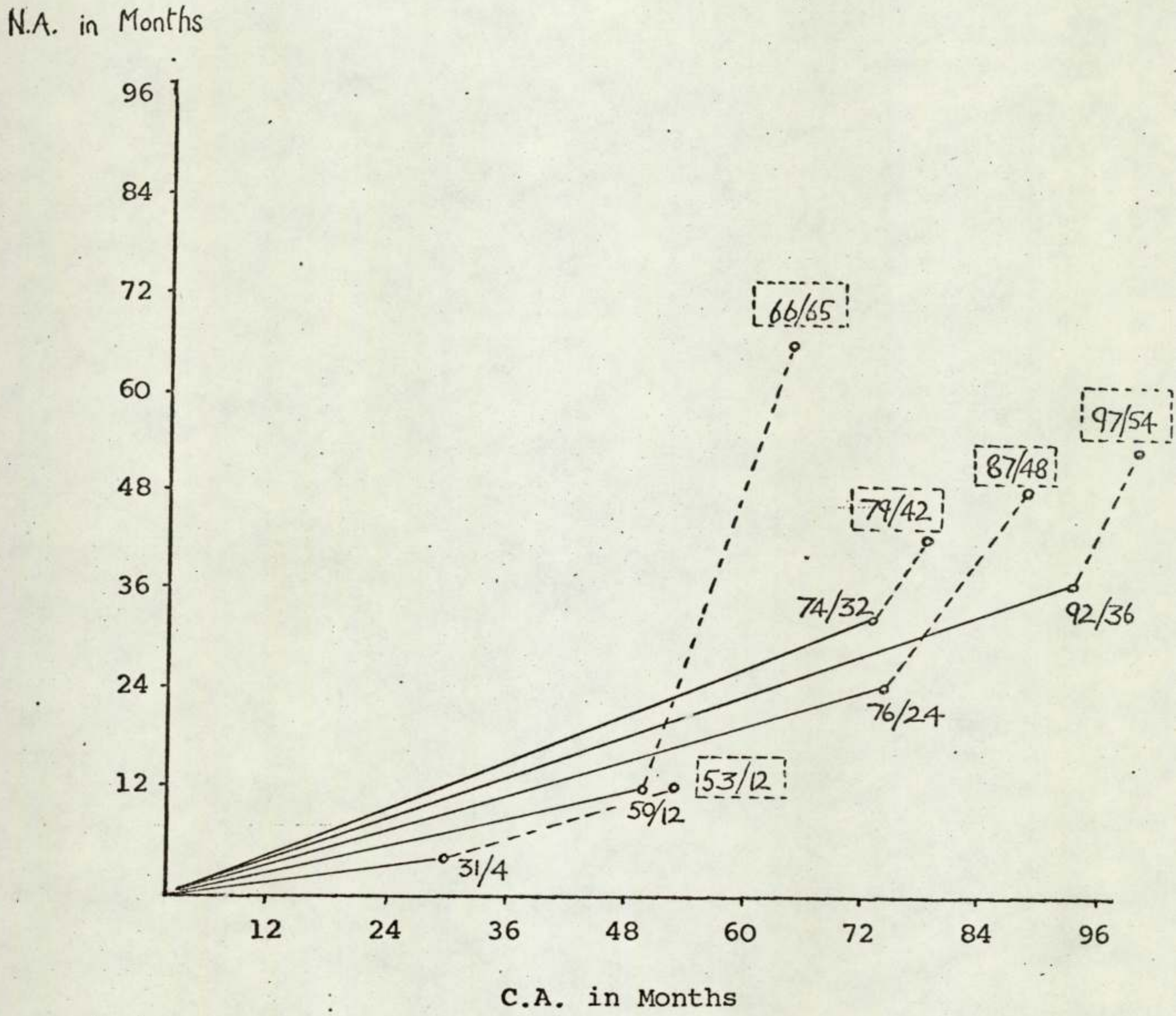
(b) The strain of a day long intensive programme is too severe on the family of the child, in particular the mother. It should be noted that to have a handicapped child in the family is a severe strain per se, which is perhaps somewhat alleviated by some positive action to help the child.

(c) The dubiety, or at least lack of scientific proof, of the Doman - Delacato theories of brain damage. Again, it could be argued that no theories of development or of learning have total scientific validity.

In view of the small amount of time currently given to individual teaching in the day school, (5.22% of the day) and of the apparently good results claimed by Glenn Doman for children on his home programmes, shown in Diag.4, it seemed sensible to investigate the feasibility of adapting such a programme to the day school. Inevitably the programme would be a severely curtailed version of the Doman - Delacato remedial treatment, this being dictated by constraints of time, labour and the exclusion of any medical remedies such as vitamin enrichment of diet, all of which are important parts of the full programme. A pilot project was undertaken over a period of one term in a day special school with 8 of a class of 12 pupils. The 4 omitted were new children to the class and were receiving special "reception" attention. The eight children were in the chronological age range 60 months to 81 months. This small project was by way of a feasibility study, the major concern being to mobilise sufficient labour and utilise available furniture and equipment. The experience from this term's work suggested that an experiment on a larger basis was certainly possible, using ancillaries and students

DIAGRAM 4 SOME RESULTS CLAIMED BY G. DOMAN AND C. DELACATO FOR CHILDREN WHO HAVE UNDERTAKEN HOME PROGRAMMES.

(After Doman & Delacato 1967).



N.A. - Neurological Age.

C.A. - Chronological Age.

31/4 - CA 31) NA 4) At 1st evaluation

——————— Development BEFORE programme begun

[53/12] - CA 53) NA 12) At subsequent evaluation

- - - - - - - Development AFTER programme begun.

in particular as extra labour, and the equipment of the average special school seemed to meet the needs with a little ingenuity. The staff were open minded and pleased to co-operate.

The major aim of the full study is to determine whether a modified Doman - Delacato programme would be effective in the day special school in improving overall development. Its effectiveness is measured by Doman by means of Development Quotients, comparing progress before the treatment related to time, and progress during the treatment related to time.

$$D.Q1 = \frac{\text{DEVELOPMENTAL AGE OR MENTAL AGE}}{\text{CHRONOLOGICAL AGE AT START}}$$

$$D.Q2 = \frac{\text{DA OR MA AT END OF STUDY-DA OR MA AT START OF STUDY}}{\text{DURATION OF STUDY}}$$

In this study, overall development was measured before and after the period of the experiment using a well known standardised test, namely the Peabody Picture Vocabulary Test.

Development Quotients were also calculated and appear in the results given.

A secondary aim is to consider progress in language development, perhaps the most crucial area of development in the severely subnormal child, and one which needs as much attention as possible as early as possible in order to enable the child to reach his highest potential before puberty, an apparently critical age in language acquisition (Lenneberg 1967). As it has been shown that there is a close relationship between immediate memory span and language performance (Graham 1968. Graham and Gulliford 1968), and that low memory span and low IQ correlate closely (Miller 1956), a test of immediate memory span is given at the start of the experiment and at its conclusion. This has the additional value of showing any improvement in what is probably a neurological deficit, a matter central to the Doman - Delacato remedial treatment.

I V

REVIEW OF RESEARCH

After many years of relative neglect, there has been something of an explosion in research into mental handicap, both in the broadly speaking medical sphere and in the psychological field. The three most valuable volumes for background information and lists of sources are those edited by A. Baumeister 1968, N. Ellis (1963) (updated by subsequent reviews of research) and P. Mittler 1970. However, four more specific areas of research have been investigated and reviewed in this chapter. They are:-

a) The Doman - Delacato theories of brain damage, neurological organisation and remediation programmes.

b) Other remedial programmes for severely subnormal pupils.

c) Experiments using specific programmes with severely subnormal pupils.

d) Language development in severely subnormal children.

A) THE DOMAN DELACATO THEORIES OF BRAIN DAMAGE AND REMEDIATION.

The work of the Institutes for the Achievement of Human Potential in Philadelphia has its history in the neurosurgery of Temple Fay in New York before the Second World War.

Important to their view of human development is the concept of neurological organisation, defined by G. Doman and C. Delacato as:

> "the degree to which the central nervous system, and more specifically the brain, provides the organism with all the capabilities necessary to relate it successfully to its environment". (Doman and Delacato 1967).

In human beings it includes homeostasis of the autonomic nervous system and is responsible for the development and maintenance of fundamental human functions such as cross pattern walking, speech, reading, tactile discrimination and so on. They are seen as the result of a continuum of evolutionary processes extending over the whole span of life on earth, the nervous system having been in the forefront of evolutionary progress, enabling the survival of better adapted organisms (Fay 1954). Phylogenetically, the human brain contains evolutionary levels which have their roots in lower forms of life. It has inherited a series of hierarchical levels which develop from the lowest levels upwards. This point is the cornerstone of the concept of neurological organisation as seen by Doman and Delacato, and is summed up in the phrase often used by them, that ontogeny recapitulates phylogeny.

For 40 years the building blocks of this concept have been known (Langworthy 1933). He noted that a fairly reliable guide to the time when nerve tracts become functional in the human child is seen by the time after conception at which nerve fibres become myelinated. Mature, functioning nerve cells have a sheath of myelin whereas those of the foetus have not. While a sheath of myelin is not essential for the functioning of nerve pathways it is usually the case that it accompanies the attainment of use in the nerves. Langworthy states that:-

> "from studies of myelination, it is certainly clear that the myelination of pathways has been differentiated phylogenetically".

If as Doman and Delacato insist, ontogeny recapitulates phylogeny, then the appearance of myelination of nerve tracts in the human brain C.N.S. indicates approximately the order in which the development of neurological organisation progresses in the foetus, infant and child. The following sequency is quoted by E. Thomas (1969).

Conception + 2 to 4 months.	Relatively little myelination.
+ 4 months.	Ventral and dorsal spinal roots, ie, the oldest phylogenetically, are myelinated.

Conception + 5 months.	Cervical portion of the spinal cord is myelinated and slowly develops towards the sacral portion and up into the brainstem.
+ 8 months.	Beginnings of myelination in the mid-brain.
+ 9 months.	Beginning of myelination of optical tracts and cranial nerves. Olfactory tracts and white matter of cortex not myelinated.
Birth + 2 months.	Rapid increase in myelination and the beginnings in the cortico - spinal tract.

This maturation of the nerve tracts continues up to the age of puberty, or possibly longer. Growth in the thickness of the myelin sheath continues for many years. One important further consideration is this : that myelination of sensory pathways is dependent upon the presence of adequate stimuli, ie, they develop by use. In summary then, the several nerve tracts become myelinated in the order of their phylogenetic development, which is the order of their importance in controlling the basic activities of the organism, and sensory stimuli are required for their further maturation. Both of these points are central to Doman - Delacato programmes designed to enhance neurological organisation. (E. Thomas 1969)

Even an injured brain has potential that can be influenced by programmes which stress the experiences and sensory input thought to be necessary for the developing brain during infancy before the cortex has begun to function fully. The integrity of each phylogenetic brain level is claimed to depend on the proper functioning of the level below it. (Doman and Delacato 1967). Support for this view is strongly indicated in Luria 1973 where he notes hierarchical organisation of the brain into primary, secondary and tertiary zones, responsible for increasingly complex synthesis of incoming information. The relationships between the three levels do not remain the same, but "change in the course of ontogenetic development", and the proper functioning of the higher levels depends on the proper functioning of the lower levels.

The concept of neurological organisation as presented by Doman and Delacato is concerned less with the mechanisms of neurological organisation and more with its adaptive potentialities. They consider that brain injured children can be helped because the organism has a capacity for spontaneous adaptive re-organisation by the Central Nervous System.

This is perhaps equivalent to the "equipotentiality" of Lashley, who found that learning in rats did not depend on specific cortical areas but on the amount of cortical area removed, the amount of learning lost being directly proportional to it. (Lashley 1933). This implies that all cortical structures have a potential for more than a specific function, for example vision or speech. A later observation that the removal of the "visual cortex" in rats caused a greater loss of learning capacity than the removal of the eyes alone strongly supports this (Lashley 1943). It is well known that various degrees of functional recovery occur spontaneously following traumatic brain injury. It is therefore reasonable to hypothesise, claim Doman and Delacato, that remedial regimens which increase the frequency, intensity and duration of the sensory input believed essential for the development of effective neurological organisation,will improve it.

The developmental stages or functional levels that relate to the phylogenetic brain levels are made explicit in the Doman Delacato Development Profile. This is based upon chronological ages when selected functions are normally expected to develop and on the functional brain levels believed to be chiefly responsible for them, and is the instrument of evaluation and the design of remedial programmes. Diagram 5, inside the rear cover, shows the profile.

Children evaluated by this instrument are termed 'brain injured' if their performance does not match the appropriate normal range of chronological age. Doman and Delacato insist on the term brain injured as a diagnosis for such children, and do not use terms like spastics, athetoids and so on, which are symptomatic terms and not diagnostic. In other words, treatment should be directed at the cause of the handicap which is the injury to the brain, rather than to the symptoms. The term brain injury as used by Doman and Delacato refers to non-progressive injury to the brain, which may have occurred at any time in utero, at birth or subsequently. The aetiology of such injuries varies, for example from lack of oxygen supply or from damage by forceps delivery, but the common factor is that some portion or portions of the brain have been injured, resulting in the disruption of the brain's neurological organisation. Progressive brain injury, such as a tumour, or a deficient brain, ie, not complete structurally, are considered beyond the scope of their remedial programmes.

The basic sensory areas evaluated by the profile are visual (culminating in reading), auditory (understanding of speech), and tactile (stereognosis). The comparable motor areas are mobility (culminating in cross pattern walking), language (proper speech) and manual competence (proper writing). These six areas are divided into sequential levels of function which develop from birth to the time when general cortical control and lateralisation are established. The correspondence of functions and brain levels is not exact, and the levels are given age ranges when such functions are normally to be expected to occur (see Diagram 5). The data for these ages owes much to the child development studies of A. Gesell and are therefore based on samples of U.S. children. They do not necessarily hold good for all ethnic groups and classes - there are well known differences in rates of development due to cultural, psychological and environmental variables - hence the wide chronological differences for the age limits in the stages. In use, the Development Profile does not attempt to evaluate psychological or emotional disorders, but the child's functional ability at any time. By drawing a line on the profile in each of the six areas, above which none of the functions can be performed, a visual picture of the child's developmental levels is obtained.

By assigning one point scored for each developmental stage, a numerical value can be calculated, the maximum score being 42 points, which represents a completely neurologically organised child. Deductions are made for poorly performed functions. The score is then converted into Neurological Age (N.A.) using 96 months C.A. as the equivalent of a full score of 42. By comparing NA to CA, an estimate of the rate of growth can be obtained, a Development Quotient (DQ) in effect, an example being shown in Diagram 6. The major criticism of the Doman Delacato Development Profile and its use is that there has been no validating study done on it. It would be of interest to compare one month of Neurological Age with one month of Mental Age as assessed on a current standarised test. Research is currently under way at Keele University by Dr. N. Beasley and Mr. J. Hegarty on these matters in observations of 20 British children who have been evaluated and given home programmes using the profile. No figures are published yet, but at a seminar held in Manchester in June 1973, Dr. Beasley indicated that there was a good correlation between Neurological Age and Mental Age for these children. In a study carried out on the 20 British children on Doman - Delacato home programmes, M.As were measured by Cattell Infant Intelligence Scale, or Stanford Binet Intelligence Test and ranged from one to fifty two months. On the same day, assessments of N.A.

DIAGRAM 6 RATES OF GROWTH

a) Generalised form of Doman - Delacato Development Profile (cf Diag 4)

Level	Time Frame	Visual Competence	Auditory Competence	Tactile Competence	Mobility	Language	Manual Competence
7	96m	xxxxxxxxxxx POOR		xxxxxxxxxxx POOR			
6	67m		xxxxxxxxx POOR			xxxxxxxx POOR	
5	45m		ooooooooo	ooooooooo	xxxxxxxx		xxxxxxxxxxx
4	26m	ZERO		poor POOR			ooooooooooo poor POOR
3	13m	ooooooooo		poor	oooooooo poor POOR	ooooooo	poor POOR
2	2.5m			poor	poor POOR		
1	birth			poor			

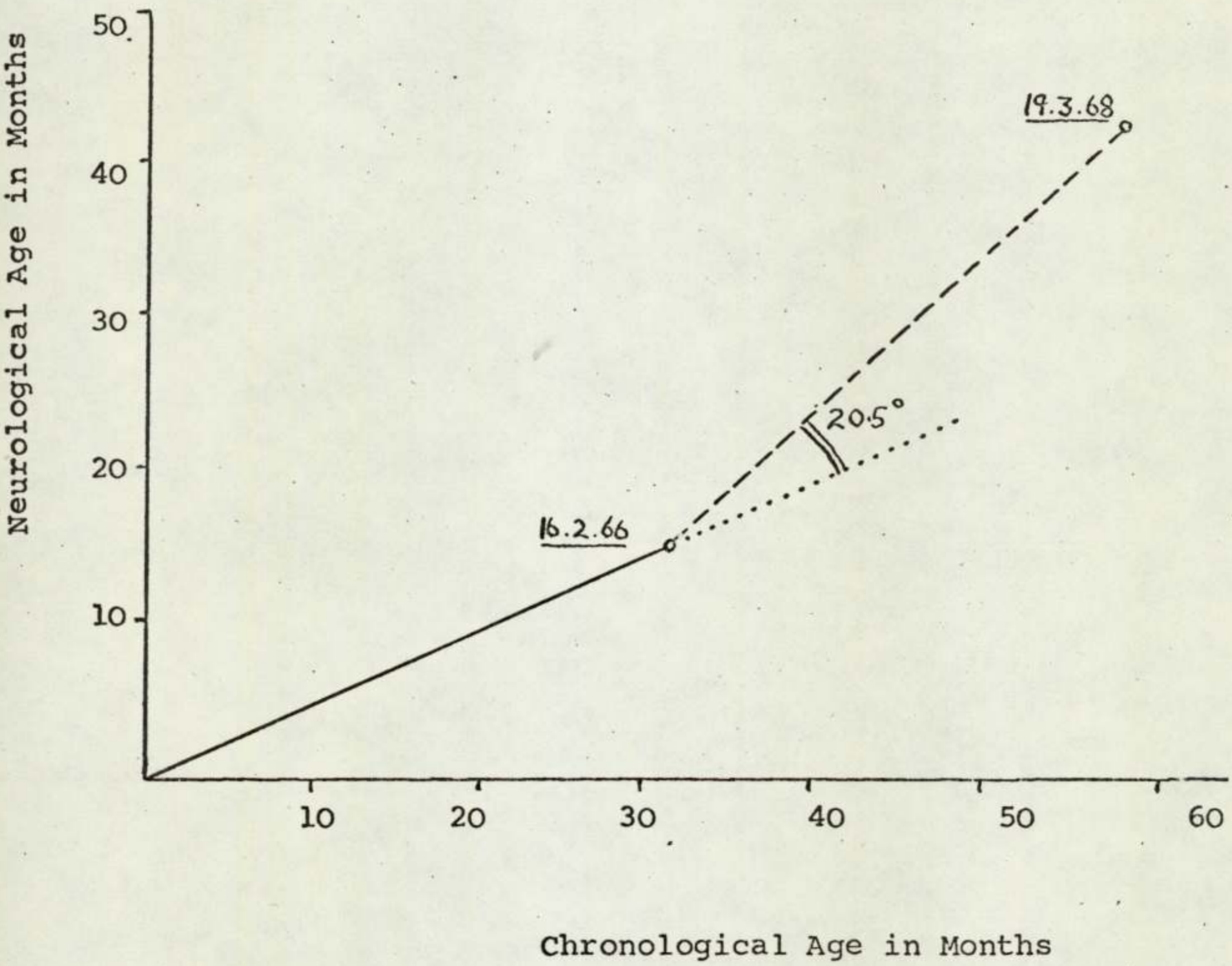
ooooooooo (poor) — 1st Visit 16.2.66 Score 19 — N.A. 15m; C.A. 32m; D.Q. (Growth Rate) $\frac{15}{32} = 0.47$

xxxxxxxxx POOR — Last Visit 19.3.68 Score 29.5 — N.A. 42.5m; C.A. 57.5m; D.Q. (Growth Rate) $\frac{27.5}{25.5} = 1.08$

N.B. Any "block" not completed scores 0.
Any "block" poorly completed scores $\frac{1}{2}$

(After Thomas 1969)

b) RATES OF GROWTH FOR THE SAME CHILD IN GRAPH FORM



Angular Change in growth rate 20.5°

——— Rate of Growth 1. 0.47 of "normal"(See 5a)

------ Rate of Growth 2. 1.08 of "normal" (See 5a).

Change in growth rate is therefore:

$$\frac{1.08}{.47} \times 100 = 299\%$$

were carried out by a Doman Delacato team from Philadelphia. The correlation coefficient between M.A. and N.A. was +0.89 and there was no significant difference between the two scores of any one child. There appears, therefore, to be substantial agreement between the two measures, and comparison can be made (Beasley 1973).

Having used the profile as an evaluative instrument, a programme of remediation is composed for a given child. Each programme has as its base the highest level in each of the six areas at which the child performs perfectly, and is founded on the following principles.

1. The brain is a hierarchy, and ontogenetically the human brain develops from the lowest level upwards, this recapitulating phylogeny. The maturation of higher levels therefore, depends on the functional integrity of lower levels. (Cf. A. Luria 1973).

2. Function determines structure, ie, the functional use of nerves and muscles increases their size and development, while lack of use can cause atrophy.

3. Sensory input and motor activities are essential for the development of learning as a manifestation of neurological organisation.

4. Increased duration, frequency and intensity of sensory imput and of motor activities can often increase the rate of progress of neurological organisation of a developing brain.

5. To increase neurological organisation it is necessary to retrace steps in the normal process of neurological organisation, going back as far as is necessary to commence treatment at the correct level.

The treatment programmes involve maximum use of time available, and of space available for bodily movements, the latter being considered essential in the programmes for severely handicapped children, whose brain injury is such that even the smallest movement is an achievement. Allowing children to sit in chairs or lie on couches, for example, over long periods of the day, is wasting their time. They should be on the floor and receiving encouragment to move, even being placed on a slight slope if self induced movement is not possible. The important procedures for a treatment programme are as follows:-

1. Sensory patterns of locomotion imposed on the child (Patterning). The pattern of movements will be homolateral, or cross pattern, depending on the developmental levels of the child, and are the movements characteristic of human creeping and crawling.

2. Crawling on the abdomen and creeping on all fours for long periods.

3. Constant talking to the child.

4. Practice of manual and bi-manual skills with small objects.

5. Visual stimulation, including flashing lights and convergence exercises.

6. Auditory stimulation, like loud noises of various frequencies.

7. Tactile stimulation, such as brushing of limbs where vital sensation is poor, and the identification of small objects in a bag by touch alone.

8. Increase the carbon dioxide content in the blood which is reported to increase cerebral circulation. (Thomas 1969).

9. Limitation of fluid intake and the intake of sodium and other thirst provoking foods. This is reported to lower the accumulation of cerebro-spinal fluid and be beneficial, especially where seizures are

common (Fay 1947) and seems also to be of benefit for hyperactive children.

10. Brachiation exercises, involving hand over hand movement along a high horizontal ladder, which improve chest capacity and assist in the development of convergence of vision.

11. Suspension inverted, which means that the child is hung by strong straps by his ankles. It is claimed that this assists blood circulation to the brain, and at the same time is of value in improving general balance. It is a common attitude for children to adopt on climbing frames in the normal run of play, though the rear of the knees is usually the point of suspension. Further motion while inverted includes spinning, which disorientates the child and is claimed to enhance balance subsequently. Though the sight of a child engaged in this activity may appear horrifying to some, it is undoubtedly enjoyed by the child if approached in the right way initially.

12. Vitamin enrichment of diet, through quite considerable fortification of food with tablets and careful cooking and choice of food. The point of this is to maintain a high health standard so that the child will not lose time through common illnesses like the common cold and its associated complaints.

It is clear that one aim of such a programme is to produce as good and rich an environment as possible in which the brain can develop, both in terms of optimum body conditions and environmental stimulation. An example of a programme for a child at home is shown in Table 5 , from which it is obvious that such routines are extremely time consuming and arduous. External help is required with patterning, 3 or 5 people being required depending on the size of the child. Considerable re-structuring of the life of the family is also inevitable. It is interesting to note that in Brazil, centres have been established to which parents bring their children and then augment the staff as volunteer helpers.

The results of programmes so far seem to indicate a considerable amount of success in terms of accelerating rates of development. The growth rates of three cases quoted by E. LeWinn in Thomas (1969) are shown in Diagram 7. These examples show marked accelerations in progress when measured on the Doman Delacato Profile, relating Neurological Age to Chronological Age. Doman, in lectures to parents of brain injured children, states that 30% of children who embark on a home programme achieve complete neurological organisation; 40% make significant gains, and 30% show little or no increase.

TABLE 5 EXAMPLE OF A DOMAN - DELACATO HOME PROGRAMME

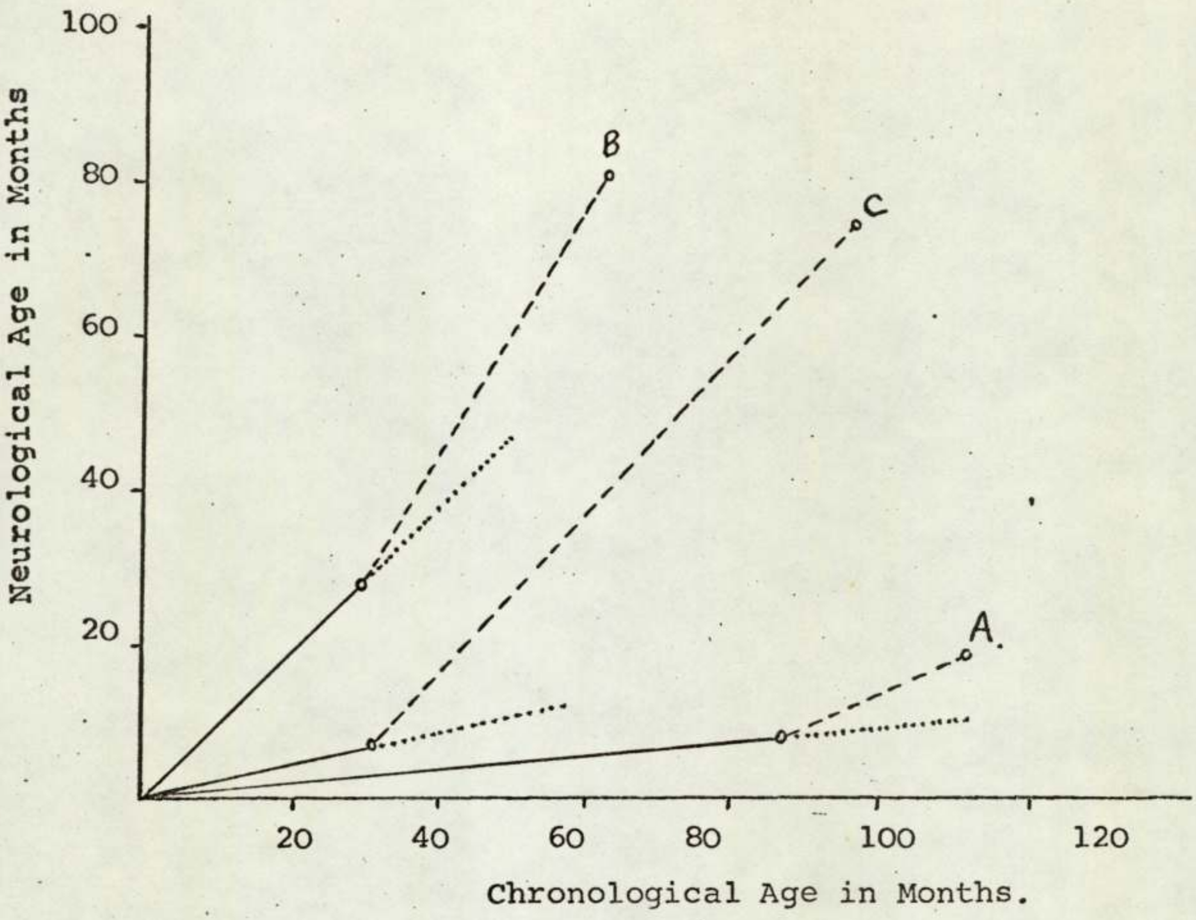
Statement of Goals for next 4 months.

1. Better total balance.
2. Verbal responsė to a simple verbal question.
3. One social gain; (not hugging all comers).

VISION Basic Vision 5X each eye.	FREQUENCY PROGRAM OF 12 SEQUENCES DAILY. 1. Masking. 2. Suspended Inverted with Rotation-5mins. 3. Masking. 4. Brachiation - 1 min. 5. Crawl 1 min. 6. Masking. 7. Creep 1 min. 8. "Gymnastics" 3mins. eg, walking the plank, stepping stones, jump offs, step downs, rope ladder, obstacle course, walking & marching, running. 9. Masking. (About 15 minutes total)
AUDITORY Systematic discip-lining. Expand vocabulary.	
TACTILE Objects in bag. 4 Cross Patterns + Creep 5m Crawl 5m.	
MOBILITY Gymnastics	
LANGUAGE Involve in conver-sation ad lib.	
MANUAL Copying words and couplets.	
READING Written messages. Daily diary. Receive letters each day.	
MATHS Counting games.	
MEDICAL Fluid restriction. Vitamins as before. 72 + maskings daily.	
MISCELLANEOUS	

NAME__________ DATE__________ SIGNATURE__________

DIAGRAM 7. RESULTS OF DOMAN - DELACATO HOME PROGRAMMES ON THREE U.S. CHILDREN (THOMAS 1969).



Child A 1st Visit CA 85 NA 7.5 DQ 0.09

Last Visit CA112 NA 20 DQ $\frac{12.5}{27} = 0.47$

Angular change in rate of growth 20.5°
Percentage change in rate of growth 522%

Child B 1st Visit CA28 NA 26 DQ 0.93
Last Visit CA62 NA 81 DQ 1.62

Angular change in rate of growth 18.5°
Percentage change in rate of growth 174%

Child C 1st Visit CA31 NA 7.5 DQ 0.24
Last Visit CA96 NA 76 DQ 1.04

Angular change in rate of growth 34.5°
Percentage change in rate of growth 433%

(From figures by E.B. LeWinn in Thomas 69)

The reasons for this are not understood, and no valid and reliable prognosis for a given child can be made. The results of the treatment of 335 brain injured children are reported in Doman and Thomas (1968). The ages of the children ranged from 3 to 272 months, with a mean Chronological Age of 89.9 months, standard deviation being 41.1 months. The mean Neurological Age was 34.5 months, standard deviation 18.3. These were the figures at the beginning of therapy. At the close of the study, 290 (86.6%) showed some improvement in their rate of neurological development. The mean angular change in rate of neurological development was 14.4°, with a standard deviation of 15.6. In terms of C.A. and N.A., this means that after 60 months of treatment, neurological age (mean) had increased by 40 months, a Developmental Quotient of 66.6% during treatment, compared with 38.3% prior to treatment. Graphs showing rates of development are published in the publications of the Institutes for the Achievement of Human Potential (1967). These show the progress of 324 children who underwent initial evaluation in 1962 - 63, and the mean gain in Neurological Age is shown as 16.95 months over a mean time period of 9 months.

However, all these figures are difficult to interpret as there are no published full validation studies of the Doman Delacato Development Profile and its concept of neurological age. How, for example, does a month of neurological age compare with a month of mental age as measured on conventional standarised tests? What is required is some measure of progress during treatment that is recognised medically and educationally. In the study currently in progress by Beasley and Hegarty of Keele University in which a group of British children on Doman Delacato home programmes is being compared with a similar group undergoing normal state provided treatment, Beasley and Hegarty have found that after one year, the children doing Doman Delacato programmes have a mean Development Quotient of 77% during that year, compared with one of 29% before. This again is using the Doman Delacato instrument, and the lack of controlled study makes it difficult to assess the value of the figures. No doubt when the study is complete, some comparison can be made against the group in Special Education.

Additional to the criticism of Doman and Delacato on grounds of lack of controlled studies of their methods, there are others founded either on medical grounds, e.g., questioning the effect of patterning, or founded on psychological grounds, for example the stress imposed on the child and the family by the programme. The most comprehensive of these criticisms came from the American Medical Association (R.D. Freeman 1967). In the same periodical is another account of an experiment conducted using Delacato's programmes for backward readers. (Robbins 1967). The author sought to test whether (a) creeping and crawling performance, and laterality were related to reading performance; (b) whether a programme based on the Doman - Delacato rationale improved reading ability. 250 students from Grades III to IX in a Chicago school were given a summer reading programme. Pupils were assigned at random into an experimental group, a placebo group and a control group, and were taught by all the teachers for an equal amount of time. The experimental group performed creeping, walking and lateralisation tasks, but were not "patterned". The placebo group spent an equivalent amount of time daily in sports activities and musical activities, and the control group no specified activities at all. In the results, neither of the hypotheses could be confirmed significantly, and the conclusions drawn were as follows.

(a) That the Doman - Delacato theory, not being supported by the findings of the experiment, was of dubious validity.

(b) That the relationship between neurological organisation and behavioural tasks like reading, not being supported by the experiment, again casts doubts on the validity of the whole rationale.

(c) That verifiable, empirical evidence from a controlled experiment is needed if "advocates of the theory (Neurological Organisation) wish to gain acceptance and recognition from the scientific community".

While the Robbins experiment may have been well conducted and the results statistically validated, the experimental group had in fact only a minimal programme of tasks peculiar to Delacato's practices, and cannot, therefore, be considered a fair experiment on which to judge the whole concept of neurological organisation, and the results claimed for such programmes that are based upon it. The great difficulty of using these methods in schools is that the "frequency, intensity and duration of stimuli" cannot approach that of a full home programme, as a previous item showed (Page 8).

B) OTHER APPROACHES AND REMEDIAL PROGRAMMES FOR E.S.N.(s) PUPILS.

There are two other approaches of major importance which need to be reviewed when the Doman - Delacato methods are being studied. These are the contributions of Newell Kephart and Marianne Frostig, with the work of Kephart showing peculiar simularities to that of Doman & Delacato.

The Glen Haven Archievement Centre in Colorado, like the I.A.H.P. in Philadelphia, is a clinic to which children with many degrees of brain injury and learning disability come with their parents, are evaluated and given home programmes. Kephart seems to combine the quantitative approach to development of Gesell with the more qualitative of Piaget. He suggests that the accumulation of information goes on quantitatively until a certain point is reached when there is a change. From the quantity of data collected, a generalisation arises, and immediately all future data is processed and all previous data is re-processed in the light of that generalisation. Development then proceeds in a series of steps, the accumulation of a suitable body of information being a pre-requisite of each qualitative step.

If the child fails to make these steps, through failure of the central nervous system to organise, store and integrate the input, he may be able to accumulate more facts and master simple skills. However, he will fall further behind his peers because of his inability to generalise, and therefore process information quickly. This failure to make generalisations is one of the chief characteristics of subnormal children according to Kephart, because injury or developmental failure, of unknown origin perhaps, has disrupted the organising ability of the central nervous system. Input via the sensory channels remains disintegrated. Each stimulus generates one response only, instead of interlinked groups of responses, and this in part explains the repetitive nature of much of the behaviour of E.S.N.(s) pupils. It is why free play, through which the normal child learns a great deal, is inappropriate for the E.S.N.(s) child.

Kephart outlines seven stages of development:-

a) The Motor Stage.
b) The Motor-Perceptual Stage.
c) The Perceptual Motor Stage.
d) The Perceptual Stage.
e) The Perceptual-Conceptual Stage.
f) The Conceptual Stage.
g) The Conceptual-Perceptual Stage.

Each stage is named after the dominant method of gaining experience. For example in the Motor-Perceptual Stage, the hand is the principal explorer and leads the eye, whereas in the Perceptual Motor Stage, the opposite is the case, as the child's vision has matured enough to range freely over the environment. Kephart lays considerable stress, as do Piaget and Doman and Delacato, on early movement patterns. "Solid concepts rest on solid percepts which in turn rest on solid basic motor patterns". They are the foundations of all the more complex learning because they provide the means of self orientation. Orientation and the beginnings of spatial understanding start with the Kinesthetic understanding of the child's own body, as it relates to gravity, especially his mid line. Balance grows as motor experience grows. Again, Doman attaches importance to this, and it is an aim of the 'suspension inverted' part of a programme.

Kephart's remedial programmes begin of course with diagnosis through a study of the whole child. The object is to determine the point or points of breakdown in the developmental sequence. (cf. the levels of neurological organisation of Doman).

There is no one profile as with Doman & Delacato, but four major tests are used; the Purdue Perceptual-Motor Survey (designed by Kephart and Roach), the Frostig Test for Visual Perception, the Wepman Test of Auditory Discrimination, and the Illinois Test of Psycholinguistic Abilities. The PPMS covers the motor and perceptual stages, and the Frostig, Wepman and ITPA cover the perceptual-conceptual stages. Once the point of breakdown has been determined, remediation begins at that point and follows through the whole developmental sequence, rather in the way that Doman insists that progress to a higher brain level depends upon the integrity of the functions of all levels below it. Kephart has developed a variety of activities suitable for use at home or at school, using apparatus like trampolines, balance bars and walking boards. Some studies using his techniques will be considered subsequently. Where he differs from Doman and Delacato is in the way that he notes that remediation cannot just be a matter of taking the child back in time. He has grown and developed, and however disturbed they may be, the lower level circuits of development have been integrated into more complex ones, and remedial training must take this into consideration. Ways need to be found of working through the developmental sequence as quickly as possible, using the child's present stage of development as well.

Dr. Marianne Frostig holds a rather different view of helping handicapped children. Her aim is to take the child forward from the level he has reached in various developmental areas by providing a balanced compensatory programme of remediation. She does not seem to attach as much importance to the sequential development of "movement". She does not believe that it is necessary to take a child back to the point of breakdown (Kephart) or functional brain level (Doman) to start a programme of remediation. If a child is given only sensori-motor training, the right moment could be missed for the achievement of other learning, ie, learning must go on alongside remedial activity. Development is seen as taking place in 6 areas, emotional, social, cognitive, perceptual, language and sensori-motor. Areas of strength require on going teaching, while areas of weakness need remedial treatment. The tests used for evaluation are; the Frostig Movement Skills Test, the Frostig Test of Visual Perception, the Wechsler Intelligence Scale for Children and the I.T.P.A. However, it is visual perception that receives the emphasis rather than the movement emphasis of Kephart and Doman, with auditory perception alongside.

In Dallas, Texas, there is currently an evaluation centre and special school designed to meet the needs of "children with learning disabilities", approved by the State to "serve language and learning disabled minimally brain injured and visually handicapped children". The approach is based on the thinking of Temple Fay, Carl Delacato, Newell Kephart, Marianne Frostig and Raymond Dart, drawing from each source the ideas that prove most effective. In other words techniques are used which appear to work, rather than for any other reason. Some of Dart's basic movements, patterning, creeping, crawling, balance bar, overhead ladder, special diet vitamin enrichment are all used. Some children have proceeded into the normal public school system, others have entered suitable employment. It would be of great interest to see quantitative information from this centre, where there is no singular adherence to one theory, but where what are considered the most effective techniques from a variety of sources are used.

C) EXPERIMENTS USING SPECIFIC PROGRAMMES WITH E.S.N.(s) PUPILS.

There are published research reports of a number of experiments in school, hospital or home, where severely subnormal children have been given a strict programme of individual attention and environmental enrichment, and their performance assessed, in mostinstances against a control group .

Mary Woodward (1959) sought to show that behaviour of severely subnormal children could be classified according to the main types of sensori-motor activities itemised by J. Piaget. It was noted that many of the apparently purposeless mannerisms of E.S.N.(s) children resembled the early movements of very young infants.
Part of the experiment sought to relate the sensori-motor intelligence(Piaget1953) of normal infants to the behaviour of olderE.S.N.(s) children. The subjects were in two age groups, Group A between 14 and 16 and Group B between 7 and 9 Years. Each Group was observed during play with various manipulative and noise producing toys, and then six problems were devised, two from each of Piaget's Stage IV, V and VI of sensori-motor intelligence . Each group was also observed in tests where toys or sweets were hidden for varying lengths of time to to establish the childrens' object-concept stage.

The results for the sensori-motor tests are shown in Table 7, where a very close correspondence between observations of responses and the stages of Piaget is evident.

TABLE 7 PERFORMANCE OF 64 S.S.N. CHILDREN ON ITEMS FROM PIAGET'S STAGES OF SENSORI MOTOR DEVELOPMENT.

ITEMS TESTED	SOLVED BY	PIAGET'S STAGE
Sucks Objects	65	I
Directs hand to month	65	II
Co-ordinates visual & grasp	62	II
Manipulates Objects	53	III
Co-ordinates visual & hearing	49	II
T-Screen	37	IV
O-Screen	32	IV
String	25	V
Support	22	V
Bars	12	VI
Rake	6	VI

(From M. Woodward 1959)

PIAGET'S STAGES OF SENSORI-MOTOR DEVELOPMENT

I - Extension of reflex activity.

II - Integration of reflex activities with higher activities.

III - Reproduction of initially chance-made movements.

IV - Application of existing behaviour patterns to new situations.

V - Discovery of new behaviour patterns through discovery.

VI - Invertion of new means to solve problems by foresight.

This suggests that the sensori-motor development of severe retardates follows the sequence described by Piaget for normal infants. In a further study (Woodward and Stern 1963), the aims were:-

i) to determine locomotor, language and social development of children classified at the six sensori-motor stages.

ii) to examine patterns of development in young E.S.N.(s) children.

At the last sensori-motor stage, children solve problems in such a way that they seem to be aware of the permanence of objects (ie, they persistently search for hidden objects). Piaget suggests that this behaviour shows that the child has some means of representing the objects to himself even in their absence, implying the development of a symbolic function which makes possible the rapid and systematic acquisition of language. From the previous research (Woodward 1959), E.S.N.(s) children were shown to pass through the stages of sensori-motor development as do normal very young infants. The completion of sensori-motor development in E.S.N.(s) children, should, then, be important to their acquisition of language. The subjects of the experiment were 83 severely retarded children between 1 and 9 years of age

(Mean 4.85), all with IQ's of less than 50 (where measurable), and excluded children with specific deficits like deafness, poor vision, cerebral palsy and hydrocephalus. Only 3 had measurable Terman Merrill IQ's, of 42, 41 and 31, the rest falling below the lower limit of the scale. They were all resident at a London hospital and were tested on Gesell schedules for locomotor and language assessments. Some of the results are shown in Tables 7 and 8. Basal age refers to the age level at which the child succeeded with all items, and highest point age represents the highest age level at which any success was achieved. The points of particular note in the study are these:-

i) the inequality in development between locomotor and language progress as shown in Table 8.

ii) the importance of the completion of Stage VI in E.S.N.(s) children.

TABLE 7 RELATIONSHIP BETWEEN PIAGET'S SENSORI-MOTOR STAGES AND LOCOMOTOR AGE (GESELL) FOR 83 S.S.N. CHILDREN.

PIAGET'S SENSORI-MOTOR STAGE	NO. OF CHILDREN (N=83)	MEAN C.A. IN YEARS	LOCOMOTOR AGE IN YEARS		
			BASAL AGE MEAN	HIGHEST POINT MEAN	HIGHEST POINT RANGE
III	10	2.48	0.43	0.60	0.38-0.77
IV	10	3.80	0.83	1.02	0.54-2.00
V	29	4.83	1.41	1.55	0.77-3.00
VI	34	5.88	2.32	2.38	0.94-4.00

N.B:- Basal Age is the age at which the child succeeded at all items.

Highest Point is the highest age level at which any success was achieved.

(From Woodward & Stern 1963)

TABLE 8 RELATIONSHIP BETWEEN SENSORI-MOTOR STAGE, LOCOMOTOR AND SPEECH DEVELOPMENT.

PIAGET'S SENSORI-MOTOR STAGE	NO. OF CHIL-DREN	LOCOMOTOR AGE. HIGHEST POINT MEAN AGE	SPEECH AGE IN YEARS	
			MEAN	RANGE
III	6	0.617	0.487	0.23-0.77
IV	8	1.058	0.403	0.15-0.69
V	21	1.660	0.784	0.54-1.25
VI	33	2.330	1.196	0.62-2.00

HIGHEST POINT AGE - the highest age level at which any success was achieved.

(From Woodward & Stern 1963).

Woodward and Stern quote Gesell and Thompson (1929) in saying that locomotor development is mainly influenced by maturation, since intensive training made little difference. On the other hand, much of Piaget's account of sensori-motor intelligence is a description of learning processes, especially in the acquisition of speech. The results of this experiment suggests that E.S.N.(s) children develop relatively more rapidly in aspects which are mainly maturational (ie, locomotor) and relatively more slowly in those aspects which involve learning, such as language. Such a conclusion is important in the education of E.S.N.(s) children and particularly relevant to the Doman Delacato system. Put quite simply, if the sensori-motor development of the E.S.N.(s) child can be accelerated, which is what Doman and Delacato are trying to do, the sooner can the acquisition of skills like language and reading be accomplished, and the potential ceiling of the child's ability at the somewhat arbitrary age of 16 years, "the upper limit of the developmental period" (Heber 1961), is raised.

There are some experiments which have aimed at testing the effects of sensori-motor training on other behaviours.

Edgar, Ball, McIntyre and Shotwell (1969) hypothesised that "changes in sensori-motor integration assumed to result from intensive sensori-motor training would be reflected in gains in adaptive behaviour". Experimental and control groups of 11 severely retarded children, excluding any mongols, were tested for IQ (Kulhmann Binet), and D.Q. (Gesell). The experimental group received 15 - 20 minutes a day of intensive training using adaptations from Kephart, such as walking board, trampoline and balance board. The control group had a similar period per day with individual attention on more traditional activities such as swings, inset puzzles, clay and educational toys. The experiment lasted 8 months, and the results are shown in Table 9 . Developmental Ages were estimated from raw scores, the mean D.A. gained by the experimental group was 6.0 months (DQ 75%) and for the control group was 2.2 months (DQ 27.5%).
Another experiment, by Maloney, Ball and Edgar (1970), investigated the effects of individual attention and reinforcement procedures with three groups of institutionalised mentally retarded children. One group received no systematic treatment, a second received individual attention with mainly sedentary tasks and reinforcement for attempting and succeeding at the various tasks (The Attention Motivation Group),

TABLE 9 SURVEY OF PRE AND POST TEST PERFORMANCE OF EXPERIMENTAL AND CONTROL GROUPS ON GESELL SCHEDULES - (EDGAR, BALL, MCINTYRE AND SHOTWELL 1960).

	EXPERIMENTAL			CONTROL			DIFF.
	PRE	POST	't'	PRE	POST	't'	F
Motor	22.8	35.4	6.55[c]	18.2	23.5	2.68[a]	7.47[a]
Adaptive	21.0	29.4	5.18[c]	11.6	15.4	2.31[a]	4.12
Language	5.4	10.6	5.22[c]	4.1	5.6	1.49	6.92[a]
Personal-Social	14.8	29.3	5.88[c]	12.1	17.0	2.00	7.54[a]
FULL SCALE	64.1	104.6	8.29[c]	46.0	60.0	3.17[b]	15.17[c]

NB:- Pre and Post test figures represent number of items passed beyond D.A.1.0.

a - p .05

b - p .01

c - p .001

The experimental group, therefore, showed greater gains than the control group in the sub tests and in the full scale.

and a third group received individual attention with gross motor activities adapted from Kephart, with reinforcement for attempting and succeeding the tasks. (The Sensori-Motor Training Group). Both the Attention Motivation and the Sensori-Motor Training Groups demonstrated significant gains from pre - to post experiment testing. However, the Sensori-Motor Training Group achieved significantly greater gains. This experiment suggests that reinforcement and increased personal attention improve the performance of severely subnormal children, but that intensive sensori-motor training significantly stimulates growth beyond the contributions of attention and reinforcement only. A closely allied study is that of Morrison and Pothier (1972), where the subjects were 27 children aged 4 years who lived at home and attended a day nursery school for retarded children. There were 3 groups of 9 children, much the same as in the Maloney, Ball and Edgar study, and assessment was by means of the Derver Developmental Screening Test, which measured Gross Motor, Fine Motor, Language and Personal-Social performances. The results are shown in Table 10 and similar conclusions can be drawn from them.

TABLE 10 A SURVEY OF PRE AND POST TEST PERFORMANCE ON THREE GROUPS ON THE DENVER DEVELOPMENTAL SCREENING TEST (MORRISON & POTHIER 1972).

GROUP		GROSS MOTOR		FINE MOTOR		LANGUAGE		PERSONAL-SOCIAL		FULL SCALE	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
"Sensori-Motor"	Pre	25.70	7.43	23.34	8.81	20.68	7.09	26.32	7.99	24.47	6.57
	Post	43.70	11.02	28.00	7.76	48.70	7.89	37.26	5.86	39.14	4.91
"Gross-Motor"	Pre	21.39	6.80	21.95	7.09	19.73	9.27	19.05	7.23	20.28	6.63
	Post	25.71	7.01	27.17	9.26	30.60	15.27	28.98	5.74	28.88	8.63
"Attention"	Pre	23.58	7.92	27.19	6.97	21.58	11.46	26.49	9.14	24.41	7.83
	Post	27.96	12.24	26.10	5.67	38.50	16.08	33.64	9.05	31.38	9.54

A 't' test comparison of the mean gain in scores between pre and post test evaluation, demonstrated a significantly greater gain in scores for the Sensori-Motor Group when compared with the Attention Group. ($t = 3.94$. $df = 16$ p $.01$). The same comparison between Gross Motor and Attention Groups did not demonstrate a significant difference.

All three of the above experiments use applications of Kephart's training programmes and demonstrate the benefit of sensori-motor training for severely subnormal children. Much of the Doman-Delacato treatment is concerned with tactile, visual and auditory stimulation and with motor activities like crawling and brachiating. In the home programme, the frequency and duration of such activities could be expected, then, to bring about an improvement in developmental progress, probably greater than in the experiments described. In the school, some increase in rate of development should occur. The current research project at the Department of Psychology at the University of Keele by Beasley and Hegarty, where E.S.N.(s) children in the United Kingdom who have visited the Doman - Delacato Centre in Philadelphia are being assessed, has no published results yet. However, tentative interim results show that the children, from 1 year to 16 years of age and on home programmes entirely (ie, no school attendance at all), have over a period of 1 year increased their rate of development from a mean of 0.29 to one of 0.77. These figures were reported at a Seminar held at The University of Manchester Institute for Science and Technology in June 1973, and refer to progress on the Doman - Delacato Development Profile.

They therefore refer to progress in terms of Neurological Age as described previously. Beasley and Hegarty have assessed all the children twice a year usingthe Stanford Binet (1960) Test and find a good positive correlation between the Neurological Age of Doman and Delacato, and the Mental Age of the Stanford Binet (r = +0.89). These interim results suggest, then, that the Doman - Delacato home programme has produced a measurable increment in the performance of the British children engaged upon it, at least comparable with the results of the Edgar, Ball, McIntyre and Shotwell (1967) project.

D) LANGUAGE DEVELOPMENT OF SEVERELY SUBNORMAL CHILDREN.

The second element of this study was to assess the value of using Doman - Delacato methods in the classroom in furthering or accelerating language development. The study of language per se has produced an enormous literature in the last 25 years or so, and psycholinguistics has become a major area of study and research. It is necessary therefore, to limit quite severely the aspects of language to be covered in this review. Three main areas seem particularly relevant.

1. The process of language acquisition, especially the development of Chomsky's ideas on the "innate programming" of the human brain to acquire language so rapidly.

2. The link between immediate memory span and language, ie, whether the delay in the acquisition of language by retarded individuals is necessarily a matter of poor 'storage', lack of knowledge of the rules of language, or rather a matter of poor input and output channels.

3. Some experiments in specific language programmes with severely subnormal children.

The process of language acquisition as, initially at any rate, a developmental rather than a cognitive process, is associated in particular with the work of N. Chomsky, G. Miller and E. Lenneberg. A consideration of the opinions of these investigators is relevant here because Doman and Delacato themselves see language as the specifically human attribute that above all else marks homo sapiens, it being through language that higher, complex thought and reasoning are possible (Cf Piaget 1953 and Luria 1959).

In his later works, especially "Language and Mind" (1968), Chomsky more and more sees the importance of linguistics in psychology and philosophy, and in particular to insist upon the importance of generative grammar (Chomsky 1957) for the investigation of the structure and workings of the human mind. Earlier studies of language (Bloomfield 1935) were distinctly behaviourist in giving a mechanistic account of language in terms of stimulus and response. Skinner (1957), in "Verbal Behaviour", as a hard line behaviourist, added his weight to the S - R view of language. Chomsky's classic and well known review of Skinners opinions (Fodor and Katz 1964), bases its criticism on the striking fact that at the age of 5 or 6 years, a child can produce and understand an enormous number of previously unencountered utterances. In other words, however well stimulus - response learning can account for habits, associations, and other behaviour patterns in humans and animals, it cannot explain creativity, an aspect of human behaviour most manifest in language. This is not to say that stimulus - response cannot account for many of the aspects and uses of language, but that it does not come to grips with the creation of unique sentences. Chomsky makes clear the distinction between competence in language, which he sees as the level of grammar that the individual has attained, and performance, which must take into account neurological, physical and psychological facets, like limitations of the central nervous system, larynx, or memory span.

Lenneberg (1967) has further opinions on language acquisition which are strikingly similar to those of Doman and Delacato. He makes the assumption initially that the child's capacity to acquire language is a consequence of maturation because:-

(a) The milestones of language acquisition are normally interlocked with others in physical areas such as stance and gait, as shown in Table 11.

(b) Such hand in hand development is frequently preserved even when the whole developmental process is slowed down, as in severe mental retardation, as shown in Diagram 8.

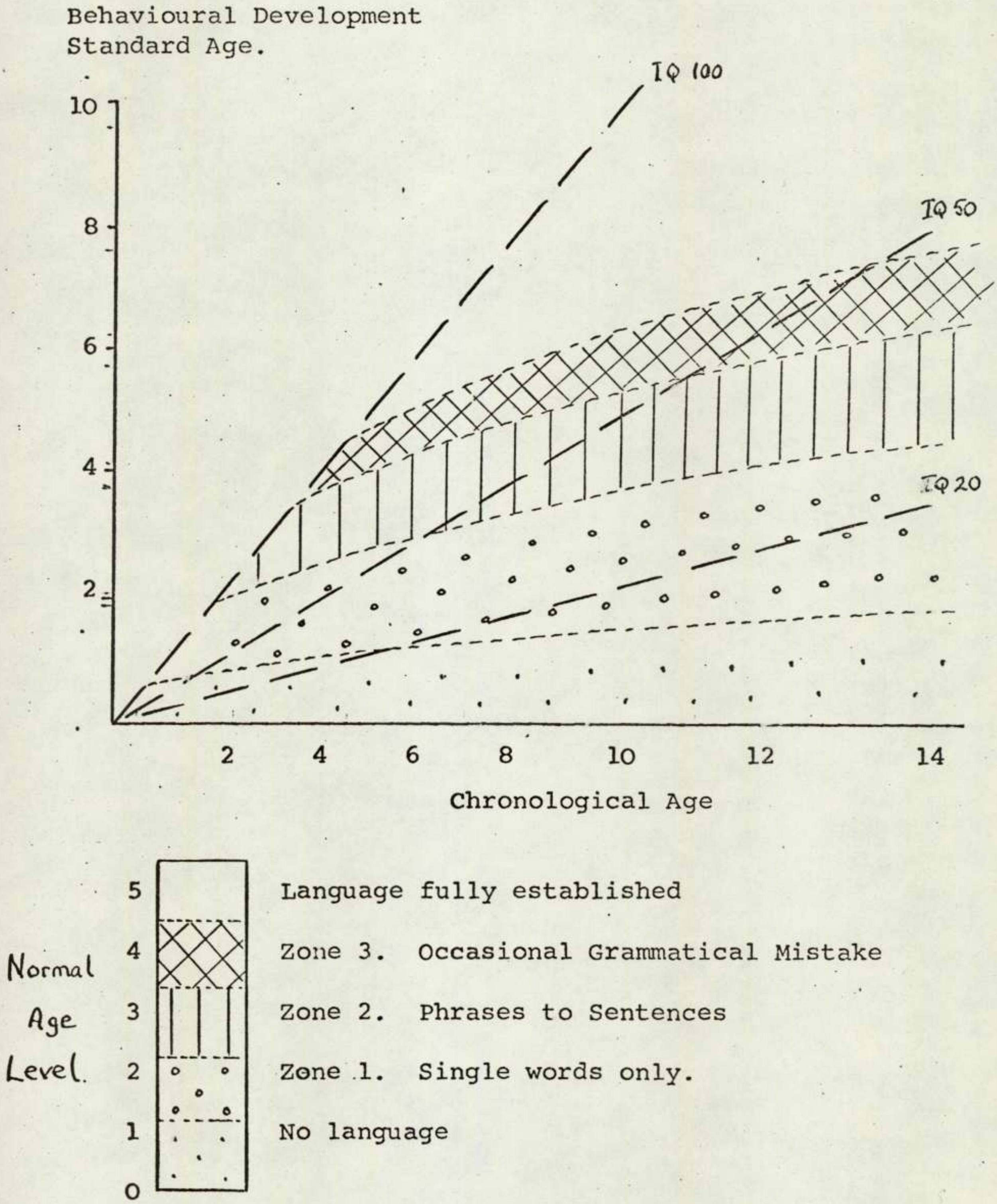
(c) There is no evidence that intensive training measures can produce higher stages of language development than the equivalent stages in other areas of development.

TABLE 11 SIMULTANEOUS DEVELOPMENT OF LANGUAGE AND MOTOR DEVELOPMENT.

(E.H. Lenneberg 1967)

AGE IN MONTHS	VOCALISATION AND LANGUAGE	MOTOR DEVELOPMENT
4	Coos & Chuckles	Head self supported:tonic neck reflex subsiding:sits with pillow props on 3 sides.
6 to 9	Babbles:sounds like "ma" or "da" re-duplicates sounds.	Sits alone:pulls up to stand-ing:prompt unilateral reaching: 1st thumb opposition to grasp.
12 to 18	Small no.of "words": follows simple commands & responds to "No".	Just stands alone:creeps:walks sideways while holding on: takes a few steps when hand held: grasp, prehension & release developed.
18 to 21	20 words at 18mths. to 200 at 21: points to many objects: forms 2 word phrases: comprehends simple questions.	Stance fully developed: gait stiff: sits on small chair with fair aim:creeps downstairs back-wards: has difficulty in build-ing 3 cube tower:throws a ball clumsily.
24 to 27	Vocabulary of 300-400 words:2-3 word phrases:was pre-positions & nouns.	Runs, but falls easily: can quickly change stance eg,kneel, sit, stand, walks up and down stairs, one foot at a time.
30 to 33	Rapid increase in vocab. 3-4 word phrases common:word order & grammar approx. that of surroundings:many unique utterances unlike many an adult would make.	Good hand a finger co-ordina-tion:moves digits independently: improved manipulation of objects: can build tower of six cubes.
36 to 39	Vocab. of 1000 words or more: well formed sentences & good grammar, though not all has been mastered. About 90% comprehensibility.	Runs smoothly with accelera-tion & deceleration:negotiates sharp & fast corners easily: walks stairs using alternate feet: jumps 12". Can ride tricycle, and stands on one foot for a few seconds.

DIAGRAM 8. RELATIONSHIP BETWEEN BEHAVIOURAL DEVELOPMENT, DEGREE OF RETARDATION AND STAGE OF LANGUAGE DEVELOPMENT.



(After E.H. Lenneberg 1967)

However, the important message from Lenneberg is this. Primary language cannot be acquired with equal facility within the normal human life span. There is a critical period for language acquisition, which at the beginning is limited by lack of maturation (Cf Doman, and Delacato's functional development of 'brain levels' from the lower levels upwards), and at the end by the loss of adaptability and re-organisation flexibility in the brain that accompanies the onset of puberty, when brain maturation, including full lateralisation, seems normally to finish, whether complete or not. (Cf. Doman and Delacato's Level VII - complete neurological organisation and establishment of laterality). Lenneberg states, nevertheless, that language acquisition cannot be attributed directly to any one maturational process: about 60% of the mature value of cerebral growth is attained before the onset of speech, at about 2 years of age normally. (Lenneberg 1967).

Species differ in their embryological and ontogenetic histories, with man's brain maturation being much slower certainly than that of any other primate. It is not merely a question of a stretched time scale, for the human baby is not born as a foetalised version of other primates. The developmental events in his natural 'programming' are sui generis, so that man's unique acquisition of language is intimately related to his evolutionary history, especially to his unique degree of cerebral lateralisation. The development of the child occurs on a broad front and must be assessed also on a broad front. The Doman-Delacato Development Profile, Gesell, Griffiths, and to some considerable extent I.T.P.A. scales all attempt to do this and enable remedial programmes to concentrate on areas of special deficit. These deficits may, of course, be the result of environmental deprivation in some way, as Bernstein and others have shown with regard to language development (Bernstein 1960). If the deficits in language are neurological in origin, then there seems to be little point in prescribing language programmes per se, but rather programmes that intensify sensori-motor development as well. This, again from observation, seems to be where Doman and Delacato methods score, and conventional classroom schedules fall short, if not fail altogether, with severely subnormal children. The point is also made clearly that the development of severely retarded children needs to be worked at very intensively and on the broad front indicated, between the ages of about 2 years and 13 years, when language acquisition seems virtually to stop, though vocabulary no doubt continues to expand.

An interesting study relating the theoretical bases of Chomsky and Lenneberg to the language development of subnormal children is that of Lackner (1968). He took an admittedly small number of subjects for his investigation only 5 (boys and girls). He aimed to show that the development of syntax, as shown by the use of progressively more sophisticated types of sentence (declarative, negative, interrogative, negative interrogative, passive, negative passive and negative passive interrogative), follows increasing mental age. (See Table 12). The mental age level required for the ultimate sentence was 8 - 10 years, while single declarative sentences occur at 2 - 3 years. The point is also made that children do not imitate closely the language of adults, except in so far as the child's comprehension level permits. Perhaps the most interesting, though to be expected, observation was that normal children of mental age corresponding to that of the subnormal children, could understand the sentences generated by their subnormal matched child, but had the capacity to produce longer sentences. This point leads to the possibility that the subnormal child's performance in producing sentences is lower than that of a normal child matched for mental age because, in communications jargon, though his storage system is equivalent, his retrieval system or channel capacity is lower.

TABLE 12 FREQUENCY OF SENTENCE TYPES IN THE 1,000 SENTENCE SAMPLES FROM EACH CHILD.

MENTAL AGE	SENTENCE TYPE						
	D	N	Q	NQ	P	NP	NPQ
2 = 3	563	275	162	0	0	0	0
2 = 11	517	293	171	19	0	0	0
3 = 3	516	337	99	37	11	0	0
4 = 9	430	393	127	41	9	0	0
8 = 10	438	351	119	45	24	18	5

D - Declarative

N - Negative

Q - Interrogative

NQ - Negative Interrogative

P - Passive

NP - Negative Passive

NPQ - Negative Passive Interrogative

(Lackner 1968)

A fascinating model of language performance deficit as a result of either lack of knowledge of the rules of grammar, or limitation of memory span (channel capacity), is given by Miller and Chomsky (1963). They visualised two manufactured language processing devices, one of which has a comprehensive programme of generative grammar, but a severely restricted short term storage capacity, and the other of which has a more than adequate short term storage, but a far less complete programme of the rules of grammar. Both machines will be inadequate to deal with language properly, the first because some sequences will demand more short term storage space, and the second because it has an inadequate programme of rules for dealing with some sequences. The experiment by Graham (1968) was based on such a model.

44 children, mean C.A. 9 years and mean IQ 62 (Stanford Binet or WISC), with no gross articulatory handicap, were tested for short term memory using unstructured strings of words randomly selected, and for performance on 24 eight word sentences each using different transformational rules. Using a novel system of scoring for the eight word sentences, whereby each word could receive 1, 2 and 3 points depending on its correct reproduction, its correct sequence vis a vis the preceding word, and vis a vis the succeeding word, performance in the 24 sentences was compared with short term memory.

The results are shown in Table 13. Similarly, when mean scores for each sentence type are plotted for subjects of different measured short term memory, (see Diagram 9), it is clear that the ability to cope with more complex rules of grammar is related to short term memory capacity, ie, sentences have become more difficult to reproduce partly because their degree of organisation and structure make increasing demands on short term storage. The extremely high correlation between sentence recall and short term memory suggests that short term memory is a determining factor independent of C.A. or M.A.

One conclusion to be drawn from these considerations of memory span is that a language programme for E.S.N.(m) or E.S.N.(s) children which is planned purely to include "language enrichment", which is often the case in special schools, is doomed to failure, except perhaps in so far as increased vocabulary and articulation are concerned. A more comprehensive developmental programme is required, which seeks to increase or accelerate what might be termed brain development. If the methods of Doman and Delacato, and Kephart, can be shown, inter alia, to increase short term memory capacity, then improvement in language should take place.

TABLE 13 SCORES ON SENTENCE RECALL AT SEVEN LEVELS OF SHORT TERM MEMORY.

(N.C. Graham 1968)

1.	Short Term Memory Score	2.0	2.5	3.0	3.5	4.0	4.5	5.0
2.	Mean R-W Score In Sentences	2.25	5.4	9.0	11.25	15.8	18.0	21.8
3.	Mean I-S Score In Sentences	13.8	16.8	19.5	20.5	22.5	22.9	23.8
	n =	4	4	11	4	8	5	8

1. Mean length of longest unstructured strings of words correctly recalled.
2. Right-Wrong Score - Mean number of sentences per list correctly recalled.
3. Item + Sequence Score - 1 point for each word correctly recalled.

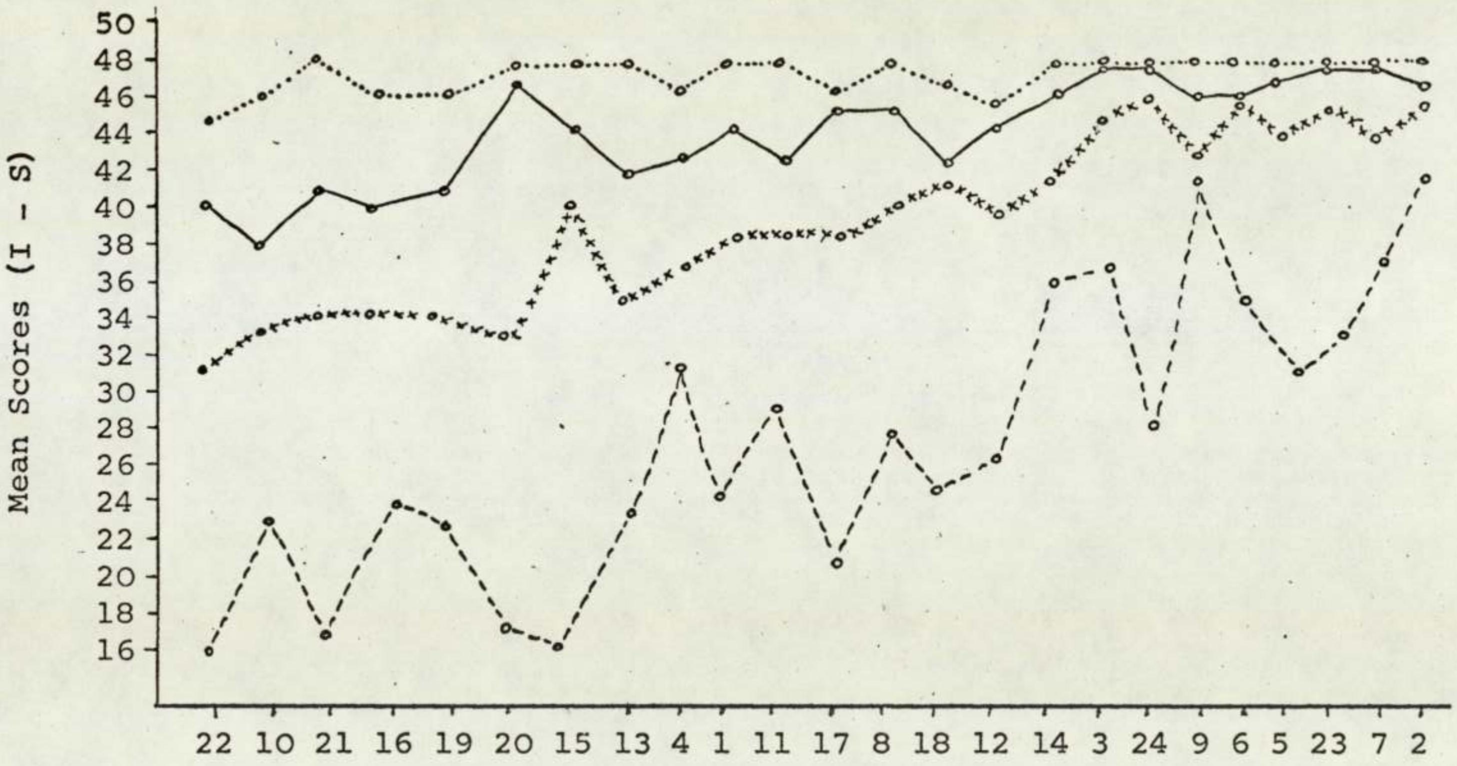
   1 point for correct preceding word or sentence boundary.

   1 point for correct succeeding word or sentence boundary.

Both scoring methods were compared for their respective rank ordering of subjects (r = + 0.98) and sentence difficulty (r = + 0.87), both coefficients being significant (p = 0.001).

DIAGRAM 9 **MEAN I - S SCORES PER SENTENCE TYPE OF 4 SHORT TERM MEMORY GROUPS ON 2 LISTS OF 24 SENTENCES.**

(N.C. Graham 1968)



Numbers represent each sentence type,

"Difficult" ⟷ "Less Difficult".

5)
4) Short Term Memory Score
3)
2)

- 76 -

V

THE EXPERIMENT

INTRODUCTION

The Doman - Delacato home programme has achieved some popularity and notoriety in the last five years in this country. While some considerable success has been achieved (Beasley 1973), considerable criticism also has been made of the intensity of the programme and its effect on the home of the child. Likewise, the financial cost and the effort to maintain the increased strain on income through "funds" is a major criticism.

To employ a full Doman - Delacato programme in a Special School would be out of the question in terms of labour supply if nothing else. However, with the current interest in the learning of the mentally handicapped and the new spirit entering many of these schools consequent upon their transfer to the education from the health authorities, there seemed a case to try some elements of the Doman - Delacato approach in a school. The school chosen had children from 3 to 16 years of age, from a wide socio-economic background, some living at home with one or both parents, others living in an adjacent residential unit.

THE SUBJECTS

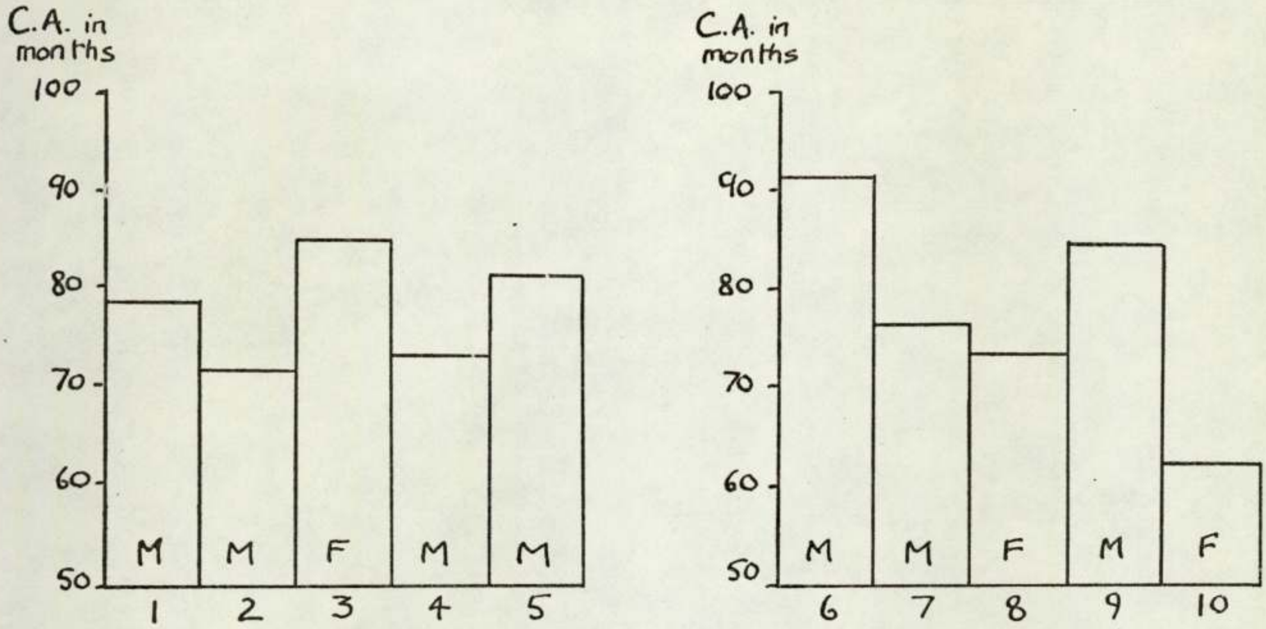
The Infants Class was chosen, in which the 10 children were in the charge of an energetic qualified teacher who operated in an informal atmosphere. She was open to new ideas, but in a critical way, and had attended meetings at the Teachers' Centre on the Doman - Delacato approach. The necessary co-operation of the class teacher was therefore obtained. The children were divided into 2 groups of 5 in a random manner, Group A to become the experimental and Group B the control group, as in Diag. 10. The mean C.A. for each group at the start of the experiment were 78.m. for Group A and 78.2 m. for Group B. The experiment was to run for two terms, a total of 20 school weeks of 5 days, each group to receive 30 minutes attention each day.

ORGANISATION

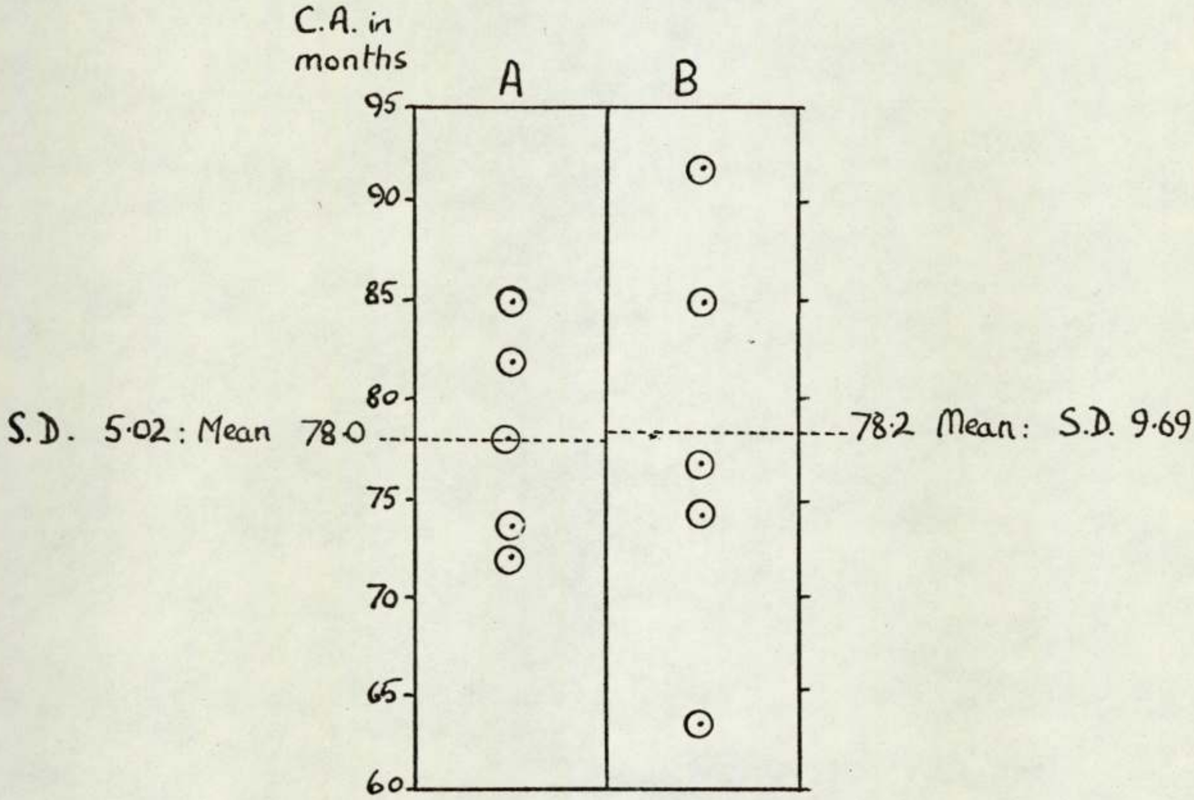
The experiment was to determine whether the Doman - Delacato approach was feasible in day school and whether it was more effective than conventional methods. A small pilot study (Chapter III) had suggested that it was feasible, and had also suggested that the individual attention received by a child in such a school amounted to only 5.22% of the school day,

DIAGRAM 10 THE TWO GROUPS FOR THE EXPERIMENT

GROUP A - EXPERIMENTAL GROUP B - CONTROL



COMPARISON OF MEANS FOR EACH GROUP



Wilcoxon's sum of Ranks Test (NA = 5 NB = 5 R = 26)

No significant difference between the two groups in terms of C.A.

compared with the 39.05% received by a child on a full Doman - Delacato programme. In order to control the length of individual attention received, both groups received an equal amount of such attention and from the same assistants. While Group A was performing the experimental activities in the classroom, Group B was taken to a separate room where the class teacher and her assistant worked with them on small group activities. After 30 minutes, Group A went to the class teacher for the small group activities, and Group B came to the classroom to perform the control activities, supervised by the same assistants and for the same 30 minutes period of time. Thus each group worked in the classroom, separated from the other, for 30 minutes, with the same assistants, so that time, place and personnel were common to each group; the only difference each group experienced was the nature of the activity performed, the effectiveness of which the experiment sought to differentiate.

The assistants numbered 5 or 6 each day and were volunteers who had expressed an interest in the work as a result of notices displayed. They were all student teachers, male and female, each of whom spent 1 hour in the school on 1 day of the week.

The result was a team for each day, which remained fairly constant during the period of the experiment. There were reserves for those occasions when illness, examinations etc., prevented the students from attending. All initially attended briefing meetings, and the first week of the experiment was a demonstration and familiarisation week.

THE ACTIVITIES

The activities for each group are outlined below, but a fully detailed list of them appears in Appendix I.

Group A (Experimental)

1.	Cross Patterning	-	4 mins.
2.	Creeping and Crawling	-	4 mins.
3.	Arm & Leg Swing, balance beam, stepping stones.	-	4 mins.
4.	Small objects in a bag and flash cards.	-	4 mins.

Occasional - Brachiation on an overhead ladder.

All of these activities feature in Doman - Delacato home programmes and are intended to develop better motor co-ordination (1 & 2), better balance (3), better tactile and manual competence (4), better visual performance (2 & 4) and all were more fully explained in Chapter IVA. As long as 2 followed 1, the activities could be done in any order but for a 4 minute period only, and a schedule was produced to assist the helpers. It took time for all the children to be willing to be patterned in a satisfactory way, and this activity was approached gently from the start. There was little difficulty with the other activities. In 4, the objects to be identified in the bag were varied, as were the single word flash cards, which were of parts of the body.

Group B (Control)

1.	Jig-saw puzzles	-	4 mins.
2.	Picture books	-	4 mins.
3.	Construction toys	-	4 mins.
4.	Sand/Water play	-	4 mins.

Occasional - Pedal toys or slide.

These activities were determined by what was the normal type of activity in small groups or individually for each afternoon in that particular class. Each pupil had individual attention for each activity for 4 minutes on each one, and the activities could be done in any order. Fuller details of the activities can be found in Appendix I.

The discrepancy between the total time for the activities and the 30 minutes given to each group is explained by the fact that with E.S.N.(s) children especially, some considerable amount of time and ingenuity is needed to follow programmes such as these, and to establish relationships which facilitate their following. Among the groups, for example, were 6 hyperactive children, one very timid physically, two with virtually no speech and 3 with Down's Syndrome, all of whom presented their problems. However, on the whole the problems were quickly recognised and then anticipated. While the schedules were vital to set a pattern of activities, the rigid adherence to them was not always possible, nor perhaps desirable.

THE TESTS

As indicated in Chapter IV, a test of general ability was required, as was a test in the broad area of language. For reasons which are elaborated below, the tests finally selected were the Peabody Picture Vocabulary Test (1965 Edition), and a test of Memory Span. Both tests have a merit of being relatively easy to administer, which is a major consideration with young severely subnormal children.

The P.P.V.T. measures verbal intelligence via hearing vocabulary, and requires no reading or speaking ability on the part of the child, just an ability to communicate yes or no in an understandble manner. The pictures are clear and free of unnecessary detail; it is relatively easy to establish a rapport with the child, and the test is untimed, all factors which make the test an eminently practical one for the children in question. The validity of the P.P.V.T. has been well studied, and these studies include many with subnormals in the USA and England (Mein 1962, Moss and Edmonds 1960). The Schools' Council have chosen this test in their current project into educating the mentally handicapped in Britain (Leeming 1975). There were the disadvantages of:-

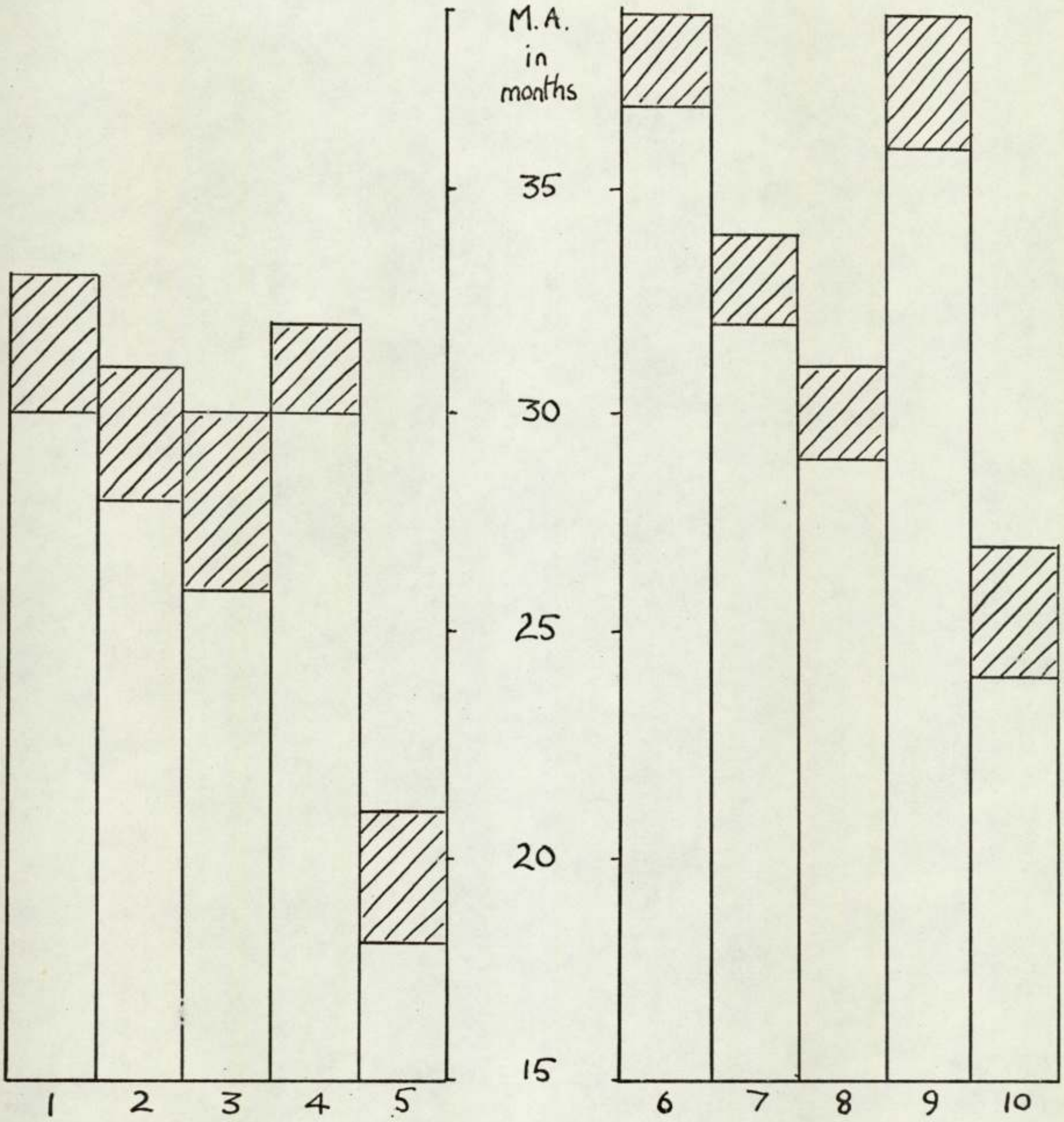
a) the two items within the range of the children which were totally unfamiliar to them ("caboose" and ""Wiener"). These items were omitted, so that a child could not score on them by pure chance.

b) some of the raw scores obtained fall within the range of extrapolated norms for Mental Age, ie, M.A. below 30 months, and must therefore have a lower validity.

The advantages far out weighed the disadvantages for the purpose of this small experiment, and the P.P.V.T. was administered twice, once immediately before and once immediately after the experiment, and the results appear in Diagram 11.

The second test was one of memory span. As the normal way of testing memory span is by the aural reception of digits or nonsense syllables, a more appropriate method was required for the young subnormal children in the experiment. As the pilot project has shown that the P.P.V.T. was relatively easy to administer and its validity as an indicator of I.Q. has been well studied, a test was planned using cards on which simple, clear, line drawings were made on one side only, similar to the items of the P.P.V.T. The drawings were all of objects of one syllable to make the language skill required as simple as possible, it having been noticed in a previous pilot test that performance on object recognition with young E.S.N.(s) children decreased as the length of the name of the object increased. There were 10 cards of familiar objects, to compare with the 10 digits available in a digit span test.

DIAGRAM 11 PRE AND POST TEST SCORES ON THE PEABODY PICTURE VOCABULARY TEST (1965 ED)



GROUP A

EXPERIMENTAL

Mean Pre-Test 26.4

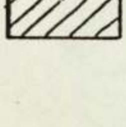
Mean Post-Test 29.4

GROUP B

CONTROL

Mean Pre-Test 31.6

Mean Post-Test 33.8



Pre to Post
Test difference

The test was administered in the following manner, having settled the child on his own and established rapport.

I a) Place one card face up and name the object on it.

b) Turn the card face down.

c) Ask the child "What is under the card?" or "What is on the other side of the card?"

d) After the child's response, turn the card face up to show the child what it in fact was.

e) Repeat this three more times, with a different card each time.

II a) Place two cards face up and name the objects left to right.

b) Turn the cards face down, left to right.

c) Point to the left card and ask "What is under this card?"

d) After the child's response, turn that card face up to show him what it was.

e) Repeat for the right card.

f) Repeat a - e three more times, with a different pair of cards each time.

III Repeat this procedure with 3 cards, then 4 cards and so on, each time working left to right.

The scoring of the test is relatively simple, and is similar to the system used by Graham (1968) in his study of memory span and language. One point is scored for each correct response only, ie, a point is scored if the particular card required is correctly named, no allowance being given for sequence errors. Table 1 is an example of the scoring. The test finishes at the level at which the child fails to score on 50% or more of the tries given. The score is calculated by adding the totals for each level completed. In the instance of the example in Table 17 it is:

$$\frac{4}{4} + \frac{8}{8} + \frac{10}{12} + \frac{7}{16} + \frac{2}{20}$$

$$= \frac{120 + 120 + 100 + 52 + 12}{120}$$

$$= \frac{404}{120} = \underline{\underline{3.36}}$$

A list of the cards used and full details of test scores for each child are given in Appendix II, and the results of pre and post tests for Groups A and B are shown in Diagram 12.

TABLE 14 AN EXAMPLE OF THE SCORING OF THE TEST FOR MEMORY SPAN.

Name: ______________________

Date: ______________________

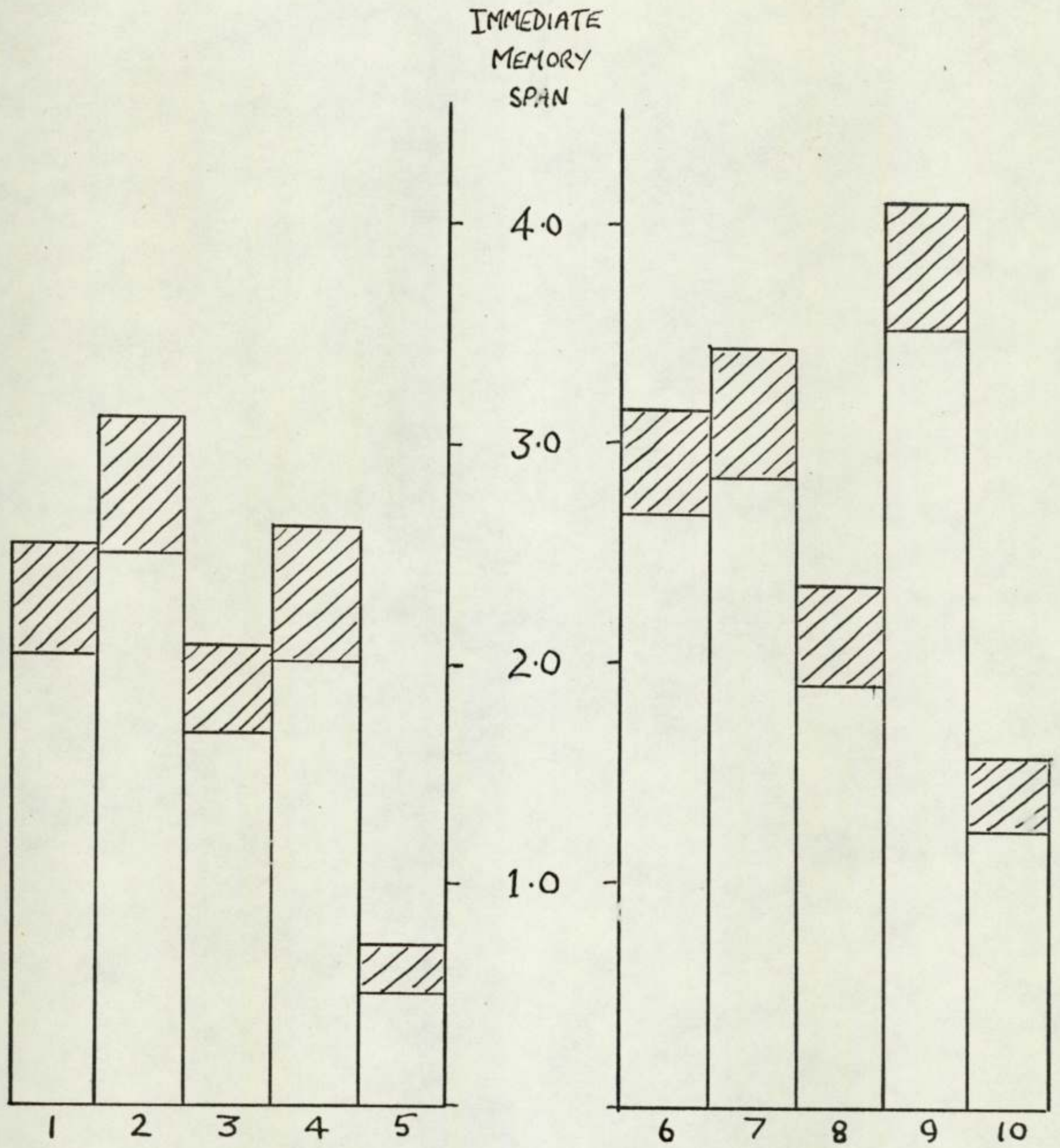
TRY NO. / NO. OF ITEMS	1ST	2ND	3RD	4TH	TOTAL
1	1	1	1	1	4/4
2	2	2	2	2	8/8
3	2	3	3	2	10/12
4	2	1	2	2	7/16
5	1	0	1	0	2/20

$$\frac{4}{4} + \frac{8}{8} + \frac{10}{12} + \frac{7}{16} + \frac{2}{20}$$

$$= \frac{404}{120} = \underline{\underline{3.36}}$$

Immediate Memory Span - 3.36

DIAGRAM 12 PRE AND POST TEST SCORES ON THE TEST OF IMMEDIATE MEMORY SPAN



GROUP A
EXPERIMENTAL

Mean Pre-Test 1.74
Mean Post-Test 2.20

GROUP B
CONTROL

Mean Pre-Test 2.44
Mean Post-Test 2.91

Pre to Post Test differences

Giving the test to the children was relatively easy: they found it fun and were keen to co-operate, a most important element in a test for E.S.N.(s) children. It is hoped to develop this test subsequently. As immediate memory span is closely related to measured intelligence, and to language (Graham 1968), it is a useful measure to have, and an easily administered test would be a useful tool in the assessment of E S.N. (s) children.

V I

THE RESULTS

Having set up a 'classical' experiment using pre and post testing on an experimental and a control group, the DIFFERENCE scores for each group on each test could be analysed. Random assignment of each child to the groups controlled, as far as possible, independent variables like sex IQ and aetiology. The common criticism of pre and post test situations, that the pre test sensitises the experimental group and could enhance their subsequent performance, is unlikely to apply to E.S.N.(s) children. In this case neither group knew which was the experimental group and, as when Group A was engaged on the experimental activities, Group B was engaged on activities with the class teacher in a different room, and vice versa, neither group could know what the other was doing. The degree of communication between the children at other times made it unlikely that one group could indicate to the other what happended for the 30 minutes in the classroom. Similarly, the tests given were quite unlike any of the activities involved in the experiment and attitude to the tests was unlikely to be affected by the activities.

Tabulated results for each test appear in Tables 15(a) and (b) and the mean difference scores for each test appear separately in Diagram 13. To establish the significance levels of the difference scores the Students' 't' test was applied and the levels were as indicated in Diagram 13, namely 0.10.

TABLE 15(a) PRE AND POST TEST MENTAL AGES AND PERCFNTAGE CHANGES FOR EACH CHILD ON THE P.P.V.T (1965).

(P.P.V.T. RAW SCORES IN BRACKETS)

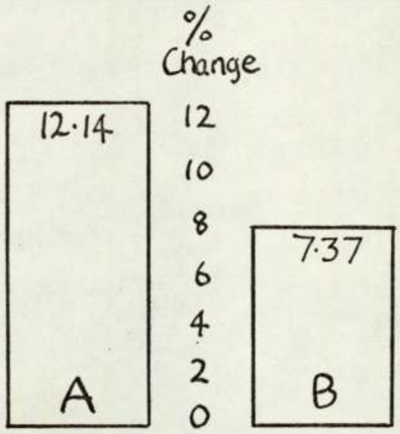
CHILD	PRE TEST	POST TEST	PERCENTAGE CHANGE
1	30 (20)	33 (24)	+10.00
2	28 (16)	31 (22)	+10.71
3	26 (13)	30 (20)	+16.66
4	30 (20)	32 (23)	+6.66
5	18 (1)	21 (5)	+16.66
	GROUP A	MEAN % CHANGE	+12.14
6	37 (30)	38 (31)	+2.71
7	32 (23)	34 (26)	+6.25
8	29 (18)	31 (22)	+6.89
9	36 (29)	39 (33)	+8.33
10	24 (9)	27 (15)	+12.50
	GROUP B	MEAN % CHANGE	+7.37

TABLE 15 (b) PRE AND POST TEST SCORES AND PERCENTAGE CHANGES FOR EACH CHILD ON THE I.M S TEST

CHILD	IMMEDIATE MEMORY SPAN		
	PRE TEST	POST TEST	PERCENTAGE CHANGE
1	2.05	2.54	+23.90
2	2.50	3.10	+24.00
3	1.66	2.08	+25.30
4	2.00	2.55	+27.50
5	0.50	0.75	+50.00
	GROUP A MEAN % CHANGE		+30.14
6	2.65	3.13	+18.11
7	2.83	3.42	+20.84
8	1.92	2.33	+21.35
9	3.55	4.11	+15.77
10	1.25	1.54	+23.20
	GROUP B MEAN % CHANGE		+20.02

DIAGRAM 13 SUMMARY OF MEAN PERCENTAGE IMPROVEMENTS FOR EACH GROUP ON EACH TEST.

1. Peabody Picture Vocabulary Test (1965)

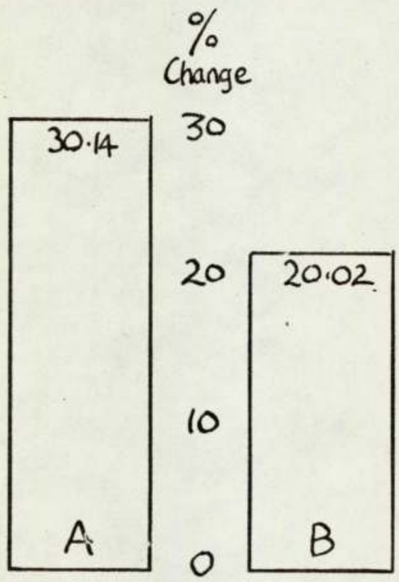


Significance Test $t = 1.90$

$df = 8$

$p = 0.10$

2. Immediate Memory Span Test



Significance Test $t = 1.96$

$df = 8$

$p = 0.10$

The null hypothesis was "that the pre to post test differences for Groups A and B would not be significantly different". The results show that the mean percentage changes for each group were significantly different at the 0.10 level in each test, and the null hypothesis can tentatively be rejected. The 't' test of significance was chosen as it is particularly suitable for difference score analysis and to small samples.

Using the extrapolated norms for M.A. for raw scores on Form (a) of the Peabody Picture Vocabulary Test (1965 Edition), on the pre test, both groups had one child whose M.A. was below the 2 - 0 year level, the mean M.A. for Group A being 26.4 months and for Group B 31.6 months (Diagram 11). With the Memory Span Test, the mean for Group A on the pre test was 1.74 and for Group B it was 2.44 (Diagram 12). The random assignment of subjects to each group had produced a control group (B) whose mean scores on both tests at the start of the experiment were higher than those for the experimental group (A). The range of ability in the class, from M.A. 37 months to M.A. 18 months made this a likely occurence if the two extreme cases were in different groups, as happended so that the mean M.A. of the experimental group (A) was depressed.

As a quick and convenient check on whether the difference between the groups in terms of mental age was a significant one, the Wilcoxon Sum of Ranks Test was applied to the pre-test results for both the P.P.V.T. and the test of memory span. In both cases, $N_A = 5$, and $N_B = 5$. For the P.P.V.T., $R = 21$, and for the I.M.S. test, $R = 22$, neither being significant at even the 0.20 level. The use of percentage improvements on the pre-test scores should, in any case, overcome the difference between the two groups in terms of absolute initial scores.

As Tables 15(a) and 15(b) have shown, the percentage improvements over the period of the experiment in both tests were greater for the Experimental than for the Control Group, 12.14% against 7.37% for the P.P.V.T., and 30.14% against 20.02% for the test of I.M.S., all figures significant at the 0.10 level.

It would appear, then, that Group A, the experimental group, achieved a significantly greater improvement as measured on the two tests than did Group B, the Control Group. Can it therefore be suggested that Doman - Delacato methods are more effective than more conventional methods on the strength of these results? In assessing the results, certain considerations must be made.

a) The size of the sample was very small, ie, 5 in each group. On the strength of figures based on such a small sample, no statement can be made with real confidence although the results were just significant statistically. A much bigger experiment would be required before a really confident statement could be made, but such a study was beyond the scope of this project. If it is viewed as a pilot experiment, then the results suggest that a bigger scale project would be worthwhile. There are also precedents for experiments with such a small number of subjects, such as that of Lackner (1968) discussed previously.

b) Could results similar to those obtained have come from an experimental group doing some other special programme?

This is a matter of conjecture, but the answer would probably be yes, bearing in mind the research of Edgar et al, Morrison and Pothier and others. Perhaps more to the point is to ask whether a group doing activities, no matter what they comprised, that were novel to them would perform well compared with a group doing routine activities. In such a case, greater motivation could well be a major causal element in the better performance. To this end, a project involving three groups could be worthwhile, one using Doman - Delacato methods, one using some other (to the children) novel activities, and a control group on conventional activities . However, within the limits of this particular study, it was Doman - Delacato methods which gained the better results.

c) Some conventional activities in Day Special Schools, such as water play, sand play and jig-saws, tend to be rather repetitive and non-progressive. A child, for example, may do the same jig-saw each day, partly because one teacher with one assistant cannot hope to supervise a graded programme for each child all the time. The results could have shown that such activities contribute little to the progress of the child.

However, the control group did show improvements measured on both tests, most likely due to the big increase in individual attention received rather than the activities themselves. The 30 minutes received each day was approximately 10% of the school day. It could be suggested that planned, structured programmes, with a maximum of one to one activity, are more effective than less formal activity.

d) The greater increase on the tests by the experimental group may not have been maintained over an extended period. It has been noted by Beasley and Hegarty (1973) that the "first assault" of the Doman - Delacato home programme brings about quite a dramatic increase in thechild's rate of development, but one which slows down after about 12 months, after which rate of progress may be little different from that before the programme was started. It could be that this effect can be seen in this small experiment, but it should be borne in mind that a Doman - Delacato home programme is a 100% programme. The use of some of their methods for 30 minutes a day in a school would be unlikely to have the saturation effect of a full home programme, and benefit might therefore last longer.

It was decided to carry out a further set of tests 4 months after the conclusion of the experiment to see whether the rate of improvement in the performance of Group A had been maintained. During that 4 months the class had proceeded with (for them) a normal classroom routine and had not had contact with the experimental equipment or the assistants. Part of the period was vacation time.

The same tests were administered as at the start and the end of the experiment and results appear in Tables 16(a) and 16(b). As Group A had made a mean improvement of 12.14% on the P.P.V.T. and 30.14% on the test of I.M.S. during the 20 week experiment, and Group B had made a mean improvement of 7.37% and 20.02% on the same tests during the same period, the null hypothesis was "That the two groups should continue to make the significantly different rates of improvement over the later 4 month period as they had done over the 20 week period of the experiment".

The mean differences between the scores at the end of the experiment and the scores 4 months later for both tests are shown in Diagram 14, and when the Students 't' test is applied, are found to be not significantly different. The null hypothesis can be rejected, reinforcing the original claim that the Doman-Delacato methods did bring about an increased rate of progress during the period of the experiment.

TABLE 16(a) POST AND FOLLOW UP TEST MENTAL AGES AND PERCENTAGE CHANGES FOR EACH CHILD ON THE P.P.V.T. (1965).

(P.P.V.T. RAW SCORES IN BRACKETS)

CHILD	MENTAL AGES IN MONTHS		
	POST TEST	FOLLOW UP TEST	PERCENTAGE CHANGE
1	32 (23)	33 (25)	+3.13
2	31 (22)	33 (25)	+6.46
3	30 (20)	32 (24)	+6.67
4	32 (23)	34 (26)	+6.25
5	21 (5)	22 (7)	+4.76

GROUP A MEAN % CHANGE +5.45

6	38 (31)	40 (34)	+5.26
7	34 (26)	36 (29)	+6.45
8	31 (22)	33 (25)	+3.13
9	39 (33)	41 (35)	+3.13
10	27 (15)	29 (18)	+7.40

GROUP B MEAN % CHANGE +5.07

TABLE 16 (b) POST AND FOLLOW UP TEST SCORES AND PERCENTAGE CHANGES FOR EACH CHILD ON THE I.M.S. TEST

CHILD	IMMEDIATE MEMORY SPAN		
	POST TEST	FOLLOW UP TEST	PERCENTAGE CHANGE
1	2.54	2.89	+13.77
2	3.10	3.41	+10.00
3	2.08	2.39	+14.90
4	2.55	2.84	+11.37
5	0.75	1.12	+49.33

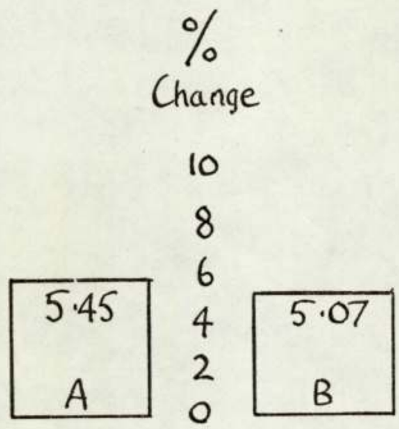
GROUP A MEAN % CHANGE +19.87

6	3.13	3.70	+18.21
7	3.42	3.91	+14.32
8	2.33	2.88	+23.60
9	4.11	4.63	+12.65
10	1.54	2.25	+46.10

GROUP B MEAN % CHANGE +22.97

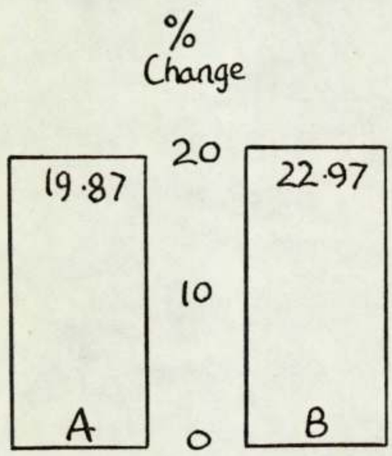
DIAGRAM 14 SUMMARY OF MEAN PERCENTAGE IMPROVEMENTS FOR EACH GROUP ON EACH TEST FOUR MONTHS LATER.

1. Peabody Picture Vocabulary Test



Significance Test $t = 0.35$
df = 8
N.S.

2. Immediate Memory Span Test



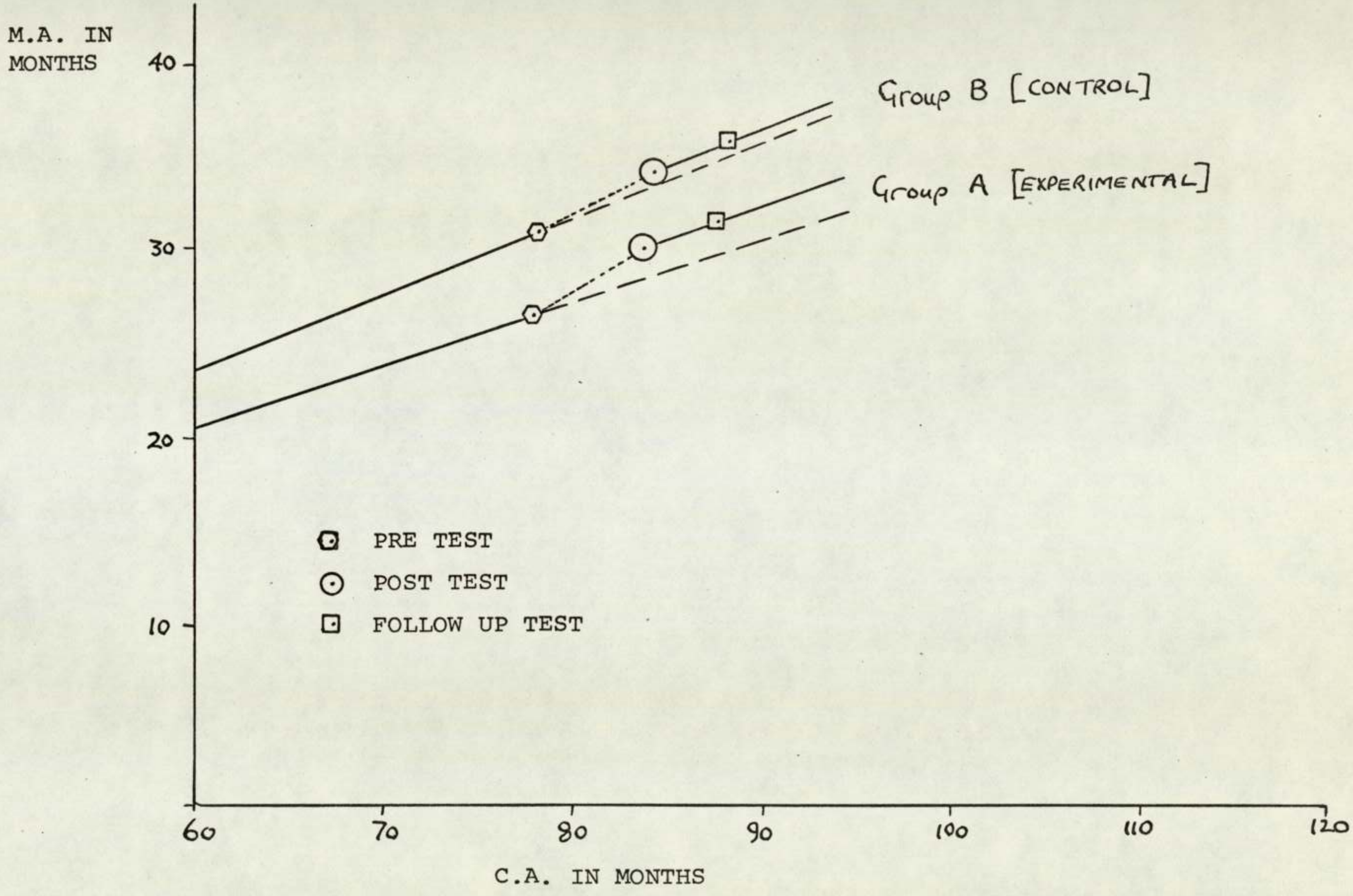
Significance Test $t = 0.32$
df = 8
N.S.

This can be shown graphically as a comparison of rates of development for each child.

Both groups had a greater rate of development during the experiment, with Group A (experimental) having the greater of the two improved rates as shown statistically above. The mean rate of development for each group are shown graphically in Diagram 15, where the greater change in gradient of Group A during the experiment is apparent.

The greater similarity between the gradients before and after the experiment are also shown, but significant is the fact that the amount of progress made by Group A overall was greater at the final testing than that of Group B. The relatively greater gains made by Group A during the experiment were not lost when the experiment ceased, even though the rate of progress fell slightly.

DIAGRAM 15 GRAPH OF MEAN RATES OF DEVELOPMENT FOR EACH GROUP
BEFORE, DURING AND FOUR MONTHS AFTER THE EXPERIMENT



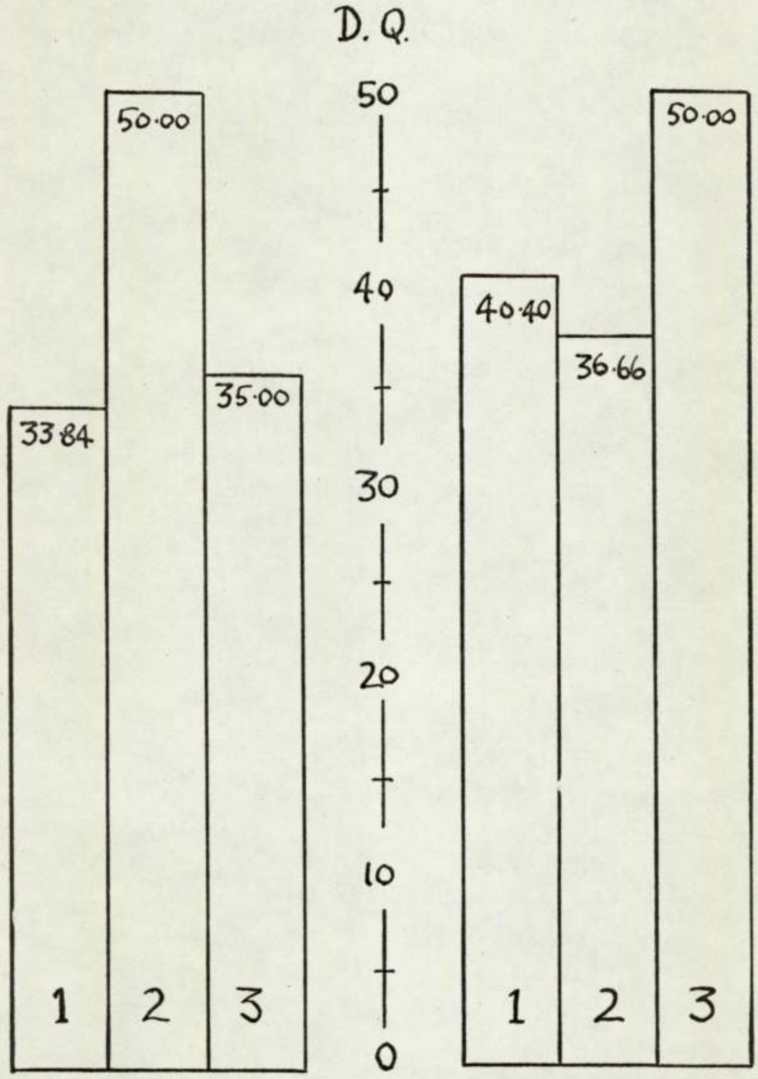
When Developmental Quotients are calculated as shown in Diagram 16, the rate of increase of Group A during the experiment is more obviously greater than that of Group B. The histograms also reveal clearly the generally higher level of ability as measured for Group B (Control), which random assignment to groups had fortuitously created. It should be noted that the D.Q. 3 values are for a four month period only.

Since it could be argued that the lower initial measured ability level of Group A could cause it to be expected that the group would make more progress in any case, and since the significance level of the results was a barely acceptable 0.10, a further comparison is made. If mean D.Q. scores for each group are calculated from the first application of the P.P.V.T., these can be used as a guide to the amount of progress, in terms of M.A. that each group could be <u>expected</u> to make in the 6 months of the experiment and the 4 months to the follow up test. By comparing the <u>observed</u> mean M.A.s for each group on the P.P.V.T. at post and follow up tests with the <u>expected</u>, an indication of the differential rates of progress of the two groups can be gained. As Diagram 16 has shown, the mean D.Q. for Group A at the start was 33.84, and for Group B was 40.40.

when correlation coefficients are calculated as shown in Tables [illegible] the [illegible] were [illegible] and during the experiment [illegible] were obviously greater than that of Group B. The histograms also reveal clearly the generally higher level of ability as measured for Group A (Control) which school assignment [illegible] had [illegible] particularly created. It should be noted in Table 3.10 a [illegible] decline for a [illegible] month period only.

Since it could be argued that the lower initial measured ability level of Group B [illegible] it to be expected that the group would make more progress in any case and since the significance level of the results was [illegible] only acceptable 0.10 a further computation is made. If mean D.Q. scores for each group are calculated from the first application of the D.E.V.T. these can be used as a guide to the rate of progress [illegible] A [illegible] Each group could be expected to make in the 6 months of the experiment and [illegible] by the following test. By comparing the observed mean M.A.s for each group on the D.E.V.T. post and [illegible] with the predicted, an indication of the differential rates of progress of the two groups can be gained. The Diagram 15 has shown the mean D.Q. for Group A at the start was 71.[illegible] and for Group B was 69.40.

DIAGRAM 16 MEAN DEVELOPMENT QUOTIENTS FOR EACH GROUP BEFORE, DURING AND FOR FOUR MONTHS AFTER THE EXPERIMENT



GROUP A GROUP B

$$D.Q.1 = \frac{\text{M.A. AT START OF STUDY}}{\text{C.A. AT START OF STUDY}} \times 100$$

$$D.Q.2 = \frac{\text{M.A. AT END OF STUDY - M.A. AT START OF STUDY}}{\text{C.A. AT END OF STUDY - C.A. AT START OF STUDY}} \times 100$$

$$D.Q.3 = \frac{\text{M.A. AT FOLLOW UP TEST - M.A. AT END OF STUDY}}{\text{C.A. AT FOLLOW UP TEST - C.A. AT END OF STUDY}} \times 100$$

Table 17 shows that at the end of 10 months, ie, at the follow up test, Group A had made 4.40 months progress, whereas the expected progress would have been 3.38 months, assuming a continuation of the rate of progress current to the start of the experiment. The equivalent figures for Group B were 4.20 months of measured progress, compared with the expected progress of 4.04 months. In other words, Group A made 1.02 months more than expected, and Group B made 0.16 months more than expected over the 10 month period. Previous comments show that this extra gain for Group A took place in the 6 month period of the experiment. By using D.Q. values in this way, the lower absolute level of the experimental group at the start of the experiment is shown not to be of great significance.

As a final check on the validity of the figures from the tests used, the Verbal Comprehension (Scale A) and the Expressive Language tests of the Reynell Developmental Language Scales, were administered to both groups at the same time as the follow up tests were given. The results for the Verbal Comprehension Scale appear in Diagram 17 and for the Expressive Language Scale in Diagram 18.

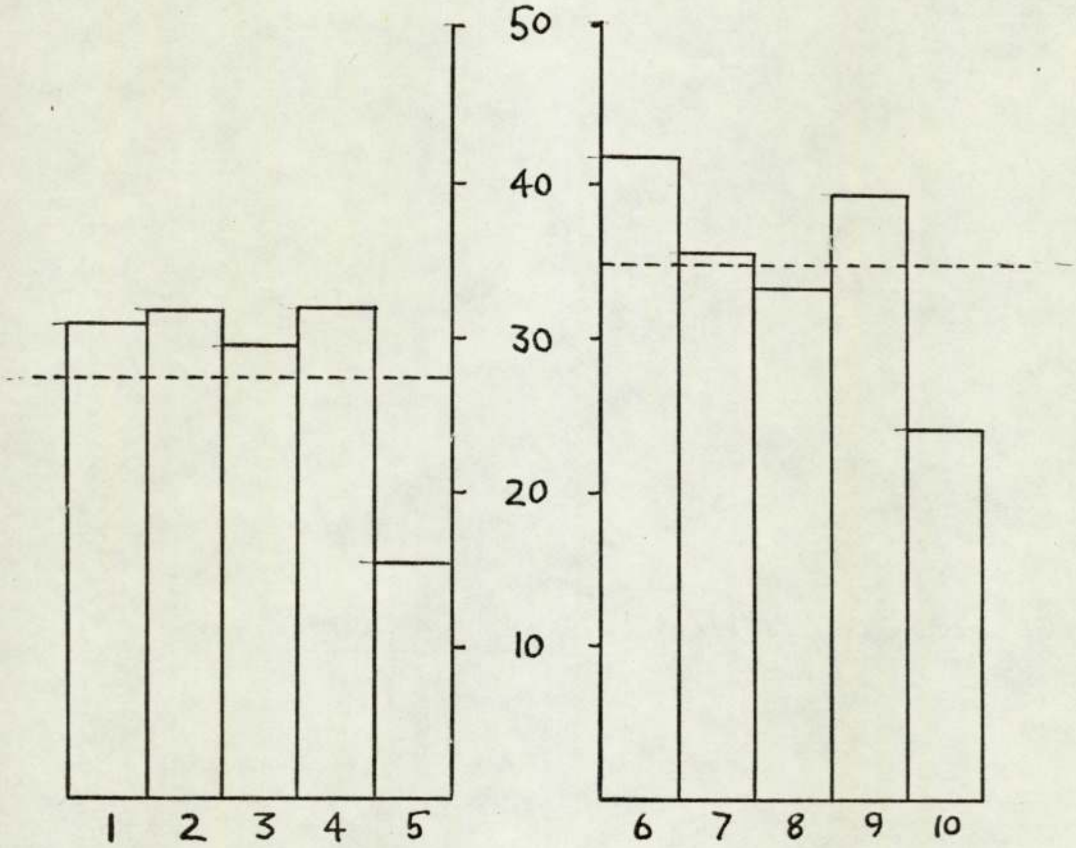
TABLE 17 A COMPARISON OF OBSERVED PROGRESS IN MENTAL AGE AND PROGRESS IN M.A. TO BE EXPECTED USING MEAN PRE TEST D.Q VALUES FROM THE P.P.V.T RESULTS

GROUP AND PRE TEST D.Q.	POST TEST M.A. IN MONTHS	FOLLOW UP M.A. IN MONTHS	
Experimental A 33.84	28.43	29.78	Expected
	29.40	30.80	Observed
Control B 40.40	34.02	35.64	Expected
	33.80	35.80	Observed

An examination of correlation between the Reynell Scales, Peabody Test, Memory Span Test and Chronological Age was undertaken and the correlation coefficients appear in Table 18, using the Product Moment C.C. The correlations are all high and positive with the exception of those for C.A. The latter were to be expected, but the other high, positive values increase the confidence to be placed in the results obtained from the P.P.V.T. and I.M.S. tests for the experiment.

DIAGRAM 17 REYNELL DEVELOPMENTAL LANGUAGE SCALES
VERBAL COMPREHENSION

FOLLOW UP TEST SCORES FOR EACH GROUP

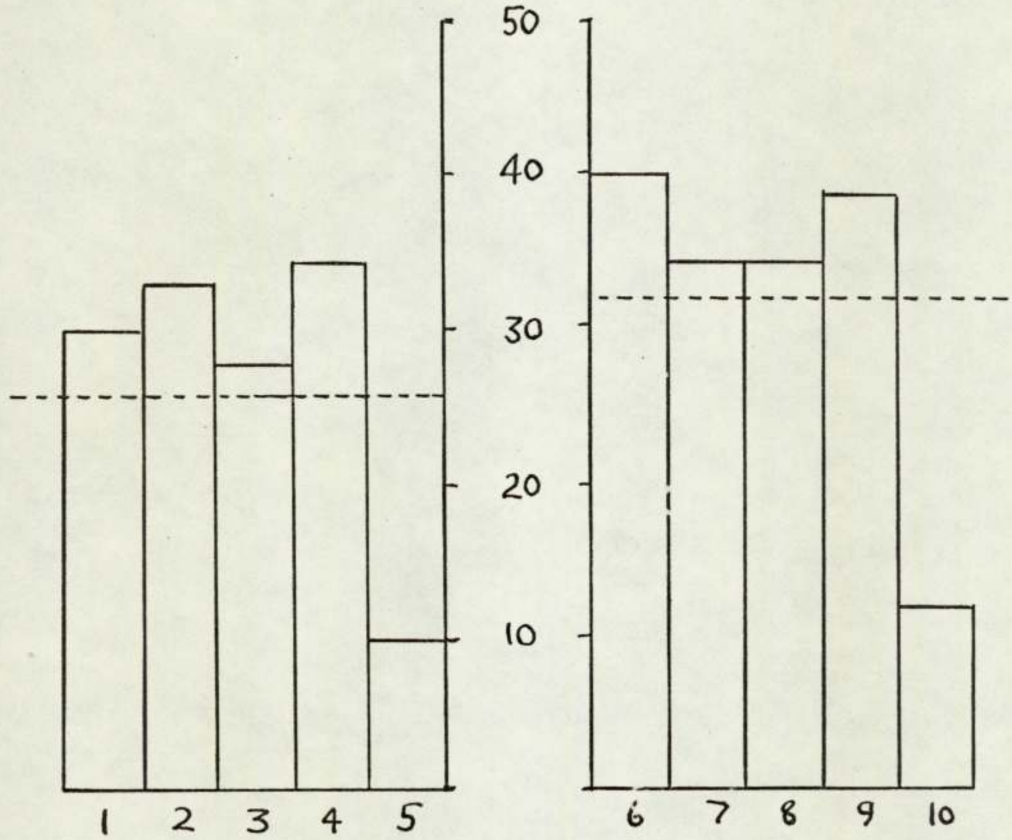


GROUP A GROUP B

Mean 27.8 ---------- Mean 34.4

DIAGRAM 18 REYNELL DEVELOPMENTAL LANGUAGE SCALES EXPRESSIVE LANGUAGE

FOLLOW UP TEST SCORES FOR EACH GROUP



GROUP A GROUP B

Mean 26.6 --------- Mean 31.6

TABLE 18 PRODUCT MOMENT CORRELATION COEFFICIENTS FOR CHRONOLOGICAL AGE, REYNELL DEVELOPMENTAL LANGUAGE SCALES, PEABODY PICTURE VOCABULARY TEST (1965) AND TEST OF IMMEDIATE MEMORY SPAN

REYNELL VERBAL COMPREHEN^N SCALE 'A'	1				
REYNELL EXPRESSIVE LANGUAGE SCALE	+0·970	1			
IMMEDIATE MEMORY SPAN	+0·885	+0·837	1		
PEABODY PICTURE VOCABULARY TEST	+0·985	+0·934	+0·903	1	
CHRONOLOG - - ICAL AGE	0·273	0·273	0·267	0·289	1
	REYNELL VERBAL COMPREHEN^N SCALE 'A'	REYNELL EXPRESSIVE LANGUAGE SCALE	IMMEDIATE MEMORY SPAN	PEABODY PICTURE VOCABULARY TEST	CHRONOLOG- -ICAL AGE

There remains the question of how the Doman - Delacato methods, even in a small, school based experiment as this, can bring about improvements in scores on tests which, on the surface, have no particular connection with the activities prescribed. Any test which purports to give a figure for Mental Age is indicating a particular level of development reached, ie, the level at which the average, normal child of the same Chronological Age should function. The Peabody Picture Vocabulary Test, as shown, correlates quite well with more complicated mental and developmental tests like W.I.S.C. and Stanford Binet (1960). Anything which assists or hinders a child's developmental rate should be apparent in the results of a test like the P.P.V.T. Memory Span is a component of general development with a big influence on language development. Anything which improves I.M.S. should therefore improve overall competence in particular in language and thought. Immediate memory span, as it improves, and subsequently declines, with maturation, seems to be a more directly <u>neurological</u> element. If Doman -- Delacato methods do improve neurological organisation as claimed, by providing stimulus to the central nervous system of particular but various types frequently, intensively and over extended periods, it could be expected that I M.S. would improve accordingly, as has appeared to be the case here.

This ought to allow more rapid development as a result of a better retrieval mechanism. It could also be suggested that a dramatic increase in sensori-motor stimulation at the levels of development reached by the children in this experiment accelerates the child's perceptual development and makes him more alert to his environment and more able to attempt to deal with situations as they arise in it. This is really a corollary to Woodward and Stern's work as reviewed in Chaper IV. Intensive stimulation can improve and indeed establish synaptic connections in the central nervous system as is shown in many cases of stroke and cerebral haemorrhage (Luria 1973). A more efficiently organised nervous system should be better able to relate the organism to its environment and bring about an enhanced level of development.

Some other results from the experimental group were observed, but not objectively measured. The children with the greatest mobility problems seemed to gain from the patterning and crawling activities, one child in general co-ordination and another in general confidence of movement. Three of the children, who had no reading skill at all before the experiment, could correctly recognise most of the words for parts of the body, printed large and displayed singly. Only one of the children in the control group could attempt this with any success, and she could read before the project began. This suggests that the Doman approach to reading (Doman 1964) has something to offer in the Special School. The children in the experimental group, with one exception, learned to identify small objects by touch alone when requested to pull the named object from a bag. The class teacher's subjective opinion was that two of the children in the experimental group had made "noticeable progress".

V I

CONCLUSIONS

The current project has been a small investigation into a particular approach to improving the performance of E.S.N.(s) children in Day Special School. The approach of Doman and Delacato is one of frequent, intensive activities carried out over a long period of time, designed to increase dramatically input to a child's brain. This increased input assists the brain and central nervous system in its attainment of greater neurological organisation, with the result that the child's abilities improve. The theoretical base of their approach, that ontogeny recapitulates phylogeny, while not proven, has a good deal of support (Luria 1973).

The practical results of their home programmes have been good and sometimes dramatic. Whatever the theoretical background, their practical application seems to achieve results - such situations are not unknown in other areas of science. One particular merit of a Doman - Delacato home programme is that it sets specific goals over a given period, normally about three months, at the end of which achievements are compared with goals, and a new set of goals established.

The means to achieving the goals are highly structured in the form of an intensive and quite rigid programme of activities. These two elements are often lacking in the learning situations found in Day Special Schools in this country. Another element of value is that of setting challenging but realistic goals, and of not underestimating a child's capability. The reading aspects of this experiment are an example of the latter. In other words, for some part of the school day, an intensive, structured programme of activities can achieve results in terms of development better than a wholly informal approach, in which stimulus material is available waiting for the children to use it. Such a programme based on Doman - Delacato methods, seems to be effective with those children whose mental age is below 36 months. A similar project carried out in a residential school with E.S.N.(s) children from age 3 years to 14 years but with severe physical handicaps from cerebral palsy and spina bifida, and based on a Doman Delacato style of programme, has suggested that good results in the area of gross motor ability in particular, can be expected. (M. Hendley & A. Robinson 1973).

There is in a day school the logistic problem of organising labour to carry out such a programme for part of the day.

Experience suggests that a good proportion of parents of mentally handicapped children, among those who do not have full time work, are willing to come to school and help on a rota system. There is an increasing development of "Social and Community Studies" in Secondary Schools at 5th and 6th Form level, part of which is often undertaken in a Special School or similar establishment. Housewives Registers, Parent-Teachers Associations and similar bodies can all provide labour if properly motivated and organised. The Parent's Workshops of the Hester Adrian Research Centre in Manchester point to the willingness of parents to involve themselves with the school and to supplement at home what the school attempts during the day. It is, therefore, quite possible to supplement the staff of the school with volunteer assistants for a short time each day.

This project did not set out to show that the methods of Doman and Delacato are superior to all others. Their approach has gained popularity and notoriety for a variety of reasons connected with its theoretical base, its intensive programming and its claimed results.

There is much of merit in the approach, in particular that a set programme of activities is followed, goals are set and achievements appraised. The results of the investigation suggest that a relatively limited period of time each day (or most days) in which Doman - Delacato techniques are used, is an effective way of increasing the progress of E.S.N.(s) children at or below the 3 year developmental level. Such a programme involves some degree of planning by the teacher, which is by no means too difficult. The increasing professionalism among teachers of E.S.N.(s) children will hopefully move them to look at the various approaches to achieving better progress in their pupils. This project purports to show that the particular approach of Doman and Delacato is worthy of consideration, and that a wider based experiment over a longer time period might provide more significant results.

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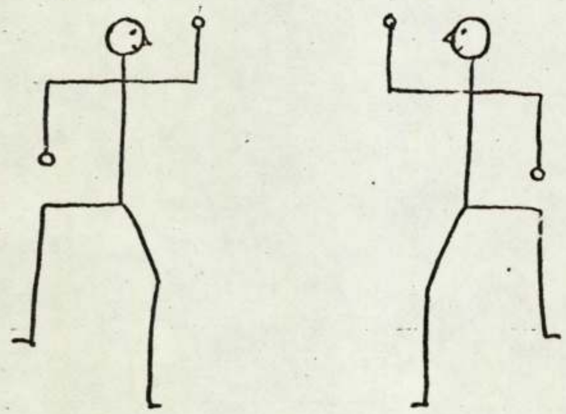
APPENDIX I

DETAILS OF THE ACTIVITIES FOR EACH GROUP IN THE EXPERIMENT

GROUP A - EXPERIMENTAL

1. Cross Patterning. The child lies face down on a physiotherapy table, and has his limbs moved by assistants in such a way and in such a rhythm that crawling is simulated, as below:

(i) (ii)



and so on.

The pattern of good, co-ordinated movement is thereby "imposed".

2. Crawling. The child moves forward in a "Commando Crawl", with body in contact with the floor, one of the first forms of locomotion for a young child.

Creeping. The child moves forward on hands and knees with body off the floor, his weight supported by arms and upper legs.

3. Arm and leg swing. The child is held by the wrist and ankle by an assistant on each side, and is given a "swing boat" motion.

Stepping stones. Wooden blocks, 15" x 15", with a depth of 4", arranged in various ways to encourage the children to step from one to another, depending on the ability and confidence of the child.

Balance beam. Wooden plank, 5" wide and 8 ft. long, which can be placed at various heights, and along which the children are encouraged to walk.

4. Small objects in bag. A linen bag 6" x 10", in which were:- a marble, paper clip, safety pin, button, 5 pence coin, curtain hook, small key, dice. Normally only 3 or 4 items were in the bas at any one time. The assistant named each article, gave it to the child to feel, put it into the bag, and asked the child, when 4 objects were inserted, to pull out one of them eg, "give me the marble".

Flash Cards. These were the names of parts of the body, hair, eye, nose, lips, ear, hand, leg, foot, chin, finger, toes, arm. They were in 3" red lower case letters on white card, 5" x 10". They were presented initially by telling the child what the word was. Subsequently, the word could be shown to the child for him to say the word, or point to the appropriate feature.

GROUP B - CONTROL

1. Jig Saw puzzles. These were school property, and were wooden and 10" x 8" in size. Some were regular jig-saws, others inset jig-saws.

2. Picture books. These were Mail Order Catalogues, in which the children were encourages to find objects, or name them or otherwise talk about them.

3. Construction Toys. They were 2" cube wooden bricks, lego plastic building blocks, and an interlocking material called "sticklebrick".

4. Sand Play. A trough of 3ft. diameter, full of sand, with spades, buckets, spoons and other receptacles.

Water Play. At a sink with taps, pouring cylinders, a water wheel and small cups.

APPENDIX II

Test of Memory Span

a) List of items used on the cards, all of one syllable, and all familiar objects.

Hand,	Egg,	
Car,	Book,	Cards all 4" x 4"
Bus,	Brush,	
Cat,	Cup	
Door,	Spoon	

b) Scores in detail for the children.

i) PRE-TEST

	ITEMS / CHILD	1	2	3	4	5	I.M.S. VALUE
A	1	4/4	7/8	2/12	0/16	0/20	2.05
	2	4/4	6/8	7/12	3/16	0/20	2.50
	3	4/4	4/8	2/12	0/16	0/20	1.66
	4	4/4	4/8	5/12	1/16	0/20	2.00
	5	2/4	0/8	0/12	0/16	0/20	0.50
B	6	4/4	8/8	7/12	1/16	0/20	2.65
	7	4/4	8/8	7/12	4/16	0/20	2.83
	8	4/4	6/8	2/12	0/16	0/20	1.92
	9	4/4	7/8	11/12	9/16	4/20	3.55
	10	3/4	2/8	3/12	0/16	0/20	1.25

ii) <u>POST-TEST</u>

	ITEMS / CHILD	1	2	3	4	5	I.M.S. VALUE
A	1	4/4	8/8	5/12	2/16	1/20	2.54
	2	4/4	7/8	9/12	6/16	2/20	3.10
	3	4/4	5/8	4/12	2/16	0/20	2.08
	4	4/4	7/8	6/12	2/16	1/20	2.55
	5	3/4	0/8	0/12	0/16	0/20	0.75
B	6	4/4	8/8	8/12	6/16	2/20	3.13
	7	4/4	8/8	10/12	8/16	2/20	3.42
	8	4/4	6/8	5/12	2/16	1/20	2.33
	9	4/4	8/8	12/12	13/16	6/20	4.11
	10	4/4	3/8	2/12	0/16	0/20	1.54

iii) FOLLOW UP TEST

	ITEMS / CHILD	1	2	3	4	5	I.M.S. VALUE
A	1	4/4	8/8	8/12	5/16	0/20	2.89
	2	4/4	8/8	10/12	7/16	3/20	3.41
	3	4/4	6/8	5/12	2/16	0/20	2.39
	4	4/4	8/8	8/12	3/16	0/20	2.84
	5	4/4	1/8	0/12	0/16	0/20	1.12
B	6	4/4	8/8	12/12	8/16	4/20	3.70
	7	4/4	8/8	11/12	12/16	5/20	3.91
	8	4/4	8/8	7/12	4/16	1/20	2.88
	9	4/4	8/8	12/12	14/16	12/20	4.63*
	10	4/4	6/8	6/12	0/16	0/20	2.25

* Child 9 tried a 6 item span and scored 4/24, which is included in her final I.M.S. value.

'P R O F I L E'

Brain Stage	Time Scale	Visual Competence	Auditory Competence	Tactile Competence	Mobility	Language	Manual Competence
Sophisticated Cortex	Av. age 72 months	Eye dominance established and used in reading	Comprehension of appropriate vocabulary	Identification of objects by touch alone, using dominant hand.	Dominance established in legs in skilled activity.	Expression of appropriate vocabulary using properly structured sentences.	Dominance established and used in writing.
Primitive Cortex	Av. age 36 months	Recognition of letters and shapes	Can hear and understand large vocabulary when simple sentences used.	Description of objects by touch alone - 'prickly', 'soft' etc.	Cross lateral pattern established in walking and running.	Uses large vocabulary . Simple, short sentences.	Manual dominance established.
Early Cortex	Av. age 18 months	Perception of differences in similar but non-identical shapes.	Comprehension of 6 - 20 words.	Differentiation of similar but unlike objects by touch.	Walking without use of arms for balance. Can carry toy.	Speaks using 6-20 words Echolalia. Tries to sing.	Pincer grasp, bimanual and simultaneous.
Initial Cortex	Av. age 12 months	Perception of depth resulting from convergent or binocular vision.	Comprehends 3 or 4 words in context, and 2 or 3 word phrases in context and association with gesture.	Discriminitive awareness of third dimension by touch.	Walks upright using arms for balance.	Uses 1 or 2 words, and 2 word phrases.	Pincer grasp - one hand at a time.
Midbrain	Av. age 7 months	Perception of detail with an outline.	Can hear meaningful sounds.	Appreciation of tactile sensations within his experience.	Crawling on all fours culminating in cross lateral crawl.	Can make meaningful sounds.	Use of palmar grasp but only has voluntary release when in contact with hard surface.
Pons	Av. age 2.5 months	Recognition of shapes or outlines within experience.	Response to threatening sounds.	Response to threatening sensations.	Purposeful crawling movements in prone position culminating in cross pattern action.	Vocal response to threatening situation.	Clasps and unclasps hands. Open at rest.
Medulla and Cord	Av. age Birth to 1 month	Response to light - eg. reflex closure to bright light.	'Moro' reflex in response to loud sound.	At rest thumbs grasped in rest of hand. Babinski response.	Purposeless movement of limbs.	Birth cry - lusty cry only expression of anger	Grasp reflex

DIAGRAM 4 THE DOMAN DELACATO DEVELOPMENT PROFILE 1971 VERSION.