UNIVERSITY OF SOUTHAMPTON

THE STRUCTURE OF SENSORIMOTOR INTELLIGENCE IN SEVERELY AND PROFOUNDLY MENTALLY HANDICAPPED CHILDREN

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by

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For my parents,

and for Grandpa.

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ABSTRACT

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THE STRUCTURE OF SENSORIMOTOR INTELLIGENCE IN SEVERELY AND PROFOUNDLY MENTALLY HANDICAPPED CHILDREN

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The nature of sensorimotor development in severely mentally handicapped children is poorly understood. The aim of the study reported in this thesis is to investigate the structure of sensorimotor intelligence in this population.

The Uzgiris-Hunt (1975) Scales were employed in a Piagetian approach to the assessment of severely mentally handicapped children. The results suggested deficits in imitation and object permanence in their profile of abilities, relative to normal infants. Evidence is presented that these results were not a simple reflection of the subjects' motor handicaps, nor were they a function of institutionalisation. It appears that sensorimotor intelligence in the severely mentally handicapped is qualitatively different from that of non-retarded infants.

A pilot-training study in vocal and gestural imitation and object permanence with a small group of subjects, was carried out. It was possible to train gestural imitation and object permanence, but no improvement occurred in vocal imitation.

These findings are consistent with a difference position on the nature of severe mental handicap, since a fundamental departure from the normal course of development is demonstrated.

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CHAPTER ONE

THE APPLICATION OF PIAGET'S THEORY TO THE MENTALLY HANDICAPPED

1.1 Introduction

Inhelder (1943) was the first to apply Piaget's theory to the cognitive assessment of the mentally handicapped. Twenty-five years later her research was published in English, entitled "The Diagnosis of Reasoning in the Mentally Retarded", it has been a major inspiration for subsequent research efforts to apply Piaget's theory to the mentally handicapped. By proposing that intellectual development in the mentally handicapped was subject to fixation in the stages of operational development, Inhelder demonstrated how Piaget's stage theory may provide an alternative to the psychometric classification of this population. Inhelder questioned the validity of psychometric tests and argued that they do not take into consideration structural or functional questions. She showed how Piagetian conservation and problem solving tasks may be used as clinical tools to diagnose the level of functioning in a retarded person. She recommended the use of classificatory systems based on Piaget's theory of cognitive development. Inhelder studied mild and moderately retarded individuals, who were thought to function at the pre-operational and conconcrete operational stages of development.

Woodward (1959) extended Inhelder's work to the period of infancy and applied Piaget's theory of sensorimotor development in the classification of severely and profoundly mentally handicapped children. Woodward suggested that the six sub-stages of the sensorimotor development, described by Piaget could be used to classify the intellectual functioning of this population. In Woodward's pioneering study her assessment was based on just two areas of sensorimotor intelligence. However, in 1975 the Uzgiris-Hunt Scales of Infant Psychological Development were published. Based on Piaget's theory, these ordinal scales enable seven areas of sensorimotor intelligence to be assessed.

The potential utility of the Uzgiris-Hunt Scales to clinical assessment of the severely mentally handicapped has been widely recognised (e.g. Wachs, 1970 ; Kahn, 1976) and the Scale is beginning to find application as a means of studying the structure of sensorimotor intelligence in this population.

Theorists continue to debate whether the intellectual development of the mentally handicapped merely proceeds at a slow rate, showing normal patterns of development, but finishing earlier in the developmental sequence, or whether it is qualitatively and structurally different to that in normal children. Commonly known as the 'developmental versus difference' debate, this provides the theoretical question to which the thesis is addressed.

The Uzgiris-Hunt Scales are applied here in an experimental approach - this does not assume complete acceptance of Piaget's theory or the way it has found translation to the Scales. Rather, the Scales are viewed as a means by which cognitive development in severely mentally handicapped children may be investigated, always bearing in mind that the Scales themselves and Piaget's theory may be subject to criticism.

In addition to gaining a better understanding of the nature of sensorimotor intelligence in this population, such information may have practical implications for intervention and the thesis will also examine this question.

The aim of this thesis is to increase our understanding of the nature of sensorimotor development in severely mentally handicapped children taking a Piagetian approach to their intellectual assessment and training.

1.2 Definition of Severe Mental Handicap

In Britain two categories of mental subnormality are recognised by national legislation - "subnormality" and "severe subnormality". The Mental Health Act of 1959 defined severe subnormality as::

> "a state of arrested or incomplete development of mind which includes subnormality of intelligence and is of such a nature and degree that the patient is incapable of leading an independent life or of

guarding himself against serious exploitation, or
will be so incapable when of an age to do so".
(Section 4, paragraph 2).)

This definition focuses on the dependency of the severely subnormal individual, on special care facilities and subnormality of intelligence is actually defined in these operational terms.

1.2.1 Classification of Mental Handicap : According to Severity of Symptoms

Clarke and Clarke (1974) have discussed the various classifications which have been applied to the mentally handicapped.

The most frequently employed system of classification according to severity of symptoms is that recommended by the American Association of Mental Deficiency (AAMD) in 1973. This system uses intelligence quotients (IQ. s) to distinguish four categories of retardation. The following figures are applicable to tests with a standard deviation of 15 : mild retardation = 55-69 ; moderate retardation = 40 - 54 ; severe retardation, 25 - 39 and profound retardation under 25. (Grossman, 1973).

This system is intended for use with an assessment of "adaptive behaviour". It assumes that I. Q. is assessed with a standardized, normative test which yields a reliable and valid index to the individual's intellectual status. This thesis is concerned with the last two categories : severe and profound mental retardation - i.e. those individuals with an I. Q. under 40, and they will hereafter be referred to as the "severely" mentally handicapped.

1.2.2 Etiological Factors in Severe Mental Handicap

Severely mentally handicapped children have almost always incurred very serious and often extensive brain damage (Robinson and Robinson, 1976). Symptoms of brain damage are also common amongst the moderately retarded and in a few cases among mildly retarded individuals. In a high proportion of cases even today the causes of severe retardation are obscure, however there is evidence for the existence of pathology in the vast majority of cases, as post-mortem examinations have revealed brain abnormalities (Crome, 1954).

The classification 'brain-damaged' represents an omnibus category, applicable to any case where the normal structure or function of the brain has been distorted (Robinson and Robinson, 1976).

Although a distinction may be drawn between genetic and non-genetic etiologies, perhaps a more meaningful classification is based on the time at which damage occurred in the development of the individual. It is known that many brain damaged children initially sustained injury in utero, others during the perinatal period and a smaller number post-natally (Robinson and Robinson, 1976). There is some disagreement as to whether greater impairment results from damage sustained early or late in development.

One position emphasises the greater vulnerability of the foetus and infant when undergoing periods of rapid growth and differentiation (Lenneberg, 1968). Furthermore, a person will have benefitted from intact development and normal patterns of functioning before the injury. On the other hand the plasticity of an immature brain may allow for compensation and reallocation of functions to undamaged areas which have not yet become differentiated. Research findings are inconclusive but the weight of evidence suggests that a greater degree of impairment results from damage incurred early in life. (e.g. Hebb, 1949).

Brain damage resulting in severe mental handicap is diffuse and generalised and is thought to occur before birth when the whole brain is developing rapidly (Lenneberg, 1968). Furthermore, those areas of the brain undergoing the most rapid differentiation are most vulnerable and damage produces greater intellectual deficits.

Clear conclusions cannot be drawn since there is evidence that problems occurring during the perinatal period may be confounded by abnormal development during the prenatal period. Consequently, much remains unknown regarding the differential effects of etiology and neurological handicaps on the development of intellectual functions. As Robinson and Robinson (1976) have noted "As yet there are no known behavioural patterns based on physiological or psychological etiology which can be said to be certainly diagnostic of any given underlying condition". (1976, p. 324). Thus, possession of etiological information does not necessarily simplify the problem of understanding psychological functioning in profound mental handicap.

1.2.3 Description of the Characteristics of Severely Mentally Handicapped Children

Severely mentally handicapped children represent an extremely heterogeneous group of individuals in every respect, from etiology to number and severity of handicaps. In addition to depressed general intelligence, the severely mentally handicapped child may have multiple sensory and motor handicaps, including impaired visual, auditory, spatial, kinesthetic, and tactual, perception. Boll (1972) compared 27 brain damaged children with 27 controls and identified the relative order of the most serious handicaps of the brain damaged group to be : in concept formation ; visual perception ; auditory perception ; motor speed and tactile form perception.

Fieber (1978) has noted that the high incidence of sensory and multisensory impairment in vision and hearing which exists in this population has frequently gone undiagnosed and thus may not be appreciated by those approaching these children as learners and communicators. Motor handicap may result in lack of motor control in arms and legs. Some individuals fail to achieve the sitting posture or even to acquire head control and many profoundly mentally handicapped children are confined to wheel chairs.

That a relationship exists between physical and mental development has been confirmed repeatedly in the last twenty five years (e.g. Rudel, Teuber and Twitchell, 1974 ; Hofer, 1981). Many severely mentally handicapped children are underweight at birth and their physical growth is frequently slow. Even when they have reached maturity they may appear somewhat 'stunted.' Down's Syndrome individuals are well known for their limited stature.

Many of these children have epilepsy and some suffer from emotional disturbance and hyperactivity, whilst others are extremely passive and inactive.

So, the picture is of associated intellectual, motor and emotional disturbance, a global rather than a specific developmental abberation.

1.3 Theories of Mental Retardation

The lack of firm empirical data on the nature of intellectual development in the mentally handicapped has meant that psychological theories have had an important role in providing a framework for research.

1.3.1 The Developmental versus Difference Debate

Over the last 15 years a debate between two major positions on cognitive development in the mentally handicapped has been the stimulus for many studies comparing retarded and non-retarded persons. Referred to as the "developmental versus difference controversy", it has involved two theoretically opposed theories on how cognitive development in the mentally retarded may best be characterised.

Although the controversy has usually involved moderately handicapped populations, it has also been extended to the severely mentally handicapped and development during infancy - the period with which this thesis is concerned.

1.3.2 The Developmental Position

The developmental position, originally put forward by Zigler (1969) and elaborated by Weisz, Yeates and Zigler (1982), postulates that both normal and retarded individuals proceed through an invariant sequence of stages in cognitive development. The stages are those described by Piaget (1954, 1964). Retarded individuals differ mainly in the rate of their development, to progress more slowly through the cognitive stages and to attain a lower final level of development than is the case with normal individuals. When retarded and normal people are matched for level of cognitive development, which is usually operationally indexed by psychometrically assessed "mental age" (MA), they should not differ in performance on any other reasoning tasks. This postulate is intended to apply only to retarded individuals not afflicted by any organic impairment. (Zigler 1969).

1.3.3 The Defect Position

Exponents of the 'defect' position or as Zigler (1969) has termed it, the "difference" position, hold that retarded individuals differ from normals qualitatively in ways other than merely the rate or ceiling of development. For example Milgram (1973) has maintained that cognitive stages in retarded individuals are structurally different from those in normal development. His argument is that the conceptual functioning of a retarded person is more likely to show evidence of more primitive stages of development, when he is required to perform Piagetian-type tasks. Milgram's (1973) view shows some similarities with Inhelder's (1968) notions of "viscosity", "oscillation" and false equilibrium" in mentally retarded childrens' reasoning. Inhelder (1968) used these terms to describe the turgid, unstable, erratic nature, of her subjects reasoning. (Her position has been viewed as consistent with both developmental and difference positions).

Some of the more prominent defect theorists (Luria 1961 ; Ellis 1963 ; Spitz 1982) have evolved their own models which involve the incorporation of physiological postulates.

Ellis (1969), an important exponent of the difference position, has rejected indices such as 'MA', 'IQ' or 'developmental level' on the grounds that they lack explanatory power and do not describe the behavioural differences that exists between normal and retarded individuals. Ellis (1969) believes that the term "defective" would more appropriately describe this population than "retarded" which has connotations of a 'developmental-lag' which might be overcome in time.

Another 'difference' theory, the Soviet position on the nature of mental retardation has been called 'defectology'. It applies to persons with organic impairment and is mainly associated with the work of Luria (1961, 1963). Luria made numerous studies of the mentally retarded from which he derived his ideas. According to Luria (1963) the mentally retarded child has behavioural deficiencies which reflect under-development of the brain and serious defects in mental functioning. Luria believed the transition from external actions to internal mental operations to be a critical feature of normal mental development and this was mediated by speech. According to Luria, the mentally retarded child remains at the level of specific external actions, unable to acquire language, "the second signalling system of reality" which comprises a system of abstract, social signs through which reality is socially mediated, (1963, p.2). Thus all future mental development is precluded as normal mental operations cannot be established. This also causes anomalous formation of all the more complex aspects of intellectual activity. Luria thought that diminished strength, balance and lability of basic nervous processes prevented the establishment of complex systems of neural connections which tended to be fragmentary and inflexible in the retarded person. This reduced the efficiency of the cortex preventing the acquisition of speech which forms the "basis of the more complex connections of the second signalling system" (1963, p.12).

Another aspect of Luria's theory is that the verbal system is dissociated from the motor system, with the result that a retarded persons' perceptual-motor processing may be less disrupted than his verbal-conceptual ability. Some support has been found for Luria's claims (e.g. O'Connor and Hermelin 1958).

1.3.4 The Debate

A brief summary of the empirical evidence which has implications for the developmental versus difference debate will now be reported. This has taken place mainly in relation to Piaget's pre-operational and concrete operational periods of development and has intensified interest in the application of Piaget's theory to mentally handicapped populations.

The developmental position (already described) involves two independent propositions on the similarity between retarded and non-retarded development. One concerns the "similar sequence" and the other "similar structure" of cognitive development. The first proposition predicts that the sequence of development is invariant and that mentally retarded and normal children will acquire behaviours in the same sequence. The second hypothesis predicts that IQ matched retarded and non-retarded individuals are similar in cognitive structure. Cognitive structure is the way in which the intellect is organised (e.g. the logico-mathematical forms that underlie particular types of reasoning, which may be measured by Piagetian problem solving tasks).

Weisz and Yeates (1981) have accomplished an impressive review of 30 studies, involving 104 separate tests of these hypotheses with mentally handicapped subjects, using Piagetian conceptual measures. In their evaluation of the evidence they drew an important distinction between studies which screened organically impaired subjects from their mentally handicapped sample and those that did not. Weisz and Yeates (1981) found that out of the 33 comparisons which met this requirement 30 provided evidence in support of the similar structure hypothesis, whereas studies which included organically impaired subjects found evidence in support of the difference position. Thus, although there is evidence that organic impairment does qualitatively affect performance on Piagetian reasoning tasks (Zigler and Balla, 1982; Balla, Styfco and Zigler, 1971 ; Weisz, Yeates & Zigler, 1982), most of the evidence favours a developmental-lag model of mental handicap. As the similar structure hypothesis has been formulated to apply to non-organically damaged children (Zigler 1966, 1969 ; Weisz and Zigler 1979) the evidence supports the developmental position. Studies have also found that retarded individuals pass through the same developmental sequence in the order which occurs in normal development. (Weisz and Zigler 1979).

The two postulates of similar sequence and similar structure which derive from the debate do have relevance to more severe categories of mental handicap. The following reasons are suggested: Firstly, many of the empirical studies on this subject have included some brain damaged subjects in their samples. Secondly, some defect theorists (Ellis, 1969, Milgram, 1969 ; 1973 ; Spitz, in press) have maintained that certain kinds of organic impairments (such as in Down's Syndrome or brain injury) do not influence behaviour significantly and therefore it is not necessary to exclude organically impaired subjects when constructing experiments to test the developmental-lag hypothesis. Thirdly, implicit in Piagetian theory are claims for universality in the developmental sequence. According to Kohlberg (1969) the postulate of an invariant sequence of cognitive stages rests upon an assumed invariance in particular features of the environment and of the nervous system and upon "a logical analysis of orderings inherent in given concepts" (p.355). These inherent orderings are viewed as logically essential and independent of individual differences. It appears therefore that the similar sequence hypothesis expounded by developmental theorists - as Weisz and Zigler (1979) note "seems to predict a truly universal ordering of stages - an ordering that is the same for retarded children of all etiologies (including genetic impairment, brain injury, and other neurological anomalies) as it is for all non-retarded children". (p.833). As will be seen Piaget's sequence of stages in sensorimotor development has been replicated repeatedly with severely mentally handicapped children. However with respect to the postulate of "similar structure" - a postulate which is of central concern to the present investigation, in the case of severely mentally handicapped children, evidence is far from conclusive as very few studies have investigated this issue.

Findings have frequently been confounded with the variable of institutionalisation. Zigler and Balla (1982) have criticised researchers for ignoring institutionalisation as a potent variable : "In any consideration of the developmental position it is necessary to discuss the effects of institutional experience on the behaviour of retarded persons" (1982, p.5). Unfortunately, many studies have failed to control for effects of institutionalisation, thus it is impossible to discern real differences between retarded and normal individuals.

Apart from developmental-lag and difference theories there is no comprehensive model of cognitive development or cognitive structure in the severely mentally handicapped. The theoretical conflict generated by the above debate has given a new emphasis to comparative research into the processes, in contrast to the products, of learning and reasoning (Weisz 1976 ; Weisz and Achenbach 1975) in normal and mentally handicapped individuals. As Weisz and Zigler (1979) argue :

> "The growing interest in the pursuit of developmental universals, and the growing intensity of the developmental versus difference debate, have thus combined to lend theoretical force to research comparing the cognitive development of retarded and non-retarded persons along Piagetian lines".
> (p. 832)

There has been relatively little research that has used Piaget's theory as a framework from which to investigate the cognitive structure of sensorimotor intelligence in severely mentally handicapped children.

In the following section a brief historical account of the intellectual assessment of the mentally handicapped will be given with a discussion regarding the changing conceptualisations of early intelligence amongst theorists. This discussion is intended to provide a rationale for the adoption of Piaget's theory as a tool for investigating intellectual development in severely mentally handicapped children.

1.4 The Historical Background to the Intellectual Assessment of the Mentally Handicapped

Alfred Binet devised the first practical intelligence test. At the turn of the century he was commissioned by the Minister of Public Instruction in Paris to devise an instrument capable of identifying mentally retarded children whose education might be more appropriate if conducted in separate facilities. In response to this request Binet and Simon (1905) published what is recognised as the first real intelligence test. It was a scale consisting of 30 items arranged in an empirically determined order of difficulty, which sampled several complex mental abilities such as judgement, comprehension and reasoning, abilities which Binet believed to be the essence of intelligence.

In 1908 Binet and Simon published an improved scale, containing 58 items. It was the first scale to employ the construct of mental age (MA) thus providing an operational definition of intelligence based on a child's performance on the scale.

Robinson and Robinson (1976) have noted that the translation of the scales into a number of languages and their immediate adoption by psychologists was mainly due to their ability to assess, objectively, levels of mental retardation. However, psychometric tests have been most successful "not because of their contribution to a theoretical understanding of intelligence, but because they met an urgent social need" (1976, p. 21).

Despite their utility psychometric tests have received much criticism, particularly as they are not based on a theory of intellectual development and an account of the quantitative conceptualisation of the intellect which they embody.

1.5 Conceptualisations of Infant Intelligence

There have been two major conceptualisations on the nature of intelligence which have greatly influenced the thinking of theorists and test constructors on early infant intelligence. One position holds that intelligence is a unitary predetermined trait or general capacity (g) (Spearman 1904, 1923, 1927 ; Stern 1914) and the other position conceives of intelligence as a composite of various abilities or skills which do not depend on a central underlying capacity for their expression (Thorndike 1914 ; Thurstone 1938 ; Guilford 1959).

According to Dunst (1978) there appeared to be little agreement amongst early investigators as to the structure of infant intelligence and most views were speculative rather than based on objective data which could refute or confirm the existence of 'g' during infancy.

During the middle years of the infant intelligence test movement, 1936 - 1955, however a series of factor analytic studies (Richards and Nelson 1938, ; McNemar, 1942 ; Maurer, 1946 ; Hofstaetter 1954) provided a more objective empirical foundation for discerning the structure of infant intelligence.

Dunst (1978) has concluded from his review of these studies that most researchers during this period 1936 to 1955 "generally contended that either 'g' or an analogous construct characterised the structure of infant intellectual activity" (p. 386). It appears that Bayley (1955) who conceived of intelligence as multi-faceted was the only dissenter to this proposal. In his review of the literature on the structure of infant intelligence (Dunst, 1978) has emphasised the influence of "two major events", on contemporary conceptualisations. One was the translation of Piaget's (1951, 1952, 1954) works on infant development into English; the other was a monumental factor analytic study of several infant and pre-school intelligence scales carried out by Stott and Ball (1965). "Both events served as the impetus for a new conceptualization of infant intelligence". (Dunst, 1978 ; p. 386).

Stott and Ball's (1965) analysis of the test protocols of nearly 2000 infants on the Bayley (1933), Cattell (1940) and Gesell (1925) scales yielded 4 to 8 distinct factors. In addition the loadings on these factors varied at different age levels. Stott and Ball (1965) concluded that their data provided empirical evidence that infant intelligence is a multi-dimensional construct and that it cast serious doubt on the conceptualisation of infant intelligence as a quantitative linear, general capacity. Later factor-analytic studies provided further support for Stott and Ball's viewpoint on the structure of infant intelligence (Maurelli ; 1972 ; McCall, Hogarty and Hurlburt, 1972).

Another important investigation, the Fels study (McCall et al. 1972), involved factor analysis of the scores of 224 infants on the Gesell (1925) scales at four age levels (6, 12, 18 and 24 months). Results yielded four dominant clusters, perceptual contingencies at 6 months, imitation at 12 months, verbal labeling and comprehension at 18 months and verbal fluency-grammatical maturity at 24 months. Although the data obtained in this study were derived from scales based on a completely different model, nevertheless McCall (1976) states :

> "The similarity to Piagets (1951) theorizing, as well as to Hunt's (1961) interpretation of it, is striking. .... Although the analyses were not done with an a priori theory in mind, the results were remarkably consistent with Piaget's description of mental development in the first 2 years of life".
>
> (1976, p. 114).

As McCall et al. (1972) concluded their findings provide evidence of emphatically marked shifts in the organisation of cognitive abilities, which suggest a model incompatible with one based on a construct such as 'g', which suggests a quantitative linear progression. Further McCall's (1976) interpretation of their results emphasise the importance of sensorimotor abilities in providing the foundations for later symbolic and linguistic development.

> "At a general level these observations are consistent with a Piagetian concept of epigenetic development in which qualitatively different behaviours build upon their predecessors, unfolding in a logical sequence. An important point is that there are relationships between diverse behavioural emphases (e.g. sensorimotor exploration, imitation and language) within and across ages that suggest it would be profitable to consider early language, for example as somehow emerging from, or at least related to, antecedent sensorimotor behaviours".
> (1976 ; p.115).

Thus there has been a broadening in theorists' conceptualisation of the nature of infant intelligences from the construct of a fixed, stable capacity which changes only quantitatively from birth to maturity, to one in which intellectual development involves a hierarchical process whereby functioning at one stage incorporates the abilities found in earlier stages but also involves new abilities unique to that stage and where change is qualitative as well as quantitative. (Bloom, 1964 ; Uzgiris, 1970 ; McCall, et. al., 1972). Dunst (1978) suggests that this conceptualisation of early intelligence is compatible with the majority of contemporary investigators who have been interested in delineating the structure of the intellect in infancy (e.g. Corman and Escalona, 1969 ; Bayley, 1970 ; Hunt, 1961 ; Kopp, Sigman and Parmelee, 1974 ; Lewis, 1973 ; McCall et al. 1972 ; Stott and Ball, 1965 ; Uzgiris, 1976):

> "the contemporary viewpoint held by most investigators of infant infelligence is that infant intelligence is comprised of multiple and varied sets of abilities, and that there are qualitative shifts in the prominence of different factors at successive levels of development. Although such a point of view received its impetus in part from Piaget's infant psychology, it is a perspective that is congruent with one which was advanced by Bayley (1933, 1955, 1970) ever since the beginning of the infant testing movement".
> (Dunst, 1978 ; p. 389).

Whether Piaget's description of sensorimotor development implies that abilities develop relatively independently of one another or all at the same rate, is a complex issue. It is directly relevant to this thesis and will be discussed in more depth later. Despite the contribution of theoretical and statistical approaches in specifying the nature of early intelligence, the precise nature of early mental abilities, their interrelationship and the transitions involved in their ontogenesis throughout the sensorimotor period, are still poorly understood even in normal developments. (Wohlwill 1973).

As will be seen, research in this area may become more systematic, replicable and standardized (e. g. Casati and Lezine 1968 ; given that a number of investigators have constructed Escalona and Corman 1968 ; Uzgiris and Hunt 1966) ordinal scales of infant psychological development based on Piaget's (1951, 1952, 1954) theory. In contrast to traditional psychometric infant tests, these scales measure separate domains of sensorimotor intelligence.

Traditional psychometric infant tests have been criticised in that they produce just one score - an index which is neither very informative nor educationally prescriptive (Hogg and Mittler 1980). They implicate a conceptualisation of intelligence such as 'g' as a unitary trait (Honzik, 1976). Their use with respect to the mentally handicapped is therefore extremely limited. As Wachs (1970) has pointed out such tests provide no indication of an individual's strengths or weaknesses.

Perhaps the most obvious inadequacy of the use of psychometric tests in relation to the mentally handicapped - is that they are unable to tap the rudimentary skills found in severely impaired persons. These tests fail to discriminate among individuals at the extremely low end of the I.Q. distribution hence the search for alternative assessment instruments which may be more informative.

Instruments derived from Piaget's (1954) theory of cognitive development in infancy appear to have this face validity, in addition they have the advantage of a firm theoretical base regarding the epigenesis of intelligence.

As Piaget and Inhelder (1941) commented many years ago, conventional intelligence tests are concerned with the products of intellectual functioning rather than with their underlying processes.

As the concern of the present study is with the investigation of early cognitive abilities in severely mentally handicapped children the employment of an instrument which attempts to tap these underlying cognitive domains, is of crucial importance.

In contrast to psychometric tests Piagetian based scales measure distinct aspects of intelligence, and a hierarchical, ordinal progression is assumed between successive scale steps (Uzgiris and Hunt 1975). Implicit in the construction of these scales is the assumption that sensorimotor intelligence is comprised of distinct, relatively independent abilities or domains (Uzgiris and Hunt 1975). To what extent this assumption is compatible with Piaget's stage theory is an issue which does not appear to have been addressed in the literature.

Before describing the various Piagetian sensorimotor scales which have been constructed an outline of the main tenets of Piaget's theory together with his account of development in the sensorimotor period will be given.

1.6 Piaget's Theory of the Epigenesis of Intelligence

Piaget views psychological development in terms of 'epigenesis' rather than the predetermined unfolding of innate properties. He is as much concerned with the development of knowledge as with psychological development and the source of knowledge is action. On contact with the environment, the organism acts, at first these actions (schemes) are reflexive, but later they become co-ordinated. Through action (which includes imitated acts) the child gains an increasing knowledge of reality which later becomes internalised in the form of internal representation. Thus there are different levels of 'knowing' - these are, 'instinctual', 'sensorimotor' and later 'operational' and are indicated by different forms of action towards objects in the world.

Piaget characterises the developmental process in terms of a series of stages which are invariant in order but may be attained at different ages. A child does not necessarily function exclusively at one stage, but as the stages involve a particular way of dealing with situations and ways of reasoning it might be expected that a child's level of thinking would be defined by the stage he had reached.

Four major stages are defined by Piaget, these are the sensorimotor (0 - 2 years) ; pre-operational (2 - 7 years) ;

concrete operational (7 - 11 years) and formal operations (11 - adulthood). It is the first stage of development which is central to the present investigation - the sensori-motor stage. For a more detailed account of Piaget's theory the reader is referred to Flavell, (1963).

As mentioned previously the reason for the present investigation being concerned only with sensori-motor development is because it addresses only the most severe categories of mental handicap. Severely mentally handicapped children do not usually attain a more advanced level of functioning and certainly do not progress past the pre-operational stage, (Inhelder 1966, 1968) but tend to become fixated at one of the earlier stages.

Piaget's sensori-motor period of development will now be briefly described.

1.6.1 The Sensorimotor Stage of Cognitive Development

The conclusions reached by Piaget have been summarised in an exposition of his theory on sensorimotor development (Piaget and Inhelder, 1969). Close and detailed observation of his own three children constituted Piaget's method of empirical data collection on which his theory of sensorimotor development is grounded. (Piaget 1952, 1954, 1962). He has outlined a general description of the changes in intellectual functioning that take place during infancy, together with a specific account of development in the construction of such aspects of reality as the object concept, space, causality, time and also development in imitation and the capacity for representation. Development in respect of all of these categories has been presented in terms of a sequence of six invariant sub-stages, which seem to suggest distinct levels or forms of organisation and a degree of congruence across these categories, in respect of each stage of development. The issue of 'stages' in sensorimotor development or indeed in development per se is somewhat controversial, especially as Piaget has not attempted to characterise their organisation formally in terms of overall structure pertaining to each domain. The status to be accredited to the stages of the sensorimotor period is not straightforward.

Although Piaget has given many examples of behaviours indicative of each stage, his characterisation has tended to be restricted to the specific domain under consideration. Piaget has stipulated criteria for the six stages which pertain to the different areas of sensorimotor intelligence (e.g. general sensorimotor intelligence, development of the object concept, response to relations of time, space and causality and imitative behaviour). However the question is whether or not there is an underlying structural basis to these behavioural hierarchies. Piaget (1954) infers that all these abilities depend on the same process of structural change and to the extent that the concept of stage suggests a qualitatively distinct level of organisation, then some form of congruence or parallelism across the various sensorimotor domains might be anticipated. However, Piaget does not appear to attribute much importance to age-equivalence in acquisition of the various levels of functioning in different domains or to state that temporal synchrony might be expected.

Wohlwill (1973) has drawn attention to the lack of research on Piaget's sensorimotor sub-stages. Empirical studies appear to be restricted to attempts to construct Piagetian ordinal scales for infant assessment (Uzgiris-Hunt 1966, Escalona and Corman 1966). Nevertheless, Piaget's (1960, 1973) "structure d'ensemble" criterion of the stage concept which he emphasized, logically leads to the prediction of stage congruence across domains, as it states that concepts which obey identical laws may be expected to be manifested concurrently. (Pinard and Laurendeau, 1969). In logical opposition to the structure d'ensemble principle is Piaget's notion of horizontal decalages, which represent "temporal lags in the ages at which formally equivalent concepts are mastered". (Wohlwill 1973, p. 208). This phenomenon recognised by Piaget, is rather incompatible with Piaget's stage theory which postulates synchrony in the various sensorimotor areas of development.

Clearly Piaget's stage theory in respect of the sensorimotor period requires empirical validation and studies which assume synchrony in normal development may not be justified in doing so, a factor which does have implications for any straightforward Piagetian interpretation of abnormal development.

Generally, sensorimotor development involves gradual differentiation resulting from the assimilatory and accommodatory processes which eventually reach equilibrium within a relatively stable structure. Central to this process is the progressive objectification of reality for the infant and complementary to this, the evolution of awareness of self as an agent in the world. For the infant at this stage no distinction exists between perception and action, thus initially the infant develops through acting on immediately perceived objects and only later do the two become differentiated enabling 'figurative' and 'operative' knowing.

The neonate possesses a limited repertoire of un-coordinated reflexes which are necessary for any subsequent development. During the first 4 months the adaptive process begins, initially perhaps by chance, but this is later repeated until eventually two schemes are co-ordinated or a new scheme develops. This process is termed 'circular reaction ' - at first 'primary'circular reactions enable, for example, the infant to progress from the reflexive sucking scheme to the more differentiated scheme of sucking fingers or to seeing and touching an object in a co-ordinated fashion where these were once differentiated actions.

From 4 to 8 months the infant acts on his environment in an instrumental manner through 'secondary' circular reactions which imply that if his actions produce an interesting event he can repeat the same action in order to prolong the event or make it reoccur. The development of intentional behaviour proceeds through the co-ordination of secondary circular reactions into more complex schemes e.g. search for hidden objects and interest in new events just because of their novelty.

From the second year on the infant's intelligence is no longer defined only in terms of 'action' but involves the representation of events which are not directly available to the senses. Essentially the transition is from overt physical action to covert, internalised action which for Piaget marks the beginning of abstract representation. During this period the child acquires the object concept - the realisation that objects have an existence which is independent of his actions towards them. The culmination of the sensorimotor period is marked by the infants ability to represent events etc.

symbolically which enables him to 'know' without having to act.

1.6.2 The Development of Representation

For Piaget imitation plays a central role in symbolic development, or the semiotic function which gives rise to the capacity for internal representation. "It is clear from the outset that the problem of imitation is linked with that of representation. Since representation involves the image of an object, it can be seen to be a kind of interiorised imitation and therefore a continuation of accommodation". (Piaget, 1951, p. 5). Piaget emphasises the active nature of imitation, stating that it is far from being "automatic" or non-intentional and represents an example of the primacy of accommodation over assimilation. He even considers pre-verbal imitation to be one of the "manifestations of intelligence" (Piaget 1951, p. 5).

The capacity for representation is viewed as the most significant achievement of the sensorimotor period and provides the necessary cognitive structures for the acquisition of language. There is a growing body of research which has looked at the question of the relationship between language development and earlier sensorimotor abilities.

Thus the attainment of the sixth (and final) sub-stage of the sensorimotor period represents an important milestone in a child's cognitive development, despite the fact that the child's thought is not yet systematic or logical.

1.7 The Utility of Piaget's Theory in the Assessment of Severely Mentally Handicapped Children

Piagetian theory is concerned with the type of psychological operation involved in a given response rather than its success or failure, therefore it provides a conceptual framework from within which to investigate the responses of mentally handicapped children. The type of manipulation performed on an object indicates type of thinking which in turn depends on the underlying cognitive structures. Given the high prevalence of sensory and motor deficits in the mentally handicapped, adaption of tasks where necessary is quite permissible as the aim of a Piagetian assessment is to tap '<u>competence</u>' not merely sample '<u>performance</u>' which can fluctuate considerably in this population. Competence may be equated with the existence of the necessary cognitive structures. Furthermore, the Piagetian method allows a child repeated opportunities to modify his response if he failed on the first presentation.

The theory therefore is particularly suited to the practice of eliciting the desired response from a mentally handicapped child- who is likely to be deficient in attention or motivation (Zigler, 1969). Both materials and tasks may be adapted or varied to compensate for the multiple and severe physical disabilities of a particular child. The flexibility permitted in the type of materials that may be used overcomes the phenomena of attachment to a particular class of objects or indeed a child's attachment to one particular object. The above factors are also useful in cases of psychosis and emotional disturbance, which are common in this population. (Woodward, 1963).

Another advantage of this approach to the assessment of profoundly mentally handicapped children is the fact that 'speed' of response is not viewed as an important factor - naturally children with motor disabilities will be slower in their responses and will generally display less precision than normals. As Woodward (1963) suggests many sensorimotor tasks can be adapted even for the deaf and blind.

Perhaps the greatest advantage gained in the adoption of a Piagetian approach to assessment of this population is that the sequence of cognitive development postulated by the theory is in a definite, invariant order. This feature of the theory is useful in assessment procedures of the mentally handicapped as, if an individual has achieved a certain level of development in the sequence, then he must have passed through the proceeding stages but has not yet reached the succeeding stages in the sequence. The reason this assumption has utility is on account of the slowness in development shown by the mentally handicapped. The long period of time spent at a given stage of development may imply that earlier behaviours have been completely lost from their repertoire. This could potentially mislead the examiner who may assume a particular child is not exhibiting a certain response because he has not yet attained that level of functioning. (Kahn, 1976).

Another factor related to slowness of development in the mentally handicapped is that in Piagetian theory 'age' is not considered an important factor in the achievement of tasks. This contrasts with the psychometric approach - the drawbacks of which were described earlier. The advantages of Piagetian assessment have been investigated by Devries (1974) who has looked at the relationship amongst Piagetian, I. Q. and achievement assessments and found that a factor analysis defined factors in Piagetian tasks which were not present in psychometric tests. Generally her results confirm the inadequacy of the psychometric approach - "Piaget's tasks do seem to provide a theoretically and empirically more valid assessment of intelligence than psychometric measures". (1974 ; p. 755).

In summary then for a number of reasons the adoption of a Piagetian approach to the assessment of the mentally handicapped greatly facilitates the assessors work and a child's repertoire of behaviours become clearer in meaning when placed in the broader context of Piaget's theory of cognitive development.

1.8 The Genevan Position on the Nature of Mental Handicap.

Inhelder (1943) was the first to apply Piaget's theory to the investigation of mentally handicapped populations. She used Piaget's description of the later stages of pre-operations and concrete operations to classify mildly and moderately retarded people according to the behaviours they manifested ; despite this, as noted earlier she did note differences in the reasoning of the retarded. Her investigation did not extend to the severely mentally handicapped or down into the sensorimotor period of development.

The Genevan position on mental handicap, advanced by Inhelder (Inhelder 1966, 1968 ; Inhelder and Piaget, 1947) may be viewed as being consistent with developmental-lag theory (described previously). It holds that the cognitive development of mentally retarded children follows through the same stages of development as in normal development - in accordance with the principle of 'universality' in stages of cognitive development. However, development is viewed as progressing at a slower rate and finishing at a lower final level. The Genevan position posits that the cognitive development of mentally retarded persons "is characterised by fixations or blocking of the operational activity at different stages of development" (Inhelder, 1966 p. 311). The stage at which an individual becomes fixated depends on the degree of handicap - in the case of most of the severely handicapped and all of the profoundly mentally handicapped, fixation occurs in the sensorimotor stage and pre-operational thought is never attained. Moderately mentally handicapped individuals may become fixated within the pre-operational stage and mildly mentally handicapped persons at the concrete operations stage.

1.9 Studies which have applied Piaget's Theory of Sensorimotor Development to Severely Mentally Handicapped Children

During the last decade there has been not only a great increase in the number of studies dealing with severely retarded children but also a rapid increase in the number of researchers interested in the utility and applicability of Piaget's theory to assessment and intervention with severely retarded children. Some investigators have been interested in demonstrating the universality of Piaget's theory. By showing that even the profoundly retarded pass through the same stages of development, impressive evidence of Piaget's universality principle is obtained (Weisz and Zigler 1979).

More pertinent to the present concern, other investigators have been interested in using Piaget's theory to increase knowledge and understanding of the intellectual development of the mentally handicapped and in its prescriptive role for determining the content of special education programmes.

Woodward's (1959) study represented an extension of Inhelder's work and provided the foundations for later attempts which aimed to demonstrate the applicability of Piaget's description of sensorimotor development to severely mentally handicapped children.

Woodward examined the behaviour of 147 severely mentally handicapped children under free-play conditions and assessed their ability in object permanence and "sensorimotor intelligence"(i.e. means-ends abilities). (The study did not include causality, spatial or temporal aspects of sensorimotor intelligence, or imitation). On the basis of this assessment, Woodward found that her subjects could be classified as functioning in one of the six sub-stages of the sensorimotor period. The vast majority of her subjects showed the abilities found in all the earlier sensorimotor stages, which Woodward interpreted as evidence of ordinality in the sequence of the six sensorimotor sub-stages. In addition, a high level of correspondence between stage of 'sensorimotor intelligence' and 'object concept development' was found for 87 percent of subjects.

Although this study provides some evidence of the ordinality or sequentiality of Piaget's stages of sensorimotor development in severely retarded children, it does not constitute as good a proof as a longitudinal study. Further, it does not examine all areas of sensorimotor intelligence.

Piaget's theory provided an explanation for the somewhat bizarre appearance of the behaviours of these children - behaviours that are quite normal in infants but appear bizarre in older children. Repetitive hand mannerisms could be viewed as secondary or derived secondary and tertiary-circular reactions. For example other behaviours such as repetitive banging, shaking and hitting of objects could be classified as secondary circular reactions characteristic of stage 3 infants ; repeated dropping of objects from varied heights or banging of objects on various surfaces could be described as tertiary circular reactions evidenced by normal infants at stage 5 of the sensorimotor period. Despite finding a strong concordance for stage scores between "sensorimotor intelligence" and "object permanence" it should be noted that when assessed in a formal situation only 43 subjects' stage scores corresponded to the type of circular reaction they exhibited under free-play conditions - which tended to be characteristic of an earlier level of functioning. Woodward (1959) noted however that the majority of such cases also showed signs of emotional disturbance.

This early study has important implications. It demonstrated that behaviours which appear as pathological symptoms among the mentally handicapped may be used as indices of their cognitive development, also it confirmed Piaget's sequence of sub-stages in severely mentally handicapped children.

An extension of the above study was carried out by Woodward and Stern (1963) who examined the "developmental patterns" of 83 severely retarded children. Subjects were under 9 years old and had been classified into sensorimotor stages. The main theoretical concern of the study focused on the relationship of language development to sensorimotor stages of development. More specifically the aims were :

(i) to assess the childrens' locomotor, language and social development in relation to sensorimotor stage, and :

(ii) to examine the patterns of development in young severely retarded children.

The results revealed that generally speaking locomotor development was in advance of sensorimotor intelligence, which in turn was in advance of speech. Development in language, drawing ability and social responses was found to be associated with the attainment of stage six of the sensorimotor period. Thus the authors concluded that the final stage of the sensorimotor period represented "a major event in the development of severely subnormal children". (1963, p. 20). This study also suggests that motor and cognitive development may be dissociated.

A number of years after Woodward's two studies, some investigators constructed Piagetian sensorimotor scales of development. Studies which have used these scales will be reviewed in the more specific context of research which has been carried out with the Uzgiris and Hunt (1975) Scales, in the next chapter. However, there has been one study of cognitive development in profoundly mentally handicapped which although based on Piaget's theory did not use Piagetian ordinal scales.

Rogers (1977) was interested in two conflicting hypotheses (related to the 'developmental versus difference' debate) regarding the cognitive characteristics of profoundly retarded children. On the one hand Inhelder's (1966) position suggests that profoundly retarded children differ from normal children primarily in their rate of development rather than in the pattern of their development. According to Rogers (1977) an alternative and perhaps more "prevalent" theory (a defect position) views the development of profoundly retarded children as qualitatively different from that of normal infants since authors argue that impaired neurological functioning, disrupts learning abilities (Ayres, 1972 ; Robinson and Robinson 1970). Rogers examined the sensorimotor skills of 40 profoundly retarded institutionalised children between the ages of 8 and 14 years. She found that "stage attainments followed Piaget's hypothesized invariant sequence and generally replicated findings made with normal infants but lacked the parallel stage performance across the 4 domains as theorized by Piaget" (1977, p. 837). Stage congruence between domains ranged from as low as 10 to 57 percent. More specifically "object permanence" and "spatiality" were more advanced than were causality and imitation. Imitation was the least developed domain and characteristic of earlier stages than development in the other domains.

A definite correlation was found between mental age and sensorimotor development, although none was found between chronological age (CA) and sensorimotor development. Results were generally interpreted as providing support for a 'developmental' explanation of cognitive development. However, Rogers concluded that there was more independence between the various domains of sensorimotor intelligence than would be expected from Piaget's stage theory.

The above studies investigated two of Piaget's postulates which are highly relevant to this thesis. They looked at the issue of whether the sensorimotor abilities conform to Piaget's hierarchisation and structure d'ensemble stage criteria (Piaget, 1960, 1973). The hierarchisation criterion was supported in that both Woodward's (1959) and Roger's (1977) studies found sensorimotor stages to be constant and invariant in this population. Evidence was not conclusive for the structure d'ensemble criterion, that acquisition of different concepts which obey identical structural laws can be expected to be manifested concurrently. (Pinard and Laurendeau, 1969).

Although Woodward's (1969) study appears to provide support for Piaget's notions regarding the structural and organisational properties of sensorimotor intelligence, in this population, the validity of her data has been questioned, by Dunst, Brassell and Rheingrover (1981) in that it involves a "major methodological flaw (Dunst et al 1981, p. 134). This flaw, Dunst argues is also applicable to Rogers' (1977) study. Both studies rely on the assumption that development in different domains is constant, with no fluctuation, periods of rapid transition or consolidation, and without horizontal decalages - phenomena described by Piaget (1960, 1973).

Dunst et al. (1981) argue that both studies assume a deterministic model (i. e. make assumptions about the cause of development), in that they have failed to control for either MA, CA, or developmental level, despite the wide range in the subjects' age, i. e. from 8 to 16 years.

Control of developmental level and comparison with normal infants is critical ; the organisation of sensorimotor development may be considered a changing network of inter-relationships which vary as a function of developmental status (see Uzgiris 1976). Further, there is a lack of empirical evidence regarding how much stage congruence across domains may reasonably be expected in the case of normal infants.

As Wohlwill (1973) has noted Piaget's 'stage' concept requires fresh examination, to ascertain how much synchrony exists among the various sensorimotor domains in normal development.

In conclusion the few studies that have employed Piaget's theory of sensorimotor development in the investigation of cognitive development in severely and profoundly mentally handicapped children have found evidence that development in this population proceeds through Piaget's invariant sequence of stages, but parallel stage acquisitions across domains of sensorimotor intelligence have not been convincingly demonstrated, indeed Rogers' (1977) study provided some evidence to the contrary.

1.10 Summary

(i) Severely mentally handicapped children are extremely heterogeneous in terms of etiology, extent and number of handicaps.

(ii) Traditional psychometric tests have been found either inadequate or inappropriate for the assessment of more severe categories of mental handicap.

(iii) The 'developmental versus deficit' debate involves two conflicting postulates : mentally handicapped individuals pass through the same, structurally similar sequences of development, but at a slower rate and attain a lower final level. The opposite view is that mentally handicapped individuals are qualitatively different in their cognitive functioning ; that it is characterised by abnormal development and specific deficits. Although much of the Piagetian literature supports the developmental position, there is evidence in support of both positions and the controversy continues.

(iv) A number of studies have found support for a conceptualisation of early intelligence which is more in line with Piaget's theory of the epigenesis of intelligence, rather than one based on a simple incremental, linear 'model of intelligence'.

(v) A number of investigators have found Piaget's theory of sensorimotor development applicable in describing the functioning of severely and profoundly mentally handicapped children.

CHAPTER TWO

RESEARCH WHICH HAS EMPLOYED THE UZGIRIS-HUNT SCALES

2.1 Introduction

This chapter will focus on the body of research which has employed the Uzgiris-Hunt Scales. Before these studies are described, other Piagetian sensorimotor scales that are available will be briefly discussed and reasons for the selection of Uzgiris-Hunt's instrument given. A brief description of the abilities measured by the Uzgiris-Hunt Scales is also presented.

2.2 Piagetian Sensorimotor Scales of Psychological Development

An increasing number of researchers on early cognitive development have advocated Piagetian based scales, both in the assessment of normal infants (Stott and Ball, 1965; Thomas, 1970 ; Hunt, 1976) and in the assessment of mentally handicapped children (Wachs, 1970 ; Kahn, 1976).

The main Piagetian scales which have been constructed are the Uzgiris-Hunt Scales (1966, 1975) ; the Casati-Lezine Scale (1968) and the Albert Einstein Scales of sensorimotor development (SSD), constructed by Escalona and Corman (1966). Other scales include those constructed by Décarie (1965) and Mehrabian and Williams (1971). Table 2.1 overleaf provides a summary and simplification of these Piagetian Scales, and the abilities they are thought to measure.

The scales tabulated overleaf are still very much in the experimental stage and it is not always possible to see how different scales relate to others. As Uzgiris (1976) has noted, although it is generally agreed that sensorimotor functioning must be assessed in more than one domain, there is not complete agreement as to the structure of sensorimotor development. It is clear that the domains assessed by the different scales vary from test to test. Furthermore, "even when the same domain appears to be represented within two assessment scales, the tasks included to tap functioning within that domain differ" (Uzgiris, 1976 ; p.159). This difficulty seems to warrant further investigation, although scales other than Uzgiris and

Table 2.1 Sensorimotor Abilities Measured by Piagetian Scales

Author	Date	Object Concept	Means-Ends	Imitation	Causality	Space	Schemes	Other
Décarie	1965	x			x			
Casati-Lezine	1968	x	x				x	x
Escalona & Corman	1966	x				x		x
Bell	1970	x						
Mehrabian & Williams	1971	x		x	x			x

Hunt's are somewhat rudimentary and many do not attempt to sample all abilities. Therefore selection of Uzgiris and Hunt's (1975) instrument in order to investigate sensorimotor intelligence was an obvious choice.

The Uzgiris-Hunt Scales, as Wilson (1978) notes "recently published after nearly a decade of informal use" (1978 ; p.136) are currently viewed as the most comprehensive of the Piagetian Scales available (Bricker and Bricker, 1973 ; Kahn, 1979) and are the most frequently employed of the Piagetian scales available. In contrast to the other scales outlined above, the Uzgiris-Hunt Scales measure 7 distinct areas of sensorimotor intelligence, cover all of the sensorimotor sub-stages and have a greater number of items.

Scale I measures the development of object permanence - an ability to which Piaget attributed much importance. The scale tests the infant's comprehension of object displacements, indicated by his search for hidden objects. Acquisition of the object concept is thought important for the development of representation.

Scale II measures means for obtaining desired environmental events and involves assessment of the infant's ability to exploit perceived relationships between objects for desired ends e.g. pulling a cushion in order to obtain a toy which is placed on top of it.

Scale IIIA measures vocal imitation. The early items of the scale assess the infant's ability to engage in a vocal exchange, and then requires imitation of familiar vocalisations, whilst later items involve measurement of the infants response to the presentation of unfamiliar vocalisations. Scale IIIB measures gestural imitation which follows a similar progression, measuring the infant's response to the presentation of simple, familiar manual gestures (such as patting a surface), to imitation of unfamiliar gestures. The later items of the scale measure "invisible" gestures - i.e. gestures which the infant cannot see himself perform such as facial expressions.

Scale IV measures the development of operational causality or development in the objectification of causality which is supposed to be involved in the construction of reality. It measures the child's ability to anticipate events and later his appreciation of centres of causality external to himself - for example this might be indicated by the infant handing a toy back to the examiner after having watched a demonstration of it spinning. Scale V, the Construction of Object Relations in Space is concerned with the objectification of space and measures the child's appreciation of spatial relationships by his ability to localise objects and sounds.

Finally, Scale VI measures schemes for relating to objects and assesses the predominant actions an infant displays in relation to various objects. Initially the scale measures simple schemes such as shaking and banging, then later, throwing, naming and dressing. According to Piaget if a child displays a scheme, then he must have the necessary cognitive structures.

A detailed description of the cognitive abilities measured by the scales is given in Chapter 3.

2.3 Overview of Research using the Uzgiris-Hunt Scales

Since studies which have used the Uzgiris-Hunt Scales cover a wide variety of topics, they will be outlined briefly. Detailed discussion of each study will then follow:

Since their construction in 1966 with revision and publication in 1975, there have been many investigations using the Uzgiris-Hunt Scales with various populations from normal infants to profoundly mentally handicapped children. The reliability, validity and ordinality of the Scales has also been examined (see Chapter 3). In relation to normal infants much of the research has used the Scales to measure and examine the influence of various environments on the development of sensorimotor intelligence (e.g. Paraskevopoulos and Hunt, 1971 ; King and Seegmiller, 1973 ; Wachs, Uzgiris and Hunt, 1971).

Another major area of research has concerned the relationship between early sensorimotor abilities and other types of development, particularly language acquisition, both in non-retarded infants (Snyder, 1978 ; Zachry, 1978 ; Bates, Benigni, Bretherton, Camaioni and Volterra, 1979 ; Siegel, 1981) in deviant and mentally handicapped children (Kahn, 1975 ; Cicchetti and Sroufe, 1976 ; Curcio, 1978 ; Wachs and DeRemer 1978; Greenwald and Leonard, 1979 ; Mahoney, Glover and Finger, 1981) and in the severely mentally handicapped (Kahn, 1975, 1983 ; Capuzzi, 1978 ; Lobato, Barrera and Feldman, 1981). Only one study has investigated sensorimotor development itself in mentally handicapped children, using the Uzgiris-Hunt Scales (i. e. Dunst, Brassell and Rheingrover, 1981). Another area of research has concerned the employment of the Scales in training and intervention studies with mentally handicapped children.

As the thesis is concerned with application of the Scales to the assessment of mentally handicapped children, studies which have used the scales with this population will be reviewed first.

2.4 Studies which have employed the Uzgiris-Hunt Scales to assess Sensorimotor Intelligence in Mentally Handicapped Children

Studies which have used the Scales with the mentally handicapped fall mainly into three major areas of investigation : the relationship between sensorimotor intelligence and communication ; training and intervention ; and statistical properties of the Scales with the severely mentally handicapped. By far the largest number of studies have examined the relationship between performance on the Scales and communication development. They will be considered first.

2.4.1 The Relationship between the Uzgiris-Hunt Scales and Development in Communication

There are a number of issues which have concerned investigators interested in language and communication in mentally handicapped children. One concerns the attempt to demonstrate a systematic relationship between sensorimotor development, communication and language and this frequently rests on the assumption that sensorimotor development is a prerequisite for linguistic development. The expectation that early abilities are predictive of subsequent abilities derives from the hypothesis that continuities exist in mental development. According to cognitive theorists such as Bruner (1966) and Piaget (1960) there is a common substrate to diverse cognitive abilities, although the behaviours that are best used as indices of underlying cognitive structure may change as the child develops. As McCall, Einchorn and Hogarty (1977) suggest, development appears discontinuous, but may be controlled by the same fundamental process.

There is some support for this thesis in normal children (e.g. Bloom, 1973 ; Bates et al., 1977) although the evidence is not conclusive as to whether the relationship is causal or coincidental.

If similar, systematic patterns can be found in mentally handicapped children, then additional evidence for a causal relationship may be furnished. Furthermore, there is the question of whether language deficiencies evident in the mentally handicapped (e.g. O'Connor and Hermelin, 1958) are solely the result of delayed development, or whether specific deficits (Gibson, 1975) exist. Perhaps more importantly, this issue has relevance to the question whether there is any justification for training sensorimotor abilities as part of early language intervention programmes for mentally handicapped children (Kahn, 1975). The subject of training will be dealt with later however, in the section of this review which deals with intervention studies.

The following studies all employed the Uzgiris-Hunt (1975) Scales with mentally handicapped children. Although the subject of communication and language is not of central concern to this thesis it nevertheless constitutes a large part of the literature on the use of the Uzgiris-Hunt (1975) Scales with the mentally handicapped and provides useful information.

(i) Mild-Moderately Mentally Handicapped Children

Curcio (1978) examined the relationship between sensorimotor functioning and communication development in children classified as mute and autistic. The 12 male subjects were all classified as severely disturbed and ranged in age between 4 years, 9 months, and 12 years ($\overline{X}$ = 8 years 1 month). Four of the Uzgiris-Hunt (1975) Scales were employed to assess sensorimotor development in object permanence, means-ends, gestural imitation and causality. Earlier scale items below stages III to IV (6 - 8 months) were omitted. Non-verbal communication - i.e. use of proto-imperatives (requests), protodeclarations (e.g. pointing, showing), and acts of greeting and departure and requests for assistance were assessed through observational methods. Results indicated that the greatest discrepancy between the 4 sensorimotor domains occurred between object permanence and gestural imitation - performance was highest on object permanence and lowest on the Gestural Imitation Scale, with 5 out of the 12 subjects showing no imitation of gestures and all subjects performing below Stage V in imitation, yet no child scored below Stage V on object permanence. None of the subjects spontaneously used protodeclarative gestures to point out or show objects to adults.

Curcio (1978) drew the following implications from his results, reasoning; that as Rogers (1977) had also found a similar pattern of low gestural imitation, high object permanence for profoundly retarded children, then this pattern may not be specific to autism but may occur in populations known to have a high incidence of CNS pathology - e.g. in severely/profoundly retarded populations (Rutter and Bartak, 1971 ; Tarjan Digma and Miller, 1961). Curcio (1978) also pointed out that a number of investigators have emphasized the importance of imitation in language development (e.g. Demyer et al., 1972 ; Lovaas, 1977) and for communication in autistic children. The absence of protodeclaratives such as pointing and showing was thought to indicate the possibility of an important qualitative deficit in mute autistic children, leading to a distinctly different pattern of prelinguistic development.

One problem with Curcio's analysis of his results is that he has failed to take normal development into account but seems to have compared scale performance in terms of absolute numbers (i.e. scale-steps). It appears that no formal analysis was carried out on his data, which led to the apparently mistaken conclusion that subjects performed best on object permanence. In fact, if Curcio's (1978) data is re-examined it suggests that subjects performed best on means-ends, and lowest on object permanence and imitation. Furthermore, although Curcio states that his autistic subjects are not mentally handicapped, as their mean age is 8 years, it can only be assumed that they are severely retarded, or else considerable ceiling effects could be expected. Lack of standardization data for these scales makes it imperative that studies employ a control group or analyse findings according to age-norms.

Seibert (1979) also found a relationship between cognitive development and early communication skills. Seibert (1979) used 5 of the Uzgiris-Hunt (1975) Scales - all except the 2 imitation scales, with a heterogeneous sample of children who showed a variety of handicaps. There were 47 subjects with a mean age of 27.8 months and a mean mental age of 16.5 months. Results indicated a high correlation between mean sensorimotor scale scores and mean communication scores ($r = .88$, $p < .001$).

Greenwald and Leonard (1979) extended the studies of Snyder (1978) and Bates et al.(1977) by testing whether prelinguistic performatives (assessed by Cattell's Infant Intelligence Scale) differed as a function of sensorimotor stage in mentally handicapped children and whether this difference resembled that found for normal children. There were 3 groups of subjects - 15 Down's Syndrome children with a mean age of 18.27 months and a mean IQ of 62 ; 20 normal infants with a mean age of 9.65 months and IQ of 117.85 and 5 older Down's Syndrome children with a mean age of 39.6 months and IQ of 62.0. All subjects were apparently functioning at either Stage IV or Stage V of the sensorimotor period, a classification which was arrived at on the basis of their performance on 3 of the Uzgiris-Hunt Scales - the Means-Ends, Causality, and Schemes Scales. Communication development was assessed using Snyder's (1978) imperative and declarative performative tasks (see page 34). Results indicated a significant difference for all subject groups between Stage IV and Stage V children with respect to imperative scores. The authors considered this consistent with Bates et al's (1977) finding for normal infants, that stage of sensorimotor development in means-ends, causality and schemes is associated with significant differences in communication skills. Therefore, <u>level</u> of sensorimotor development represents an important variable in prediction of communication development for both Down's Syndrome and normal children. In contrast to normal subjects younger Down's Syndrome children did not use words or vocalisations, a finding consistent with Kahn's (1983). Greenwald and Leonard (1979) concluded that as sensorimotor abilities appear to be related to other types of development, then assessment of these abilities may provide a "particularly good means of gaining insight into their general functioning" (1979, p. 301).

When evaluating these results it should be noted that Greenwald and Leonard's (1979) method of selecting subjects and method of stage allocation on the basis of 3 sensorimotor scales only, may have introduced bias into their results, as the 3 scales were selected on the basis of Bates' (1977) findings of their strong relationship with communication skills. Subjects who did not perform at the same stage on all three scales (i.e. 18 normal and 7 retarded children) were dropped from the study. The above procedures therefore ensured from the outset that the authors conclusion that "the communicative behaviour of Down's Syndrome children seems generally consistent with the sensorimotor stage at which they are operating" (p. 302) would be supported since any discrepancies or inconsistencies were effectively excluded from their analysis.

A study by Mahoney, Glover and Finger (1981) compared Down's Syndrome and normal infants to establish whether sensorimotor abilities are precursors of language development, and in extension of Greenwald and Leonard's (1979) study, whether Down's children have "specific verbal deficits greater than would be expected on the basis of their measured sensorimotor development". (1981, p. 22).

Subjects consisted of 18 Down's Syndrome infants with a mean age of 29.1 months and a mean developmental age (assessed by the Bayley, 1969 scale) of 16.8 months, and 18 normal infants with a mean age of 16.3 months and mean developmental age of 17.1 months. All scores except for the Schemes Scale of the Uzgiris-Hunt test were used to assess cognitive development. Linguistic ability was assessed with the Receptive and Expressive Emergent Language (REEL) Scale. (Bzoch and League, 1970).

Mahoney et al.(1981) reported that their results indicated that the Down s' group showed significantly lower scores for vocal imitation, but significantly higher scores than the normal group on means-ends. Significantly inferior performance for the Down's group was also found for the REEL measures. With respect to their correlational findings the authors reported that for the Down's group object permanence and gestural imitation scores correlated with receptive language, but only object permanence correlated significantly with expressive language. Overall Vocal Imitation was reported as the only scale which showed significant correlations with REEL measures.

Mahoney et al. (1981) drew the following implications from the results of their study. That results supported previous findings that Down's Syndrome evidenced delay in their language compared to their general level of cognitive development and that their performance in most sensorimotor domains is comparable (relatively) to that shown by younger normals. The authors suggested that their results required replication with other mentally handicapped populations in order to establish their generalizability.

Unfortunately, there appear to be a number of ambiguities, inconsistencies and contradictions present in Mahoney et al.'s reporting and in the authors' interpretation of their results. First, the largest difference in scale means between the two groups is in gestural imitation, in favour of the Down's Syndrome group. This aspect of the results was not mentioned by the authors. Second, the normal control group does not appear to provide adequate control for the normal developmental range of performance. Third, Mahoney et al.'s (1981) interpretation of their correlation matrix involves some rather disturbing inconsistencies whereby some coefficients are marked to indicate their significance whereas others of the same, or greater value are not.

In conclusion, the results of this study require re-analysis and re-interpretation, however the methodological flaws do not appear to invalidate the Down's childrens' depressed scores in vocal imitation. A more parsimonious explanation for these findings might be due to the difficulty these children have in articulation due to anatomical abnormalities (Gibson, 1975). This would also explain their superior performance in gestural imitation on which they may rely more heavily due to their difficulties in vocalising.

In a recent study Kahn (1983) has examined the correlation between sensorimotor development and two other aspects of development - communication development and adaptive behaviour (i.e. physical, social, self-help and communicative skills). Six of the Uzgiris-Hunt Scales (excluding the Schemes Scale), the AAMD Adaptive Behaviour Scale (ABS) and the REEL Scale were administered to 76 severely/profoundly mentally retarded children with a mean C.A. of 6.25 years. Results indicated that Object Permanence, Vocal Imitation and Gestural Imitation were the best predictors of adaptive behaviour - as measured by language (ABS) and Reel, Expressive and Receptive language ages, Socialization (ABS), Independent Functioning (ABS) and Self-Direction (ABS). These findings were interpreted as being consistent with Piaget's belief that specific cognitive structures are necessary for the acquisition of certain skills, and with previous studies (e.g. Kahn, 1975 ; Wachs, 1978); however, Kahn drew attention to the incompatability of his findings with Bates' (1976) contention that Means-Ends behaviours are critical to language acquisition. Kahn's (1983) results did not support this proposition.

In conclusion, despite these shortcomings, the evidence seems to suggest that the abilities measured by the Uzgiris-Hunt Scales are related to other important aspects of development such as communication, and language.

The above studies tended to examine mild to moderately handicapped populations or more specific populations such as autistic or Down's Syndrome. More directly related to the focus of this thesis are the severely mentally handicapped. There have been a few studies which have used the Uzgiris-Hunt Scales to investigate the relationship between sensorimotor, communication and language development in this population and these will now be considered.

(ii) <u>Severely Mentally Handicapped Children</u>

An important variable which needs to be controlled in studies of the mentally handicapped rests with the population itself. For knowledge regarding the mental development and functioning of this considerably heterogeneous group of individuals to accumulate, defining one's subject-pool may be a critical procedure. Studies in which subjects vary greatly in the severity of their symptoms may lose potentially useful information and results may be difficult to evaluate. For example, as noted earlier, Weisz and Yeates (1981) concluded from their review of the 'developmental versus difference' literature that a dichotomy could be drawn between non-organically damaged, individuals, with the latter evidencing qualitatively different functioning. How useful this distinction is, remains to be empirically validated. Certainly <u>extent</u> of damage must be a relevant variable, but unfortunately such information is rarely available. Thus, severity of behavioural symptoms and impairment in functioning appear to be the most practical criteria on which to base subject selection.

Results that have been obtained with moderately handicapped populations such as Down's Syndrome may not hold for, or be generalizable to, the severely and profoundly mentally handicapped, who may be qualitatively different in their development. As this study is concerned specifically with the most severe categories of mental handicap, and as the literature which has involved the use of the Uzgiris-Hunt Scales with other less impaired populations may not be generalizable to severely/profoundly mentally handicapped children, they are treated here as a distinct population.

After Woodward and Stern's (1963) pioneering study on the relationship between sensorimotor, communication and speech development in profoundly mentally handicapped children there was a considerable delay before further studies of this population were published. It is only in recent years that a renewed interest in this area of investigation has taken place : Kahn (1982) has commented -

> "Since severely and profoundly retarded persons often exhibit poor, if any communication skills, and since many efforts to train communication skills with this population have not been successful, researchers in the area of mental retardation also became interested in the potential relationship between sensorimotor development and learning to communicate with low-functioning retarded children."
>
> (1982; p.18).

In 1975 Kahn employed the Uzgiris and Hunt (1966) Scales to study the relationship between stage of sensorimotor development and the development of meaningful speech in 16 profoundly mentally handicapped children, who ranged in age between 47 and 98 months (mean = 69). All subjects were assessed on four of the Uzgiris-Hunt (1966) Scales : Object Permanence, Means-ends, Causality and Imitation. Results indicated that all children who had exhibited meaningful speech demonstrated Stage VI functioning on the Object Permanence and Imitation scales. Of the 8 children who had not exhibited speech, 5 were functioning below Stage VI on all of the four scales.

Significant correlations were found between all scales and meaningful speech, the most significant were between speech and imitation (r = .82) and object permanence (r = .67).

In his discussion of his results Kahn hypothesized :

> "If, as these findings seem to indicate, cognitive structures which develop during Stage VI of Piaget's sensorimotor period are necessary for the acquisition of meaningful expressive language, then training of prelingual, profoundly retarded children to develop language skills should begin with an assessment of their cognitive level ... These children would probably benefit more from training activities directed toward raising their cognitive level".
>
> (1975 ; p. 642).

Kahn's (1975) findings provided further support for Woodward and Stern (1963) in their proposition that the achievement of sensorimotor Stage VI is necessary for the development of meaningful speech.

Lobato, Barrera and Feldman (1981) investigated the sensorimotor functioning and prelinguistic communication of 40 institutionalised severely and profoundly retarded children and adolescents whose age ranged between 6.25 and 18.75 years (mean = 13.17). They administered 5 of the Uzgiris-Hunt Scales, all except the Spatial Relations and Schemes scales and a set of communication elicitation tasks which required the use of gestures in imperative and declarative contexts. More competent sensorimotor performance was associated with a higher frequency of sophisticated and symbolic forms of gestural communication. Communicative skills at each sensorimotor stage fell below general sensorimotor performance. This finding is compatible with Greenwald and Leonard's (1979) suggestion that after a certain chronological age linguistic skills might surpass cognitive skills. Unlike the subjects in Greenward and Leonard's (1979) study the subjects in Lobato et al's (1981) study were older, lower functioning children living in institutions. Unfortunately therefore, Lobato et al.(1981) could not determine how much of the effect was due to increased chronological age or how much was due to 'institutionalisation'.

Kahn (1983) administered all of the Uzgiris-Hunt (1975) Scales in a study of 4 profoundly retarded children, designed to compare training in sign language and speech training. Results revealed that in the sign language group, the highest achievers performed better on the Causality, Object Permanence and Schemes scales, than the other three subjects. The lowest achiever was considerably lower than the others on the Causality and Gestural Imitation scales. From his review of the above studies Kahn (1982) has concluded that :

> "... it seems likely that profoundly retarded children can learn to use signs at Stage IV, can learn to use single words at Stage V and can learn to combine spoken words only when firmly established in Stage VI. Obviously, while a start has been made, more research is needed to pinpoint these cognitive prerequisites more precisely".
>
> (1982; p. 27).

In summary, the scales which seem to show the consistently strongest relationship with communication skills are the Object Permanence, Vocal and Gestural Imitation and Causality scales.

Kahn's interest in sensorimotor prerequisites has been largely motivated by his concern with training severely mentally handicapped children. The question of intervention is never far removed from investigations concerning the severely mentally handicapped as any evaluation of research in this area inevitably involves the question of implications for training.

One of the concerns of this thesis is whether training severely mentally-handicapped children on the Uzgiris-Hunt Scale in an attempt to raise their level of cognitive functioning is a viable proposition. Before reviewing intervention studies, other studies with severely mentally handicapped children will be presented and a brief discussion of some of the studies which have used the Scales to investigate various issues with normal infants will be given. This will not be an exhaustive review, it is intended to represent a sampling only, of this literature.

In summary, the evidence from the studies reviewed above suggests that the abilities measured by the Uzgiris-Hunt (1975) Scales are related to important areas of development such as communication and language. There appears to be evidence that symbolic and linguistic development are dependent on sensorimotor development. However, which sensorimotor abilities are involved is not clear, although the evidence suggests that the specific scales involved may be Gestural Imitation ; (Curcio, 1978 ; Mahoney et al., 1981 ; Kahn, 1983), Object Permanence (Mahoney et al., 1981 ; Kahn, 1983), and Vocal Imitation (Kahn, 1983). In the case of disturbed autistic children, Curcio (1978) suggested ability in means-ends and causality may be prerequisities for communication. These children were found to attain low scores on the Gestural Imitation scale (Curcio, 1978).

Only in Kahn's (1983) study were all of the Uzgiris-Hunt Scales administered. For example, Greenwald and Leonard (1979) administered Means, Causality and Schemes Scales, Curcio (1978) administered four scales omitting vocal imitation, spatial relations and schemes, Seibert (1979) omitted both imitation scales and Mahoney et al. did not employ the Schemes Scale.

In conclusion, in many of the above studies the Scales were not used to obtain a complete assessment of sensorimotor intelligence and often their use was not of central concern.

2.4.2 Research which has examined other issues with Mentally Handicapped Children

Two other studies have used the Uzgiris-Hunt (1975) Scales to investigate the relationship between cognitive development and other types of development such as affective development and adaptive behaviour.

Cicchetti and Sroufe (1976) examined the relationship between affective development and cognitive development in a longitudinal study of 14 Down's Syndrome infants who ranged in age between 4 and 24 months. Affective development was assessed according to age of onset, and the total amount of, laughter, smiling and negative reactions to a variety of stimuli. The children's etiologies were heterogeneous.

The cognitive assessment comprised the Uzgiris-Hunt (1975) Scales and the Bayley (1969) Scales. Results showed a clear relationship between cognitive and affective development, with performance on the Uzgiris-Hunt Scales at 13 months and on the

Bayley at 16 months, paralleling affective development. The authors suggested that smiling provided a sensitive indicator in these "affectively unresponsive infants" of cognitive receptivity to stimuli. They concluded that their results lent support to the theorising of Piaget and others regarding the interdependence of cognitive and affect and for the "generality of the view that development is integrated and organised". (1976 ; p. 924).

On closer examination the lack of detail reported by the authors of the results of the Uzgiris-Hunt Scale scores makes interpretation problematic. It is not clear whether all of the Scales were administered, since only object permanence and causality scores are reported; no reference is made to performance on the other scales.

Wachs and DeRemer (1978) investigated the relationship between performance on the Uzgiris-Hunt (1966) Scales and adaptive behaviours measured by the Alpern-Boll Development Profile (1972) in young "developmentally disabled" children. The 25 subjects' ages ranged between 11 and 50 months. They were classified according to A.A.M.D. standards as follows :

There were 3 cases of severe retardation, 9 of moderate retardation and one case of borderline retardation. Results indicated significant correlations (around .5) between adaptive behaviour and cognitive development, especially object permanence and tasks involving foresight (e.g. means-ends). Findings were interpreted as providing further evidence in favour of the utility of Piagetian-based Scales with young, retarded children and in evaluating a child's pattern of strengths and weaknesses.

These two studies, therefore, provide evidence that the Uzgiris-Hunt (1975) Scales measure abilities which are related to other types of development such as affective development and adaptive behaviour.

Methodological problems and inappropriate data in the analysis render the results of the studies reviewed in this section (e.g. Cicchetti and Sroufe, 1976 ; Curcio, 1978 ; Greenwald and Leonard, 1979 ; Mahoney et al., 1981) rather ambiguous.

Of concern to the present thesis is whether mentally handicapped children perform differently from normals on the Scales and evidence bearing on this from the above studies is unclear. There is some evidence that Down's children are inferior on the Vocal Imitation Scale (Mahoney et al., 1981) and compensate by relying more heavily on gesture, and perform best on the Means-ends Scale (Greenwald and Leonard, 1979). There is also evidence that autistic children show inferior performance on the Gestural Imitation Scale and are relatively more advanced on the Means-ends Scale (Curcio, 1978).

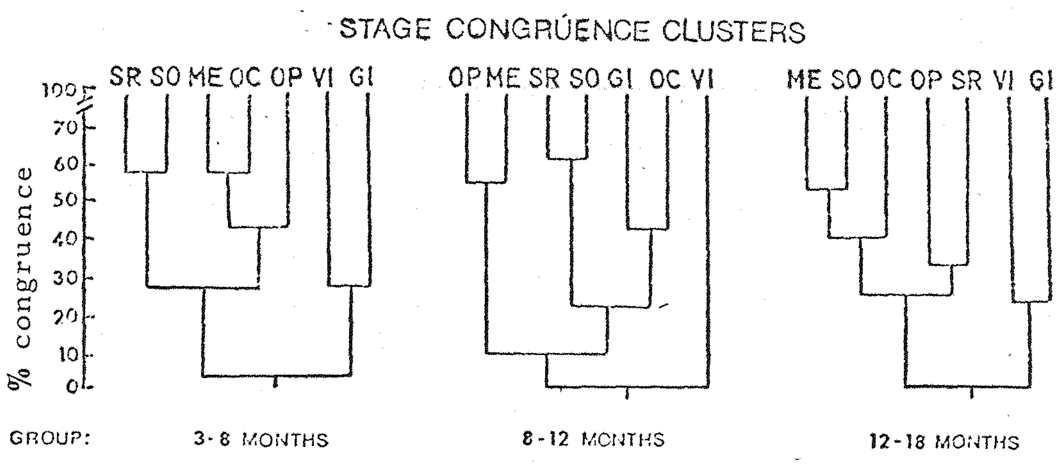
A general criticism of much of the research in this area involves inadequate control for normal development and failure to control for different stages or levels of development (Wohlwill, 1973). There has also been failure to take into account that the number of steps vary among the scales of the Uzgiris-Hunt instrument - a factor which influences many of the statistical analyses that have been performed.

There has been one study however, by Dunst, Brassell and Rheingrover (1981) which examined the structure and organisation of sensorimotor intelligence in a retarded population, of mainly, mildly retarded infants. This study is considered separately as it stands apart from the body of research on the Uzgiris-Hunt Scales and is more pertinent to the present study in its aims. It appears to be the only study to employ a more refined methodology and extends the earlier work of Woodward (1959) and Rogers (1977) using the Uzgiris-Hunt Scales as a research tool in the investigation of the structure and organisation of sensorimotor abilities in mentally handicapped infants. Unlike the studies of Woodward (1959) and Rogers (1977) however, who examined cognitive development in severely and profoundly mentally handicapped children, Dunst et al. (1981) examined cognitive development in mild to moderately mentally handicapped infants and toddlers, taking into account changes that may occur depending on developmental level.

Dunst et al. (1981) administered all of the Uzgiris-Hunt Scales to 143 retarded infants. They had three main aims : first, to determine whether hierarchical cluster analysis (HCA), a method of partitioning variables into optimally homogeneous groups, provided a useful procedure for examining Piaget's structure d'ensemble stage criteria (i.e. stage congruence across domains). The second was to examine the patterns of development in the subjects and the third was to ascertain whether there were shifts in the pattern of sensorimotor abilities at successive levels, or stages of development. Subjects were divided into 3 mental age groups: 3 to 8 months, 8 to 12 months and 12 to 18 months, which corresponded approximately with sensorimotor sub-stages III, IV and V.

Results indicated that just over half of the inter-scale correlations at each age level were significant and of moderate magnitude. For the two youngest age levels Vocal Imitation showed no relationship to the other scales.

The most striking finding revealed by the HCA was that for all 3 age levels vocal imitation formed a separate cluster and at two of these levels vocal and gestural imitation together formed a separate cluster. Figure 2.1 below presents a representation of the clustering networks found among the Scales by Dunst et al (1981). The stage congruence clusters indicated fairly similar



Key: OP — Object Permanence
ME — Development of Means
VI — Vocal Imitation
GI — Gestural Imitation
OC — Operational Causality
SR — Construction of Object Relations in Space
SO — Development of Schemes

Figure 2.1. Clustering networks among the Uzgiris-Hunt (1975) Scales from Dunst, Brassell & Rheingrover (1981)

changing networks amongst the scales, for each age group with shifts occurring amongst all scales with the exception of Vocal Imitation, which consistently formed a separate branch. Dunst et al. (1981) concluded: that development in the sensorimotor period is less synchron ous than would be predicted from Piaget's theory on the structural properties of cognitive development and that the cognitive processes involved in vocal imitation are different from those involved in other sensorimotor abilities in the case of mentally retarded children. The investigators concluded that their results suggested a model of cognitive development characterised by phases of dis-equilibration and stabilisation amongst structurally related cognitive domains - similar to that proposed by Wohlwill (1973). In addition, they suggested that HCA has great utility as a technique for studying the structure and organisation of cognitive development.

It could be argued that Dunst et al's (1981) study is not a proper test of Piaget's principle of structure d'ensemble since their subjects were mentally handicapped. Their results do suggest however, that Piaget's criterion of structure d'ensemble as measured by the Uzgiris-Hunt Scales, does not hold for mentally handicapped infants. Also the investigators interpretation that their results indicate "some unique structural patterns in the early cognitive development of retarded children" does not seem fully justified in that their study did not provide an adequate test of such a proposition since it failed to control for normal development. Despite this shortcoming Dunst et al's (1981) findings do provide sound empirical data on the pattern of cognitive development in mildly retarded infants. How the profiles differ from those of normal infants and whether performance on some scales was significantly depressed relative to other scales, remain empirical questions.

In conclusion the study by Dunst et al. (1981) appears to be the only one which has used the Scales to examine the nature of sensorimotor intelligence in mentally handicapped infants and their subjects were mostly mildly handicapped. Furthermore, the authors did not investigate whether their subjects were relatively advanced or deficient on certain scales.

2.4.3 Summary

(i) A relationship has been found between the abilities measured by the Uzgiris-Hunt Scales and development in communication, affect and adaptive behaviour.

(ii) Scales which appear to show the strongest relationship to communication skills at all levels of mental handicap are Object Permanence, Vocal Imitation, Gestural Imitation and Operational Causality.

(iii) There is some evidence that mentally handicapped children may be backward in speech and in gestural imitation, however studies have not established the pattern of normal development.

(iv) The Uzgiris-Hunt Scales have not been used to examine the structure of sensorimotor intelligence in severely mentally handicapped populations.

2.5 The Properties of the Uzgiris-Hunt Scales with Non-Retarded Infants

The finding that the Uzgiris-Hunt Scales are related to development in communication and language, in mentally handicapped populations, also holds with normal infants, indeed, many studies have investigated this issue with normal infants (e.g. Snyder, 1978 ; Zachry, 1978 ; Bates, Benigni, Bretherton, Camaioni and Volterra, 1979 ; Siegel, 1981). Scales which have shown the strongest relationship to communication are Vocal and Gestural Imitation (Bates et al, 1979) ; Object Permanence, Causality and Spatial Relations (Zachry, 1978) and Means-ends (Snyder, 1978). Thus findings are similar to those for the mentally handicapped.

The Uzgiris-Hunt Scales have also been employed to measure the influence of different conditions of rearing. Paraskevopoulos and Hunt (1971) investigated "two basic domains of intellectual development" (p. 301) first described by Piaget (1936, 1937), namely object permanence and imitation using the two corresponding Uzgiris-Hunt (1966) Scales, (modified versions), under differing conditions of rearing.

Subjects were 233 children ranging in age between 5 months and 5 years. They formed 3 groups from various environments : (i) the municipal Orphanage of Athens, (ii) the Metera Baby Centre of Athens (a model orphanage) and (iii) home-reared working-class children. The results indicated that the conditions of rearing had a marked influence on object permanence and vocal imitation, but not on gestural imitation. The children living in the orphanage evidenced the greatest delays and the Metera Centre children showed greater delays than the home-reared children. Correlations between the 3 scales were highly significant ranging from .64 between Vocal Imitation and Gestural Imitation and .93 between Gestural Imitation and Object Permanence. The authors concluded that although the 3 abilities appear to develop uniformly together whatever promotes gestural imitation must differ from whatever promotes vocal imitation and object permanence. They emphasised the importance of object permanence and imitation in the development of central representative processes.

One difficulty with the above study appears to reside in the age of the subjects which extended up to 5 years, thus there may have been cases of retardation which were independent of the effects of institutionalisation.

Thus it is difficult to arrive at a definite conclusion regarding the effects of institutionalisation.

A related issue was investigated by Wachs, Uzgiris and Hunt (1971) who tested the scales' sensitivity to socio-economic status. They administered 4 of the scales, in Object Permanence, Means-ends, Vocal Imitation and Schemes (1966, IPDS) to 102 infants between 7 and 22 months of age. Results proved positive in showing that the Scales were sensitive to the socio-economic status (SES) of the infants - infants low in SES were progressing more slowly.

In another study the effects of environmental stimulation was examined. Sensorimotor development in deaf and normal infants was compared using the 1966 version of the Uzgiris-Hunt Scales. Best and Roberts (1976) examined the relationship between subjects' performance on the Uzgiris-Hunt (1966) Scales and environmental stimulation measured by the HOME inventory.

Subjects ranged in age between 23 and 38 months. The results indicated a significant difference between the two groups with respect to vocal imitation, in favour, not surprisingly of the normal children.

The deaf subjects were found to be progressing normally on all the other sensorimotor scales. Two scales which correlated most highly with the home environment for the deaf subjects, were causality and gestural imitation, however in the case of causality the correlation was positive, but in the case of gestural imitation the correlation was negative. Best and Roberts accounted for this consistently negative relationship by suggesting that some factor must be involved in gestural imitation which was not measured by the HOME inventory.

There are a number of problems with this study. The Uzgiris-Hunt Scales are appropriate for use with normal infants up to about 22 months. The subjects in this study ranged from 23 to 38 months - well past the sensorimotor stage of development. If the deaf infants were not developmentally delayed then use of the scales was inappropriate. It appears that the authors did not take into account the fact that they were analysing ordinal data and that the number of items in the scales varied considerably. Testing for absolute differences between mean scale scores, as they did, was inappropriate.

Therefore the Uzgiris-Hunt Scales appear to be sensitive to various environmental influences. Another issue concerns its predictive validity.

Wachs (1975) investigated the predictive validity of the Scales between 12 and 24 months with Stanford-Binet performance at 31 months for normal infants. This was the first longitudinal study which attempted to relate performance in all sensorimotor abilities to psychometric measures of intelligence. The results indicated that all of the Uzgiris-Hunt (1966) Scales were significantly correlated with subsequent Binet scores. Of the sub-scales, Object Permanence was found to correlate most consistently with later Binet scores. A similar pattern of correlation with Binet scores was found for the Causality and Vocal Imitation Scales.

Another question which has been studied concerns how the Scales relate to other developmental scales.

King and Seegmiller (1973) examined the relationship between the Bayley Scales and the 1966 version of the Uzgiris-Hunt Scales with 14 to 22 month old male infants. They found that the scales seemed to measure independent abilities and to be most applicable below 18 months. After 18 months of age most of the scales were insensitive and produced pronounced ceiling effects.

In conclusion, studies with normal infants have explored a number of different questions about the properties of the Scales, and these appear to be generally favourable. All the above studies utilised the earlier version of the scales however, and out of these only two utilised all of the scales (i.e. King and Seegmiller, 1973 ; Wachs, 1975). Thus even in relation to normal infants the Scales are still in the experimental stage.

2.5.1 Summary

(i) The Object Permanence and Imitation Scales appear to be sensitive to different conditions of rearing.

(ii) The Scales have been found sensitive to socio-economic status and environmental stimulation.

(iii) There is evidence in favour of the predictive validity of the Scales and they appear to be related to psychometrically assessed intelligence.

(v) The Scales are sensitive up until 18 months but thereafter produce ceiling effects.

2.6 Intervention and Training Studies with Mentally Handicapped Children

There are two important features of Piaget's theory which render it useful in providing a framework or system for guiding intervention programmes. First, it is an interactionist theory which acknowledges the role of appropriate environmental events in the formation or acquisition of new concepts, i.e. Piaget states:

> "The establishment of cognitive or, more generally epistemological relations, which

consist neither of a simple copy of external objects nor of a mere unfolding of structures pre-formed inside the subject, but rather involve a set of structures progressively constructed by continuous interaction between the subject and the external world".

(1970; p.703).

Since Piaget's theory emphasises the interactive nature of development between organism and environment there has been some controversy as to whether "training" is a logical implication of the theory (Engelmann, 1971 ; Kamil and Derman, 1971 ; Kohlberg, 1968) and there has been some discussion regarding the acceleration of acquisition of sensorimotor abilities (White and Held, 1968).

Piaget (1973) has recognised the efficacy of certain procedures in enhancing development, but with the qualification that there may be no obvious or logical 'way' of constructing the necessary situation which results in the acquisition of a particular concept. For the normally developing infant learning is an active process involving the infant's own attempts to modify his environment. Mentally handicapped children on the other hand, are often extremely passive in seeking out information and may be unable to extract relevant aspects from the environmental array of stimuli, for themselves. If the assumption that the normal sequence of cognitive development is also appropriate in the case of the mentally handicapped, is accepted and many educators do, e.g. (Banus, 1971 ; Bricker and Bricker, 1973 Baldwin, 1976 ; Cohen, Gross and Haring, 1976 ; Haring and Bricker, 1976), then the following comments of Bricker and Bricker seem sensible :

"Attempts at amelioration should represent a synthesis of the available facets of our knowledge of the normal course of development and the variables that influence it. As an infant interacts with his environment, structural and conceptual organisations of behaviour are formed which will alter the subsequent interactions the child (delayed as well as normal) will have with future environments".

(1973 ; p.6).

The second important feature of Piaget's theory which has implications for intervention is that each successive level of cognitive development derives from the preceding cognitive structures and the order of succession is invariant. The studies reviewed earlier indicate that in general the sequences specified for most of the Uzgiris-Hunt Scales, hold for the severely mentally handicapped. (i.e. Woodward, 1959 ; Rogers, 1977 : Kahn, 1976). Herein lies the major advantage of adopting Piaget's theory in the specification of intervention sequences. Kahn (1979) has suggested that the concept of "readiness" is probably the single, most important aspect of Piaget's theory for the educator. This resembles Hunt's (1961) notion of the "match" which has received support from Brassell & Dunst (1978) who found that an enriched environment was not sufficient for development to occur, it was necessary for the environment to be appropriately constructed for the cognitive level of the child.

Although the Uzgiris-Hunt Scales were not intended to be prescriptive, Uzgiris (1976) has suggested that comparison of rates of progression along any given scale may provide a means of studying the influence of different environmental variables. According to Weikart and Lambie (1968) the Uzgiris-Hunt Scales provide the most inclusive framework on which to be basic cognitive curriculum activities.

The studies to be reported here will focus on research which has employed the Uzgiris-Hunt Scales with mentally handicapped children in an attempt to promote their level of cognitive functioning.

2.6.1 Clinical and Educational Approaches

There are a number of books available which deal with assessment and intervention based on the Uzgiris-Hunt Scales designed for teachers of the severely and profoundly mentally handicapped children (e.g. Tilton, Liska and Bowland, 1972 ; Snell, 1978 ; Tawney, Knapp, O'Reilly and Pratt, 1979). The Wabash Center's "Guide to Early Developmental Training" (Tilton et al, 1972) provides guidance for assessment and suggestions for training many of the Scale's items.

Despite the apparent usefulness of the Scales in clinical and educational settings and the finding that the scales are now being used widely in assessment and intervention of the mentally handicapped children, experimental research in this area is still in its early days.

2.6.2 Experimental Studies

An examination of the literature suggests that there have been few studies which have investigated the efficacy of training mentally handicapped children on items from the Uzgiris-Hunt Scales in an attempt to advance their level of cognitive functioning. Most of the studies which have examined this issue have dealt only with training in object permanence. The following review describes 7 such attempts by four investigators in the field (Brassell and Dunst, 1976 ; 1978 ; Henry, 1977 ; Kahn, 1977a, 1978, 1983 ; Steckol and Leonard, 1981).

Brassell and Dunst (1976) first attempted to accelerate development in object permanence, using the Uzgiris-Hunt Scales with severely retarded children and adolescents. Twenty-one subjects were assigned to one of three groups in order to compare two training procedures for acquisition of the object concept. One group was exposed to a "typical" training procedure of 15 steps. Another group had a training procedure involving a sequence of much smaller sub-steps and the evaluation was more elaborate. The third group served as a control and received no training. Both experimental groups received reinforcement for successful responses, in the form of praise. Training consisted of eight 10-minute sessions. Four of the Uzgiris-Hunt Scales were administered : Object Permanence, Means-ends, Operational Causality, and Object Relations in Space. All subjects were given a pre-test, a post-test and a second post-test sixty days after training in order to assess retention. Results indicated that the two training sequences influenced the acquisition of the object concept equally. However neither of the procedures resulted in long-term retention. Brassell and Dunst, (1976) suggested that the improvements in object concept development shown by the subjects may have been due to "transient motivational factors operating in the testing situation" (1976 ; p. 527). They noted that, contrary to expectation, the reduction of training tasks into smaller units did not appear to result in much additional benefit although this procedure seemed to result in more stable learning. They suggested that 'intensification' of training might produce more gains.

In another study, Brassell and Dunst (1978) conducted large-scale intervention with handicapped infants which involved parental training in object permanence. Ninety-one infants were involved ranging from severely and multiply handicapped to those classified as "high risk" for future impairment. Uzgiris-Hunt's Object Permanence Scale was administered in pre- and post-test to all subjects as part of a 'package of intervention activities'. The intervention programmes included the following aspects of development : motor, language, social, behavioural, walking, pre-school skill training and cognitive development involving areas of sensorimotor intelligence other than object permanence. The object permanence programme comprised six stages which were very similar to the sub-stages described by Piaget (1936). Of the 91 subjects, 24 received object-construct-training and the remaining 67 subjects formed a control group. Parents were visited by a "home trainer" every week for an hour over 4 or 5 months. Results of the training indicated a moderate but significant difference between the two groups in object permanence scores. Brassell and Dunst concluded that "large-scale intervention programmes do appear to have potential in accelerating the object construct in handicapped infants and young children" (1978 ; p. 509). They also pointed out the need for longitudinal studies which would indicate whether such cognitive gains were stable or only transient.

In an unpublished dissertation Henry (1977) has reported a training study involving young pre-school mentally handicapped children. In this study the parents of the 23 children in the experimental group carried out the training. All subjects were given a pre-test and post-test on all but the Schemes Scale of the Uzgiris-Hunt Scales. The experimental group received training in object permanence, vocal imitation and gestural imitation. In addition subjects were tested on four other occasions, three times during the twelve week training period and once six weeks after training, when only the trained scales were administered.

The tasks trained were directly related to scale items and procedures included the well-known techniques from learning theory of shaping, prompting and reinforcement of successive approximations. Results of the pre- and post-test revealed significant improvement for the experimental group on all six of the scales. Their scores were also significantly higher than the control group on 5 of the scales, the exception being the Spatial

Relations Scale. The results were interpreted also as evidence for transfer of learning to untrained Means-ends and Operational Causality Scales. The second post-test revealed that retention occurred only in abilities which had been trained.

Perhaps the most important aspect of this study is it provides evidence that parents may successfully train their children in certain sensorimotor abilities including vocal and gestural imitation. Both Brassell and Dunst (1978) and Henry (1977) provide evidence that the parental training of object permanence may be successful.

Kahn (1977b) has carried out a two-part investigation involving training severely mentally retarded children in object permanence and language. In the first part of the study, eight severely retarded, institutionalised children between the ages of 43 and 78 months were matched according to age, etiology and Object Permanence Scale scores and allocated to either an experimental or a control group. A pre-test consisting of all seven of the Uzgiris-Hunt Scales was administered to both groups. The experimental group received individual training - the contents of which was derived directly from the items of the Object Permanence Scale, since the sequence has been found to be ordinal. Object permanence was selected because, according to Piaget, it is critical for memory and mental imagery - thought to be crucial aspects of cognitive functioning. Training of the four experimental subjects took place in an isolated room for 45 minutes per day, 3 days a week for a period of 6 months. Training programmes were designed to help the subjects improve their performance with reinforcers consisting of food and praise. Both groups received post-tests immediately after training and 12 months later.

The 4 experimental subjects succeeded on the highest item of the object permanence scale. Increased scale scores ranged between 7 and 11 steps (mean = 9.5 steps) and in addition 3 of the subjects showed gains on 5 of the other scales, of between one and five steps. In contrast, only one of the control subjects showed a gain and this was small. The results of the second post-test provided evidence for long-term retention although the gains had dropped to between 6 and 9 steps on the trained scales and on the other scales minor gains and losses were found, which balanced each other out. This also occurred for the control group. Kahn concluded that the training was "reasonably durable with some small generalisation to other scales". (198 ; p. 34).

Kahn also indicated the need for more research because the study was limited to a small number of subjects and the control was a placebo group rather than one controlling for additional attention. Kahn (1982) also discussed the practical significance of the subjects' increased ability in object permanence and hypothesized that it might enhance self-help or language development. He concluded that additional research was required to pinpoint the precise areas and levels of sensorimotor intelligence that were prerequisite for other skills important to severely mentally handicapped children, such as meaningful speech.

The second part of the study involved a language training programme which was one developed by Bricker, Dennison and Bricker, (1976). Two experimental subjects and two matched controls were matched with two more subjects, for age and etiology. The two additional subjects also had Uzgiris-Hunt Scale scores similar to the experimental subjects on their second post-test. All six subjects received individual speech training for 20 minutes a day, 5 days a week for $7\frac{1}{2}$ months. The results showed that the four subjects who were functioning at Stage VI in object permanence at the beginning of the training programme, progressed much faster than the two control subjects who were below stage VI. The two subjects who were functioning at Stage VI in object permanence without training did not improve in their speech as much as the two subjects who received training.

Kahn (1982) emphasized the significance of these findings in that children functioning at a particular cognitive level (Stage VI object permanence) can benefit more from a language training programme than children functioning at lower cognitive levels. He noted that previous findings (e.g. Kahn, 1975 ; Greenwald and Leonard, 1979) had only demonstrated a correlation between sensorimotor ability and language development whereas his (1977) findings provided evidence in support of Piaget's view that the acquisition of language <u>depends</u> on prior cognitive development. An important issue raised by Kahn is whether the improved scores reflected changes in the underlying cognitive structures or merely the acquisition of certain skills. He also questioned whether long-term retention of improvement in trained abilities implies that the "cognitive structures needed for the tasks may have been present all along" and the initial assessment may have under-estimated the children's actual level of competence.

These are important considerations in the evaluation of attempts to train mentally handicapped children. Unfortunately the variability and day-to-day fluctuations in the responses of mentally handicapped children make such issues difficult to resolve. Clearly, a need exists for well controlled studies. It could be suggested that attempts to match a small number of individuals on a one-to-one basis may not constitute an ideal method of control since severely mentally handicapped children may not all progress (Wohlheuter and Sindberg, 1975) in their mental development at the same rate. Perhaps averaging the scores of a larger control group might offer an alternative method.

In conclusion, experimental studies provide evidence that even severely mentally handicapped children can benefit from training on the Object Permanence Scale and that gains may be durable. Apart from Henry's (1977) dissertation, no studies have attempted to train mentally handicapped children on scales other than the Object Permanence Scale. More research is required on the effects of cognitive training on the Uzgiris-Hunt Scales with older, institutionalised children.

2.6.3 Summary

(i) Studies have shown that training mentally handicapped children in Object Permanence may lead to large gains.

(ii) Parents have been successful in training their young mentally handicapped children on the Object Permanence, Vocal Imitation and Gestural Imitation Scales.

(iii) Studies have not always found evidence for long-term retention.

(iv) Children functioning at stage six of the sensorimotor period have been found to benefit more from language training than children at a lower stage of development.

(v) It is not clear whether cognitive structure may be altered through training or whether improvement indicates that the necessary cognitive structures were present all the time.

CHAPTER THREE

DETAILS OF THE UZGIRIS-HUNT SCALES AND GENERAL METHODOLOGY OF THE INVESTIGATION

3.1 Introduction

In this chapter the Uzgiris-Hunt Scales will be described in further detail in order to set the scene for research to be reported in subsequent chapters. The abilities measured by the Scales will first be described and evidence for their ordinality will be presented. Evidence of the statistical properties of the Scales with the severely mentally handicapped will be reviewed in some detail.

Following this general background material, those aspects of methodology common to the whole thesis will be presented and the characteristics of the population selected for study will be described.

3.1.1 Description of the Uzgiris-Hunt Scales

The Uzgiris-Hunt (1975) Scales measure cognitive development in 7 areas of sensorimotor intelligence. The Scales (Scale Steps and Critical Actions) are presented in Appendix A Tables I to VI, here a description of the types of abilities measured by the Scales is given.

Scale I : Visual Pursuit and the Permanence of Objects

No. of Steps : 14

This scale measures what Piaget refers to as development in the construction of the object concept, which involves recognition by the infant that objects have an independent existence. The Scale starts with the innate scheme of looking and the orienting response which may be elicited when a change is introduced into the infants' visual field. Development proceeds from the visual pursuit of objects which move progressively faster and along increasingly wide arcs, to fixation on the point of disappearance of objects and then anticipation of their re-appearance. Visually guided reaching is then followed by desire for (or recognition of) a partially hidden object and then by search for a completely hidden object. The Scale then measures the infants' ability to follow displacements, multiple displacements, followed by invisible displacements and finally successive, invisible displacements of objects. Uzgiris (1975) has suggested these abilities indicate the persistence of central processes which afford a limited construction of perceptually absent events. The ability to follow invisible displacements or hidings is taken to imply a new level in central representational processes which permit the infant to consider the independent existence of the object from that of its container and to infer the location of the object from the movements of the container. Finally the Scale measures the ability to reverse the operation of successive invisible displacements by requiring the infant to reverse the order of his search, when the location of the object is where he first saw it disappear. The authors suggest this Scale is the development of representation.

Scale II : The Development of Means for Obtaining Desired Environmental Events

No. of Steps : 13

Scale II commences with the presence of handwatching, then measures visually guided reaching and the infants' attempts to maintain or regain perceptual contact with interesting events. These items are followed by measurement of action schemes in novel situations which involve accommodative modification of these schemes in the achievement of a perceptual or motor end or goal. The Scale measures the reorganisation taking place through the transformation involved when the infant becomes able to intend goals prior to embarking on the means for their attainment. Eventually the Scale measures foresightful behaviours which require the infant to select appropriate means to a given end. Schemes constructed earlier become co-ordinated with each other in goal-directed sequences. According to Piaget the achievement of co-ordination between means and ends, marks the beginning of intelligent activity. He also stressed the importance of novelty in behaviour, demonstrated in goal directed sequences being freely constructed in new situations.

The Scale taps therefore what Piaget described as interest in novelty and engagement in experimentation or 'groping' which gives rise to invention. Thus trial and error learning is implicit in successful performance on the Scale, evidenced through the systematic variation in the application of a scheme and its adjustment to a goal.

Scale IIIA : Vocal Imitation

No. of Steps : 9

Vocal imitation is thought to begin with the 'ready-made' scheme of vocalisation. The first scale step starts with "cooing" sounds (as opposed to sounds signifying distress). Certain vocalisations and patterns of vocalising become familiar to the infant through repeated exposure. If an adult imitates either the infants' vocalisations or the sounds he typically makes, rather than using adult speech, the infant becomes very attentive ; eyes and pupils widen and there is an increase in mouth movements and the infant may return similar vocalisations. Uzgiris points out that recognisable patterns of input are most attractive to the infant, both visual (e.g. Hunt 1963, 1965, 1970, 1971 ; Uzgiris and Hunt, 1970) and auditory (e.g. Friedlander, 1970) and suggests that familiarity probably motivates reciprocation.

As interest in novelty develops infants also imitate progressively more unfamiliar sound patterns, initially through a process of gradual approximation and later immediately. It is important to note that as the vocalisations presented to the infant must be part of his/her repertoire in the case of the first few scale steps, Uzgiris and Hunt do not specify the actual sounds but merely the type of sounds (e.g. babbling) which are characteristic of a certain stage in development. Thus the Scale measures the infants' ability to vocalise sounds in response to his "own" sounds, than to vocalise similar sound patterns which may involve "shifting" his vocalisations to match those of the model. Later the Scale measures the infants ability to accommodate to novel sound patterns through a process of approximations to the model. Finally, the Scale measures the infants' ability to imitate novel sound patterns and then new words.

Therefore, in order to administer this scale a period of observation may be necessary, unless the examiner is already familiar with the child's own vocalisations.

Scale IIIB : Gestural Imitation

No. of Steps : 9

The Scale which assesses gestural or motor imitation follows a similar progression of scale steps to those in the vocal imitation series.

Infants first imitate simple gestures or schemes within their repertoire of early motor schemes, such as patting an object. Later scale items tap more complex actions which require accommodative modifications of familiar schemes, such as hitting 2 blocks together or shaking a cup with a block inside it. The next steps assess unfamiliar gestures which the infant can see himself perform such as opening and closing the hand or drumming fingers on a surface. The last steps involve unfamiliar, invisible gestures - such as facial expressions. Likewise the early items in this scale depend on actions or schemes which are known to the infant, so the actual behaviours are not specified, merely the category and level of complexity as outlined above. Examples of suitable gestures are however suggested by the authors to provide guidelines. The imitation of invisible, facial gestures (that is gestures invisible to the child), according to Piagetian theory, indicate the existence of some representational capacity. Although the authors indicate that they are confident regarding the sequence of steps in both imitation scales (Uzgiris -Hunt, 1975) in the case of certain of the steps both inter-observer agreement and inter-session stability were relatively low on account of infant/examiner interaction and variability in the infant's motivation.

Scale IV : Operational Causality

No. of Steps : 7

Scale IV measures the infants' capacity to appreciate active causality through repeated perceptual or motor encounters with environmental events. It measures the infants' developing ability to control, through his hand movements, what he sees. Thus, it assesses active attempts to regain interesting perceptual events. Piaget has named such self-initiated actions which anticipate an outcome, "procedures" (Piaget, 1936). Uzgiris suggests that procedures "appear to be generalisations of particular repetitive actions to circumstances other than the ones in which they originated" (1975 ; p. 116), and gives the following example,

> "after watching the examiner put a toy penguin in motion by pulling a string dangling from it, infants who have learned to shake their legs to cause certain events will shake their legs in an apparent effort to get the examiner to repeat the spectacle".
> (1975, p. 116)

At this stage, it seems that the infant attributes causality to his own actions. Later the Scale assesses the infants' appreciation of agents of causality, separate from himself. This is evidenced by the infants attempts to act directly on the source of an interesting event himself. Still later infants learn to appreciate the power of other people in producing interesting events, for example when their own efforts have failed, e. g. in order to produce musical sounds from a toy they will hand the toy back to the other person to make it work.

The development of causality is concerned therefore with the demonstration of greater degrees of approximations involved in infants attempts to discover objective causes of interesting events (this does not mean mechanical knowledge of sophisticated toys).

Despite the difficulties that might be involved in assessing infants behaviours in response to items on this scale, inter-observer agreement is high and inter-session stability was found to be at a respectable level (Uzgiris & Hunt, 1975).

The authors suggest that like the Object Permanence Scale, the Operational Causality Scale represents a series of landmarks in the construction of reality. As there are only seven steps in this Scale they are almost equivalent to Piaget's six sub-stages.

Scale V : Construction of Object Relations in Space

No. of Steps : 11

Scale V measures the infant's increasing appreciation of, and own construction of object relations in space. At first the recognition that objects differ in their position in space is demonstrated by the infants slow, alternate glancing between two objects in his visual field. Later this becomes more rapid, thus indicating comparison of two inputs. The Scale also measures the co-ordination of the looking and listening schemes, as infants learn that things heard are also things to search for and look at, and the co-ordination of the looking and grasping schemes involved in visually-guided reaching.

Another ability involved in the construction of object relations in space, requires accommodation of the looking scheme to objects moving rapidly in space. This requires the infant to reconstruct the trajectories of rapidly moving objects through extension of the glance along the trajectory, thus permitting the infant to locate the object. Uzgiris and Hunt (1975) suggest that this ability seems to depend in part, on acquisition of the object concept and partly on the ability to extrapolate the trajectory of an object. Further scale-steps involve the recognition of the reverse side of objects, understanding relationships such as the container and the contained and concepts such as equilibrium and gravity. The Scale finally measures the ability to make detours in order to reach an object. Both inter-observer agreement and inter-session stability are consistently high for the steps in this Scale (e.g. 93% - 100% ; 71.9% - 94.1%) respectively. (Uzgiris & Hunt, 1975).

Scale VI : Schemes for Relating to Objects

No. of Steps : 10

This scale assesses the ways in which the infant acts on objects. Uzgiris and Hunt (1975) suggest that "the development of these activities may be described as a series of peaks in the tendencies for certain ways of interaction" with objects, (p.122). Initially infants appear to apply the dominant schemes in their repertoires to objects indiscriminately regardless of the object's properties. The first 5 steps of the Schemes Scale involve essentially motor or manipulative skills. Later, through the scheme of 'examination' infants attend to the particular characteristics of objects and apply manipulative schemes selectively. The differentiation of schemes takes into account not only the physical characteristics of objects but also their social significance or function. Generally infants' actions indicate increasing social awareness and activities such as 'showing' objects to another person, demonstrating appreciation of their usual function, naming and other socially acceptable ways of interacting with objects become characteristic of an infants behaviour.

Inter-observer agreement is consistently high for the 10 steps in this Scale and mean percentages of inter-session stability are nearly all about 70%. However the ordinality of this scale is somewhat under question, scalogram analyses carried out by the authors have found this scale to show the lowest level of ordinality out of the seven scales. Kahn (1982) has noted that a longitudinal study is necessary to establish the ordinality of this scale. The lack of evidence for its ordinality may not indicate invalidity of the sequence of scale steps but rather reflect the possibility that infant development may involve the disappearance of earlier schemes as more sophisticated means of relating to objects are developed.

3.1.2 Statistical Properties of the Scales

In this section information on the statistical properties of the Scales i.e. on their reliability, validity and ordinality will be presented. This will include data, collected by Uzgiris and Hunt when they constructed the Scales, on their sample of 83 normal infants, and the results of a few important studies on the ordinality of the Object Permanence Scale with normal infants.

A detailed review of studies of the statistical properties of the Scales with the severely mentally handicapped will be presented. This body of evidence forms the empirical basis and justification for the use of the Scales in the present study.

(i) Normal Infants

Table 3.1 presents details of the reliability, ordinality and correlation of the Scales with the chronological age of the infants. The 83 infants in the sample were aged between one and twenty-three months. It can be appreciated that the figures reported by Uzgiris (1976a) appear quite satisfactory for scales measuring development in such young infants.

Studies have found evidence of ordinality for the Object Permanence Scale and the most well-known study was

Table: 3.1. Statistical properties of the Uzgiris-Hunt (1975) Scales with normal infants

	Observer reliability(% agreement	Infant performance stability(% agreement)	Scalability (Green's I)	Correlation with age (r)
Visual pursuit and permanence of objects	96.7	83.8	0.97	0.94
Development of means	96.2	75.5	0.81	0.94
Imitation - Vocal	91.8	72.6	0.89	0.88
Imitation - Gestural	95.7	70.0	0.95	0.91
Development of operational causality	93.7	71.2	0.99	0.86
Construction of object relations in space	96.9	84.6	0.91	0.91
Schemes for relating to objects	93.0	79.0	0.80	0.89

*from Uzgiris, 1976.

Miller, Cohen and Hill's (1970). Miller et al. investigated the ordinality of the 16 steps of the 1966 version of the Scales with 84 infants between the ages of 6 and 18 months. Their results did not support either Piaget's (1954) theory or the sequence of the tasks. Miller et al. (1970) found that single invisible displacements were mastered before visible, sequential displacements. Thus infants had more difficulty in following successive hidings of an object in spite of the object re-appearing each time.

In order to clarify these conflicting findings a second study was carried out using a more refined methodology for investigating the ordinality of the Object Permanence Scale by Kramer, Hill and Cohen, (1975). They combined cross-sectional and longitudinal designs over a six month period with 36 infants, this time using a modified series of just 6 of the items. The tasks were found to be ordinal, a finding which was interpreted to support both Piaget's (1954) theory and the empirical data of Uzgiris-Hunt (1975). In contradiction to Miller et al's (1970) study, Kramer et al. found that single and sequential visible displacements were mastered before single invisible displacements.

Although Kramer et al's (1975) study provides evidence for the ordinality of six main steps in the Object Permanence Scale, their results do not constitute evidence for the ordinality of all of the scale steps.

Further evidence for the ordinality of the Object Permanence Scale has been found by Kopp, Sigman and Parmlee (1973) with 24 infants aged between 7 and 18 months. Kopp et al's results also provide some evidence of the ordinality for the Means-Ends Scale. Further evidence for the ordinality of the other Scales is lacking.

Most important to the concerns of this study are the properties of the Scales with severely mentally handicapped populations. This research will be reviewed next.

(ii) <u>The Severely Mentally Handicapped</u>

In 1969 Wachs concluded that standard, psychometric infant tests were of limited value for use with mentally handicapped children. In so far as the measurement of different abilities are collapsed into a single score, then standard tests were of little help in curriculum planning or in programmes for remediation of specific intellectual deficiencies.

(a) Studies with Adults

A few studies have investigated the 1975 scales with severely mentally handicapped adults. The first of these was carried out by Lambert and Vanderlinden in Belgium (1977), who examined the reliability and validity of the scales with 11 profoundly retarded, institutionalised adults between 19 years 3 months and 38 years 6 months. Most of the subjects were totally non-verbal with the exception of 3 individuals who had repertoires of less than 10 words. Ordinality of four of the scales was tested by correlating the scale steps passed with their order of difficulty. Results yielded statistically significant correlations in respect of Means-ends ($r = .88$), causality ($r = .64$) and spatial relations ($r = .56$); however no ordinality was found for the Object Permanence Scale. Thus this study provided some evidence of ordinality for the 3 scales mentioned above. However, the small number of subjects, render any conclusions that can be drawn tentative, especially since the ordinality was far from perfect.

There is a problem associated with the attempt to demonstrate scale ordinality (or sequentiality) by the method of scoring the total number of steps passed, rather than by longitudinal studies. In the case of older retarded children or adults it may be difficult to elicit some of the earlier behaviours measured by the scales, since they may have disappeared - for example it may not be possible to observe hand-watching in an adult.

As Kahn (1982) has pointed out, hand-watching is more likely to be observed in an infant, but tasks which measure a retarded person's eye-hand co-ordination can be regarded as evidence of them having attained this earlier ability. It could be argued that modifications and considerations are necessary when administering the scales to older retarded subjects. Investigators (e.g. Silverstein et al. 1975 ; Lambert and Vanderlinden, 1977) who have not assigned scale scores on the basis of the highest-step achieved (the method recommended by Uzgiris and Hunt, 1975) have assigned scores based on the total number of steps "passed" and therefore may have encountered difficulty in establishing the scale's ordinality.

Kahn (1982) has argued that "on some of the scales, causality and schemes in particular, it is not possible to observe some of the lower scored behaviours, if the higher scored behaviours are observed since they are mutually exclusive" (1982 ; p.16). Therefore it is necessary to take this consideration into account when examining evidence regarding the ordinality of these scales with older populations.

In an unpublished manuscript Cook (1978) has reported a more extensive investigation of the utility of 5 of the Uzgiris-Hunt (1975) Scales (excluding the Imitation Scales) with 65 profoundly retarded adults who had a mean age of 28.3 years (s.d. = 5.54 years). Cook (1978) found it necessary to substitute food for toys, a modification of procedure consistent with Serafica (1971), Karlan (1980) and Kahn (1982) who all found "preferred" objects to be considerably more effective. Scalogram analyses provided evidence of the ordinality of just two scales - Object Permanence and Means-ends. This is in contrast to Lambert and Vanderlinden's (1977) results, as they failed to find evidence for the ordinality of the Object Permanence Scale. It is not surprising that Cook failed to demonstrate ordinality in the Causality and Schemes Scales, since these scales would require a longitudinal investigation (Kahn, 1983). Lack of ordinality found for the Spatial Relations Scale is inconsistent with the findings of Lambert and Vanderlinden (1977). Kahn (1982) has argued that in spite of the lack of evidence of ordinality, "the continued use of the Spatial Relations Scale in experimental research and training studies would seem to be appropriate". (1982; p.14).

Cook (1978) also found moderate (.47 to .71) inter-scale correlations. Internal consistency correlations were found to be adequately high on all of the scales (.85 to .97) with the exception of the Schemes Scale which might be explained by the low scalogram index found for this scale.

In addition to Cook (1978), Barenbaum (1980) has also investigated the utility of the Uzgiris-Hunt Scales with severely retarded institutionalised adults. All scales except Schemes were administered to 60 adults between 18 and 60 years (mean = 25.22 years). Results indicated high internal reliability and test-retest reliability for all scales except the Gestural Imitation Scale. Guttman's scalogram analyses indicated that object permanence and spatial relations were ordinal with this sample. The ordinality of the spatial relations scale is consistent with the findings of Kahn (1976) and Lambert and Vanderlinden's (1977) findings but inconsistent with those of Cook (1978) and Silverstein et al. (1975). Inter-scale correlations were consistent with those of Cook (1978). Lack of ordinality in the means-ends and the imitation scales is not readily accounted for and it was suggested that these scales require more investigation with this population.

In summary, the above studies with profoundly retarded adults provide rather inconsistent evidence for the ordinality of the scales. Two out of three studies showed the Means Scale (Lambert-Vanderlinden, 1977 ; Cook, 1978), the Object Permanence Scale (Cook, 1978 ; Barenbaum, 1980) and the Spatial Relations Scale (Lambert-Vanderlinden, 1977 ; Barenbaum, 1980) to be ordinal. In each case one study failed to demonstrate the ordinality of these scales. Only one study (Barenbaum, 1980) investigated the ordinality of the imitation scales with this population, and this failed to find support for it. It has been suggested that longitudinal studies are necessary to demonstrate the ordinality of the causality and schemes scale with this population. (Kahn, 1982).

Studies of the utility and statistical properties of the scales with severely mentally handicapped children and adolescents will now be discussed.

(b) <u>Studies with Children</u>

Wachs (1970) first examined the utility of the Uzgiris-Hunt (1966) scales with retarded children as a more useful alternative to standard tests. He administered all scales to 16, mostly organically brain-damaged subjects, ranging in age between 3 and 6 years ($\overline{X}$ = 4.10). Although Wachs does not indicate the severity of retardation, the mean IQ of the subjects was 54.73 which would imply they were mildly retarded. Wachs found the scales appropriate for use with these children and most sensitive in relation to the lower IQ ranges. A significant relationship was found between Binet IQ scores and performance on the Uzgiris-Hunt Scales. Wachs concluded that the Uzgiris-Hunt Scales "as a Piaget-based scale of intellectual development, seems to be measuring the types of abilities commonly considered to be intellectual in nature" (1970 ; p. 3). Wachs thought their main advantages lay in the pattern of abilities the scales yielded for each child (in contrast to a heterogeneous single score), which could indicate particular deficiencies.

Wachs (1970) did not comment on the fact that although the scales are sequential there is no obvious one to one correspondence between scales ; without this and without approximate mental ages or norms, it is difficult to see how strengths and weaknesses can be evaluated, unless comparison with normal infants is made.

Serafica (1971) utilised Uzgiris and Hunt's (1966) Object Permanence Scale to investigate development of the object concept in "deviant" (i. e. infantile autism symbiotic psychosis and childhood schizophrenia) children. There were 8 subjects ranging in age between 4 and 8 years. Although the deviant development of the subjects was not attributable to mental retardation, it was not ruled out. Results suggested that development of the object concept in these children followed a similar sequence to that postulated by Piaget, however horizontal décalage was found favouring search for "preferred" objects rather than "neutral" objects. This study provides some support in favour of the ordinality of the 16 items in the Object Permanence Scale with a small group of developmentally deviant children, however the age of the subjects suggests that they were probably retarded in development. One shortcoming of the study is that 8 subjects does not represent a sufficiently large sample on which to determine the ordinality of the Scale.

Foxen (1976) found that the Schemes Scale was applicable in the assessment of a group of profoundly mentally handicapped children. However they were characterised by "patchiness" in their development - i. e. their repertoire of schemes appeared to span a number of developmental levels.

Lambert and Saint-Remi (1979) also administered the Schemes Scale to 20 profoundly mentally handicapped children to test the utility of this scale. They concluded from their investigation (which included comparison with the Brunet-Lezine test) that the scale was useful for the assessment of subjects when traditional testing is not applicable. They also suggested that the scale had implications for education.

Silverstein, Brownlee, Hubell and McLain (1975) conducted a study with 64 institutionalised severely and profoundly mentally handicapped children which compared the object permanence and spatial relations scales with the two corresponding scales of Corman and Escalona's (1969) instrument. Scoring was carried out by counting the number of items passed rather than by the more usual method of scoring the highest item achieved. The results were similar for both sets of scales : inter-score reliabilities were very high for all 4 scales, ranging between 98.3 and 99.0. Internal consistency was also high for all scales with the exception of the Uzgiris-Hunt Spatial Relations Scale which was appreciably lower. The scalability of items was lower than that reported for normal infants. One weakness of the Uzgiris-Hunt Object Permanence Scale was the finding of a slight ceiling effect - a lack of discrimination at its upper end.

Thus, Silverstein et al's results indicate that the Object Permanence and Spatial Relations Scales can be used reliably and to some extent validly with severely and profoundly mentally handicapped children. However, the low index of consistency found for the Uzgiris-Hunt spatial relations scale casts some doubt on the validity of this scale with this population.

Another study which employed two of the Uzgiris-Hunt (1975) Scales with severely and profoundly retarded children was carried out by Karlan (1980). Karlan administered the Object Permanence and the Means-ends Scales to 14 retarded children between the ages of 8 and 17 years (mean = 12 years 6 months). Karlan found high inter-observer reliabilities, but test-retest reliability was questionable for both scales. He also found evidence for the ordinality of the Object Permanence Scale, but failed to find ordinality in the case of the means-ends Scale. However, Karlan's results may be spurious according to Kahn (1982) in that he refers to the Object Permanence Scale as having 15 and the Means-ends Scale 12 items, rather than 14 and 13 items respectively. In addition the scale steps do not follow exactly the same order as the items. Karlan also found subjects performed better when "most preferred" objects were used rather than "least preferred" objects, consistent with the findings of Serafica (1971) and Cook (1978). Thus, in the case of older retarded samples there may be a 'motivational problem' which makes certain earlier behaviours more difficult to elicit. Clearly the attempt to demonstrate ordinality by eliciting all items preceding a subject's highest score is problematic.

It could be argued that studies which have failed to establish ordinality by this method do not provide evidence <u>against</u> the ordinality of the scales. Therefore the above studies do provide 'some' evidence of the ordinality of the Object Permanence and to some extent the Spatial Relations Scales.

Kahn's (1976a) study is the only one to have examined the utility of all seven of the Scales with severely and profoundly mentally handicapped children. He administered all of the Scales to sixty-three subjects who were aged between 3 years 6 months and 10 years (mean = 5 years 5 months). Although subjects had various etiologies, nearly half had Downs' Syndrome. Approximately half of the sample were living at home and half were institutionalised. Kahn reported high inter-examiner reliabilities (ranging between .78 and .95) and test-retest reliabilities (ranging between .88 and .96). Scalogram analyses were performed on six (the schemes scale was omitted) of the scales and Green's index of consistency was found to range between .81 to 1.0. As an index of consistency score need be only .50 or higher to indicate the ordinality of a scale, then all six scales were well within acceptable limits. Green's indices in respect of object permanence (.97) and spatial relations (.81) were appreciably higher than those reported by Silverstein et al (e.g. .70 and .30, respectively).

Kahn (1976a) also reports inter-scale correlations which mostly fall in the moderate range (.43 to .68) consistent with Cook's (1978) findings. Two very high correlations were found between causality and schemes (.93) and vocal and gestural imitation (.94). As noted earlier Uzgiris and Hunt (1975) report inter-scale correlations ranging from .80 to .93 for their sample of normal infants. It could be argued that these correlations are high due to the strong correlation between age and all types of development which occurs with normal infants. One advantage of examining inter-scale relationships with severely retarded populations is that 'age' as a possible source of commonality is usually, automatically eliminated. (Kahn, 1976).

Kahn has interpreted his results as providing evidence that all seven scales may be used reliably and as he found 6 of the scales ordinal, that they may also be used validly with severely and profoundly mentally retarded children. The Schemes Scale must be validated longitudinally.

Although Kahn (1976a) has reported mean scale scores for his subjects his analysis and discussion of his results are confined to the statistical properties of the scales; he has not addressed the issue of the structure or nature of sensorimotor intelligence in this population. The only reference to this question is made in the context of the lower inter-scale correlations. which Kahn found, compared to those found for normals. He suggested "The lower correlations of the present study can probably be accounted for by biological and experiential deficits of severely and profoundly retarded children". (1976a; p. 665).

There appear to be no other studies which have employed the Uzgiris-Hunt Scales in the cognitive assessment of severely and profoundly mentally handicapped children. Evidence regarding the 'biological and experiential deficits' which Kahn hypothesises may exist in these damaged children is sparse indeed. It is surprising that there appears to be no research to date which has utilised the Uzgiris-Hunt Scales in order to investigate this issue in relation to severely/profoundly mentally handicapped children. Not only does Kahn's study not address this question but his subjects may not be typical of this population. In Kahn's study over a third of his subjects were Down's Syndrome who having a specific chromosomal abnormality tend to have definite characteristics which contribute to their homogeneity as a population. Down's Syndrome children are frequently only moderately retarded children, thus it is possible that Kahn's subjects were less handicapped than many severely handicapped children.

In summary, Kahn's (1976) is the only comprehensive study which has administered all of the Uzgiris-Hunt Scales to severely/profoundly mentally handicapped children. There does not appear to be a study which has provided a profile of development in the sensorimotor domains of intelligence, measured by the Uzgiris-Hunt Scales, which has investigated whether or not development proceeds more or less in parallel, or whether specific deficits exist in certain areas. This issue has important implications not only for increasing our understanding of the nature of cognitive development in this population, but also for the purposes of intervention.

3.1.3 Aims of the Study

It is argued that the sensorimotor intelligence in severely and profoundly mentally handicapped children has not been adequately investigated with the consequence that no cognitive model exists in the Piagetian framework which properly characterises their capabilities or possible deficiencies. A major aim of this study is to furnish information relevant to this issue. Two important aspects of this study which relate to the methodological flaws noted by Dunst et al. (1981) in the studies of Woodward (1959), and Rogers (1977), involve controlling for stage of development and controlling for normal development. It appears that previous studies have repeatedly failed to pay adequate attention to these important considerations.

The major part of this study involves an attempt to provide a description of sensorimotor intelligence in severely/profoundly mentally handicapped children. It is on the basis of this description that the latter part of this study, which concerns a pilot-training project with a small group of children is devised.

3.2 Description of Subjects

The subjects were 45 children, of whom 27 were female and 18 male. The children attended two hospital day schools and had all been classified by the hospitals involved as severely or profoundly mentally handicapped. The age of the subjects ranged between 3 and 18 years with a mean of 11.0 years. Thirty of the children were institutionalised and 15 were living at home. Tables 3.2 and 3.3 provide a summary of this information.

Twenty-four subjects were non-ambulatory paraplegics. Five were hemiplegic. All subjects had some motor control in at least one hand. Most subjects could see and hear, although six were suspected to be partially sighted and two were deaf. Partial sensory handicaps were common. All subjects were dependent on their caretakers to look after their basic needs. The majority of the subjects were incontinent. Twenty of the subjects suffered from epilepsy and were receiving medication for it.

3.2.1 Etiology of Subjects

All subjects had received diagnostic classifications either by paediatricians or hospital doctors on their admission into the

Table 3.2. Description of Subjects according to Sex and Institutionalisation : number of cases

	FEMALE	MALE
Institutionalised	16	14
Living at home	11	4
Total	27	18

n = 45

Table 3.3. Description of Subjects' Age: Age ranges and Means according to Sex and Institutionalisation

	FEMALE		MALE	
	Range	Mean	Range	Mean
Institutionalised	5-18	12.3	6-17	12.3
Living at home	3-16	7.8	3-13	7.3
Total	3-18	10.8	3-17	11.3

institutions. Table 3.4 provides a summary of this information.

3.3 Common Aspects of Method

There are certain aspects of methodology common to the investigation as a whole. These are the materials used, the conditions of the testing situation and the procedures involved in testing, recording and scoring subject's performance on the Uzgiris-Hunt (1975) Scales. To avoid repetition all general procedures involved in the administration of the scales are described in detail here. Specific procedures for the administration of individual scale items are given by Uzgiris-Hunt (1975 ; pp. 151-204). As the assessment of severely mentally handicapped children may involve a variety of considerations and precautions, these are presented here as general aspects and features of the testing situation and are supplementary to the more specific instructions set out by the authors. Steps in the scales range between 7 and 14 and therefore provide scales of measurement which enable finer differentiation than Piaget's system permits. Success on a scale-step is credited only if the child performs the critical action for that particular step. Uzgiris and Hunt have defined the sequence of critical actions for each scale step and these are presented in Tables I to IV in Appendix A.

3.4 Materials Used

Table 3.5 presents a description of the materials which were used in the administration of the Scales.

3.5 Testing Conditions and Procedure

As far as possible testing was carried out according to the suggestions and recommendations of Uzgiris and Hunt (1975). Thus the suggested materials, eliciting situations and testing procedures described in their book "Assessment in Infancy" were adopted in this study. As the assessment of profoundly mentally handicapped children may not be as straightforward as the assessment of normal infants due to their physical and sensory handicaps and motivational deficiencies certain modifications were made and general procedural principles observed to ensure that testing conditions were maximally conducive to and appropriate for the elicitation of individual subjects' capabilities.

Table 3.4. Diagnostic Classification of Subjects*

CLASSIFICATION	NO. OF CASES
Cerebral Palsy	12
Microcephaly	8
Hydrocephaly	4
Anoxia	3
San Phillippos' Syndrome	2
Trisomy 18 Syndrome	1
Chromosome deletion	1
Spina bifida and Meningomycele	1
Cornelia de Lange Syndrome	1
Rubella	1
Encephalitis	1
Vaccine damage	1
Steroid damage	1
Unknown brain damage	8

* All subjects diagnosed as showing symptoms of brain damage

Table 3.5. Materials Used in the Administration of the Uzgiris-Hunt Scales

Ball	Brightly coloured, 4" in diameter	Cup	$3\frac{1}{2}$" in height	Plastic Animals	Selection of small farm animals
Bell	5" in height	Cushion	Neutral colour 12" x 12"	Pull-toy	Wooden dog on wheels, 5" x 6"
Blocks	12 coloured small wooden squares	Dolls	1 baby doll 5" high 1 miniature	Rattle	Set of baby's rattles
Box	Grey cardboard 5" x 4" x 4"	Jumping Jack	Wooden with movable joints	Screens	3 pieces of cloth with different patterns, 12" x 12"
Bus	Red friction toy 5" long	Kelly-doll	Roly-poly doll 8" in height	Slinky toy	Slinky, coiled wire flip over toy
Cardboard	Grey, 6" x 8"	Mechanical toy	Yellow duck which moved in a characteristic fashion - $4\frac{1}{2}$" high	Stacking rings	Set of 5 coloured rings & central pole, 7" long
Checker-boards	Two boards with coloured squares	Multi-coloured ring	Brightly coloured snap together parts	Stick	Wooden stick 18" long
Container	6" in height narrow at base	Musical rattle	Coloured plastic musical, 5" long	Stuffed toys	Two stuffed toys 4" in height
Cotton	Reel of cotton	Necklace	34" long composed of 2 types of beads	Weighted toy	Small weighted car which moves on an incline 2" long

The overall approach adopted was one which permitted considerable flexibility both in terms of the materials used, the number of presentations and in terms of adaptation of tasks to the needs of the individual. The aim was to obtain optimal performance as an index of the child's competence or in Piagetian-terms, cognitive structure. Mentally handicapped children may be inconsistent in their responses and evidence considerable variability in their performance or even apathy in responding. Therefore particular care was taken against making the assumption that failure to respond or to perform a critical action necessarily implied lack of competence. To ensure that subjects could not rather than would not respond correctly, repeated presentations of the eliciting procedures for each scale step were frequently carried out e.g. up to about 7 in some cases. Thus, although inter-examiner reliabilities were not established, this procedure did provide some measure of intra-session stability - ensuring reliability of the subjects' performance.

In cases where motor handicap was severe, materials were arranged so as to assist the child in succeeding, thus repeated attempts were permitted and as much time as was necessary was allowed in order to avoid under-estimation of a child's cognitive development due to his physical disabilities.

All assessments were carried out by the experimenter who was familiar with Piaget's theory of sensorimotor development.

Most assessments were carried out in a quiet, screened-off corner of the child's own classroom so as to avoid psychological stress or disturbance that could be caused by unfamiliar surroundings.

In some cases it was necessary to take children out of their classroom into a quiet nearby room as one of the classrooms tended to be noisy with hyperactive, ambulatory children who caused too much distraction and disturbance.

Assessments were not carried out if a subject appeared more tired, disturbed or inattentive than usual or if they were hungry, wet or uncomfortable. The order of administration of the scales was kept constant, Scale 1 was administered first and Scale V1 last to each subject. Although inter-examiner reliability may be low for the Gestural Imitation Scale, this is because different examiners unfamiliar to the child may affect his response. The examiner was familiar to the children and informally checked with their teachers that assessments were realistic and did not under-estimate the level at which they were competent.

In the case of most scales, instructions deal with considerations such as the location of the child, the materials and objects which are required, explicit directions for the eliciting procedure for each step and the suggested number of presentations for each step. (These are presented by Uzgiris and Hunt (1975, pp. 151-204).

The following procedure was carried out : the child was seated in his/her usual chair, opposite the examiner and facing towards a corner of the classroom. In cases where the child had not achieved the sitting posture they were tested supine. A table was placed in front of the child, between child and examiner which provided a working surface. All toys and objects other than the testing materials were removed from the child's immediate environment and testing materials not in use were kept out of sight in large bags and boxes. The examiners played with the child for approximately 5 minutes before administering the first scale item. All scale items were administered according to the general principles previously described and using the directions presented by Uzgiris and Hunt (1975 ; pp. 151-204). Uzgiris and Hunt's directions cover all aspects of the assessment for each individual subject, i.e. they indicate the position of the subject and the immediate space around the subject appropriate for presentation of each item ; the toys and materials appropriate for presentation of each item ; the actions to be carried out by the examiner ; suggested number of times items should be presented ; the various actions or responses subjects may be expected to demonstrate in each situation.

The order of presentation of scales was kept constant commencing with Scale I and finishing with Scale VI. Items within scales were administered according to their systematic progression from item one to whichever item appeared to represent the subject's full capacity, or to the last item in the scale whichever occurred first. When the examiner was confident that a child's response to an item reflected his/her ability, it was recorded (together with the number of presentations) either by ticking the appropriate response on the record sheet or by recording a brief description of the response, before moving to presentation of the next scale item.

When a subject began to fail scale items, administration of that particular scale was continued for a further 3 items to ensure subjects had reached the ceiling of their competence and were not merely evidencing "patchiness" in their development (lack of ordinality) or temporary variability in performance. Items which represented successes on more than one scale i.e. (handwatching occurs in both the Means-ends and Operational Causality Scales) were credited together.

The time required varied considerably according to each subject's capabilities. Generally subjects who were less able, required less time as administration of all items was not necessary. Approximate time taken for assessments ranged from 20 minutes to $1\frac{1}{2}$ hours.

3.6 Recording and Scoring Procedure

Sample assessment record forms, itemising the steps in each scale may be found in Appendix B. For each scale item, 3 to 5 possible responses are described - arranged in developmental sequence they facilitate speedy recording of a child's response.

One or in rare instances two of the possible responses represent the critical infant action considered necessary for successful performance on a given scale step. A scale step was considered to have been passed if the subject performed the appropriate critical action (see Appendix A) at least once, regardless of the number of presentations that were required.

The record forms provide a space for recording the child's response should it differ from those already indicated on the form; therefore they may be used to provide a comprehensive description of a given child's performance in each area of cognition. Space is also provided for recording the number of presentations found necessary in order to elicit the critical action.

The method of scoring employed conformed to that suggested by Uzgiris Hunt (1975) which uses the number of the highest critical action in order to arrive at a score for each scale. Uzgiris and Hunt state ..... "the top step for which an infant manifests the critical action can be used as his score on any given scale".

An alternative procedure which some investigators have employed involves counting the total number of critical actions passed in a scale. It is argued that this procedure is rather problematic for the following reasons. The main rationale for adopting the "total number of steps" method would be in cases where the 'ordinality' or 'sequentiality' principle did not apply - for example if development in mentally handicapped persons does not follow the normal sequence. As the previous review indicates there is more evidence for a positive formulation of the latter hypothesis in that development naturally and logically proceeds from simple forms to more complex forms. An important aspect of Piaget's theory is the proposition that complex abilities emerge from more simple, lower-order schemes. As Uzgiris and Hunt (1975) state, successive steps involve the re-organisation of the form of the response not merely incremental addition of more units. It is this feature of Piaget's description of sensorimotor development that enables ordinal scales to be derived from the theory. Adopting the total number of steps method may be misleading, e.g. :

> " Our observations make it evident that unless infants are made to shift their level of functioning through stress, fatigue or some other unusual process, they will not exhibit certain of their earlier patterns of actions, once these earlier patterns have been incorporated into higher-order organisations of actions".
>
> (Uzgiris & Hunt, 1975)

Thus, some actions may be difficult or even impossible to elicit at a later age, this may be so particularly in the case of older mentally handicapped children. The argument that using the highest step as an index to cognitive development may potentially lose information may be countered by the argument that counting the number of steps (a procedure used in studies of ordinality) regardless of their level, may lose qualitative information.

Therefore subjects' highest critical action on any one scale and the score allocated to it by Uzgiris-Hunt was taken as an index of functioning for that particular scale. To ensure that subjects could not achieve a higher step an attempt to elicit actions critical for 2 or 3 steps beyond the highest step achieved was considered an important aspect of the assessment. The assessment for each child comprised seven separate scores for each scale.

3.7 Structure of the Thesis and Sequence of Analyses Reported

The subsequent chapters of this thesis have been organised with the aim of presenting a developing argument on the nature of sensorimotor intelligence in severely mentally handicapped children. The way in which the argument unfolds is intended to take the reader logically through the empirical contents of the thesis.

The investigation comprises two main phases of data collection : an assessment phase and an intervention phase. Chapter 4 presents the initial results of the sensorimotor assessment of the complete sample of subjects and examines their performance profile across the seven scales. Chapter 5 determines whether the results were particular to severely mentally handicapped children by means of a comparison with normal infants. In Chapter 6 controlled comparisons for the effects of institutionalisation and motor handicap are presented.

At this point in the thesis it ispossible to accept that the findings reported in Chapter 4 do reflect the subjects' cognitive capabilities and that a similar pattern of development is not shown by normal infants.

On the basis of the evidence for cognitive deficiencies in imitation and object permanence, a training pilot-study with a small group of children was carried out.

Chapter 7 describes the training study in which an attempt was made to increase the subjects' scores on Uzgiris and Hunt's two imitation and object permanence scales.

As a whole the empirical data from the assessment and intervention phase is consistent in suggesting a qualitative difference in the structure of sensorimotor development in this population. Chapter 8 summarises and discusses the results of the investigation in relation to the issues raised earlier in the thesis, and the theoretical implications of the findings are explored in some detail.

CHAPTER 4

SENSORIMOTOR ASSESSMENT OF SEVERELY MENTALLY HANDICAPPED CHILDREN USING THE UZGIRIS-HUNT SCALES

4.1 Introduction

The study described in this chapter was designed to provide information on the structure of sensorimotor intelligence in severely mentally handicapped children, using the Uzgiris-Hunt Scales as an instrument to assess 7 different areas of ability. The main question to be addressed is whether there is synchrony or asynchrony in development among the domains comprising sensorimotor intelligence.

Broadly speaking the alternative hypotheses of synchrony or asynchrony in the development of sensorimotor abilities is analogous to the contrasting positions exemplified in the 'developmental versus difference' debate on the nature of mental retardation, described in Chapter 1 (section 1. 3. 4). To recapitulate, according to the developmental position a certain amount of synchrony in the development of sensorimotor abilities might be anticipated, whereas, according to the alternative position, specific deficits in certain abilities might be anticipated.

As reported in the preceding review of the literature, Kahn (1976) has examined the sequentiality, validity and reliability of the Uzgiris-Hunt (1975) Scales with severely mentally handicapped children. However, he did not examine their cognitive development in the various areas of sensorimotor intelligence or compare it with that of normal infants. The study by Rogers (1977) appears to be the only one to have attempted a characterisation of sensorimotor intelligence in this population, however she examined performance on Piagetian tables in just four areas and did not employ the Uzgiris-Hunt (1975) Scales or compare her results with normative data.

Thus the first aim of this study was to examine severely mentally handicapped children in terms of their relative performance across the Uzgiris-Hunt (1975) Scales.

Although Kahn (1976) computed inter-scale correlations he has not reported them in full and to date a correlational matrix for the Uzgiris-Hunt Scales on this population does not appear to have been presented.

Wohlwill (1973) has argued succinctly for correlational analyses in developmental psychology :

> "A good case could be made for the proposition that correlational analysis .... is the method par excellence for developmental study. First it represents a viable middle ground between the essentially sterile age-group comparison approach .... on the one hand .... and the highly problematical experimental approach to the study of developmental change on the other".
>
> (1973 ; p. 240).

Wohlwill has also argued that behavioural development does not occur in independent packages or units along isolated tracks "but along a variety of fronts in close interaction with one another".

Piaget's notion of stages in development and his structure d'ensemble principle (described earlier in Chapter 1) suggest that a certain amount of parallelism in development could be expected among the various domains comprising sensorimotor intelligence. Uzgiris and Hunt (1975) have indeed reported quite high correlations among the 7 scales - ranging between .8 and .9 for their sample of normal infants. How the development of the areas of cognition assessed by the Scales relate to each other poses an interesting question in the case of severely mentally handicapped children.

Uzgiris and Hunt (1975) have also presented inter-scale correlations for their sample of infants with 'age' partialled out which greatly reduced the strength of the correlations. In the case of profoundly mentally handicapped children 'age' may not be a predictive variable of cognitive development, therefore inter-scale correlations would not be expected to be confounded with age to the extent that they are in normal development. Although age is not usually considered to be a developmental variable worthy of study in normal populations, its relationship to development in the severely mentally handicapped, may not be so straightforward.

This poses an interesting question, especially since the relationship between age and the abilities measured by the Uzgiris-Hunt Scales do not appear to have been examined previously in the literature.

Wohlwill has stated :

> "If, as developmental psychologists we are to come to grips with the study of change, it is imperative that we be able to identify clearly the variables along which change occurs".
>
> (1973 ; p. 96).

Inherent in cognitive development is the notion that development or change takes place over time. Chronological age is, axiomatically an index to the passage of time. Rather than experimentally manipulate age as an independent variable, age effects can be observed through correlational analyses of changes in cognitive development as they occur along the dimension of time (ie. age). According to Wohlwill, correlational methods are much more sensitive than age group comparisons.

Most intelligence tests and development scales actually measure changes that occur with age, indeed performance is defined in terms of its functional relationship to the age variable : the functional relationship between CA and MA is poorly understood. According to developmental-lag theory on the mental development of retarded individuals, development merely proceeds at a much slower rate, thus this position predicts a lawful and systematic relationship between age and development. Despite the slower rate of development a linear correlation might be expected. In the case of difference theory there are no grounds for assuming any systematic relationship between CA and MA.

It is not age in itself which is interesting but rather what age stands for. In normal development it is an index to the interaction between maturation and environmental effects. This holds despite individual differences in rate of maturation. The significance and function of age in cognitive development in the case of severely mentally handicapped children may be better understood through studying its effect on different aspects of sensorimotor functioning. The variety of abilities tapped by the Uzgiris-Hunt Scales provide a potentially effective means of executing such a study.

Aim of the Study

The aim of this study was to investigate the nature of sensorimotor development in severely mentally handicapped children and to provide a characterisation of the structure of sensorimotor intelligence in this population in terms of their performance on the Uzgiris-Hunt (1975) Scales.

4.2 Method

Subjects : Subjects were 45 severely and profoundly mentally handicapped children of whom 27 were female and 18 were male. Thirty of the subjects were living in institutions and 15 were living at home. Subjects ranged in age between 3 and 18 years and evidenced a wide range of etiologies, physical and sensory handicap. A more complete description of the subjects has been presented previously in Chapter 3.

Materials

The following materials were used :

(i) The toys and materials itemised in Chapter 3.

(ii) Instructions for administration of scale items from Uzgiris and Hunt's 'Assessment in Infancy' (1975 ; pp. 151-204).

(iii) Record forms (see Appendix B for sample record forms).

Procedure

Prior to testing the examiner familiarised herself with the administration of the scale steps and the instructions for setting up the eliciting conditions. Also prior to the assessment phase the examiner spent time playing with and observing the children to familiarise herself with them and their individual capabilities and handicaps and to allow them to become familiar and comfortable with her. During this time the children's teachers and care-takers were carefully questioned for information on each child's capabilities, special physical or sensory handicaps, favourite toys, favourite games, typical vocalisations and familiar gestures. Information was also collected regarding the time of day that a child was usually most alert, (this might depend on whether they were habitually administered drugs for control of epileptic fits). Administration of the scales was carried out individually, to each child according to the procedures described in Chapter 3.

4.3 Results

Data-analysis was carried out to provide information on three main questions : 'How much parallelism in development is indicated by subjects' scores in the 7 areas of sensorimotor intelligence measured by the Scales ?' 'What are the correlations among the various scales?' Finally to 'what extent is performance predicted by the age of the child?'.

4.3.1 Asynchrony in Development of Sensorimotor Domains Measured by the Uzgiris-Hunt Scales

When totalled the 45 scores for each of the scales produced an uneven profile across the 7 sensorimotor domains. Table 4.1 presents the means and standard deviations of the Scale scores. It is important to appreciate that the number of items in each scale varies and consequently the means and standard deviations were translated into percentages of the total score possible for each scale, to facilitate comparison among them. A one-way repeated measures analysis of variance was performed on the data. This indicated that the variance across the 7 scales was highly significant : $F(1, 42) = 39.57$, $p < .0001$.

Figure 4.1 is a histogram that shows mean scale scores converted into percentages of the total number of steps in each scale. It shows that the variability in performance on the scales is considerable, and it is seen that 3 scales in particular are contributing to the total amount of variance - namely Gestural Imitation, Vocal Imitation and Object Permanence. Particularly striking is the depressed performance on the Gestural Imitation Scale, which seems to suggest that these subjects have hardly begun to succeed on the critical actions contained in this scale. Indeed, examination of individual scores indicates that out of the forty-five subjects, forty failed to pass even the first step in the

Table: 4.1 Means and standard deviations of Uzgiris-Hunt Scale scores for severely and profoundly mentally-handicapped children

	I	II	IIIA	IIIB	IV	V	VI
Mn	4.33	6.05	2.18	0.51	2.53	4.87	5.40
sd	4.40	4.27	2.13	1.67	1.84	3.35	3.32

Key:

Scale I — Object Permanence
Scale II — Development of Means
Scale IIIA — Vocal Imitation
Scale IIIB — Gestural Imitation
Scale IV — Operational Causality
Scale V — Construction of Object Relations in Space
Scale VI — Development of Schemes

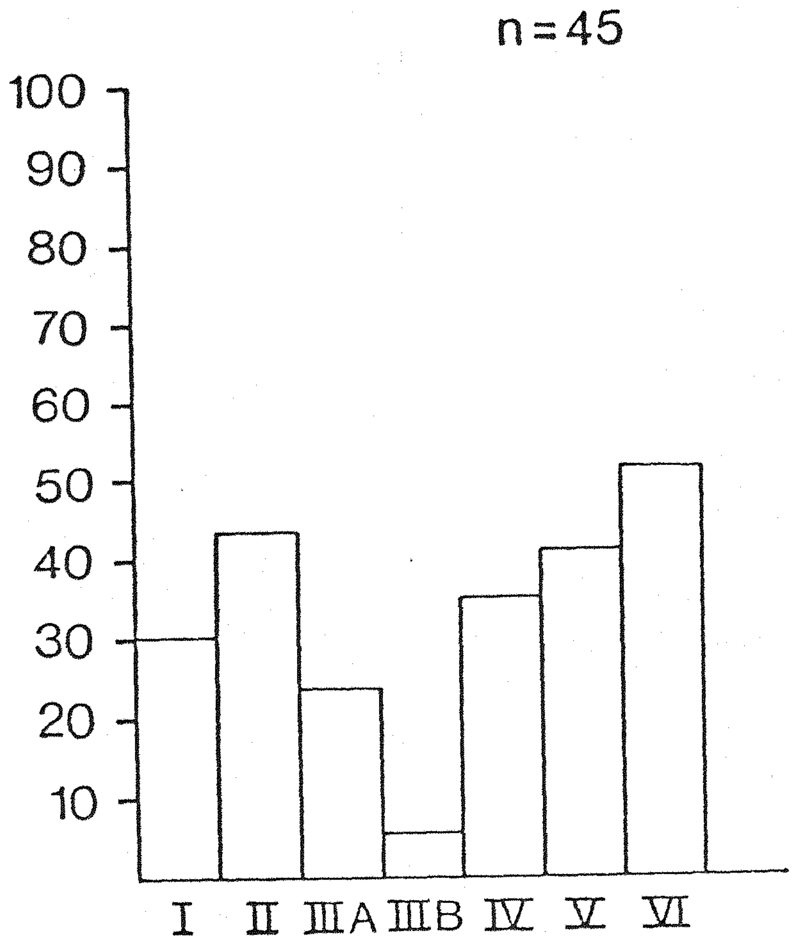


Figure 4.1 Mean Uzgiris-Hunt scale scores (expressed as %s) for profoundly retarded children classified within Piagets sensorimotor period.

Key:

Scale I	—	Object Permanence
Scale II	—	Development of Means
Scale IIIA	—	Vocal Imitation
Scale IIIB	—	Gestural Imitation
Scale IV	—	Operational Causality
Scale V	—	Construction of Object Relations in Space
Scale VI	—	Development of Schemes

Table:4.2 Intercorrelations between Uzgiris-Hunt Scale scores

	Object Permanence	Development of Means	Vocal Imitation	Gestural Imitation [1]	Operational Causality	Construction of Object Relations in Space	Development of Schemes
Object Permanence	—	0.65**	0.45**	0.32*	0.58**	0.72**	0.69**
Development of Means		—	0.38*	0.28	0.69**	0.77**	0.66**
Vocal Imitation			—	0.45**	0.47**	0.36**	0.49**
Gestural Imitation				—	0.39**	0.31*	0.35*
Operational Causality					—	0.66**	0.71**
Construction of Object Relations in Space						—	0.70**
Development of Schemes							—

* $p < .01$
** $p < .001$

1. Co-efficients for this Scale are difficult to interpret as they reflect the variability among scores for a very small number of subjects; most subjects did not obtain a score on this Scale.

Gestural Imitation Scale.

These results are important as asynchrony in the development of mentally handicapped children has not been reported in the Literature. However, in an unpublished dissertation, Gregory (1972) reported a similar Scale profile of abilities for 53 handicapped children who also performed best on Means-Ends and least well in Imitation. The only study to report mean scores for all 7 of the Uzgiris-Hunt Scales (1975 version) for severely retarded children is Kahn's, (1976) and he did not discuss variability in scale scores. Examination of Kahn's results reveals a comparable depression in both the Vocal and Gestural Imitation Scales. In the present study the means are lower, ranging from 0.51 to 6.05 (compared to 1.86-9.65 in Kahn's study). There is no particular significance in this difference - merely that the subjects in this study are more retarded even though they are older. Thus the depressed scores in both imitation scales is replicated in Kahn's results although he has not commented on them. These replications provide some assurance that these results are not artefactual.

4.3.2 Inter-Scale Correlations

Inter-scale correlations were computed using Kendall's tau correlation coefficient which is appropriate for ordinal data. Table 4.2 presents an inter-scale correlation matrix.

It should be noted that interpretation of the co-efficients obtained for the Gestural Imitation Scale is problematic as 40 of the subjects scored zero on this Scale and therefore the correlations are derived from a data base which lacks differentiation. The co-efficients reflect the performance of a very small number of subjects whose rank orderings were similar among the pairs of scales under consideration. This should be taken into account in any comparison among Scale co-efficients.

Seventeen out of the 21 co-efficients are significant at the .001 level. It is important to consider the magnitude of the co-efficients as it is not difficult to obtain significant correlations when n is large. From the correlation matrix it can be seen that inter-scale correlations range from a low figure of .28 to a moderately high one of .77 between Means-ends and Spatial Relations. The mean co-efficient is .53.

The lower correlation co-efficients obtained for Vocal Imitation cannot be accounted for in the same way as for

Gestural Imitation, as all subjects succeeded on this Scale and there was a full range of scores. Even the highest correlation co-efficient obtained for Vocal Imitation is considerably lower than the lowest obtained for the other Scales (with the exception of Gestural Imitation) which range between .58 and .77.

The mean inter-scale correlations for the Vocal Imitation scale is only .43, compared to a mean of .68 between the other five scales. Thus Vocal Imitation accounts for just 18% of inter-scale variance, whereas on average the other scales account for 46% of the variance in scale scores. Therefore it seems that, to a certain extent performance on any one Scale predicts performance on most other Scales, except those concerned with imitation.

Kahn (1983) is the only other investigator to have computed inter-correlations for the Uzgiris-Hunt Scales for severely mentally handicapped children. Kahn's (1983) correlations are overall rather higher than in the present study, ranging from .43 to .93 (mean = .58). The main difference between the two sets of results is that correlations involving the Imitation Scales found here are considerably lower than those reported by Kahn, although in the case of Gestural Imitation, as noted interpretation is difficult as most subjects failed to obtain a score on this Scale.

Performance of Normal Infants

A comparison of the results obtained here with those reported for normal infants indicates that higher correlations occur for normal infants. Uzgiris and Hunt (1975) found higher inter-scale correlations ranging from .80 to .93 for their sample of infants. Uzgiris and Hunt have suggested that since normal development proceeds over time, if age is not partialled out, the inter-scale correlations appear misleadingly inflated - i.e. since age correlates highly with all of the scales, it provides a major source of commonality among scales. In severely mentally handicapped children age is not necessarily directly related to development.

When Uzgiris and Hunt partialled age out, correlations were greatly reduced to a mean of .27. Most striking, the mean correlation for Vocal Imitation with the other scales was reduced from .82 to .10, suggesting that in normal infants age is differentially predictive of scale performance. The extent to which age predicts performance on the scales in the present sample of subjects is reported next.

4.3.3 The Relationship between Subjects' Ages and Their Performance on the Uzgiris-Hunt Scales

Kendall's tau coefficient was used to compute correlations between the chronological age of the subjects and their scores on the Uzgiris-Hunt Scales. Table 4.3 presents this information. As has been noted, in normal infants sensorimotor development correlates highly with age. Whereas, correlations between subjects' ages and scale scores were low, ranging between .06 for Gestural Imitation and .24 for the Means-ends Scale. The mean correlation coefficient for age was .16, which was not significant. None of the correlations were significant at .01 level, however two were significant at .05 level, namely Means-ends (.24) and Spatial Relations (.20). The two Imitation Scales produced the lowest correlation with age (X=.09). For Gestural Imitation the reason given on p. 93 should be noted.

These findings are interesting in view of the high correlations found by Uzgiris and Hunt between age and performance on the scales for normal infants, which ranged from .88 to .94 with a mean of .90. Therefore, in normal infants 81% of the variance in scale scores is accounted for by variance in age, whereas for the sample in the present study on average only 2.6% of the variance in scale scores is accounted for by the difference between subjects' ages. Their highest correlation with age was produced by the Means-ends Scale, which measures the child's interaction with and manipulation of objects, whereas the lowest was produced by Gestural Imitation. Therefore, it seems from these two sets of results that 'age' as a variable may have a different psychological meaning for the two populations.

4.3.4 Summary of Results

The main results reported in this chapter may be summarised as follows :

(i) A differentiated profile of scores across the 7 scales was found with highly significant variance between scale scores. Scale scores were particularly depressed in the case of the two Imitation Scales. Subjects scored highest on the Means-ends and Schemes Scales.

Table 4.3. Correlations between Subjects' Age and their Performance on the Uzgiris-Hunt Scales

	Object Permanence	Means-ends	Vocal Imitation	Gestural Imitation	Operational Causality	Spatial Relations	Schemes
Age	0.16	0.24*	0.11	0.06[1]	0.18	0.20*	0.13

*p = <.05

1. This co-efficient is difficult to interpret as most subjects did not obtain a score on this Scale.

(ii) Significant, positive correlations of moderate strength were obtained among the Scales, but those obtained for Vocal Imitation were weaker. Interpretation of the co-efficients obtained for Gestural Imitation is difficult as this ability was absent in the majority of subjects.

(iii) No relationship was found between chronological age and overall performance on the scales. A small, but significant relationship was found between chronological age and performance on the Means-ends, and Spatial Relations Scales.

4.4 Discussion

The main finding to emerge from this study was the highly significant variance in scale scores across the seven scales. This was largely due to subjects' relatively depressed scores on the two Imitation and Object Permanence Scales. A re-analysis of Kahn's data replicated these results.

The only studies to have addressed the question of congruence among sensorimotor domains in this population were those carried out by Woodward and Stern (1963) and Rogers (1977), using Piagetian tasks. In Woodward and Stern's (1963) study, stage congruence between locomotor development, speech development and social development was assessed. Development in speech, language, drawing and social behaviour was behind general sensorimotor development.

In Rogers (1977) study, parallelism in development across 4 domains, was examined. They were : "Object Permanence", "Imitation", "Causality" and "Spatiality" and consistent with the present findings, a lack of parallelism across domains was found. When uneven performance occurred, imitation tended to be the lowest. Rogers attributed "the lack of imitation to the lack of responsiveness of the institutional environment" (1977 ; p. 842). The evidence that profoundly mentally handicapped children may be particularly deficient in imitation skills was interpreted as evidence of a unique characteristic of this population.

Curcio (1978) also found inferior performance in gestural imitation - in 12 mute, autistic children and suggested that this pattern might not be specific to autism but might also occur in severely or profoundly retarded samples where there is a high incidence of C.N.S. pathology.

Therefore, there appears to be some support in the literature for the suggestion that severely and profoundly mentally handicapped children may be deficient in vocal and gestural imitation compared to their abilities in other sensorimotor domains.

The main finding to emerge from the correlational analyses is that, generally development among the various sensorimotor abilities measured by the Scales appears to develop together to a certain extent, with the exception of Vocal Imitation. (Little can be inferred about Gestural Imitation). This finding is consistent with those of Dunst et al.'s (1981) infants, however independence in the development of imitation was not indicated in Kahn's results despite the similar depression in these abilities. This may be because Kahn's subjects were higher functioning and therefore gained higher scale scores.

Overall the correlational analyses between the age of the subjects and their performance on the Uzgiris-Hunt Scales produced very low coefficients - suggesting that in severely and profoundly mentally handicapped children age is not an important variable and is not predictive of their cognitive ability. This is in sharp contrast to normal development, but consistent with Rogers' (1977) finding.

The above, general conclusion must be qualified in that performance on two of the Scales - namely Means-ends and Object Relations in Space produced small but significant correlations with age. Therefore it seems that the older the subject the greater the probability of achieving higher scores on these scales. The Means-ends Scale measures the child's ability to perceive relationships among objects in the environment and to manipulate them according to his goals or desires. The Spatial Relations Scale measures a similar type of capacity - the ability to construct and appreciate object relations in space. Thus both scales involve experience in interacting with the environment.

It is clear from these results that 'age' as a variable has a different psychological meaning for severely mentally handicapped children, from normal infants, however any interpretation of this finding will be deferred until the final chapter of this thesis.

The most important aspect of the results is the suggestion that severely mentally handicapped children evidence deficiencies in specific sensorimotor abilities. However, before accepting this conclusion a number of other possible explanations must be ruled out.

First it is possible that subjects were unable to perform gestural imitations on account of their motor handicaps, or that difficulty in motor control may inhibit gestural responses. Since over half of subjects were institutionalised it is possible that institutionalisation may have a detrimental effect on certain sensorimotor abilities - perhaps those involving interaction with other people. These potential explanations warrant investigation.

Another question to be addressed is, how this sample of severely mentally handicapped childrens' performance differs from normal infants on the Uzgiris-Hunt Scales. Other studies have provided a description of this population's sensorimotor abilities, presumably on the assumption that sensorimotor intelligence does progress as a unified whole. (Woodward, 1959 ; Rogers, 1977). Piaget (1960, 1973) proposed that the various areas of cognition involved in sensorimotor intelligence progressed more or less in synchrony, however this is a hypothesis for which little empirical evidence has been provided.

In conclusion, since it is not known whether the abilities measured by the Uzgiris-Hunt Scales do proceed more or less in synchrony with each other, it cannot be assumed that they do. Furthermore, correspondences across the Scales have not been established for normal infants. This issue is addressed in the next chapter.

4.5 Summary

(i) The structure of sensorimotor intelligence in severely mentally handicapped children is poorly understood. It is not clear whether sensorimotor abilities develop in synchrony as developmental-lag theory might predict or whether asynchrony exists among abilities.

(ii) Performance on one scale was related to performance on another, however this was less noticeable for Vocal Imitation. Little significance can be attached to Gestural Imitation results.

(iii) Age was found to bear little relationship to development, although it was weakly related to the Means-ends and Spatial Relations Scales. This finding contrasted strongly with evidence for normal infants.

(iv) Interpretation of the results requires information on the structure of sensorimotor intelligence, in normal infants.

CHAPTER 5

A COMPARISON BETWEEN THE SENSORIMOTOR INTELLIGENCE OF SEVERELY MENTALLY HANDICAPPED CHILDREN AND NORMAL INFANTS

5.1 Introduction

The comparisons presented in this chapter are based on two important considerations: first as the Uzgiris-Hunt Scales have not been standardised, it may simply be an assumption that normal development on the various scales proceeds in synchrony. Before the results of the preceeding chapter can be interpreted unambiguously a comparison with normal performance is essential. Woodward (1959), Gregory (1972) and Rogers (1977) applied Piaget's sensorimotor sub-stages to the classification of severely mentally handicapped children and Dunst et al. examined the structure of sensorimotor intelligence in retarded infants, but none of these authors made comparisons with normal infants, so little is known of the pattern of scale scores that might be expected.

The second consideration is that according to Piaget's (1954) account, the sensorimotor period involves six distinct levels of development whereby qualitative changes take place in a structured network of inter-related skills. A proper analysis of developmental data should consequently allow for any changes which may occur at successive stages. (Wohlwill, 1973). In addition to the theoretical reasons for comparing normal and mentally handicapped subjects according to their "stage" of sensorimotor development, there is a straightforward methodological reason for this procedure. Quite simply it is necessary to have some common basis for comparison of the two populations. Chronological age cannot be used to compare the mentally handicapped with normal subjects but Uzgiris and Hunt (1975) presented their data for normal infants according to sensorimotor stages. A comparison according to stages is a possible basis for controlled comparisons. Adoption of this procedure does not necessarily imply acceptance of Piaget's stage theory - rather it provides a methodology through which the two populations can be compared according to their 'level of development' - i.e. it renders the samples 'comparable'.

This procedure also affords control over the level of development. As the concept of 'stages' in development can be problematic, the concept will be briefly discussed here.

The Concept of "Stage" of Development

A definition of the stage concept is provided by Wohlwill : "stage is taken as a construct within a structurally defined system, having the property of unifying a set of behaviours". (1973 ; p.192).

There has been much discussion of the concept of 'stages' in development, particularly over Piaget's theory (e.g. Kessen, 1962 ; Wohlwill, 1973; Flavell and Wohlwill, 1969 ; Pinard and Laurendeau, 1969 ; Flavell, 1970, 1971) to name some of the most prominent writers. A certain amount of distrust of the concept has existed amongst American theorists in particular - perhaps due to its connotation of discontinuity and its emphasis on motivation. Wohlwill (1973) has argued in favour of the concept in developmental psychological research and has presented a number of methodological models for the analysis of stage data. He has pointed out :

> "Considering the numerous discussions of Piaget's use of the stage concept in his work on the development of operational thought, there has been a surprising lack of interest in the application of this concept to his work on sensorimotor development in infancy. This neglect is all the more unfortunate, since the opportunity to trace and analyze the specifics of stages-in-formation should be optimal, at least in principal, for two reasons : First because the process takes place over a more narrowly delimited set of differentiable series of responses" (e.g. the Uzgiris-Hunt Scales)" ..... Second, because within each separable aspect of sensorimotor development there is a more clearly and finely differentiated sequence of steps on which to base an empirical study of the stage problem".
> (1973 ; p.200)

The term 'stage' is used here to describe systematic interpatterning among sets of developing abilities which undergo transformation and re-organisation. Thus, it describes qualitatively defined data rather than merely quantitatively scaled data.

The justification for stage theory in cognitive development is the economy, relative consistency and the integration of behaviour it offers. The concept implies that regulating mechanisms exist underlying development of diverse abilities, at successive levels of development.

In Piaget's six sub-stages of the sensorimotor period the several domains he specifies (e.g. general sensorimotor intelligence, object permanence, appreciation of time, space and causality and imitation) are supposed to share a common hierarchical structural basis (i.e. structure d'ensemble). Thus, it appears, at least in theory, that the steps in each sequence of development may be placed in one-to-one correspondence. It is here that a degree of ambiguity exists, for Piaget does not insist on temporal synchrony and the postulation of horizontal décalage affords some flexibility in his 'stage' system. Whether there is 'structure d'ensemble' is still an empirical question.

Perhaps one reason why researchers have examined ordinality and sequentiality in Piaget's description of sensorimotor development but not synchrony among the various abilities, is due to the methodological difficulties involved. Wohlwill (1973) has criticised reliance on contingency-table data by researchers attempting to demonstrate stage congruence, because the rigid, lock-step analysis does not allow for changing networks of relationships or deviations from simple synchronous progression.

In his discussion of such methodological considerations Wohlwill (1973) has suggested that the specific behaviours in each domain need definition and operationalisation. Although he doubts whether the Uzgiris-Hunt (1975) Scales may be placed in direct correspondence with each other due to the unequal length (number of steps) of each scale he refers to the possibility that sub-sets of the steps might be classified into Piaget's six stages - the task being to group ordinally scaled items into qualitatively defined stages.

Wohlwill (1973) recommends more sensitive and appropriate analyses for developmental ordinal data of this kind - such as Kendall's coefficient of concordance and factor analysis. These tests permit analysis of correspondence between a number of variables (i.e. scales) rather than only the two afforded by the two-by-two contingency table analysis used by Woodward (1959) and Rogers (1977).

The aim of the analysis reported in this chapter is therefore to compare the structure of sensorimotor intelligence in severely mentally handicapped children and normal infants, controlling for stage of development.

5.2 Method

Subjects

Group 1 consisted of 45 severely mentally handicapped children described previously in chapter 3 (see p. 75).

Group 2 consisted of the data collected by Uzgiris and Hunt for their sample of normal infants, which was used in the construction of their Scales. The research period did not allow for the testing of normal infants in England. Uzgiris and Hunt's raw scores were used to provide the control data for normal development, as theirs was the largest sample of infants to have been administered the scales. These data was provided by courtesy of Professor I. C. Uzgiris (personal communication).

The sample consisted of 83 non-retarded infants of whom 42 were female and 41 were male. The majority of the infants were from graduate student and faculty families at Illinois University, and were from middle-class backgrounds. The infants' ages ranged between 1 and 24 months. They were selected by Uzgiris and Hunt (1975) so that there were at least 4 infants at each month of age up to 12 months and thereafter at least four infants every 2 months up to 2 years of age.

Design and Procedure

This study was designed to compare the performance of retarded and normal subjects on the 7 Uzgiris-Hunt Scales, controlling for sensorimotor stages. It consisted of three main analyses :

Analysis I : The purpose of this analysis was to ascertain whether the apparent deficits obtained for the retarded subjects reflect their unique characteristics or whether a similar pattern emerges for normal infants when both populations are examined in stage-by-stage comparisons.

Analysis II : The purpose of this analysis was to supply developmental information on the inter-relationships among the developing abilities measured by the scales for both populations.

Analysis III : This analysis involved factor analysis of the correlation matrices to ascertain whether the structure of sensorimotor intelligence differed for the two populations.

Classification of Subjects according to Sensorimotor Stages

In order to compare the retarded children and normal infants' performance sensorimotor 'stage' was chosen as the most satisfactory basis for controlled comparisons.

Uzgiris and Hunt (1975) classified their sample of infants according to Piaget's description of the specific behaviours, characteristic of each sensorimotor stage. Thus it was not necessary to carry out stage classification of the normal infants. The specific criteria used by Uzgiris (personal communication, 1982) which correspond to scale steps or critical actions may be referred to in Appendix C Table I. The classification of the retarded subjects was carried out with the aim of maximising the similarity of the two samples at each stage in order to increase the likelihood of discerning real differences between the two populations.

Procedure for Allocation of Retarded Subjects to Sensorimotor Stages of Development

As the crieria used by Uzgiris and Hunt (1975) did not appear sufficiently comprehensive for allocating the retarded sample to stages of development and in order to match the two samples as closely as possible, the following procedure was carried out:

(i) The approximate range of scores, for each scale at each successive stage for the normal sample was calculated. As a general rule it was ensured that the retarded subjects' mean scores fell within the normal range for the stage to which they were allocated. (It was necessary however to omit gestural imitation from this procedure as the majority of retarded subjects had no score on this scale). The retarded subjects were allocated to the stage at which at least three out of six scores fell. This was within the normal range for that particular stage. Thus subjects were classified into the stage which was most characteristic of their level of functioning. As a further precaution it was ensured that each subjects' total mean score across all the scales fell within the normal range for a particular stage.

5.3 Results

Table 5.1 shows the number of subjects classified at each sensorimotor sub-stage, from stage II to stage VI:

STAGES	II	III	IV	V	VI
Retarded	10	9	6	7	8
Normal	9	16	26	12	20

Table 5.1. Number of retarded and normal subjects classified at each sensorimotor stage

Stage I was not included in the analyses as subjects functioning at this level mostly failed to pass even the first of the scale steps. Five subjects were functioning below Stage II and were therefore omitted from the analyses.

Table 5.2 gives scale means and standard deviations in absolute numbers and converted to percentages of the total number of steps in each scale, for retarded and normal subjects. Figure 5.1 provides a graphical presentation of the mean scale scores as percentages.

Tables 5.3 to 5.7 present the means and standard deviations of scale scores for both groups at each sensorimotor stage. Figures 5.2 to 5.6 provide graphical presentations of mean scale scores as percentages, for each stage.

Table 5.8 provides a summary of this information in graphical format.

Table 5.2. Means and Standard Deviations of Uzgiris-Hunt Scale Scores: Retarded Children versus Normal Infants

SCALES		I	II	IIIA	IIIB	IV	V	VI
R	mean	4.53**	6.09	2.28***	0.54***	2.65*	4.86	5.51
	as %	32.36	43.50	25.33	0.06	37.86	44.18	55.10
	s.d.	4.40	4.17	2.12	1.71	1.80	3.27	3.19
	as %	31.43	32.08	23.56	19.00	25.71	29.73	31.90
N	mean	7.48	6.69	5.48	4.05	4.04	6.65	6.29
	as %	53.43	51.46	60.89	45.00	57.72	60.46	62.90
	s.d.	4.38	3.76	2.41	3.36	1.69	3.34	2.80
	as %	31.29	28.92	26.78	37.33	24.14	47.71	28.00

*** $p < .00001$
** $p < .0001$
* $p < .001$

Key:
- Scale I — Object Permanence
- Scale II — Development of Means
- Scale IIIA — Vocal Imitation
- Scale IIIB — Gestural Imitation
- Scale IV — Operational Causality
- Scale V — Construction of Object Relations in Space
- Scale VI — Development of Schemes

* Computed from Uzgiris and Hunt's data appearing in Assessment in Infancy (1975) with their permission.

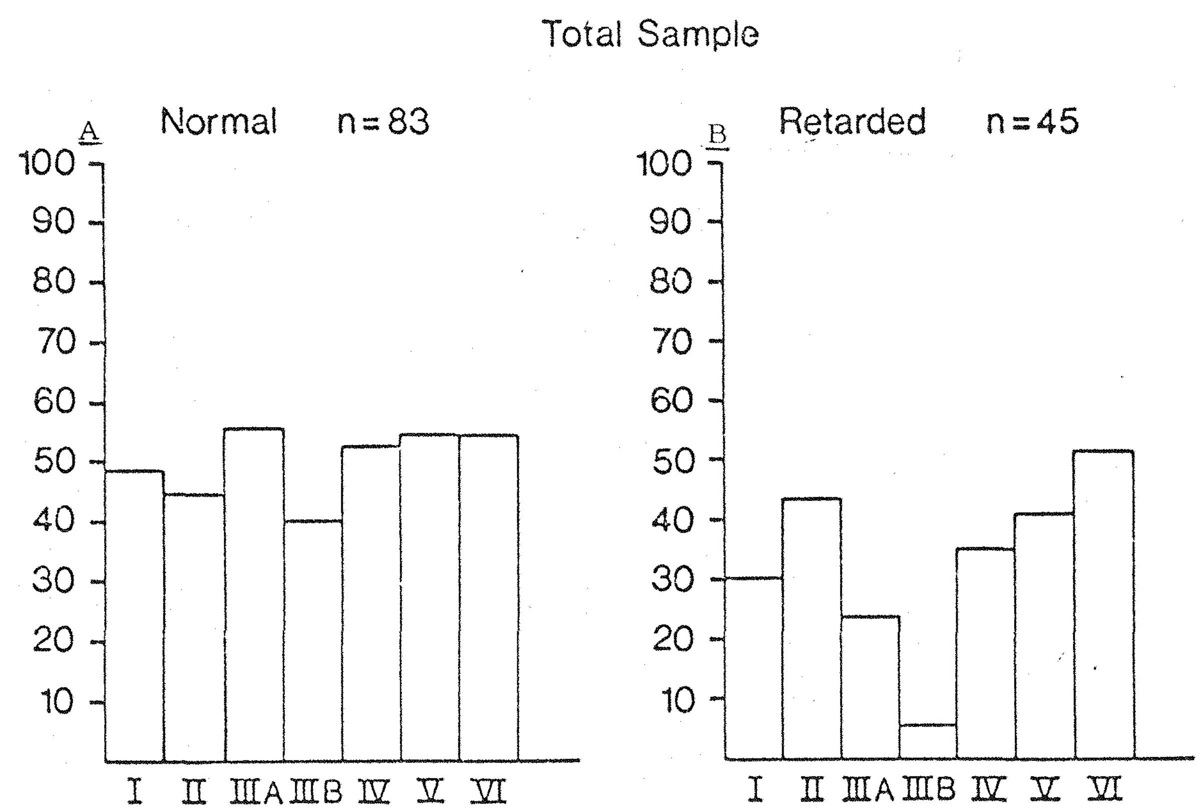


Figure 5.1 Comparison of mean Uzgiris-Hunt scale scores (expressed as %s) for normal infants and profoundly retarded children classified within Piagets sensorimotor period.

Key:
- Scale I – Object Permanence
- Scale II – Means-Ends
- Scale IIIA – Vocal Imitation
- Scale IIIB – Gestural Imitation
- Scale IV – Operational Causality
- Scale V – Construction of Object Relations in Space
- Scale VI – Schemes for Relating to Objects

Data on normal infants was derived Uzgiris and Hunt (1975) with their kind permission

Table 5.3. Means and Standard Deviations for Retarded Children and Normal Infants. Classified at Stage II

	RETARDED		NORMAL	
	Mean	S.D.	Mean	S.D.
Object Permanence	0.60	1.35	1.78	1.09
Means-Ends	1.10	1.10	1.33	1.12
Vocal Imitation	1.00	0.82	2.44	0.53
Gestural Imitation	0.00	0.00	0.00	0.00
Operational Causality	0.90	0.99	1.00	1.00
Spatial Relations	1.10	1.59	1.11	1.27
Schemes	1.10	1.28	1.55	1.13

Table 5.4. Means and Standard Deviations for Retarded Children and Normal Infants.

Classified at Stage III

	RETARDED		NORMAL	
	Mean	S.D.	Mean	S.D.
Object Permanence	1.90	1.59	2.56	1.09
Means-Ends	3.40	2.12	3.06	1.18
Vocal Imitation	1.30	0.94	3.69	1.45
Gestural Imitation	0.00	0.00	0.63	0.81
Operational Causality	1.90	0.74	2.88	1.09
Spatial Relations	3.90	0.57	3.31	1.71
Schemes	4.80	1.81	3.75	1.61

Table 5.5. Means and Standard Deviations for Retarded Children and Normal Infants.

Classified at Stage IV

	RETARDED		NORMAL	
	Mean	S.D.	Mean	S.D.
Object Permanence	4.50	1.69	7.77	2.36
Means-Ends	8.12	1.88	6.50	2.98
Vocal Imitation	2.25	1.49	5.12	1.61
Gestural Imitation	0.00	0.00	4.12	2.36
Operational Causality	2.75	0.89	4.23	0.65
Spatial Relations	5.00	1.77	7.19	1.36
Schemes	6.63	2.19	6.77	1.36

Table 5.6. Means and Standard Deviations for Retarded Children and Normal Infants.

Classified at Stage V

	RETARDED		NORMAL	
	Mean	S.D.	Mean	S.D.
Object Permanence	6.22	2.58	9.08	2.94
Means-Ends	10.00	1.80	8.42	2.15
Vocal Imitation	2.89	1.69	6.17	1.59
Gestural Imitation	0.78	1.56	5.42	2.57
Operational Causality	3.33	1.12	4.50	0.67
Spatial Relations	6.67	2.55	7.91	1.62
Schemes	7.55	0.53	7.42	1.31

Table 5.7. Means and Standard Deviations for Retarded Children and Normal Infants.

Classified at Stage VI

	RETARDED		NORMAL	
	Mean	S.D.	Mean	S.D.
Object Permanence	13.00	2.00	12.90	1.20
Means-Ends	10.33	2.42	11.47	1.68
Vocal Imitation	5.17	3.37	6.17	1.59
Gestural Imitation	2.67	3.67	7.89	1.73
Operational Causality	5.67	1.51	5.90	0.87
Spatial Relations	9.83	2.04	10.53	0.61
Schemes	9.50	0.84	9.32	1.16

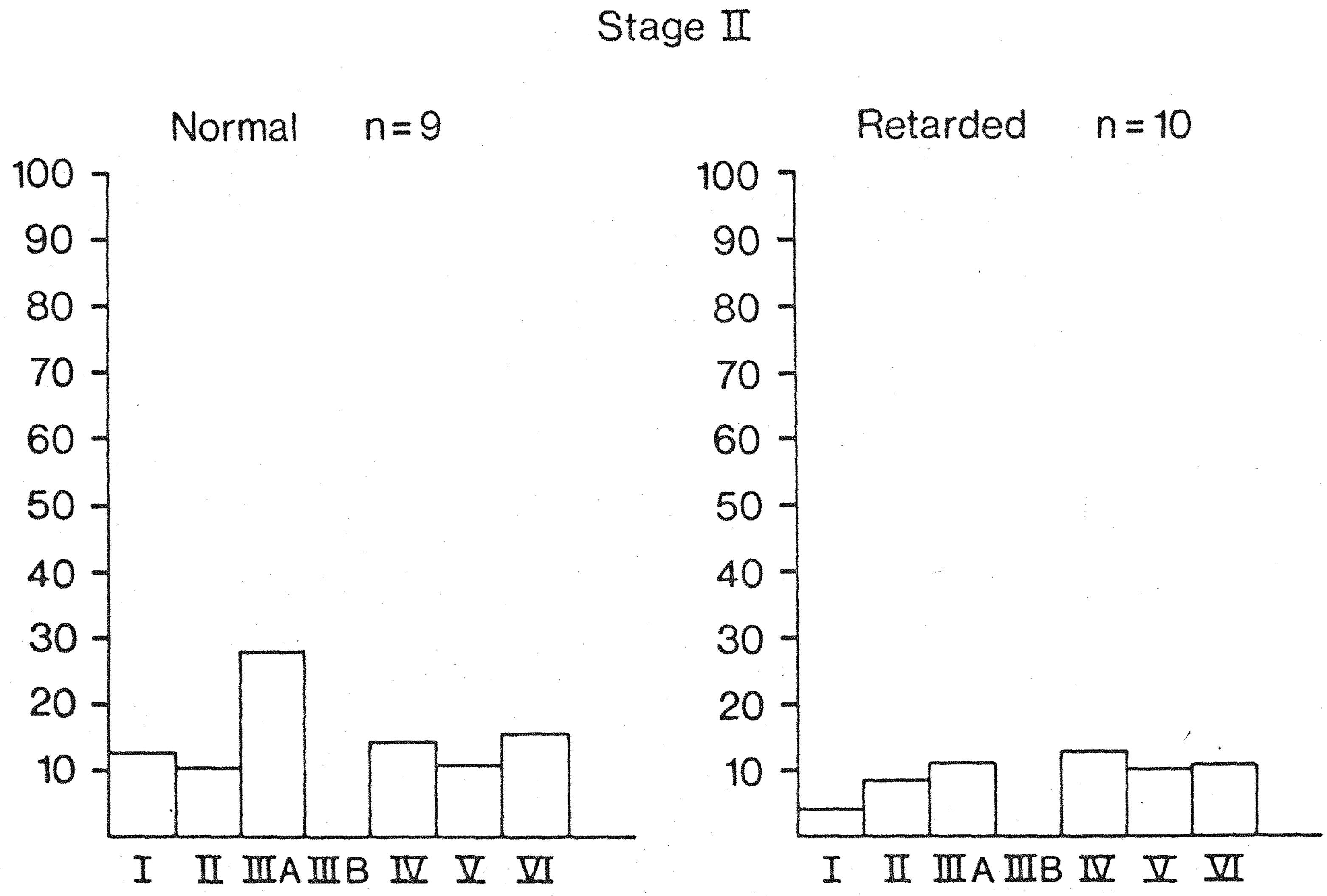


FIGURE 5.2 Comparison of mean scale scores (expressed as %s) for normal infants and profoundly retarded children classified within the second sub-stage of Piagets sensorimotor stage.

Key:
Scale I. – Object Permanence
Scale II – Development of Means
Scale IIIA – Vocal Imitation
Scale IIIB – Gestural Imitation
Scale IV – Operational Causality
Scale V – Construction of Object Relations in Space
Scale VI – Development of Schemes

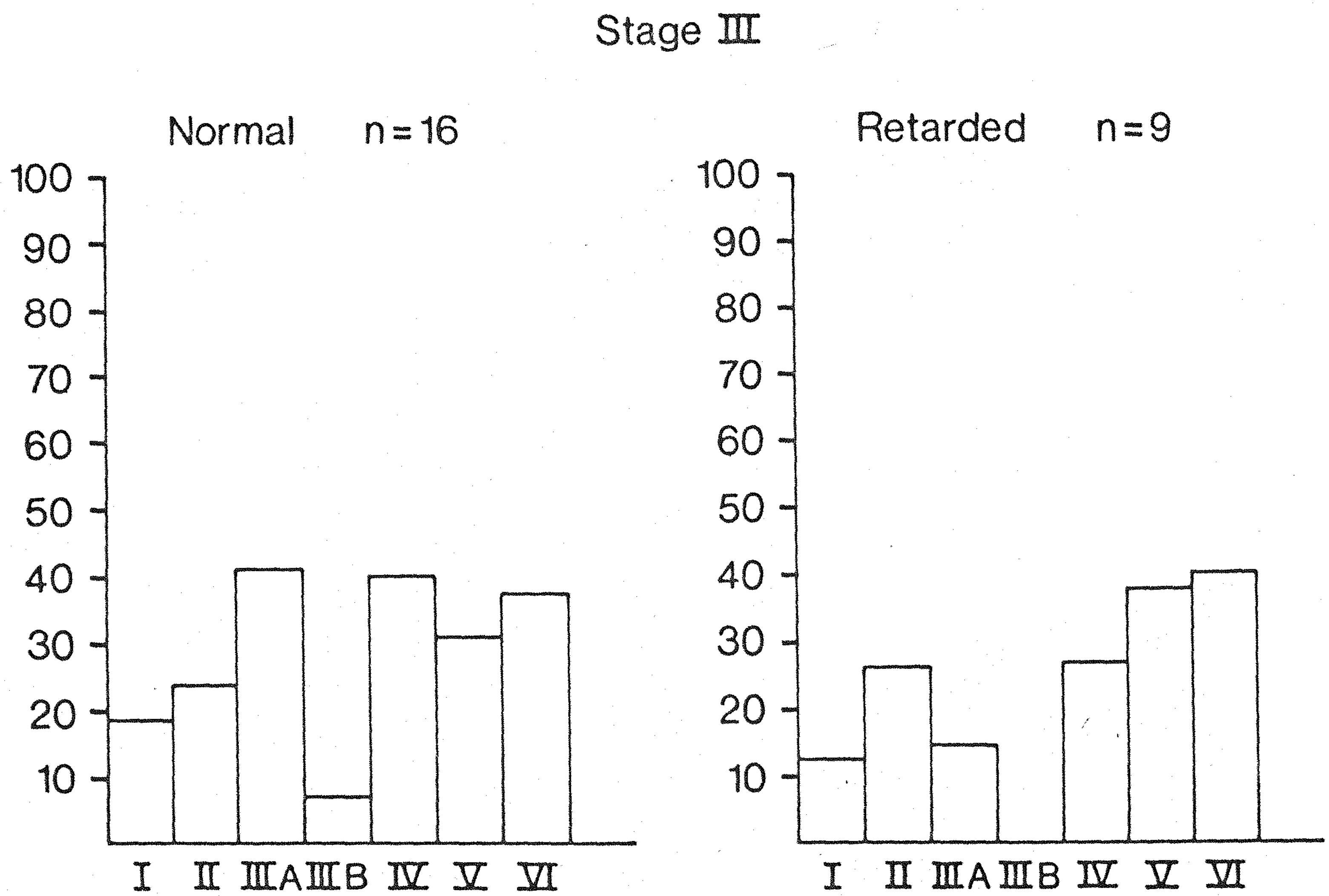


FIGURE 5.3 Comparison of mean scale scores (expressed as %s) for normal infants and profoundly retarded children classified within the third sub-stage of Piagets sensorimotor stage.

Key:

Scale I	— Object Permanence	Scale IV	— Operational Causality
Scale II	— Development of Means	Scale V	— Construction of Object Relations in Space
Scale IIIA	— Vocal Imitation		
Scale IIIB	— Gestural Imitation	Scale VI	— Development of Schemes

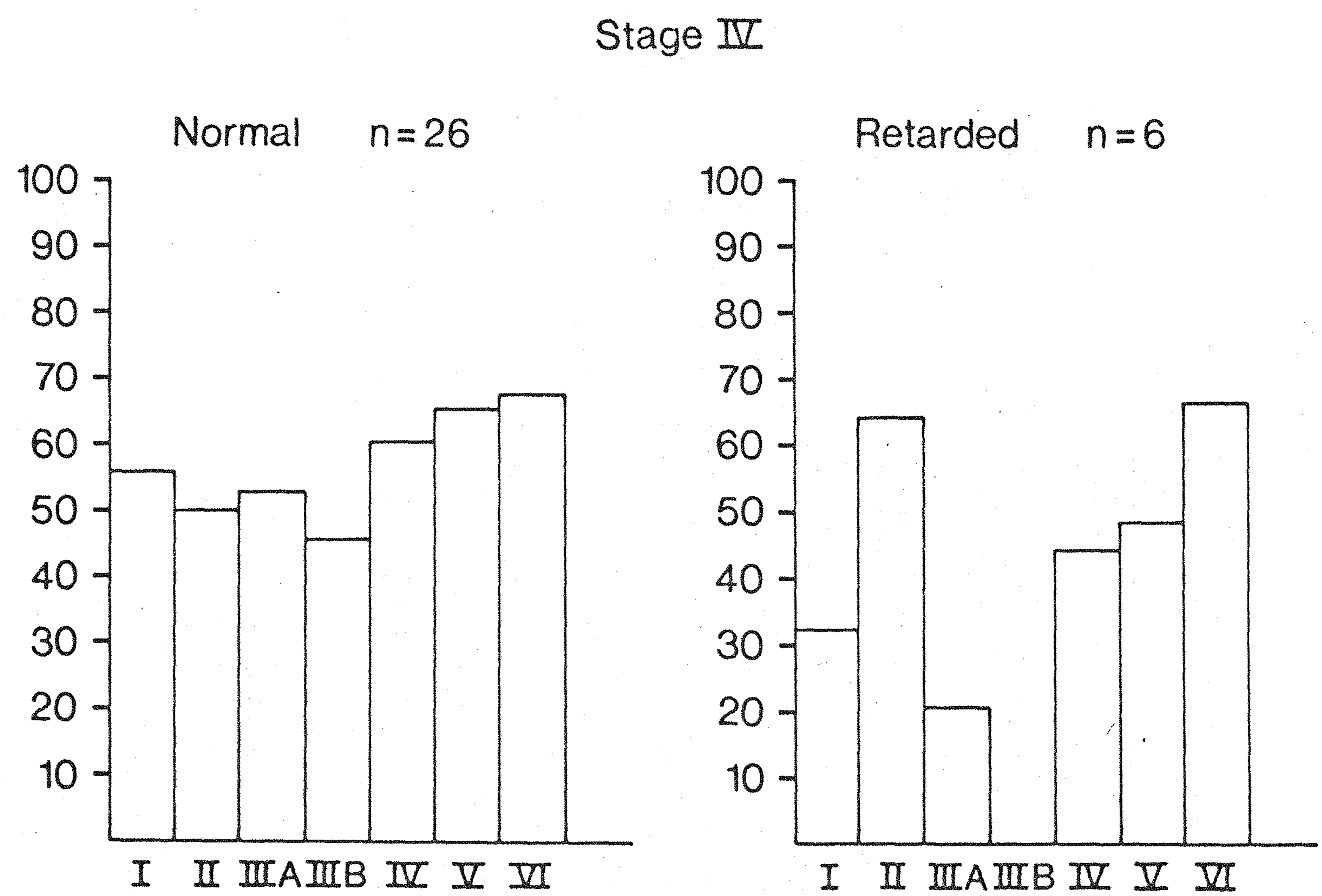


FIGURE 5. 4. Comparison of mean scale scores (expressed as %s) for normal infants and profoundly retarded children classified within the fourth sub-stage of Piagets sensorimotor stage.

Key:

Scale I	Object Permanence	Scale IV	Operational Causality
Scale II	Development of Means	Scale V	Construction of Object Relations in Space
Scale IIIA	Vocal Imitation		
Scale IIIB	Gestural Imitation	Scale VI	Development of Schemes

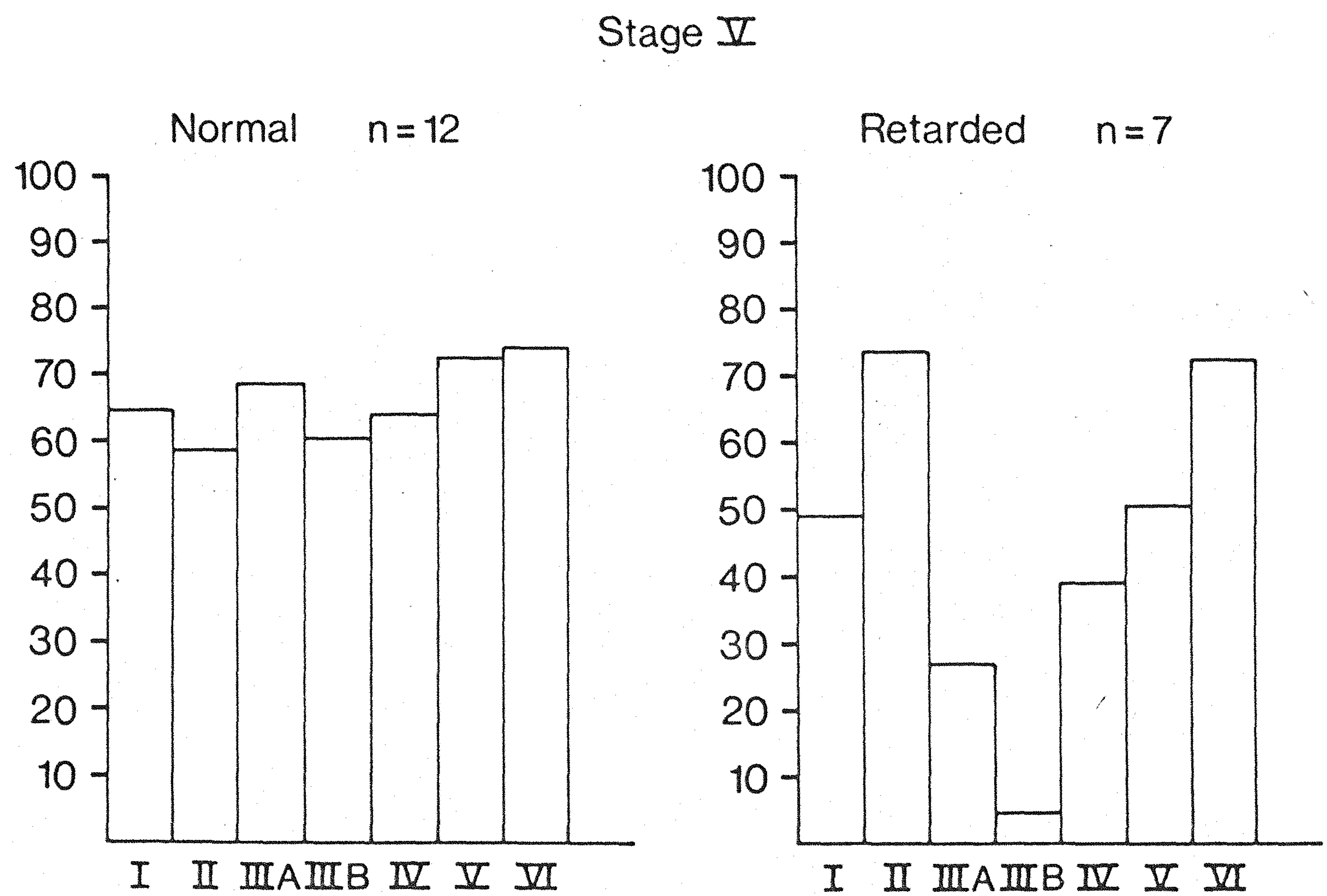


FIGURE 5.5. Comparison of mean scale scores (expressed as %s) for normal infants and profoundly retarded children classified within the fifth sub-stage of Piagets sensorimotor stage.

Key:

Scale I	– Object Permanence	Scale IV	– Operational Causality
Scale II	– Development of Means	Scale V	– Construction of Object Relations in Space
Scale IIIA	– Vocal Imitation		
Scale IIIB	– Gestural Imitation	Scale VI	– Development of Schemes

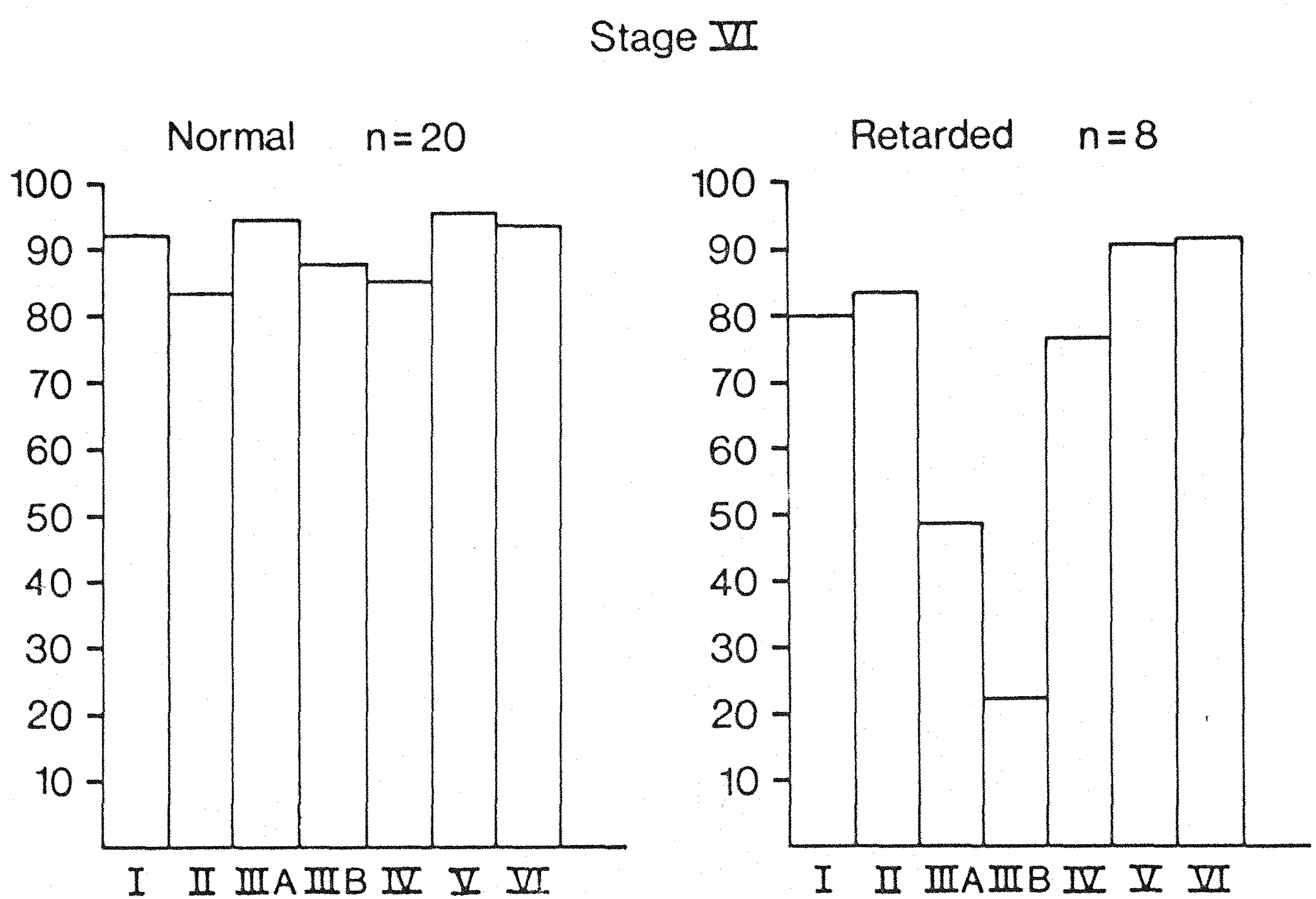


Figure 5.6. Comparison of mean Uzgiris-Hunt scale scores (expressed as %s) for normal infants and profoundly retarded children classified within the sixth sub-stage of Piagets sensorimotor period.

Key:

Scale I	–	Object Permanence
Scale II	–	Means-Ends
Scale IIIA	–	Vocal Imitation
Scale IIIB	–	Gestural Imitation
Scale IV	–	Operational Causality
Scale V	–	Construction of Object Relations in Space
Scale VI	–	Schemes for Relating to Objects

Data on normal infants was derived Uzgiris and Hunt (1975) with their kind permission

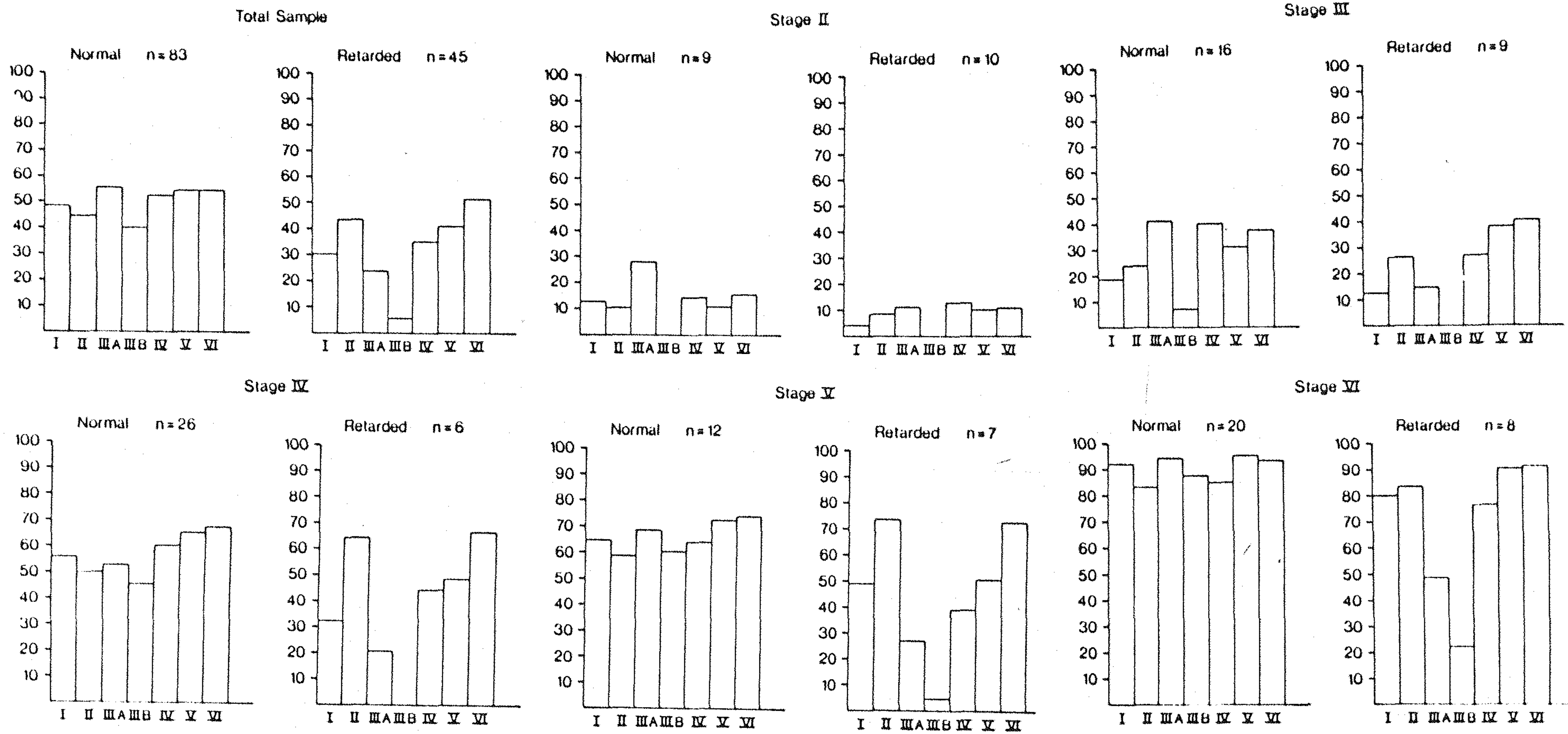


TABLE 5.8 Comparison of mean Uzgiris-Hunt scale scores (expressed as %s) for normal infants and profoundly retarded children classified within Piagets sensorimotor period.

Key: Scale I - Object Permanence
Scale II - Means-Ends
Scale III A - Vocal Imitation
Scale III B - Gestural Imitation
Scale IV - Operational Causality
Scale V - Construction of Object Relations in Space
Scale VI - Schemes for Relating to Objects

Data on normal infants was derived Uzgiris and Hunt (1975) with their kind permission

5.3.1 Analysis I : Comparison between Retarded Children and Normal Infants across the Uzgiris-Hunt Scales

Table 5.9 presents a summary of the F. values and their significance levels for analysis I. A two-way multivariate analysis of variance which compared the two sets of scores across all seven scales, controlling for sensorimotor stage, revealed a highly significant difference between the two groups. Univariate tests were then applied to the data and these revealed large differences between the two populations on four scales - namely Gestural Imitation; Vocal Imitation ; Object Permanence and Operational Causality. In contrast, no significant differences were found between the two groups on the Means-ends, Spatial Relations and Schemes Scales.

It can be appreciated from Table 5.9 that the F values for the two imitation scales are particularly large.

Having treated the two groups as the independent variable, further analyses were carried out to examine "stage" effects. Table 5.9 presents the F values for stage effects and its interaction between the two groups. A multivariate analysis revealed that overall "stage" of sensorimotor development represented a significant variable, whereby each stage was significantly differentiated as a distinct level of functioning, suggesting that the classification of subjects into stages had been accomplished in a systematic fashion.

A two-way multivariate analysis revealed an interaction effect between 'population' and 'stage' i.e. that the differences between the two groups were not consistent over stages. Univariate tests (see Table 5.10) indicated that the interaction effect was almost completely attributable to the gestural imitation scale. Sensorimotor 'stage' did not differentially affect the two populations in the case of the other scales, although the Means-ends Scale showed a small difference between the groups.

Table 5.10 provides a summary of these analyses of interaction effects between the two groups and their stage of development. This aspect of the results suggests that for each scale the differences between the two samples are consistent over Stages II to VI which show a slight numerical advantage for the normal group, except in respect of gestural imitation which shows an increasing

Table 5.9. Summary Tables of F. Values for Analysis of Variance between Retarded and Normal Populations, across 7 Scales

Variable	Error D. F.	F. Value	Significance of F.
(Multivariate Test)			
All Scales	7,109	25.75	.00001
(Univariate Tests)			
Object Permanence	1,92	25.73	.0001
Means-Ends	1,92	3.96	.06
Vocal Imitation	1,92	68.60	.00001
Gestural Imitation	1,92	62.42	.00001
Operational Causality	1,92	17.10	.001
Spatial Relations	1,92	2.30	.13
Schemes	1,92	0.04	.84

Table 5.10: Summary Table of F Values : Analysis of Variance according to Population x Stages of Development, across 7 scales

Variable	Error D. F.	F. Value	Significance of F.
(Multivariate Tests)			
Stage	1, 92	8.67	.0001*
Stage x Group	28, 448	4.60	.00001*
(Univariate Tests)			
Object Permanence	1, 92	2.75	.03
Means-Ends	1, 92	2.33	.06
Vocal Imitation	1, 92	0.83	.51
Gestural Imitation	1, 92	8.95	.00001*
Operational Causality	1, 92	1.03	.39
Spatial Relations	1, 92	1.63	.17
Schemes	1, 92	1.11	.36

advantage for the normal infants. It can be appreciated from Table 5.8 that the retarded group does not begin to succeed on this scale unless they have reached Stage V of the sensorimotor period, unlike the normal infants who begin to succeed at Stage III and show a large increment in scores at Stage IV and a consistent increase until Stage VI.

In summary, the analyses suggest a very different pattern of sensorimotor functioning in the retarded subjects. They show deficits in certain areas - especially in imitation and to a lesser degree on the Object Permanence and Causality Scales, yet in other sensorimotor areas their development is consistent across a single stage of functioning. The analysis of "stages" suggests that the retarded subjects functioning is characterised by increments in all scale scores at each successive stage except in the case of gestural imitation which is completely absent until Stage V.

In comparison with their performance in other areas the retarded subjects show considerably more ability in the Means-ends and Schemes Scales. This is particularly apparent at Stages III, IV and V for the Means-ends Scale where the retarded subjects' performance is actually in advance of normal infants.

5.3.2 Analysis II : Comparison of the Correlations among Scale Scores for Retarded and Normal Children at each Sensorimotor Stage

Kendall correlation coefficients were computed for both retarded and normal subjects separately, at each of the five sensorimotor stages. These values may be found in Appendix C.2. So much information was produced by this procedure that only the main trends and salient features of these results can be reported here.

The correlation matrices produced for the retarded and normal subjects across Stages II to VI suggested a very different pattern of results for the two populations. Normal infants showed strong inter-relationships among the scales across all stages. In contrast the inter-relationships among the scales for the retarded subjects were highly inconsistent showing both positive, negative and changing inter-relationships across stages. Whereas a definite trend emerged for the normal subjects, suggesting a high level of organisation among the various aspects of sensorimotor intelligence, the lack of any systematic interpatterning for the retarded subjects suggests disruption of organisation, although this effect is accentuated by the small number of subjects at each stage.

Correlations for the normal subjects were around .8 across all scales and stages. In a few instances highly significant negative correlations were produced by the retarded subjects e.g. -.89 between vocal imitation and means-ends, at Stage VI. Generally however correlations were low for the retarded subjects, merely indicating a lack of any relationship among the various abilities - this is particularly so for Stage II retarded subjects, for whom 9 coefficients out of the 21 produced were actually negative. Thus in the most profoundly damaged children, early intelligence is most disorganised. No correlations could be produced for the retarded subjects on the Gestural Imitation Scale until Stage V as subjects did not systematically obtain scores on this scale.

In summary, these results suggest that although normal infants may be classified into stages of development, the retarded subjects' development was not truly compatible with a stage-like progression, since development across the various scales, showed too great a degree of variability.

5.3.3 Analysis III : Factor Analysis of Results

A factor analysis of the correlation matrix for the retarded subjects was carried out which yielded two factors.

Tables 5.11 and 5.12 present factor loadings and commonalities (i.e. variance in common) and Figure 5.7 gives a graphical presentation of these results. Vo cal Imitation loaded completely and Gestural Imitation[1] showed the next highest loading on this factor. All other scales showed loadings of moderate strength. Thus factor 1 accounted for all of the variance in vocal imitation and most of the variance in gestural imitation. All scales except for the Imitation Scales showed high loadings on factor II. Vocal Imitation was not associated with this factor and Gestural Imitation was only weakly related to it. In contrast, factor analysis

1. Problems of interpretation described on p. 93 should be born in mind.

Table 5.11 Pattern of Unrotated Factor Loadings of Uzgiris-Hunt Scales for Retarded Children and Normal Infants

RETARDED

	Factor I	Factor II
Object permanence	0.48	0.74
Means-ends	0.34	0.79
Vocal Imitation	1.00	0.00
Gestural Imitation	0.55	0.20
Operational Causality	0.43	0.74
Spatial Relations	0.33	0.87
Schemes	0.53	0.67

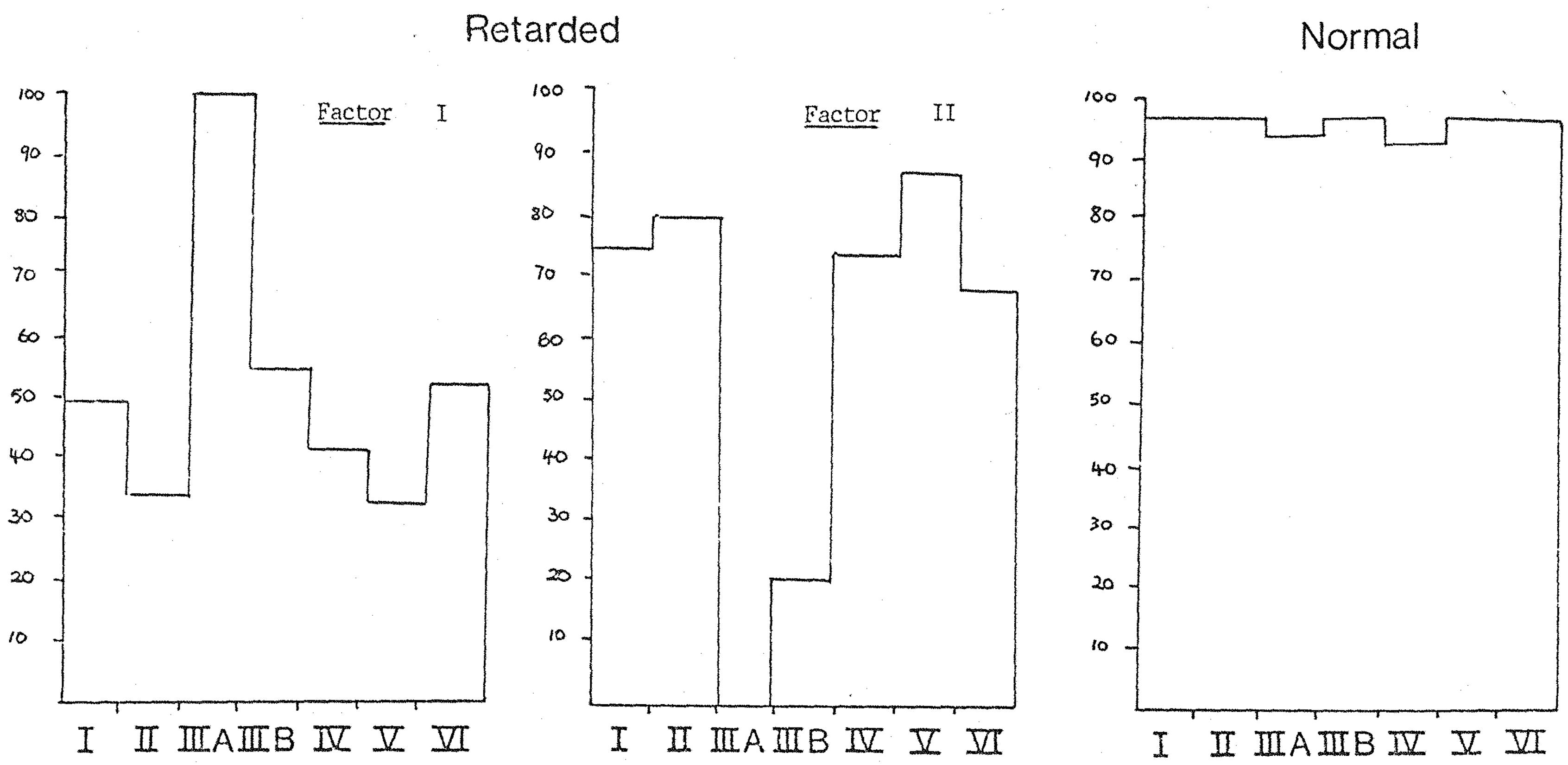
NORMAL

	Factor I
Object permanence	0.98
Means-ends	0.98
Vocal Imitation	0.95
Gestural Imitation	0.97
Operational Causality	0.93
Spatial Relations	0.98
Schemes	0.98

Table 5.12 Commonalities Obtained for Factor Analyses of Sensorimotor Intelligence in Mentally Handicapped Children and Normal Infants

	RETARDED	NORMAL
	Communalities obtained from two factors	Communalities obtained from one factor
Object permanence	0.77	.96
Means-end	0.75	.97
Vocal Imitation	1.00	.90
Gestural Imitation	0.34	.94
Operational Causality	0.74	.87
Spatial Relations	0.87	.95
Schemes	0.75	.96

Figure 5.7 Factor analytic composition of sensorimotor intelligence in retarded children and normal infants.



Key:
Scale I — Object Permanence
Scale II — Development of Means
Scale IIIA — Vocal Imitation
Scale IIIB — Gestural Imitation
Scale IV — Operational Causality
Scale V — Construction of Object Relations in Space
Scale VI — Development of Schemes

of the correlations for the normal infants yielded one factor. From the factor loadings for the scales given in Table 5.11 it can be seen that a common factor explains almost all of the variance on each scale.

In order to examine the development of sensorimotor intelligence and to investigate whether any changes in the pattern of abilities occurred in the normal infants factor analyses were carried out at each sensorimotor stage, over Stages II to VI. At each stage only one factor was found, however the factor loadings varied somewhat at certain stages with vocal imitation and operational causality demonstrating more independence.

At Stage II all scales had high loadings (.80 to .92) except in the case of vocal imitation which showed a moderate loading (.65) although generally most of the variance for all scales was accounted for by this general factor.

At Stage III all scales showed high loadings (.81 to .95) including vocal imitation, but the loading for gestural imitation was a little lower (.75). (The account given on p.93 should be noted).

At Stage IV all scales showed high loadings (.88 to .98) with the exception of the causality scale which produced little commonality (.39).

At Stage V operational causality showed less commonality with the other scales (.58).

At Stage VI vocal imitation, operational causality and spatial relations showed a little less commonality (.74 to .76) than the other scales (.91 to .96).

An attempt should be made to describe the two factors involved in the composition of sensorimotor intelligence in the mentally handicapped subjects. This is not easy. However, vocal imitation provides a clue as to the composition of the first factor, taking into account that whatever the Means-ends and Spatial Relations Scales measure, it is not associated with this factor, but with the second factor. Examination of the critical actions in these two scales shows both are similar with a high preponderance of visual-motor abilities - all of which involve either obtaining objects (means-ends) or following objects visually (spatial relations). Both scales involve visually guided reaching. Interestingly the vocal imitation scale is distinguished from all the other scales in that it does not involve a manual motor response. Its only motoric component is that involved in vocalisation.

In conclusion, the second factor may be associated with visual or perceptual-motor skills, in relation to objects in the environment. In contrast, the first factor is strongly associated with imitation and is a good predictor of vocal imitation. In the case of the normal infants no such dissociation occurs; development is proceeding in a unified wholistic fashion.

5.3.4 Summary of Results

(i) Retarded children showed depressed scores on the two Imitation Scales and Object Permanence Scale. The scores on the Causality Scale were also slightly lower than those shown by normal infants.

(ii) Inter-scale relationships for retarded subjects showed a lack of consistent organisation, compared to the high level of integration evident in the scale performance of normal subjects.

(iii) Retarded subjects' scale performance was accounted for by two factors, one mainly associated with imitation, the other appeared to involve a general sensorimotor ability dissociated from imitation. In contrast the performance of normal infants was accounted for by just one general factor.

5.4 Discussion

Comparison between Retarded Children and Normal Infants across 7 Uzgiris-Hunt Scales

The results of the preceeding analyses provide evidence for a different pattern of sensorimotor development in this sample of profoundly retarded children, to that found in the normal infants. Overall the retarded childrens' development is extremely uneven suggesting that many of them span several stages in terms of their functioning across the 7 scales. Their deficiencies in certain areas of cognition render their sensorimotor intelligence qualitatively different from that of normal infants. How important this difference is and what the consequences are for the retarded childrens' intellectual development may be better understood from a consideration of the nature of their deficits. It should be emphasised that their relative deficits are small compared to the overall extent of their retardation, but the existence of structural deficits may afford some insight into the essential nature of their deviant, intellectual development, which in the case of many of these children never reaches that equivalent of a 12 month old infant.

Results indicated that the greatest deficiencies relative to normal development occurred in imitation, both vocal and gestural and then object permanence and to a smaller degree in operational causality.

In the case of operational causality, one possible explanation for the relatively lower scores gained by the retarded subjects was the difficulty experienced by the examiner in the administration of the scale and interpretation of the subjects' responses. This scale has the least number of steps - only 7 and three of these steps involve deciding whether the child's response constitutes a "procedure" (Piaget ; 1936) which is defined as a self-initiated action which anticipates an outcome and is a generalization of a particular repetitive action to circumstances other than the one in which it originated. Another explanation for subjects' depressed scores on this scale might be due to their general passivity and a tendency not to demonstrate active responses to interesting events and spectacles, thus precluding the possibility of their responses qualifying as procedures.

With respect to object permanence there appears to be no obvious reason for subjects' deficiency - no special difficulties were encountered in the administration of the scale. In the case of the vocal imitation scale it could be argued that subjects' articulatory apparatus was inadequate; however administration of this scale requires that the vocalisations presented are in the repertoire of the child, so presumably the reason for their failure was not because they could not vocalise due to physical impediment. In the case of the gestural imitation scale, the content of items is determined in a similar fashion and the early items in the scale are supposed to be in the repertoire of the child. In view of the finding that the majority of retarded subjects did not succeed on even the first step in this scale the most obvious explanation might be the suggestion that they did not possess the necessary volitional motor control to match the presented item; although this is most unlikely it cannot be ruled out completely. Another explanation for the deficiency in both vocal and gestural imitation resides in the imitative act itself. A plausible hypothesis deriving from these results might involve the suggestion that severely mentally handicapped children are deficient in imitation, either because they cannot carry out the coding processes necessary to match their own responses with that of an auditory or visual model, or because they lack the intentionality or motivation to imitate another - which, it could be argued would depend upon perhaps on a degree of identification with, or appreciation of others and the desirability of imitating their acts.

Before more profound explanations for the finding of a deficit in imitation are explored and before discussing the significance of these findings, perhaps the most obvious explanation for the retarded subjects' lack of imitative ability involves the hypothesis put forward by both Woodward (1959) and Rogers (1977), that lack of vocalisation and imitation may be the consequence of institutionalisation. As the majority of the retarded children were living in institutions it is necessary to test this hypothesis. This issue, however, and the question of motor control will be dealt with in the following chapter.

The interaction effect found between 'population' and 'stage' of sensorimotor development and gestural imitation suggests that although Piaget's stages hold for the retarded subjects, their level of vocal imitation, object permanence and appreciation of causality are characteristic of earlier stages. However, in the case of gestural imitation, stages in development were not demonstrated - development in this area only occurred in one or two subjects who were at Stage V, and were not really apparent until Stage VI achievements in other sensorimotor areas had occurred. This is further evidence for the disruption of development in imitation.

Correlations and Factor Analysis of Sensorimotor Intelligence in Retarded and Normal Subjects

The effect of computing interscale correlations at each of the sensorimotor stages considerably reduced the size and number of relationships among the scales in the case of the retarded subject, but not for normal infants. This procedure did therefore reveal an important difference between the two populations not revealed by the correlation matrix produced for the whole sample. The lack of unity at each stage for the retarded sample in part reflects the small number of subjects and their limited scores, nevertheless the interscale relationships are too weak to be fully consistent with a stage-like progression. The fact that the performance of the retarded subjects is incompatible with Piaget's theory of stages does not however question the validity of comparing the two populations according to stages. In effect, this was equivalent to matching the two populations on three of the scales. This procedure appeared to be the only obvious means of comparison. It is because retarded subjects' performance is different from normal that finding a broad, common dimension is problematic. As development in the various sensorimotor areas is so uneven for the retarded subjects, individual performance cannot be characterised by one single stage of development. Although each stage of development was differentiated from the others, individual performance on all scales except Gestural Imitation spanned two or more stages. Thus horizontal decalages were greatly accentuated for the retarded subjects. This finding is rather inconsistent with Woodwards' (1959) conclusion that severely retarded children can be characterised in terms of Piaget's stages - as these individuals cannot be described in terms of one stage only. Woodward (1959) found a moderate degree of stage congruence; however her findings were probably influenced by the limited number of domains she examined.

These results are more in line with those of Rogers (1977) who found "unevenness", and less congruence among stage attainment across sensorimotor abilities for her sample of profoundly retarded children. Paradoxically, Inhelder (1968) predicted increased homogeneity in stage attainments across cognitive domains with increasing levels of retardation. The findings of this study and those of Rogers (1977) suggest rather, a picture of heterogeneity across sensorimotor domains for this population. The finding of a relative deficiency in gestural imitation as noted in Chapter 4 is also compatible with Curcio's (1973) data for autistic children. Curcio found a pattern of high scores on Means-ends and low scores on the Gestural Imitation Scale. This pattern may, as Curcio (1973) suggests, occur in populations with a high level of brain pathology. The finding that sensorimotor intelligence comprised two factors in the case of the mentally handicapped children, but just one in the case of normal infants also suggests some dissociation between imitation, especially vocal imitation and what appears to be perceptual-motor abilities in the mentally handicapped children. More information bearing on this however may be obtained from aspects of the investigation reported in the following chapter.

Before the theoretical implications of these findings are explored additional evidence is required in support of the interpretation that severely mentally handicapped children evidence cognitive deficits in specific areas which reflect a unique pattern of development.

As suggested above, one explanation which could account for the lack of imitation demonstrated by these children might be that it is the result of their being institutionalised. Alternatively, a simple explanation for the subjects' deficiency in gestural imitation could be that they do not possess adequate fine motor control. These hypotheses will be investigated in the next chapter.

5.5 Summary

(i) The performance of severely mentally handicapped children was compared with that of normal infants on the Uzgiris-Hunt (1975) Scales with 'stage' of sensorimotor development controlled.

(ii) Highly significant differences were found between the two populations in gestural imitation, vocal imitation and object permanence. A significant difference was also found in operational causality although this may have been an artefact of the administration of this scale. The largest deficiency in the mentally handicapped subjects was in imitation.

(iii) Correlational analyses for the two populations indicated the existence of much stronger relationships among sensorimotor abilities in normal infants, whereas mentally handicapped subjects showed a lack of consistent organisation, although this was somewhat reduced by the small size of n.

(iv) Factor analyses revealed a difference in the structure of sensorimotor intelligence for the two populations. In normal development the strong relationship among developing abilities was accounted for by just one factor - a general sensorimotor ability. In the mentally handicapped subjects, two factors emerged : vocal imitation and to a lesser extent gestural imitation loaded most heavily on the first factor. The other 5 Scales particularly Means-ends and Spatial Relations loaded on the second factor. Vocal Imitation was not associated with this second factor.

It was suggested that the two factor description of sensorimotor intelligence in the mentally handicapped might reflect a dissociation between systems involving imitation (particularly vocal imitation) and perceptual-motor skills involved in interaction with objects.

CHAPTER SIX

THE EFFECTS OF MOTOR HANDICAP AND INSTITUTIONALISATION ON COGNITIVE DEVELOPMENT IN MENTALLY HANDICAPPED CHILDREN

6.1 Introduction

The preceeding analyses suggested a different pattern from normal, in the sensorimotor development of severely mentally handicapped children. More specifically this sample of children was found to have a cognitive deficit in gestural imitation, vocal imitation and depressed ability in object permanence and causality. In order to be confident that these results do indeed provide a valid characterisation of cognitive structure in this population, it is necessary to take into account any variables which might differentially influence the retarded subjects. It is important to control for variables which might not be operative for the normal infants, or for dimensions on which the two populations differ - such variables might make the mentally handicapped subjects unrepresentative. Therefore, the aim of the analyses reported in this chapter was to consider potentially confounding variables and to control for their effects.

The Relationship between Motor Development and Sensorimotor Intelligence

Motor control seems an integral part of sensorimotor intelligence - many aspects of which involve actions towards objects and people in the environment. The nature of the relationship between motor development and sensorimotor intelligence, is rather complex and controversial, even in normal infancy. There is disagreement as to whether cognitive development occurs as a consequence of motor activity ; whether the two develop in parallel but are not causally related or whether they are synonomous at least during the first few months of life. At present, firm empirical data is sparse, on which definite conclusions could be based, and a full discussion of the issue is far beyond the scope of this thesis.

Discussion must therefore be restricted to the way in which motor control in severely mentally handicapped children may relate to their mental development. Suffice it to say that the assumption of a close link between motor and mental development has a long history as assessment of an infant's motor competence has, in the past, provided the main means of diagnosing retardation (Kopp, 1975) yet research on this is still in its early days.

Piaget's (1952, 1954) theory of sensorimotor intelligence reinforced the view that motor and cognitive development were intimately linked due to his emphasis on the active nature of intelligence in infancy. In later writings Piaget continued to stress action in development when he stated that in order to "know" objects an infant "must act upon them and therefore transform them : he must displace, connect, combine, take apart and reassemble them" (1970 ; p.704). There is some uncertainty as to whether "action" involves only motor activity or whether Piaget intended it to include the sensorimotor acts of looking and listening. However, both Piaget (1954) and Bruner (1966) have been criticised by Kagan (1971) who argued that the assumption of a close relationship between infant cognition and motor development may be an over-statement. Development of perception and cognitive structures may not necessarily depend upon motor activity. Kagan (1971) cites evidence for visual discrimination, rudimentary information processing and memory in infants (e.g. Jeffrey and Cohen, 1973). These abilities are present before the infant could have learnt them through motor interaction with objects in the environment.

Décarie (1969) has presented compelling evidence that infants without completely formed limbs such as thalidomide babies, acquire the object concept despite little experience in manipulating objects. Décaries' subjects compensated for their handicaps by using feet or mouth to substitute for hands. Decarie's evidence therefore is not necessarily inconsistent with Piaget's belief that activity and touch play a significant role in cognitive development, although it seems to suggest that perceptual and visual input may compliment motor activity and that all may contribute to the child's ability to search for objects on an "ideational" basis by the development of a representation of objects in space. Gratch (1980) points out that Piaget's view that touch tutors vision does not allow for the amount of information perceptually available about objects in the stimulus field and that this information may not depend on the prior existence of motor schemes to structure it.

Kopp (1975) has argued :

> "Too many professionals, for too long a period have conceptualized intelligence, particularly for the young, mainly in terms of voluntary, controlled motor behaviours".
> (1975; p. 151).

Kopp does however concede that motor development and cognition may be closely related, but that learning may still occur despite the absence of motor activity and object manipulation - as her study of an infant born with no limbs demonstrated. (Kopp and Shaperman, 1973).

Little is known of the relationship between the development of the motor system and cognition in severely mentally handicapped children, who appear diverse in the extent and variety of their sensorimotor and physical handicaps. As noted earlier, Woodward and Stern's (1963) study of the developmental patterns in severely subnormal children indicated that these children do not develop equally in different areas of ability. Locomotor development was significantly in advance of general sensorimotor intelligence which in turn was in advance of the development of speech.

The data obtained using the Uzgiris-Hunt Scales provides an opportunity to examine how motor ability relates to the different domains of sensorimotor intelligence, especially the fine motor abilities sometimes considered fundamental to sensorimotor intelligence. A methodological reason for examining the relationship between motor development and performance on the Uzgiris-Hunt Scales is that some items may be more dependent on motor ability than others. Thus, it is important to establish whether deficits in performance may arise as secondary effects of motor handicap.

The Effects of Institutionalisation

Rogers (1977) accounted for her subjects' inferior performance in imitation compared to object permanence, spatiality and causality "by the lack of responsiveness of the institutional environment" (p. 842) and Woodward and Stern (1963) suggested that their subjects' relatively greater retardation in speech might be the result of the unstimulating institutional environment. In the present study the majority of subjects were institutionalised - a factor which could potentially influence development in social-interactive areas. Both imitation scales assess social receptivity and the ability to engage in the activities of turn taking and reciprocation between child and adult. It is possible that children living in institutions may have multiple caretakers with consequent effects on their social development, imitative behaviour and language acquisition.

Balla and Zigler (1982) have pointed out that many studies comparing retarded, institutionalised persons and normal, non-institutionalised persons fail to distinguish between effects attributable to mental retardation and effects attributable to institutionalisation. Balla and Zigler (1982) suggest that the effect of institutionalisation has important implications for the 'developmental-difference' controversy. Weisz et al. (1982) found from their review of Piagetian evidence on this issue that the 'difference' position tended to be supported if institutionalisation was not controlled, whereas the 'developmental' position tended to be supported if it was. Balla and Zigler (1982) also emphasise the benefit of increased knowledge about institutional effects for both parents and professionals.

Several investigations have compared the performance of home-reared children with those reared from early in life in institutions, on various intellectual tasks. Some have studied normal individuals (e.g. Kohen-Raz, 1968 ; Paraskevopoulos and Hunt, 1971) others have looked at mentally handicapped individuals (e.g. Lyle, 1960 ; Shipe and Shotwell, 1965 ; McCormick, Balla and Zigler, 1975). Overall, home-reared children have been found superior, in their cognitive development and particularly in their linguistic ability. They also show less stereotyped self-stimulatory behaviours. The advantage which home-reared children have over institutionalised children has been found to persist even when home-reared children have been placed in an institution. (Matejcek and Langmeier, 1965 ; Shipe and Shotwell, 1965). In McCormick et al.'s (1975) study of resident-care in 19 institutions in the United States and 11 institutions in Scandinavia, living units for the severely retarded typically adopted more institution-oriented care practices. In contrast, King, Raynes and Tizard (1971) found no evidence of differences in care practices as a function of level of retardation. However, as McCormick et al. (1975) argue, it is intuitively plausible that profoundly retarded persons lack responsivity and provide less feedback than persons with higher intellectual ability, thus it would be easy for caretakers to become mechanical when responsivity is not evident. The issue of institutionalisation can be dealt with as one variable, but to deal with the complexities involved in such a global manner may neglect the differences between institutions. As Balla and Zigler (1982) point out :

> "Although this point should almost be self-evident, it is all too often overlooked. Institutions for retarded persons continue to be seen as uniform entities producing monolithic behavioural consequences".
> (1982; p. 46).

Variables which might be considered, include : the size of the institution - the structure (e.g. the size of the living units), demographic variables, care practices - i.e. institution-orientated or resident orientated, staff-patient ratio, staff turnover and type of staff - i.e. whether professionally trained or not. Evidence on the effects of these variables is rather inconsistent and inconclusive. King, Raynes and Tizard (1971) found care practices to be more resident-orientated in group homes and more institution-orientated in mental handicap hospitals, once type of institution did not affect care practices. Studies of normal infants suggest that differences between home-reared and institutionalised infants are mainly attributable to differing institutional practices and conditions - as, in well-staffed, stimulating institutions these differences are small. (Dennis, 1960 ; Rheingold, 1960, 1961 ; Moyles and Wolins, 1971 ; Paraskevopoulos and Hunt, 1971 ; Tizard and Rees, 1974) but in less-adequate institutions there is evidence over time for decreasing IQ's (Klaber, 1970 ; Tizard and Tizard, 1971).

Therefore, it appears that institutionalisation may have a deleterious effect on cognitive development, depending on the conditions and practices of the institution involved.

In view of this and in view of both Rogers' (1977) and Woodward and Stern's (1963) hypotheses cited above it is possible that living in an institution could differentially influence development in different cognitive domains. If this is so, imitation would appear to be a prime candidate for such detrimental effects. In order to control for the possibility that such effects were not responsible for the pattern of results found, institutionalised children were compared with home-reared subjects in terms of their scale scores. Furthermore, as the data had been collected at two institutions which differed in size, locality and staffing, a comparison between them was considered potentially informative, as, if the same pattern of results was observed for subjects from both locations, then they would be less likely to reflect factors related to any one particular institution.

Summary of Aims of Part 3 of the Study

(i) To examine the correlations between motor development and the sensorimotor domains measured by the Uzgiris-Hunt Scales in order to ascertain whether motor development is differentially related to the various sensorimotor abilities.

(ii) To establish whether or not the hypothesis 'that severely retarded subjects do not imitate gestures because they do not have adequate motor control' has any validity.

(iii) To gain a better understanding of the relationship between motor development and sensorimotor intelligence in this population.

(iv) To compare scale profiles of institutionalised versus home-reared children.

(v) To obtain a measure of reliability of the results by comparing scale profiles for the two different institutions involved.

6.2 Method

Design

This part of the study comprised three analyses, of which only analysis I involved additional data collection. Both analyses II and III involved re-organisation and reanalysis of the data already collected in part one of the study.

Subjects

Analysis I : involved the whole sample of 45 subjects, pooled over both hospitals where the study had been carried out.

Analysis II : In a second analysis, the 45 subjects were divided into institutionalised or home-reared groups of 30 and 15 subjects respectively.

Analysis III : The 45 subjects were divided into two samples of 25 and 20 subjects each defined according to the institutions they attended.

Materials

The motor scale of the Bayley (1969) Scales of Infant Development was used in Analysis I (see Appendix D). This scale was designed to measure overall body control, co-ordination of the large muscles and fine manipulatory skills. According to Bayley (1969), the scale is not concerned with "mental" or cognitive abilities but concentrates specifically on motor control. Bayley's (1969) Manual was used. Other materials and apparatus used in the motor assessment were : a low table, a one-inch cube, a plastic ring and string, two teaspoons, sugar pellets, a ball, rattle, string, a pull toy, a walking board and staircase.

Procedure

Analysis I

Administration of the Motor Scale was carried out in the children's classrooms which enabled access to corridors and stairs in accordance with the detailed instructions set out in Bayley's (1969) Manual.

Appendix D gives the Motor Scale - the items of which are divided up into 'situation codes'. According to this system, items which involve similar body postures or positions are grouped together. for facilitation of administration. The Scale was administered according to situation codes (A - R) as this method of administration is more economical and efficient. The order was kept constant for all subjects. Each item was administered according to the individual instructions suggested by Bayley in the instruction manual, (see Bayley, 1969; pp. 82-98). Most of the testing was carried out solely by the experimenter, however, in some cases the teachers of the children provided assistance. The teachers also gave information and guidance about the children's capabilities and accomplishments. Recording was carried out on a pass/fail basis against each item number.

Scoring Procedure

Scoring was according to the instructions set out in the Manual, see Bayley (1969 ; pp. 31-33) ; that is, the basal level (the item number immediately before the first failure) was added to all subsequent passes. Thus, a raw score was obtained for each subject which was the total number of items passed irrespective of how many items were failed between the basal and ceiling levels.

For normal infants the raw score is converted to a Psychomotor Development Index (PDI) by referring to tables based on age norms which take into account the infant's raw score and age. For the purposes of this study such a procedure would not have been appropriate, and as Bayley (1969) notes, in the case of the mentally retarded a direct estimate of level of functioning is more informative. Therefore the raw score was used as an index to subject's overall motor score.

The Bayley score as usually derived, collapses fine motor skills and gross locomotor control, aspects of development which in normal infants may show a systematic relationship to one another. However, in the case of individuals with specific handicaps, information may be lost by adopting such a scoring procedure. An index for both fine and gross motor control was considered desirable and therefore each subject was allocated two motor scores, one which indicated the number of passes for gross motor items and one which indicated the number of passes for fine manipulative items. As Bayley grouped the motor items according to situation codes the two types of motor control were easily differentiated. All subjects therefore received three scores indexing their total motor control, their gross motor control and their fine motor control.

Analysis II

This comparison involved reorganising the cognitive data on the Uzgiris-Hunt Scales according to whether subjects were living in institutions or at home with their parents.

A two-way, 1 x 7 ANOVA design was employed which also controlled for stage or level of development.

Analysis III

This comparison involved partitioning the cognitive data according to the institution the subjects attended. This analysis was a two-way, 1 x 7 ANOVA design which controlled for developmental stage.

6.3 Results

6.3.1 Analysis I : Correlation between Motor and Cognitive Development

Kendall's tau coefficient for ordinal data was used to construct a correlation matrix between the 3 motor assessments and Uzgiris-Hunt Scale scores. These are presented in Table 6.1 overleaf. For greater clarification Figure 6.1 presents graphical representations of the percentage of variance in Uzgiris-Hunt Scale scores accounted for by each type of motor assessment.

It can be seen from the correlation matrix that overall correlations ranged from a negligible τ .06 between gross motor control and gestural imitation to a fairly high figure of τ .74 ($p < .001$) between fine motor control and operational causality, the mean coefficient was .48 ($p < .001$). All correlations were significant at .001 level except in the case of the two imitation scales. Again, interpretation of the Gestural Imitation co-efficients is

Table:6.1 Correlations between Motor Assessments and Cognitive Development for severely and profoundly mentally handicapped children

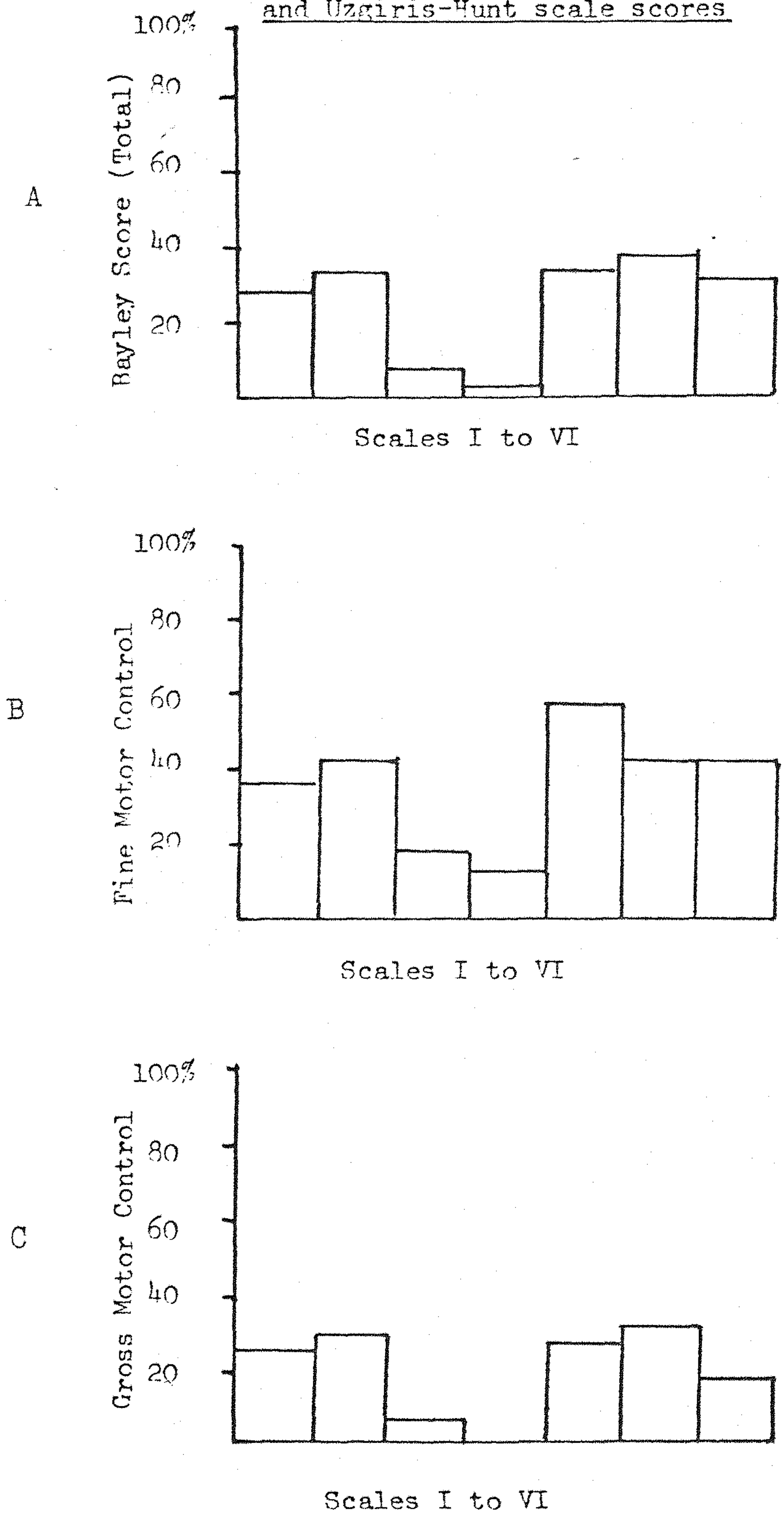
	I	II	IIIA	IIIB [1]	IV	V	VI
Total	.50**	.53**	.23*	.12	.53**	.55**	.47**
Fine motor	.60**	.66**	.40**	.34*	.74**	.65**	.65**
Gross motor	.48**	.51**	.20	.06	.50**	.54**	.44**

** $p < .001$
* $p < .01$

Key:
Scale I — Object Permanence
Scale II — Development of Means
Scale IIIA — Vocal Imitation
Scale IIIB — Gestural Imitation
Scale IV — Operational Causality
Scale V — Construction of Object Relations in Space
Scale VI — Development of Schemes

1. Interpretation is difficult for this Scale as most subjects did not obtain a score.

Figure 6.1 Variance in common between the Bayley scores and Uzgiris-Hunt scale scores



Key for Scales from left to right.

Scale I — Object Permanence
Scale II — Development of Means
Scale IIIA — Vocal Imitation
Scale IIIB — Gestural Imitation
Scale IV — Operational Causality
Scale V — Construction of Object Relations in Space
Scale VI — Development of Schemes

problematic for the reasons already discussed on page 93.

These scales did produce significant correlations with fine motor control. ($p < .01$). This is plausible as fine motor control of the 3 motor assessments, showed the strongest correlation with all of the Uzgiris-Hunt Scales. Correlations between the total raw Bayley motor score and the 7 scales ranged from an insignificant .12 for Gestural Imitation to a moderate .53 ($p < .001$) for both the Means and the Operational Causality scales. The fairly weak co-efficient of .23 for Vocal Imitation suggests that some of the scales depend more heavily on motor control than others. Finding a relationship between motor control and Means-ends and Causality is important because in the case of Means-ends, subjects gained their highest scores, yet on Causality, performance was found to be significantly depressed. This pattern seems to suggest that although both scales may require adequate motor competence, in the case of the Causality scale performance is not dependent on motor ability alone.

The mean coefficient was $\tau = .42$ ($p < .001$), thus on average 18% of the variance in scale scores is accounted for by variance in overall motor control. Although highly significant, this figure is still quite low suggesting that motor control is not a very powerful predictor of sensorimotor intelligence in this population. A large amount of variance in scores remains unaccounted for, which in turn suggests that the Uzgiris-Hunt Scales, are tapping other abilities that are perhaps more 'intellectual' in nature.

Although comparison of the co-efficients for the Gestural Imitation Scale with those obtained for the other Scales is problematic as this ability was present in a very small number of subjects, in the case of Vocal Imitation, the lower correlations are an important finding, as they suggest that deficits are unlikely to be explained simply as deficits in motor ability. The lowest coefficient produced by the fine motor score was .34 ($p < .01$) with Gestural Imitation and the mean coefficient for all scales with fine motor control was a moderate .58 ($p < .001$). The relatively strong relationship between fine motor control and Operational Causality which accounts for 55% of the variance in scores, has implications in that scales which were more depressed than Causality (i.e. the Imitation Scales and Object Permanence) actually show the least relationship to fine motor control. This is illustrated in Figure 6.1.

Therefore imitation and object permanence appear to be less dependent on fine motor control than any of the other scales and fine motor competence is not predictive of performance on these scales although it is a significant contributory factor in the case of Operational Causality.

Subjects' gross motor development and locomotory capabilities were less related to their sensorimotor intelligence than was their fine motor control. Coefficients ranged from $r = .06$ for gestural imitation to $r = .54$ for spatial relations. That gross body control should show the strongest relationship to the Spatial Relations Scale seems quite plausible in that it might be anticipated that the ability to move around in space and control one's posture and orientation should be related to an understanding of the relationship between objects in space.

Age Equivalents :

Up to this point, the question of the age equivalence of scale scores has been avoided, as it would not have been particularly illuminating. However, in the context of comparing motor and cognitive development, relating both aspects of development to age 'norms' for comparative purposes only is potentially informative. Therefore results were converted to approximate age equivalents.

It is possible to arrive at "psychomotor age" equivalents from the raw motor scores on the Bayley Scale as norms are given in the Bayley Manual. In order to arrive at an approximate mean psychomotor age for this sample the median score for each type of motor assessment was used. By looking across the columns corresponding to a Psychological Development Index of 100 and by taking the age group which has the nearest raw score to that obtained by the subjects, equivalent mean motor ages were obtained.

Although age-norms are not important in Piagetian theory and there are no formal age-norms for the Uzgiris-Hunt Scales, mean Uzgiris-Hunt Scale scores can be related to approximate age norms. Dunst (1980) has presented estimated developmental ages (EDA's) for the Uzgiris-Hunt Scale items. These were computed from all available sources of empirical evidence on normal infants(e. g. Uzgiris and Hunt 1975 ; Pinard and Laurendeau, 1969). These are estimated "modal" ages at which the scale steps are ordinarily achieved.

As the developmental age norms given by Dunst are not based on a proper standardized sample, their use has been restricted to this aspect of the study only, as a guide to ascertain whether motor development is in advance of cognitive development in this population. On all scales subjects appeared to be functioning at an age of around 5 months, although this was considerably lower for the imitation scales and in the case of Means and Schemes, level of ability was more in line with subjects' motor age.

The means and standard deviations for the motor assessments are given together with their corresponding age equivalents from Bayley (1969) in Table 6.2. below.

Table 6.2. Means and Standard Deviations of Motor Assessment in Raw Scores and Months

	TOTAL	GROSS	FINE
Mean	30.34	22.46	8.16
S.D.	17.13	13.13	4.67
Approx. M.A.	6.9	6.5	9.7

It can be seen that fine motor skills are developmentally more advanced than are gross, locomotor abilities. Subjects' fine motor control is approximately equivalent to an infant of 9.7 months, whereas their gross motor control averages to a developmental age of 6.5 months, a finding perhaps partly attributable to the prevalence of spasticity and paralysis in the lower limbs in these children.

In conclusion, results suggest that these subjects are

Table: 63 Means and standard deviations of Uzgiris-Hunt Scale scores: Institutionalised versus Home-reared children

		I	II	IIIA	IIIB	IV	V	VI
I	Mean	4.69	6.69	2.45	0.59	2.55	4.90	5.38
	sd	4.52	4.27	2.26	1.94	1.84	3.30	3.42
D	Mean	4.21	4.86	1.93	0.43	2.86	4.79	5.79
	sd	4.28	3.82	1.82	1.16	1.75	3.33	2.75

I = Children living in Institutions
D = Children living at home

Key:
Scale I – Object Permanence
Scale II – Development of Means
Scale IIIA – Vocal Imitation
Scale IIIB – Gestural Imitation
Scale IV – Operational Causality
Scale V – Construction of Object Relations in Space
Scale VI – Development of Schemes

Table 6.4. Summary Table of F values : Analysis of Variance between Institutionalised Versus Home-Reared Children on the Uzgiris-Hunt Scales

VARIABLE	ERROR D.F.	F. VALUE	SIGNIFICANCE OF F
Multivariate Test			
Institutionalisation	7.27	3.24	<.05 *
Univariate Tests			
Object Permanence	1, 33	0.18	0.68
Means-ends	1, 33	3.85	0.06
Vocal Imitation	1, 33	0.95	0.34
Gestural Imitation	1, 33	0.03	0.86
Operational Causality	1, 33	4.10	0.05
Spatial Relations	1, 33	0.09	0.77
Schemes	1, 33	3.25	0.08

developmentally more backward in those aspects of sensorimotor intelligence which do not depend purely on motor actions.

6.3.2 Analysis II : The Effects of Institutionalisation on Uzgiris-Hunt Scale Scores

Table 6.3 presents the Means and standard deviations of the scale scores for institutionalised children and children living at home. A two-way multivariate analysis of variance controlling for sensorimotor stage of development showed a significant overall difference between institutions.

In order to ascertain which scale or scales were producing this difference between the samples, univariate analyses of variance were performed on the data. Table 6.4 summarises this information. It can be appreciated from Table 6.4 that the overall variance is contributed mainly by the causality, means-ends and schemes scales, and although the difference between the two groups almost reaches an acceptable significance level in the case of the causality scale this is not less than .05. Therefore the two groups do not differ significantly on any one scale. The difference between the two groups on the Means-ends Scale favoured the institutionalised subjects and the difference on the Causality and Schemes Scales favoured the home-reared children. Of more relevance to the concerns of this study, the two samples did not differ on the two Imitation Scales or on the Object Permanence Scale. In fact the greatest amount of similarity in scale scores between the two groups was found for Gestural Imitation (see Table 6.3). No other differences were found. Small n precluded controlling for potential confounding of institutionalisation and type of institution; two analyses were necessary.

6.3.3 Analysis III : Comparison between Institutions

Table 6.5 presents Means and standard deviations for samples from the two institutions. Figure 6.2 gives a graphical representation of the means. A two-way multivariate analysis of variance, controlling for stage showed no significant differences at the .01 level, however a small difference, significant at the .05 level was found. Table 6.6 provides a summary of the F values found by these analyses. Univariate tests indicated

Table 6.5. Means and Standard Deviations of Uzgiris-Hunt Scale Scores : Institutions 'A' and 'B'

	SCALES	I	II	IIIA	IIIB	IV	V	VI
A	Means	4.04	6.25	2.46	0.33	2.21	4.63	4.96
	%	28.86	48.08	27.33	3.67	31.57	42.09	49.60
	S.D.	3.36	4.41	2.34	1.17	1.64	2.89	3.25
	%	24.00	33.92	26.00	13.00	23.43	26.27	32.60
B	Mean	5.16	5.90	2.05	0.79	3.21	5.16	6.21
	%	36.86	45.38	22.78	8.78	45.86	46.91	62.00
	S.D.	5.48	3.97	1.84	2.23	1.87	3.76	3.05
	%	39.15	30.54	20.44	24.78	26.71	34.18	30.50

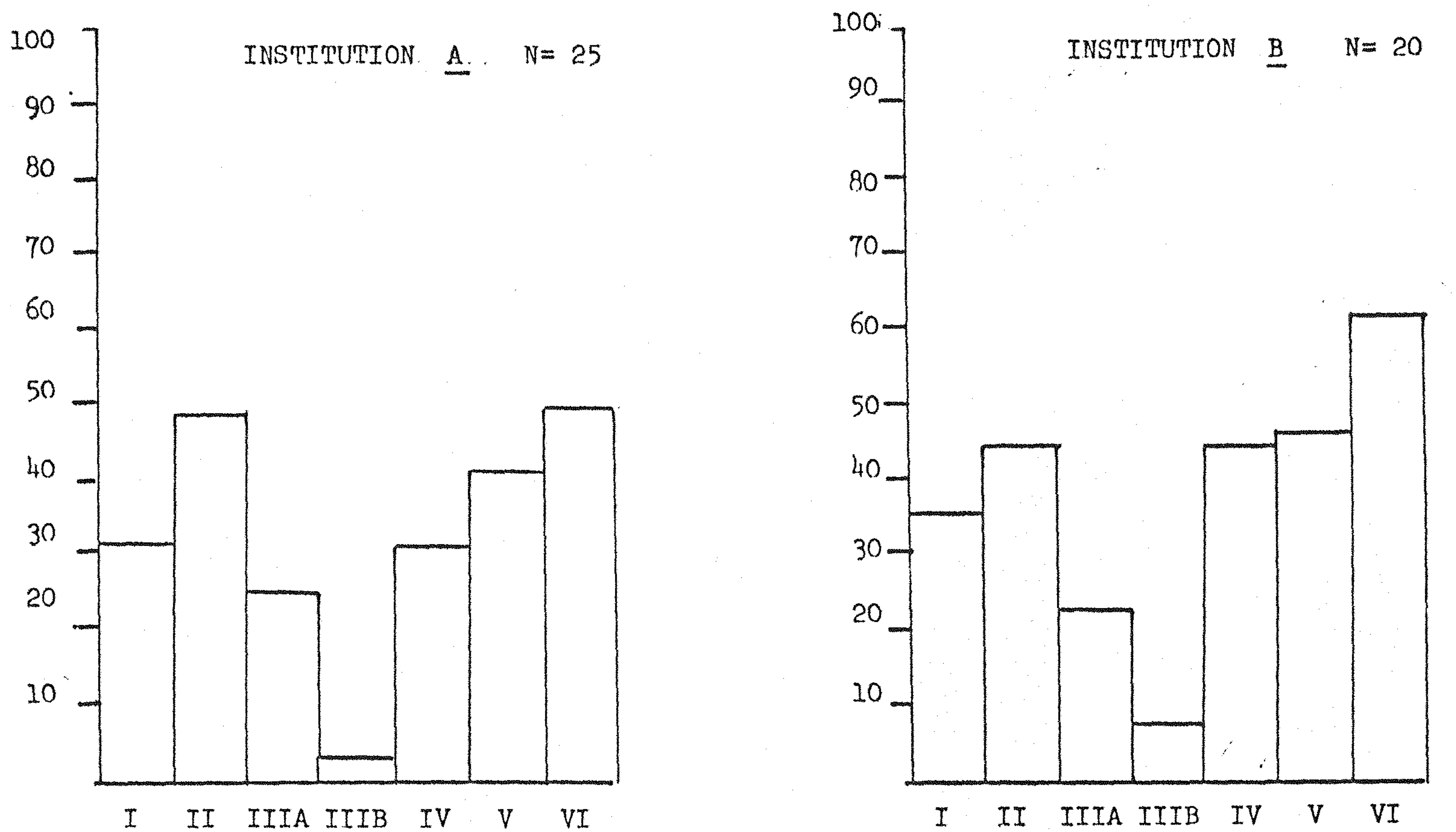


FIGURE 6.2 Comparison of mean scale scores (expressed as%s) for retarded children living at different institutions.

Key:

Scale I	—	Object Permanence
Scale II	—	Development of Means
Scale IIIA	—	Vocal Imitation
Scale IIIB	—	Gestural Imitation
Scale IV	—	Operational Causality
Scale V	—	Construction of Object Relations in Space
Scale VI	—	Development of Schemes

Table 6.6. Summary Table of F Values : Analysis of Variance between Samples : Institutions A and B

VARIABLE	ERROR D.F.	F VALUE	SIGNIFICANCE OF F
Multivariate Test			
Institution	7, 27	3.21	.05 *
Univariate Tests			
Object Permanence	1, 33	0.06	0.81
Means-ends	1, 33	0.01	0.91
Vocal Imitation	1, 33	5.12	0.03
Gestural Imitation	1, 33	0.20	0.66
Operational Causality	1, 33	11.13	0.01
Spatial Relations	1, 33	0.01	0.89
Schemes	1, 33	4.88	0.03

that the two samples differed significantly on three scales, Operational Causality, Vocal Imitation and Schemes. The largest difference between the two groups was on the Causality Scale ($p < .01$) which was consistent with the finding that home-reared children were slightly superior on this scale as most of them attended Institution B. The two samples were remarkably similar in their scores on the Gestural Imitation and Object Permanence Scales.

In view of the fairly small sample sizes at each stage, some variation in profiles might be expected. In order to ascertain why these differences had occurred the means at each stage for the two institutions were examined for the three scales in question. It was found that all differences occurred at the extremes of the developmental range. For the Causality and Vocal Imitation Scales the differences between samples occurred at Stages II and VI and on the Schemes Scale at Stage II. This suggests that differences were produced due to the small number of subjects within each stage and the wider range of scores that occurs at Stage II and Stage VI.

In conclusion, the small differences between subjects and the two institutions may be viewed as reasonable variation that might be expected among such heterogeneous populations, rather than reflecting variables associated with particular institutions. The similarity between the two populations in their overall pattern of scores supported the conclusion that the two sets of results provided a measure of reliability, particularly for the deficiency in Imitation and Object Permanence.

6.3.4 Summary of Results

(i) A relationship was found between cognitive and motor development, however this was weak in the case of the Vocal Imitation Scale.

(ii) Fine motor control was developmentally in advance of gross motor development and both types of motor development were in advance of cognitive development.

(iii) The deficit in Imitation was not attributable to institutionalisation as home-reared children showed similar deficiencies to institutionalised children.

(iv) Comparison between institutions provided reliability for the main findings.

6.4 Discussion

Relationship between Motor and Cognitive Development

From the results of the correlational analyses it is possible to conclude that for these mentally handicapped subjects motor control is a significant factor, accounting for a quarter of the variance between scores in the case of five of the Uzgiris-Hunt Scales. In the case of the Vocal Imitation Scale, motor development was more weakly related to performance, than was the case with the other Scales. With respect to Gestural Imitation, again little can be inferred due to the prevalence of zero scores. The differential involvement of motor ability in the Uzgiris-Hunt Scales increases our understanding of the abilities being assessed. The greatest contrast is between the Means and Causality Scales, and the two Imitation scales, suggesting that the former two scales are four times more likely to be measuring abilities partly dependent on motor control than the Imitation scales.*

Generally however, subjects perform best on those scales which show the greatest relationship to motor development. This is consistent with the finding that when overall mean sensorimotor level of functioning and mean motor scores are converted to estimated developmental ages, motor development is in advance of cognitive development. Fine motor skills in this sample appear to be characteristic of a higher developmental level than their gross, locomotor development. The most obvious explanation for this finding is the prevalence of spasticity in the lower limbs - many severely handicapped children maintain some motor control in their arms but become confined to wheelchairs, thus gaining more experience in fine manipulation using their hands. Subjects' fine motor control was characteristic of infants almost twice as old as their 'mental age' equivalent. Although only an estimate, this finding is consistent with the general pattern of results which seems to suggest differential impairment of sensorimotor abilities.

* Problems of interpreting Gestural Imitation must be born in mind.

It seems unlikely therefore that the deficit in gestural imitation can be attributable to a lack of fine motor skills.

The proposition that the Imitation and Object Permanence Scales may be measuring sensorimotor domains which are qualitatively distinct from other sensorimotor skills and which are more vulnerable to disruption as a consequence of damage to the CNS than other sensorimotor abilities, must be made with caution. However such a proposal appears to be a direct implication of these results. Furthermore, the results suggest that the skills measured by the remaining scales depend to a relatively greater extent on contributions from motoric and experiential aspects of development, which in turn leads to the hypothesis that Imitation and Object permanence may be relatively more directly linked to conceptual aspects of sensorimotor intelligence. Indeed there is empirical evidence in support of the notion that imitation may be an innate ability in humans (Moore and Meltzoff, 1976) and that object permanence and vocal imitation are more related to biological than environmental factors (Uzgiris , 1975).

This pattern of results suggests severely mentally handicapped children are more advanced in their motor development than their overall cognitive development. In their cognitive development there is evidence of a considerable deficit in specific domains, most notably in Vocal and Gestural Imitation. Woodward and Stern (1963), using different measures found locomotor development to be in advance of general sensorimotor intelligence which was in advance of speech development. Thus, Woodward and Stern's (1963) sample of severely sub-normal children showed relatively much greater retardation in speech than would be expected from their sensorimotor stage of development. This may reflect a similar developmental deficit to that found for Vocal Imitation in the present study.

In general then, the deficits in imitation, relative to other sensorimotor abilities that were observed in the severely mentally handicapped children cannot be explained as a simple consequence of other motor deficits. The question whether institutionalisation may be responsible will be considered next.

Comparison between Subjects living in Institutions and those living at home

The main purpose of comparing institutionalised and home-reared children was to test the hypothesis that the Vocal and Gestural Imitation deficit was partly a function of institutionalisation.

The finding that no differences existed between institutionalised children and those living at home in their imitative ability justifies rejection of this explanation for the deficiency. Therefore, it may be assumed that the deficiency in imitation is a characteristic of severely mentally handicapped children, as no other obvious explanations are available. No other differences between the two groups were found except for a small (non-significant) difference favouring Stage II home-reared children on the Causality scale.

It seems unlikely that home-reared children and children at one of the institutions were more proficient in their appreciation of causality as a function of rearing conditions, as such rearing conditions might be expected to promote gestural imitation also. Both scales measure the child's interest in and response to events created by another person and behaviour in familiar game-type situations.

Although no significant differences were found between institutionalised and home-reared children among these severely mentally handicapped children this cannot be taken to imply that the institutional environment has no deleterious effect on other populations. It may be that the subjects in this study were so profoundly mentally handicapped that variations in environmental input has relatively little influence on their cognitive development. Whereas more mildly mentally handicapped individuals may be more receptive or sensitive to environmental variations. Therefore results are not necessarily generalisable to mentally handicapped populations other than the more severe categories.

Overall what is most striking is the similarity in the pattern of results produced by both the institutionalised and home-reared subjects. If the heterogeneity of this population is taken into account, it is surprising that none of the differences between groups for any one scale reached conventionally acceptable significance levels. It appears then that results have some generalizability to severely mentally handicapped children as a population, regardless of where they are living.

In conclusion, on the basis of the preceeding results, it appears that sensorimotor intelligence in this population is structurally deficient in Vocal and Gestural Imitation and Object Permanence.

6.5 Summary

(i) Subjects' deficiency in gestural imitation was found not to be attributable to inadequate motor development. Motor development was significantly related to performance on the Uzgiris-Hunt Scales, but for Vocal Imitation this relationship was weaker.

(ii) A significant relationship was found between fine motor control and performance on all of the Uzgiris-Hunt Scales, however in the case of the two Imitation scales this relationship was much weaker. Problems of interpretation arose for Gestural Imitation.

(iii) Fine motor skills were developmentally more advanced than overall motor development and both types of motor development were in advance of general sensorimotor intelligence.

(iv) Comparison between institutionalised children and children living at home indicated that the deficiency in their imitative skills was not a function of institutionalisation. A similar pattern of scale scores was found for institutionalised and home-reared children.

(v) Overall, a similar pattern of scale scores was found for children at two different institutions. Variations which did occur did not involve either the Imitation or Object Permanence scales.

(vi) The results were interpreted to reflect particular structural deficits in sensorimotor intelligence in severely mentally handicapped children in imitation and object permanence.

CHAPTER SEVEN

PILOT STUDY : TRAINING IN OBJECT PERMANENCE AND IMITATION

7.1 Introduction

The description of sensorimotor intelligence that emerged from the foregoing analyses suggests that severely mentally handicapped children have cognitive deficits. Subjects were relatively deficient in object permanence and in imitation. One practical implication of this finding might be to attempt to reduce the discrepancy among the various sensorimotor domains. Each child's performance on the Uzgiris-Hunt Scales might indicate where intervention should be implemented.

Given that the present study has been conducted within a Piagetian framework - the proposed intervention necessarily involves at least a temporary acceptance of Piaget's description of normal development and the assumption that a model of normal intellectual development may be applicable to severely mentally handicapped children. However, the discovery of structural deficits suggests that severely mentally handicapped children may be deviant in their cognitive development. A fundamental issue for special education and a most pertinent one for theoretical psychology is whether or not anything can be done to correct this.

Hobbs (1975) has suggested that a major weakness in the field of special education is lack of comprehensive theoretical systems for selection of behaviours to be trained, which provide criteria for subsequent evaluation of the intervention. Haring and Bricker (1976) have pointed out the advantage of Piaget's theory is that it allows evaluation of general forms of responding that transcend specific situations, materials and individuals. It is one of the few comprehensive theories to have direct application to intervention programmes with the mentally handicapped. Robinson and Robinson (1976) have drawn attention to the paucity of research in this area.

> "Particularly lacking have been efforts to attempt to remediate cognitive deficiencies of retarded children by various educational means. In view of the very rich and detailed research literature which has explored cognitive functioning in normal children according to the systematic framework of Piaget it is difficult to account for the lag ...

in such research with retarded subjects".
(1976 ; p. 253).

7.1.1 Rationale for Employment of the Uzgiris-Hunt Scales to Programme Planning and Evaluation

The Uzgiris-Hunt (1975) Scales seem particularly useful to the construction and evaluation of training programmes, because sequences of steps, which may be viewed as critical indices of cognitive growth are clearly specified. They provide a system for selecting relevant and appropriate cognitive targets which are clearly described in behavioural terms. Gallery and Hofmeister (1978), emphasising that tests and assessment instruments should be clearly linked to treatment suggested that the term "treatment validity" be used to "describe those properties of a test which relate to its ability to facilitate effective instructional procedures". (1978 ; p. 105).

As Gallery and Hofmeister (1978) argue, intelligence tests provide little information on what should be taught or what the child specifically needs to learn, i. e. they lack treatment validity. They propose that unless the responses required in the treatment are similar to those required in the test, the treatment lacks content validity. The changes that result from the treatment may not be relevant to, or measured by the test. The literature in the area of mental handicap contains numerous criticisms of intelligence tests as instruments for evaluating intervention studies. (Wachs 1970 ; Robinson and Fieber, 1974).

The Uzgiris-Hunt Scales appear to have direct educational relevance - because they are based on a theory of cognitive development, they do have treatment validity. Their treatment validity is however, more questionable in the case of the severely profoundly handicapped - as noted earlier their use in intervention rests on accepting that the normative model of development is the "correct" one for these individuals. Since other comprehensive and appropriate systems on which to base curriculum planning are scarce, many professionals advocate that a developmental approach holds the greatest promise (Baldwin, 1976 ; Bricker & Bricker, 1976 ; Haring and Brown, 1976).

Perhaps the three most important tenets of this approach are :

(i) behaviour develops from simple to more complex forms ;

(ii) disequilibrium produced by environmental changes is necessary for the development of new adaptive behaviours, and (iii) there is a sequential order in development which is invariant and universal. (Bricker, Seibert and Casuso, 1980).

Bricker et al. (1980) have pointed out that Piaget's postulates regarding the universal and invariant nature of development do not lay emphasis on 'maturation' but rather, the sequential and hierarchical nature of development is governed by the logic of the interactional process. Complex levels of understanding must logically be preceeded by more simple, prerequisite forms. Thus, development does not involve the unfolding of pre-determined structures as a function of maturation, but rather the critical feature is interaction with the environment. Knowledge of the experiences necessary to this interaction might suggest appropriate environmental intervention.

The approach adopted in the present study draws on two major sources. The overall framework which specifies what behaviours to train is Piaget's theory, in the form of the Uzgiris-Hunt Scales which provide a structure for the intervention. The second source is the behavioural approach with its emphasis on means for changing behaviour by controlling antecedent stimulus events. Such an integration of cognitive and behavioural approaches to intervention has its precedents in earlier studies. (Bricker & Bricker, 1973; Bricker and Bricker, 1977; Cohen, Gross & Haring, 1976).

Mentally handicapped children are frequently unable to produce the critical response despite repeated presentation of the eliciting stimulus. By incorporating a variety of more specialised procedures derived from learning theory, into the training these children may be assisted in acquiring the desired response. Such procedures may include verbal or physical prompting, cueing, modelling and praise

As Bricker et al. (1980) note :

> "The point to be emphasized is that there are a variety of instructional strategies that will have to be used repeatedly in helping young handicapped children acquire new responses".
>
> (1980 ; p. 242).

Numerous studies have demonstrated that imitative behaviours may be trained in normal and handicapped children using instrumental conditioning techniques (e.g. Garcia, Baer and Firestone, 1971; Waxler and Yarrow, 1970).

One advantage of using a Piagetian framework for intervention programmes is that the theory of development permits a variety of experimental materials to be used, providing they are functionally appropriate for the eliciting conditions. An important consideration in programme planning for the individual profoundly handicapped child is the question of how training materials may be adapted, modified or even substituted in order to compensate for, or surmount the effects of their own special physical or sensory handicaps. One to one, individual training is the most appropriate and effective approach to intervention with profoundly handicapped children. (Bricker and Iacino, 1977) have pointed out that as full-time trainers are rarely available and removing a child from class for an hour of training per week is unlikely to be successful - they recommend that :

> "those individuals (e.g. teachers and parents) who have repeated or continuous contact with the child should be trained to deliver the necessary services".
> (1977 ; p.170).

Bricker and Iacino (1977) emphasise the need to train other individuals within the classroom setting. There are a number of reasons in favour of teachers acting as trainers. By enlisting the active participation of the childrens' regular care-takers, they are more likely to be co-operative and to support the intervention. Training then becomes an integral part of the complex daily environment. Another reason for having assistance from supportive personnel in the classroom or on the ward is that children receive training on a daily basis which might otherwise be impracticable.

7.1.2 Rationale for Intervention in the Development of Imitation and Object Permanence

The review of the literature presented in Chapter 2 indicated that no published study has trained mentally handicapped children on Uzgiris & Hunt's Vocal and Gestural Imitation Scales. Henry (1977) reported some success of parental training of very young mentally handicapped children, on these scales, but this is rather a different population from the older, institutionalised profoundly handicapped children in the present study. Kahn (1976) carried out a training study in object permanence with four severely mentally handicapped children and his results require replication. Furthermore, the children were young compared to the subjects of the present investigation.

Object permanence and imitation were selected for training primarily because these abilities had been found deficient, and, by attempting to train them more information might be obtained regarding the nature of this deficit. Previous studies (Brassell and Dunst, 1976, 1978 ; Kahn, 1977) had already suggested that it might be possible to train object permanence and this gave a further reason for choosing this scale as one of the areas for intervention.

The Role of Imitation and Development of the Object Concept in Cognitive Development

There are theoretical reasons for attempting to train imitation and object permanence, which relate to the significance and importance of these abilities in cognitive development. A more complete discussion of this topic is presented in the final chapter of this thesis which deals with the theoretical implications of the results. Here, a general background will be given.

According to Piaget (1952) the ability to construct an internal representation of the world is the direct result of developments in imitation. Imitation is thought to constitute the accommodation pole of the child's adaptation to environment. It provides a visible, external index to a process which later relates to imagery, representation, play, dreams and figurative knowledge. It is from the figurative aspect of intelligence that the capacity for symbolism is thought to develop. Piaget's theory is primarily a theory of cognitive development and he does not present a separate account of linguistic development but it is from the semiotic function that language develops. Thus, there is a theoretical link between imitation and linguistic development.

Kahn (1983) has recently found that the Object Permanence and the two Imitation Scales predict adaptive behaviour (ABS) and language (REEL) development. Thus deficits in imitation may represent precursors of linguistic deficits - so characteristic of the severely mentally handicapped. (O'Connor and Hermelin, 1963 ; Lenneberg, 1967). Therefore, a small pilot study was designed to determine whether older profoundly mentally handicapped children could be trained on the Object Permanence and Vocal and Gestural Imitation Scales of Uzgiris and Hunt's instrument.

7.2 Method

Subjects   Out of twenty subjects attending one of the institutions, seven were randomly assigned to the experimental group and the remaining thirteen were assigned to the control group.

Experimental Group   This consisted of five females (females out-numbered males in the subject pool) and two males. Their mean age was 11.1 years. A full description of the subjects' medical history is presented in Table 7.1.

Control Group   Of the thirteen control subjects, eight were female and five were male. Their mean age was 11.8 years.

As a check on the similarity between the experimental and control groups it was ensured that the two groups were comparable on the following points : age range, mean age, and mean scale scores on the Uzgiris-Hunt Scales (see Table 7.2). All subjects were drawn from the sample - whose etiologies were tabulated in Chapter 3. Control subjects showed a variety of etiologies:

Classification	No. of Cases
Cerebral Palsy	5
Microcephaly	2
Hydrocephaly	1
Anoxia	1
Rubella	1
Steroid damaged	1
Unknown Brain Damage	2

Materials

The Imitation Scales did not require materials. For training object permanence the following materials were used : 3 screens made of cotton cloth, one plain, two patterned. A variety of toys were used, depending on which toy was attractive to a particular child. A supply of chocolate buttons were also found useful in some cases. Record forms were used to record all training sessions. These were designed to record the subjects' name, the date, the type of training, the scale step to be trained, a specification of the critical action necessary for a

Table 7.1. Description of Experimental Subjects' Medical Histories

Sub.	Sex	Age	Etiology	Personal Characteristics	Sensory Handicaps	Birth Weight	Epilepsy	General Information	Parents known to be normal	Normal Siblings Known
LB	F	5	Cerebral Palsy			5lbs			✓	2
NB	F	14	Partial trisomy, translocation of chromosome 18 onto chromosome 20	Deformed toes. Poor peripheral circulation	Hard of hearing	5lbs			✓	2
JF	F	12	Brain damaged (neonatal cerebral haemorrage)		Squint	3lbs 4oz		Multiple spike and wave EEG abnormalities	✓	
DL	M	15	Birth Anoxia		Bilateral Strabismus			Difficult birth with partial asphyxia. Intensive care for a few months. Mother - right hemiparesis	✓	2
PR	M	17	Cerebral Palsy	Spastic quadraplegia Grand Mal epilepsy	Short-sighted & squint	10lbs		Paraplegia moderate in arms. Substantial doses of anti-convulsants at age 5	✓	
ES	F	5	N/K	Hypotonic; continual involuntary arm/leg thrusts		4lbs		Young mother (16) kept her pregnancy a secret until day of birth		
DW	F	14	Spina bifida meningocele & myelocele	Flaccid paraplegia Spitz Holter valve		N.K.		Definite signs of brain damage according to medics report	✓	

	EXPERIMENTAL							CONTROL						
	I	II	IIIA	IIIB	IV	V	VI	I	II	IIIA	IIIB	IV	V	VI
MEAN SCALE SCORE	5.0	7.7	3.0	1.0	3.0	5.5	6.0	4.5	6.2	1.8	0	2.1	5.1	5.9
AGE RANGE (YEARS)	5 - 15							4 - 17						
MEAN AGE	11.1							11.8						

Key:
* * Scale I — Object Permanence
* Scale II — Development of Means
* * Scale IIIA — Vocal Imitation
* * Scale IIIB — Gestural Imitation
* Scale IV — Operational Causality
* Scale V — Construction of Object Relations in Space
* Scale VI — Development of Schemes

Table: 7.2 Mean Uzgiris-Hunt Scale scores, mean age and age range of Experimental and Control subjects.

response to be considered successful and space for recording the number of presentations, the number of passes or fails and any other response made by the subject.

Design

The study was designed to examine the effects of training a small group of subjects, directly on the Object Permanence, Vocal and Gestural Imitation Scales, in a repeated measures design. Re-assessment after each type of training occurred on all of the Uzgiris-Hunt Scales.

Thus, the overall design of the study was straightforward: initial assessment or pre-test on all seven of the Uzgiris-Hunt Scales, then intervention in one domain for 10 weeks, followed by re-testing on all seven scales, followed by intervention in another domain, then re-testing on all scales and so on in the case of each of the experimental subjects. Table 7.3 shows the design of the intervention study. The control subjects were tested on the Uzgiris-Hunt Scales the same number of times and on the same occasions as the experimental subjects, however they did not receive any training in object permanence or imitation. Thus all subjects were administered the Uzgiris-Hunt Scales four times, over a period of approximately 16 months. The trainers were : the experimenter (who was involved in training each subject throughout each training block) and, during term-time, the teachers and teaching assistants. During school holidays the nurses on the childrens' wards took over from the teachers.

Although intervention studies carried out as part of everyday institutional activities have the advantage of ecological validity, they have the disadvantage of being difficult to control due to the number of variables in operation and the need to co-operate in the administration and day-to-day running of the establishment. The experimenter attempted to give each subject a minimum of 30 presentations of the item being trained per week. The amount of training given by individual teachers varied somewhat, but the experimenter attempted to compensate for this. All subjects were trained daily by their teachers and twice a week by the experimenter.

Although the experimenter provided some training continuity, as it was not possible to ensure that the ten week training blocks always fell within term-time so nurses were also shown how to administer programmes for the brief periods when the training blocks continued into

Table 7.3. Design of Intervention Study

		BLOCK I 10 wks	BLOCK II 10 wks	BLOCK III 10 wks
EXPERIMENTALS	S_1LB	VI	OP	GI
	S_2NB	VI	GI	OP
	S_3JF	OP	VI	GI
	S_4DL	VI	GI	OP
	S_5PR	GI	OP	VI
	S_6ES	OP	VI	GI
	S_7DW	GI	OP	VI
CONTROLS	S_8			
	S_9			
	S_{10}			
	S_{11}			
	S_{12}			
	S_{13}			
	S_{14}			
	S_{15}			
	S_{16}			
	S_{17}			
	S_{18}			
	S_{19}			
	S_{20}			

KEY :

OP - Training in Object Permanence

VI - Training in Vocal Imitation

GI - Training in Gestural Imitation

▨ - Testing on the Uzgiris-Hunt Scales

the school holidays. Both teachers and nurses were given demonstrations of the training procedures. At the end of the intervention subjects were rated-blind on the Scales by a second examiner (familiar with Piaget's theory and infancy). Reliabilities indicated perfect (100%) agreement for trained scale steps.

Training : General Methodology and Procedure

Each child had his/her own programme which involved training one scale step only at any one time. For each child there were two sets of record forms, one used by the experimenter, the other was kept permanently in the classroom, in the care of the teacher responsible for ensuring that the programmes were carried out daily. Thus the training carried out by the experimenter and by the teachers took place and was recorded separately. The record forms gave instructions for presenting the item to be trained.

Before the first training block the experimenter gave a demonstration to all the teachers and assistants involved in the project, of how each child's programme should be administered. Each trainer then carried out 5 presentations to the subjects in their care, while both experimenter and teachers recorded the child's performance independently. This provided a means of checking the trainers understood the criteria for critical actions. Inter-observer reliability showed perfect concordance.

In the case of the scale steps for object permanence, these are clearly specified and involve training increasingly complex hidden object retrieval problems. However, the Imitation Scales do not specify the actual vocalisation or gestures to be presented. Selection of vocalisations and gestures, depended on the repertoires of the individual children involved.

Before training imitation the experimenter observed and interacted with each individual and recorded his manual and facial gestures and vocalisations. The childrens' teachers were also consulted as some children tended to use very specific vocalisations. For the steps based on familiar vocalisations only those which the children had been heard to utter at least once were selected. Later steps are based on unfamiliar sound patterns and words - only sounds which the children had not been observed to vocalise were included. The selection of gestures followed a similar procedure, although in later scale steps an important criterion is that the child should not be able to see himself perform the gesture. For these items facial expressions which the children had not been observed to make were selected, such as raising the eyebrows and eye-blinking. Tables 7.4 to 7.6 present descriptions of the scale

Table 7.4. Scale Steps Trained in Training Block I

Subject	Scale	Step	Description	Vocalisation & Gestures Selected
LB	VI	3	Vocalising similar sounds in response to model cooing sounds	Ab-Ab Ba Ba
NB	VI	5	Vocalising similar sounds in response to models babbling sounds and shifts to match model	Ma Ma Ma Ba Ba Ba
JF	OP	8	Finding an object following a series of visible displacements	
DL	VI	3	Vocalising similar sounds in response to models cooing sounds and shifts to match model	Ah Ya Ahya Eeyu-Eeyu
PR	GI	2	Imitating a familiar simple scheme	Waving
		4	Imitating a complex action composed of simple schemes	Shaking a box containing blocks
ES	OP	1	Visually tracking a slowly moving object in an arc of 180o. Reduced to sub-step	
DW	GI	6	Imitating an unfamiliar gesture visible to the child	Peekaboo
		8	Imitating one invisible gesture immediately	Eye blinking
		9	Imitating several invisible gestures immediately	Smacking lips Protruding tongue Raising eyebrows

Table 7.5. Scale Steps Trained in Training Block II

Subject	Scale	Step	Description	Vocalisations and gestures selected
LB	OP	5	Finding an object which is completely hidden	
NB	GI	4	Imitating a complex action composed of simple schemes	Banging pegs together
		6	Imitating an unfamiliar gesture visible to the child	Patting legs
		8	Imitating one unfamiliar invisible gesture	Opening/Closing mouth
JF	VI	3	Vocalising similar sounds in response to models cooing sounds and shifts to match model	Hmmm Fee-fee Da-da
DL	GI	2	Imitating a familiar simple scheme	Clapping hands Ringing bells
PR	OP	7	Finding an object completely covered in 3 places	
ES	VI	3	Vocalising similar sounds in response to models cooing sounds and shifting to match models	Ah Ooh
DW	OP	14	Finding an object following a series of invisible displacements	
		15	Finding an object following a series of invisible displacements by searching in reverse order of hiding	

Table 7.6. Scale Steps Trained during Training Block III

Subject	Scale	Step	Description	Vocalisations and Gestures selected
LB	GI	8	Imitating one invisible gesture immediately	Pursing lips to blow kisses
		2	Imitating a familiar simple scheme	Clapping hands
		7	Finding an object completely covered in 3 places	
		8	Finding an object under 3 superimposed screens	
NB	OP	10	Finding an object following one invisible displacement with 2 screens	
		11	Finding an object following one invisible displacement with 2 screens alternatively	
		12	Finding an object following one invisible displacement with 3 screens	
		13 & 14	Finding an object following a series of invisible displacements	
JF	GI	2	Imitating a familiar simple scheme	Patting legs Clapping hands
DL	OP	5	Finding an object which is completely covered	
ES	GI	8	Imitating one invisible gesture immediately	Smacking lips together (i.e. blowing kisses)
DW	VI	9	Imitating new words directly	

items (critical actions) which were trained in the three training blocks. The number of presentations of an item being trained was recorded, usually after a block of five presentations. In any one session the number of presentations ranged between five and twenty-five, with a median of fifteen presentations. Training of an item was discontinued if the subject succeeded in performing the critical action on 3 successive presentations. When a subject had succeeded in meeting this criterion, a new programme was based on the next step in the scale.

Conversely if repeated failures occurred and there was no indication of any change or approximation towards a successful response, then the task was either broken down into smaller steps or replaced by an easier one. Such modifications are presented in Table 7.7. It was found that programmes frequently required modification, either in content, materials, or procedures. Feedback from the teachers also contributed to this process. Training usually took place in a quiet corner of the child's classroom. In one classroom, other children were ambulatory and tended to be noisy, so subjects were taken to a quiet room. The child was seated opposite the trainer, facing away from the classroom which was screened off and all materials and toys other than those required were removed. The trainer first played with the child in order to heighten his responsiveness and receptivity to the training session. Trainers were instructed to obtain the subject's attention before beginning to present the item to be trained. The specific instructions for presentation of each item which were given to trainers, may be found in Appendix D.

Table 7.8 gives a description of the general training techniques used. These included cueing, prompting, strong physical prompting, modelling and reinforcing. All successful responses, or approximations towards successful responses were reinforced using praise and/or hugs. Successful responses-defined as critical actions, were clearly specified on each child's record form.

7.3 Results

Two measures of progress were collected :

(i) Detailed records of the training in terms of the number of successes and number of presentations recorded by the experimenter and teachers during the training period.

Table 7.7. Modifications made to the Experimental Subjects Training Programmes

Name	Scale	Step	Training Block I	Scale	Step	Training Block II	Scale	Step	Training Block III
LB	VI	3	Different vocal-isations tried - content changed	OP	5	Task changed to train a pre-requisite step. Reaching and touching a doll.	GI	8 2	Training imitation of facial expression discontinued as it was unsuccessful
NB	VI	5	Different vocal-isations.tried content changed	GI	4 6 8		OP	7	Toys were sub-stituted for choc-olate as this found more effective. Set cloths substituted for nested cups which had to be removed from child to prevent her becoming absorbed in them
JF	OP	8		VI	3	Different vocal-isations tried - content changed	GI	2	
DL	VI	3	Highly distract-able. Had to be removed to quiet room	GI	2	Not due to lack of interest in gestures - sub-stituted for ringing bells	OP	5	The toys substituted for biscuits
PR	GI	2 4	Gestures were changed until it was discovered that child would only imitate two specific gestures i.e. waving and shaking due to his spasticity	OP	7	Screens were substituted for 3 cupboards as child would open cupboards but not remove screens. Very bright objects were used due to poor eye sight.	VI		Lost from study
ES	OP	1	Task of tracking was reduced to training visual fixation on object by using a brightly coloured squeezy toy	VI	3		GI	8	Facial expressions trained as child more interested in faces and social inter-action. Poor motor control hypertonic.
DW	GI	6 8 9		OP	14	Ceiling. Trained more sophisticated search. e. g. swopping hidden screen around one of which occluded object.	VI	9	Ceiling of scale. Increasing the fre-quency of imitating new words

* For description of scale steps refer to tables.

Table 7.8. Description of Techniques used during Training of Steps on the Object Permanence, Vocal and Gestural Imitation Scales

ENCOURAGEMENT	Mainly conveyed by tone of excitement and urgency in voice
VERBAL PROMPT	OP - e.g. "Where is it Nicki?" "Nicki find it, give it to me". GI - "Look Nicki" "Nicki do it". VI - e.g. "Nicki say it".
CUEING	OP - Pointing. Using eyes to indicate where the object is hidden. Looking from the child's face to where it is hidden. GI - Nod and look towards the appropriate part of the child's body. VI - Look intently at the child's mouth.
PROMPTING	OP - Pointing, or touching the cloth where the object is hidden. GI - Touching the child's arm or mouth etc. VI - Touching the child's mouth
STRONG, PHYSICAL PROMPTING	OP - Taking the child's hands, making him reach the object. GI - Making the child perform the gesture by moulding his arms, mouth etc. VI - Mould the child's mouth
MODELLING	Demonstrating the critical action.
REINFORCEMENT	Verbal : Praise, e.g. exclaim "Good girl". Physical: Hugs and kisses. Material : Biscuits, chocolate buttons.

(ii) Pre- to post-test increments on the Uzgiris-Hunt Scales - this represented a more formal measure of the effects of the training.

7.3.1 Correspondence between Experimenter and Teachers' Records of Training as a measure of reliability of intervention procedures

Tables 7.9 to 7.11 present information regarding the correspondence between the Experimenters' and the Teachers' trials in terms of their success, for the Object Permanence, Vocal and Gestural Imitation Scales. Figure 7.1 gives a graphical representation showing the correspondence between the experimenter and teacher's records. This represents the frequency of successful trials for each item trained. Twenty-one items are plotted on this graph. It can be appreciated from Figure 7.1 that quite a high level of correspondence exists between the ratio of successful trials to total number of trials for the experimenter and teachers. A Spearman Correlation for ranked data indicated that the correlation between the experimenters' and the teachers records was highly significant (rho = .92, $p < .0001$). A coefficient of .92 is particularly high in view of the many factors which might be expected to contribute to performance variability.

Therefore although the experimenter was responsible for carrying out the post-tests which could potentially introduce experimenter bias in that the experimental subjects were known to the tester, quite persuasive evidence against this suggestion may be construed from the close correspondence found between the experimenters and teachers' frequencies which represent two independent accounts of the steps acquired during training, by the experimental subjects.

7.3.2 Overall Results of the Intervention Study

Table 7.12 presents the number of gains made by experimental and control subjects on the scales which were trained. These figures represent increments measured directly after the relevant type of training. Table 7.13 presents the total number of gains shown by the experimental subjects on all scales, over the total training period. Figure 7.2 presents this information in graphical form.

It can be seen from Table 7.12 that the experimental subjects showed many more gains on the Object Permanence and Gestural Imitation Scale than the control infants, but not for the Vocal Imitation scale. A serious limitation of ordinal scales as a research tool is that data

Table 7.9. Frequencies of Successful presentations over number of Trials Recorded by Experimenter and Teachers in Vocal Imitation Training

		Frequencies (%) of successful responses = (no. of successes / presentations)		Total Number of Trials	
Subject	Step	Experimenter	Teachers	Experimenter	Teachers
LB	3	-	-	180	220
NB	5	5	16	210	110
JF	a	-	-	130	120
	3b	4	6	100	80
	c	30	25	10	20
DL	3	-	-	205	46
ES	3	47	76	270	435
DW	9	54	-	180	

Table 7.10. Frequencies of Successful Presentations over Number of Trials, Recorded by Experimenter and Teachers in Gestural Imitation Training

		Frequencies (%) of successful responses = (no. of successes / presentations)		Total Number of Trials*	
Subject	Step	Experimenter	Teachers	Experimenter	Teachers
LB	2	7	6	166	204
	8	-	-	80	160
NB	4	30	26	140	90
	6	6	11	90	50
	7	43	38	60	80
JF	2(a)	3	0	100	110
	(b)	2	2	100	100
DL	2	32	52	270	110
PR	4	48	-	150	-
ES	7	85	89	260	465
DW	6	38	40	45	10
	8	43	53	10	30
	9	60	50	40	114

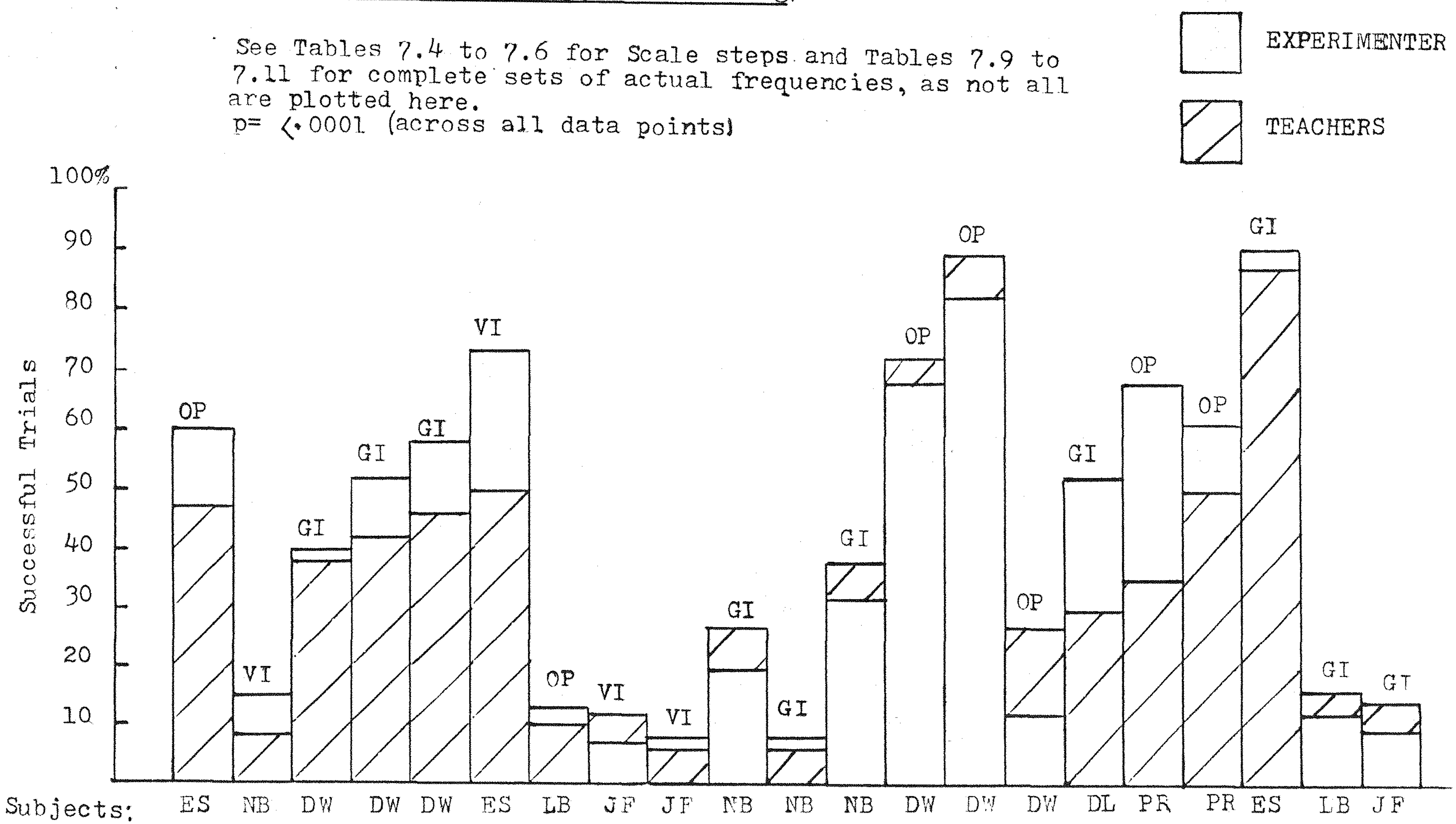
* The number of trials vary mainly because once a subject passed an item he would move on to the next item. It was not possible to maintain a fixed number of trials as holidays did not fall equally in the three phases of training, also variations occured on account of absenteeism due to sickness. PR was lost from the study due to pneumonia. Fewer trials were given in Object Permanence as this type of training took longer than training in Imitation. There was no relationship between learning and the number of trials.

Table 7.11. Frequencies of Successful Presentations over Number of Trials, Recorded by Experimenter and Teachers in Object Permanence Training

Subject	Step	Frequencies (%) of successful responses $= \left(\frac{\text{no. of successes}}{\text{no. of presentations}}\right)$		Total Number of Trials	
		Experimenter	Teachers	Experimenter	Teachers
LB	Sub-Step	10	14	240	210
	5	4	5	43	70
NB	7	60	80	20	18
	8	12	32	60	10
	10	63	-	10	
	11	30	30	40	55
	12	30	-	20	
	13, 14	29	33	40	43
JF	8	-	-	90	20
DL	5	1	6	190	42
PR	Sub-Step	33	65	80	40
	7	43	60	30	40
ES	Sub-Step (1)	40	58	150	293
DW	14	77	70	30	10
	14_1	100	87	10	30
	14_2	37	20	30	10

Figure 7.1 Training Data: Relationship between Experimenter's and Teachers' Successful Trials. (Expressed as percentages of total no. of trials for each scale step: across Subjects and type of Training).

See Tables 7.4 to 7.6 for Scale steps and Tables 7.9 to 7.11 for complete sets of actual frequencies, as not all are plotted here.
p= <.0001 (across all data points)



RESULTS OF TRAINING

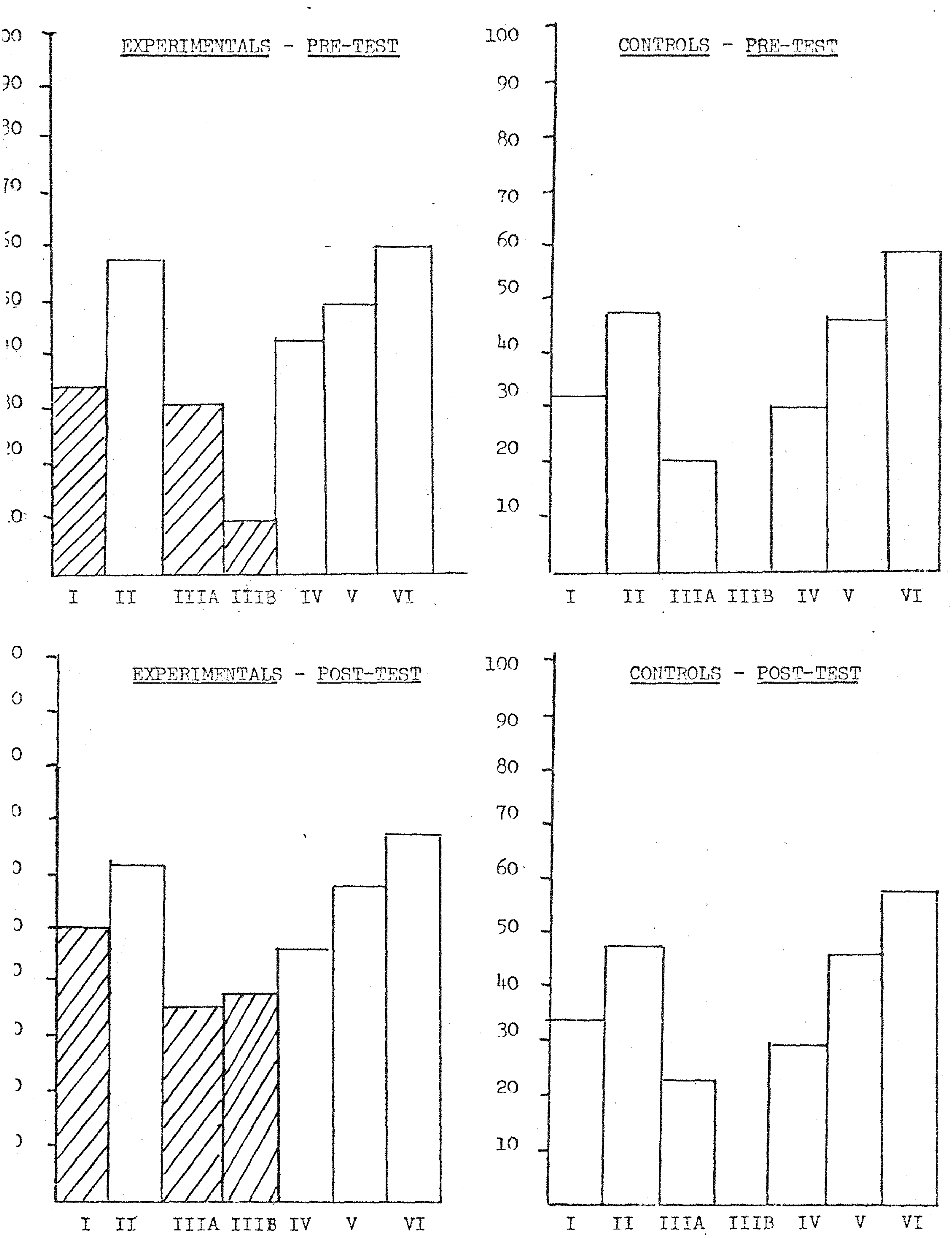
Table 7.12 Gains made from pretest to post-test: Trained Scales

U-H Scales	Experimental Group	Control Group
OP	9	2
VI	2	3
GI	16	0
	n = 7	n = 12

Table 7.13 Gains made by Experimental Group on all scales

	I	II	IIIA	IIIB	IV	V	VI	T
ES	0	0	1	7	1	3	3	15
LB	3	3	0	0	0	1	1	8
JF	0	0	0	1	0	0	0	1
NB	7	0	0	4	1	0	0	12
DW	1	0	1	4	0	2	1	9
DL	1	0	0	0	0	0	0	1
							Total	46
							Control total	5

Key:
Scale I — Object Permanence
Scale II — Development of Means
Scale IIIA — Vocal Imitation
Scale IIIB — Gestural Imitation
Scale IV — Operational Causality
Scale V — Construction of Object Relations in Space
Scale VI — Development of Schemes



Key:

Scale I	— Object Permanence	Scale IV	— Operational Causality
Scale II	— Development of Means	Scale V	— Construction of Object Relations in Space
Scale IIIA	— Vocal Imitation		
Scale IIIB	— Gestural Imitation	Scale VI	— Development of Schemes

Figure: 7.2 Total number of gains (expressed as %s) on all scales: Pre and post-training tests for Experimentals and Controls.

analysis according to scale increments is precluded. The data was therefore analysed according to the number of subjects who showed increments in the two groups.

As a whole, over all three training blocks the number of experimental subjects who increased their scores on the three scales trained was significantly greater than the number of control subjects who increased their scores on any of the seven scales. Table 7.14 presents these figures (Fishers p = .043) :

Table 7.14 Number of Subjects who showed Gains in Scale Scores : Comparison between Experimentals and Controls, according to Training Block

* p <.05

	No. of subjects who gained		No. of subjects who did not gain	
	E	C	E	C
BLOCK I	4	3	3	10
BLOCK II	4*	1	2	10
BLOCK III	3*	1	3	9
TOTAL	11	5	8	29

Only one experimental subject failed to obtain an increment on any of the three scales, whereas eight out of eleven control subjects showed no increments in scale scores. Thus, for a significant number of the experimental subjects the training was successful in that a cognitive increment was brought about whereas similar increments were not observed in the control subjects.

7.3.3 Differential Effectiveness of Training in Object Permanence, Vocal Imitation and Gestural Imitation

Table 7.15 presents the number of experimental and control subjects who achieved gains on the three scales :

Table 7.15. Number of Subjects who Showed Gains in Scale Scores : Comparison between Experimentals and Controls for Scales which were Trained, according to type of training

	No. of subjects who gained		No. of subjects who did not gain	
	E	C	E	C
Object Permanence	3*	1	3	10
Vocal Imitation	2	2	4	8
Gestural Imitation	4*	0	3	10
TOTAL	9	3	10	28

* $p < .05$

Figure 7.3 presents a graphical representation of the number of gains made by the two groups which were directly trained. Table 7.16 presents the pre-training and post-training scale scores and the increments shown by the experimental subjects on the three scales in which they received training. A series of Fisher exact probability tests was performed on the data. Significantly more subjects in the experimental group than the control groups made gains on the Object Permanence Scale. (Fishers' $p = .029$). Three out of six experimental subjects improved their performance on the Object Permanence Scale, whereas the number of experimental subjects who improved in Gestural Imitation was significantly different from the number of control subjects. (Fishers' $p = .015$). Four out of seven of the experimental subjects increased their scores on this scale whereas none of the controls showed any improvement. In terms of the number of gains in scale steps, this type of training was apparently the most effective. A total increment

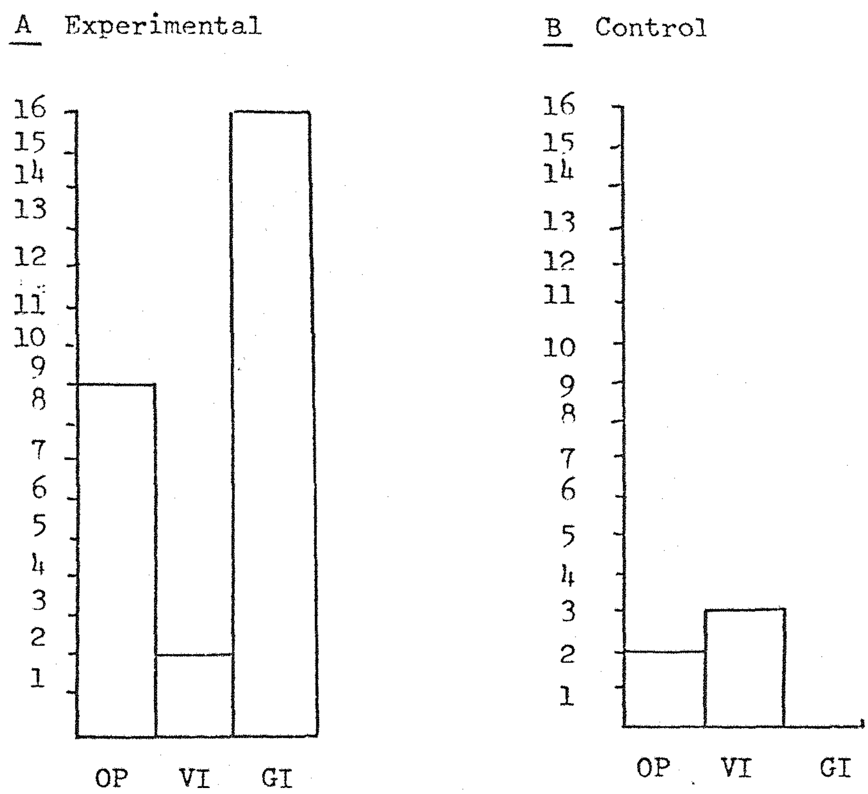


Figure: 7.3 Number of steps gained by Experimentals and Controls on the Object Permanence, Vocal Imitation, and Gestural Imitation scales.

Table 7.16. Pre-Test and Post-Test Scale Scores for Individual Subjects on those Scales which were Trained

		OP	VI	GI	Total Subject Gains
LB	Pre	2	2	0	3
	Post	5*	2	0	
NB	Pre	7	4	3	11
	Post	14	4	7	
JF	Pre	7	2	0	1
	Post	7	2	1	
DL	Pre	3	2	0	1
	Post	4*	2	0	
ES	Pre	0	2	0	8
	Post	0	3	7	
DW	Pre	13	8	5	6
	Post	14	9	9	
Total Scale Gains		12*	2	16	30

KEY :

OP - Object Permanence

VI - Vocal Imitation

GI - Gestural Imitation

* - 3 gains occurred prior to training

of 16 steps was obtained which seems a particularly large increase compared to a gain of only two steps in Vocal Imitation.

Caution should be exercised however, in assuming from these results that the training in Gestural Imitation was the most effective type of training, as 15 out of the 16 gains were obtained by three of the subjects, suggesting an interaction effect between individual subjects and type of training. In order to test for differential effects of the three types of training, a One-way Repeated Measures ANOVA was performed on subjects' scores. No significant differences were found in the variance of scale scores among the three types of training; $F(2, 11) = 2.86$, N.S. Therefore, the differences in total gains among the types of training appear to be largely determined by differences amongst the subjects, as One-way ANOVAS subtract the variance produced by subject variation.

Figure 7.4 shows scale increments on the trained scales for individual subjects. It may be concluded that the differences in gains produced by the three types of training were not significantly different from one another. The differences that were produced may be accounted for by the interaction between the type of training and individual differences in receptivity or trainability which favoured the Gestural Imitation training.

In evaluating the relative success of the Gestural Imitation training it is important to note that the large gains (i.e. 7 steps) made by one subject occurred without her passing the preceeding steps. This brings into question the ordinality of this scale and the scoring system involved in ordinal scales. Interestingly the two subjects who showed large increments on the Gestural Imitation Scale were the only ones to have passed any early items on the scales. Only one, out of eleven control subjects improved. Therefore it seems that training in gestural imitation was successful in producing change in the experimental group. The total number of steps gained in object permanence by the experimental subjects was 9, 7 of which were gained by one subject. The controls improved by just one step. Therefore, in terms of the number of gains the success of training in object permanence was contributed mainly by just a single subject. As three of the subjects showed no change after training, there appears to be a strong suggestion of individual differences in response to training in object permanence.

The difference between the experimental and control groups

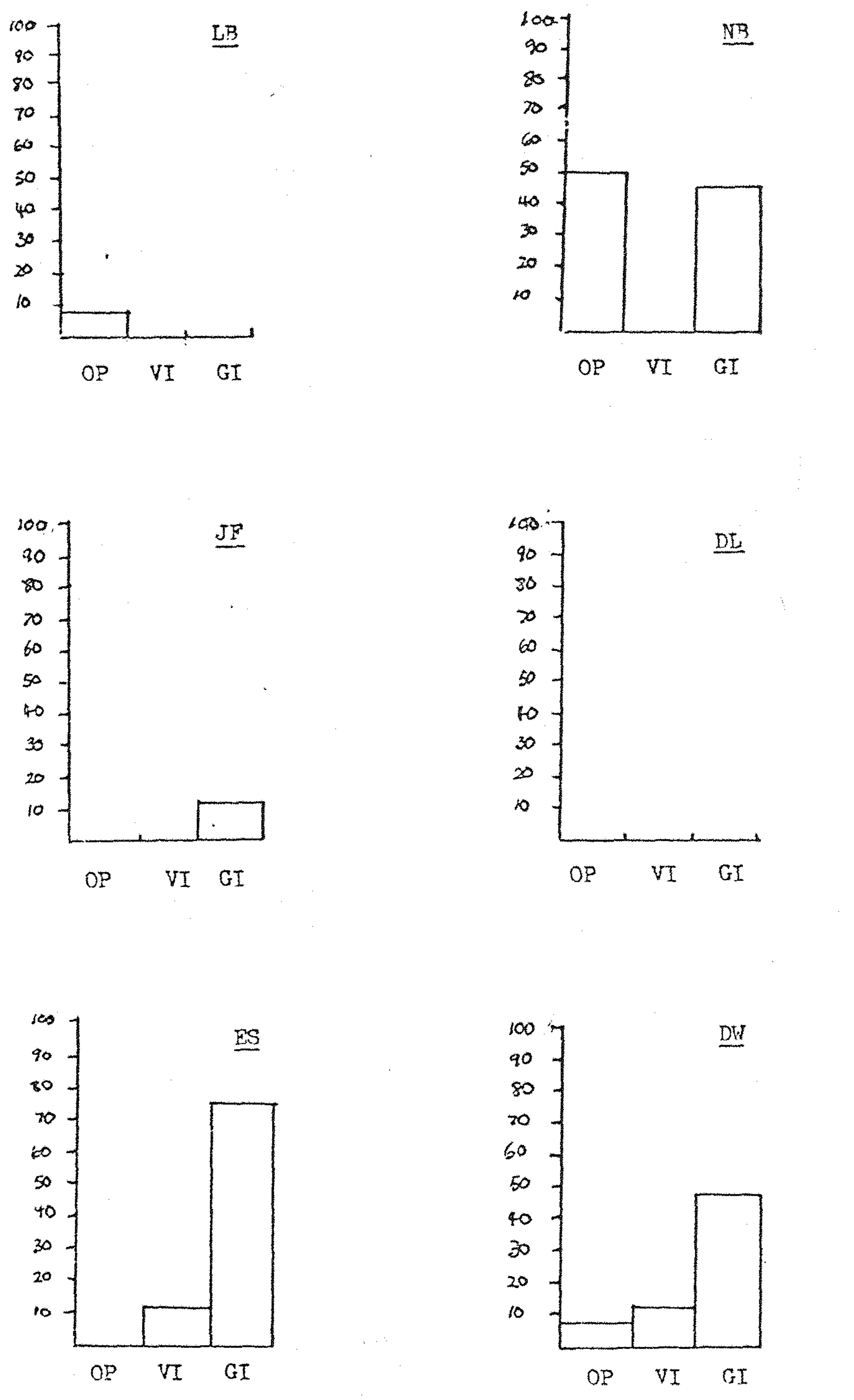


Figure: 7.4 Increments in scale scores (expressed as σs) for individual subjects on the Object Permanence, Vocal Imitation and Gestural Imitation scales.

in the number of subjects who gained an increment in their scores on the Vocal Imitation Scale was not significant. Two out of six of the experimental subjects gained one additional step each, and two out of ten controls also gained one step each, a difference in ratio which was not significant. Therefore it appears that the training in Vocal Imitation produced changes that were not differentiated from chance levels. Unlike the success of training in Object Permanence, there is no evidence for individual differences to receptivity of training in Vocal Imitation.

7.3.4 Training Data : Frequencies of Successful Trials

Figure 7.5 presents graphs of successful presentations over the number of trials for steps trained, according to the three types of training, for individual subjects.

A Pearson product moment correlation coefficient was applied to this data to establish the relationship between the number of successful responses and the number of trials. No relationship was found ($r = .07$, N.S.). Therefore successful responses were not simply a function of the number of presentations, a purely quantitative explanation does not account for the pattern of success.

Cognitive Transfer

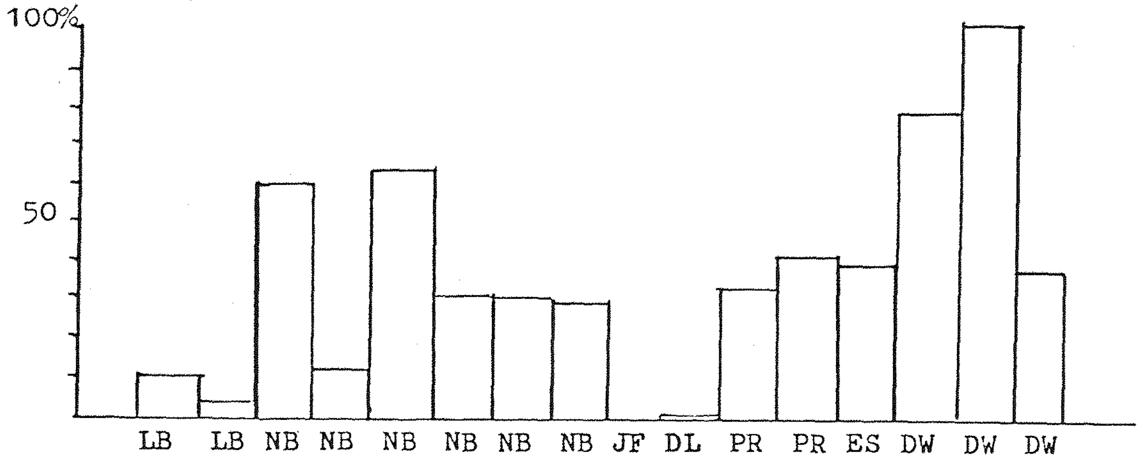
As discussed earlier in the thesis, the Scales are inter-related especially for normal infants and results of this study revealed that subjects performance on the Scales was accounted for by two factors. It seems reasonable to suppose that cognitive transfer might occur, particularly for those individuals who made large gains.

On scales which were not trained, subjects showed six gains on Spatial Relations, five on Schemes, three on Means-ends and two on Operational Causality (see Table 7.13). Three gains were made on the Object Permanence Scale which could not be attributed to training in object permanence.

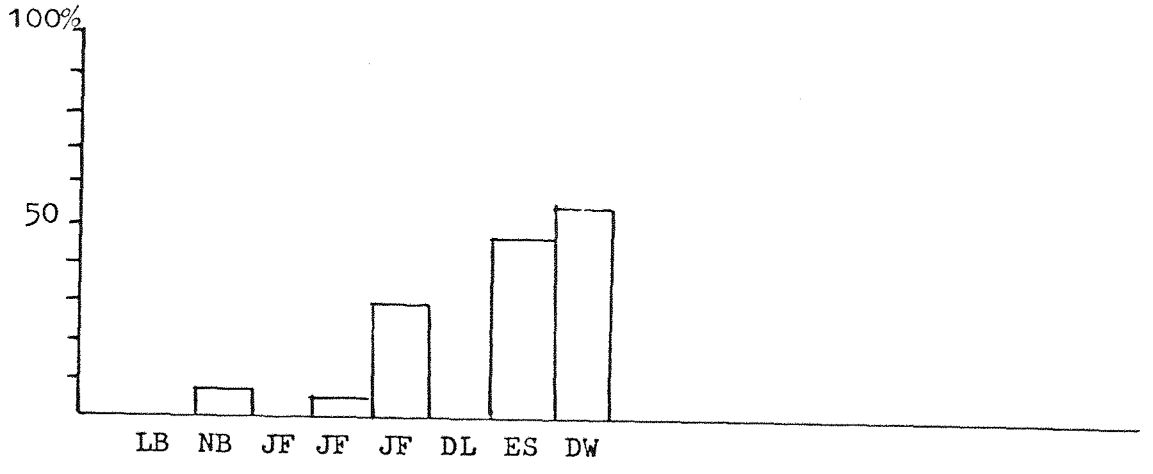
A Fisher exact probability test compared the number of experimental subjects who obtained gains on scales other than those on which they received training, and the number of controls who obtained gains on these scales over the whole training period. A significant difference was found, suggesting that the number of experimental

Figure 7.5 Frequencies of Successful Presentations for Items Trained: According to Type of Training.

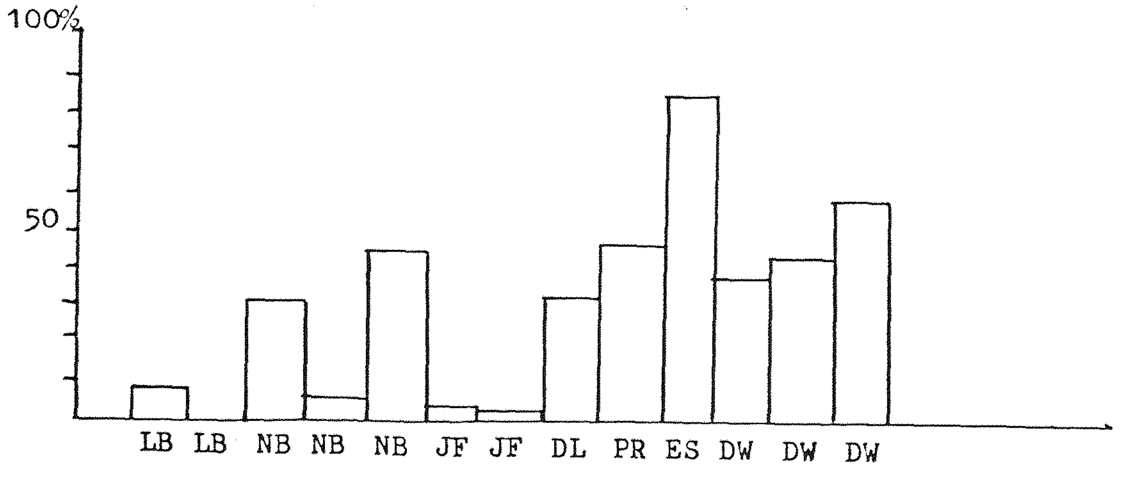
A Object Permanence



B Vocal Imitation



C Gestural Imitation



(See Tables 7.9 to 7.11 for steps trained and actual frequencies).

subjects who obtained gains on other scales was greater than would be expected by chance (Fishers' p = .039). Four out of six experimental subjects obtained gains in addition to those made from direct training, whereas, only three out of twelve control subjects made gains during the training period. Gains were not usually sufficiently frequent to permit analysis for transfer effects by training blocks. An exception was the third training block (Fisher p = .035) when three experimental subjects improved on other scales but only one control subject.

Methodological Notes

(i) Training Criteria for Successful Responses

The criteria for considering a step to have been attained during training was that the critical action be demonstrated three times in response to three consecutive presentations of the scale step. The purpose of adopting this criteria was that it furnished an objective index for deciding when the child should move on to the next scale step, rather than a formal indication of the success of the training. This was provided by the subsequent post-test which required only that a child demonstrate a critical action once during testing. In two instances experimental subjects passed the criteria for steps 3 and 5 on the Vocal Imitation Scale during training but failed to demonstrate the critical response on the post-test and consequently were not credited as having passed the scale steps. This aspect of the results will be discussed later, but the important point is that the post-test was at least as conservative as the training sessions. In no instances were subjects credited with a step on the object permanence or imitation scales during the post-test which had not been 'passed' during the training period.

(ii) Scoring of Ordinal Scales

One limitation of the scoring system of ordinal scales is that it does not differentiate between a subject who passes all the earlier items in the scale and a subject who does not - both may be assigned the same score. One subject made a seven step gain on the Object Permanence Scale, each step of which was individually trained and acquired during the training period. The apparently similar gain of seven steps made by another subject on the Gestural Imitation Scale was not achieved in the same way, as she had not passed the preceeding steps in the other scale. Unless the order of succession of the steps in the Gestural Imitation Scale is invalid, it is assumed that demonstration of a critical action presupposes possession of the necessary cognitive structures. This is usually the advantage of ordinal scales, but it is contingent upon the empirical confirmation of ordinality. More research would seem to be required in order to verify the sequence of steps in this scale, both with normal children and with mentally handicapped children.

In conclusion, despite this ambiguous aspect of the Gestural Imitation Scale, it is apparent that more subjects made gains on this scale than on either the Object Permanence or Vocal Imitation Scale, and there is a strong suggestion that individual differences interacted with the different types of training - a factor which was most prominent with respect to the training in object permanence as just one subject made really sizeable gains, whereas, three subjects did not change at all.

7.4 Discussion

The small intervention study may be considered to have been successful in bringing about gains in Uzgiris-Hunt Scale scores in the experimental subjects. On statistical grounds the training was effective, but how effective and whether the gains made, justified the teaching input are questions for which statistical tests cannot provide answers. Nevertheless, these are questions central to evaluation of intervention and these points will be examined later.

The main conclusions may be summarised as follows :

Taken as a group of subjects, the training on the three Scales was effective in terms of the number of individuals whose behaviour was altered. Similarly, training in object permanence and gestural imitation was found to be effective. In contrast, training in vocal imitation was not effective.

Overall there is some evidence that transfer to other scales may have taken place. An aspect of the results not brought out by the statistical tests is that for the 3 scales that were trained, one out of six subjects did not change at all on any of the scales and two of the subjects gained only one step each as a direct result of training on one of the scales. Thus, half of the subjects gained only two steps between them, whereas the other 3 gained 25 steps that were directly trained. The two subjects who made the most impressive gains were the only ones to have passed the early items on the Gestural Imitation Scales. These subjects also had the highest scores on the Vocal Imitation Scale and high scores in object permanence prior to the training. This factor provides one explanation for the differences between individuals in terms of their trainability. These results suggest that individuals with initially higher scores on object permanence and imitation are more likely to respond to training. It does not appear to be the case that high scores per se predict trainability, as the subject who did not change at all had high scores on the other scales. Thus, another question arising from this study is whether object permanence and imitation especially are predictive of trainability for other sensori-motor areas.

This explanation for the differential effectiveness of the training among individuals seems plausible in view of the subjects' age. It may be that older profoundly retarded children with very low initial scores are less trainable than those who are already functioning at a higher level. However, this may not be the case with very young children. Therefore, subjects appear to fall into one of two categories - they either acquired at least a minimum of six additional steps or not more than one. Thus some individuals show some receptivity to training and others are extremely resistant.

In attempting to evaluate whether training the latter category of individuals is worthwhile i.e. fruitful enough to justify the input in human time, effort and other resources, it might be useful to bear in mind that the resistant subjects received up to 400 presentations of an item. The critical factor in eliciting a response was found not to be related to the sheer number of presentations or exposure to a model. One potentially useful line of investigation might involve arriving at a cut-off point for the maximum number of presentations, after which the probability of eliciting a response may be so greatly reduced as to render non-viable the attempt to continue to train an individual on that particular scale. Therefore, it may be concluded that the gestural imitation training may be considered effective with respect to half of the subjects, that individual differences determine the effectiveness of training in object permanence, and that vocal imitation training was not effective. In evaluating the success of the training in gestural imitation, it should be taken into account that one subjects' apparently large gains on this scale might have occurred because of the order of scale items and the scoring system. Thus, the success of training in gestural imitation also interacted with individual differences in receptivity. This factor has implications for the utility of these scales in their capacity as a research tool. The scoring system recommended by Uzgiris and Hunt pre-supposes that the ordinality of the scales has been established.

The impressive gain of 7 steps by one subject was accomplished as she demonstrated the critical response for step 7 which involved making some movement in response to an unfamiliar, invisible gesture consistently, although actual imitation was not necessary for success on this step. It is for the very reason that the scoring procedure involved in the use of the Uzgiris-Hunt Scales presuppose ordinality of the developmental sequence of the scale that one can assume that a child who passes step 7 can automatically be assumed to have passed the preceeding steps. However, it is difficult to see why a mere 'response to a model' is classified under the category of 'imitation of unfamiliar gestures, invisible to the infant' and in this case the subject had not passed the earlier items in the scale. Not only does the validity of this particular item appear questionable but the category of scale items involving 'invisible gestures' (i.e. facial expressions) is somewhat controversial in view of Moore and Meltzoff's (1976) discovery of invisible imitations (tongue protrusions) in 3-week old infants. Moore and Meltzoff's (1976) evidence does not necessarily invalidate the ordinality of the Gestural Imitation Scale, but it indicates a need for more empirical research to confirm its sequence. The issue of neonatal imitation will be taken up more fully in the following chapter.

The finding that the training in vocal imitation had no significant effect is interesting and compatible with other evidence. It seems plausible to suggest that the difficulty encountered in attempting to promote vocalisation, might have occurred due to the relatively greater dependency of this ability on biological and maturational mechanisms which are much disrupted in this population. Evidence was produced earlier in this thesis (Chapter 5, section 5.3.3) which has support from Uzgiris and Hunt's (1975) own data that vocal imitation may form a separate branch of development. Uzgiris and Hunt (1975) suggested that development in vocal imitation seems to reflect the 'maturational pre-programmed' aspect of development. This explanation is suggested with caution and it should not be taken to imply that there is no point in the attempt to train vocal imitation. It may be that such training is more fruitful with mild to moderately mentally handicapped children.

Indeed, Henry (1977) found that her younger subjects did respond to parental training on the Vocal Imitation Scale. It may be that the first few years of life are particularly important for the development of vocalisation. If so, subjects' failure to progress on this scale may be due primarily to critical periods of development in the vocal system rather than due to the imitative element of this scale.

Cognitive Transfer

The gains made by the experimental subjects on other scales, in addition to those in which they received training seem attributable to the effects of cognitive transfer, as similar gains were not obtained by the control subjects.

Another possible explanation might be that the gains obtained on the other four scales reflected the possibility that the experimental subjects may have received extra attention - over and above that received by the controls. As noted previously, teachers had constructed their own programmes for the control subjects and it is unlikely that they spent more time in carrying out the programmes constructed by the experimenter. It is likely however, that the experimental subjects received more attention from the experimenter than did the controls, although the experimenter did make a point of seeing and interacting with all the subjects each week. If the additional gains were merely the effects of additional attention, it follows that gains obtained on the scales which were trained could also be attributed to adult attention rather than to the training procedure. If this were the case, one would not predict greater increases on the scales which were trained than on those which were not trained. The mean total gain for object permanence and gestural imitation was however, four times greater than the mean gain for the four untrained scales.

Therefore, it may be concluded that the gains obtained by the experimentals on the trained scales were largely the result of the training rather than of attention and that at least part of the gains obtained on the other scales may therefore be attributed to cognitive transfer.

The issue of how such factors as "attention" may be controlled is difficult to resolve. Applied studies often preclude the possibility of controlling for the multitude of variables that are likely to be in operation. Attempts to control for attention are likely to be spurious in the hospital environment, where the patients are in contact with many different personnel and where the attractiveness of individual patients or the unattractiveness of others may be influential in determining whether adults initiate contact or interact with individuals.

On the question of long-term retention, although subjects were not retested for retention weeks after the final training block - the re-tests conducted after the second and third training blocks provide evidence that steps trained in the preceding blocks were retained for at least fourteen and twenty-eight weeks respectively. In no case was a child found to regress on the scale in which he had been trained in the preceding period. There is no obvious reason to suppose that the long-term retention from the final training block should be inferior to that found for the first and second training blocks.

Long-term retention is important to the evaluation of intervention studies and the period of approximately 14 weeks between each pre- and post-test in the present study would appear to represent an adequate test of long-term retention for the steps which were trained in each preceding training block.

Therefore, although the gains made by the subjects were not as impressive as those made by Kahn's (1976) subjects, they appear to have been retained, whereas Kahn's gains seem to have been temporary. Further, it is difficult to understand from a cognitive position how a subject's level of cognitive functioning can be raised as a consequence of training but then lost again. Long-term retention of responses gives some credence to the argument that what was learnt amounted to more than mere perceptual motor-skills.

Two other aspects of the training data should be mentioned as they illustrate further differences between the subjects responses and the behaviour of normal infants. First, in some cases, subjects showed a high frequency of success but did not move on to the next step. Second, particularly during training of gestural imitation, after responding correctly on 3 successive occasions (this was the formal criteria for moving to the next step), a response might disappear again. Subjects' successful responses might be so spasmodic as to justify continuation of training in order to consolidate the new behaviour. In contrast, normal infants appear to function most of the time at whatever stage or level of development they are at - hence the rationale for infant development tests - that mental development may be inferred from overt behavioural responses.

This observation gives rise to certain theoretical speculations regarding the mental structures of the profoundly mentally handicapped, and their relationship to overt behaviour. It is difficult according to a cognitive, developmental position, such as Piaget's, to explain why some of the subjects should perform a critical action on at least one occasion - thus suggesting they have the necessary cognitive structures, yet for the "intelligent response" to be so infrequent as to give the impression that the child is not really competent.

This paradoxical situation may be neatly summarised as a competence - performance distinction and the hypothesis that might be derived from this initial observation might involve speculation as to whether normal infants tend generally to perform at the level at which they are competent. Whereas, profoundly mentally handicapped children do not necessarily perform at the level of competence for which they possess the cognitive structures and often display regressive behaviour.

A number of theorists have made similar observations - for example Inhelder (1968) accounted for this phenomenon by suggesting that the retarded persons functioning was characterised by "viscosity" causing him frequently to resort to lower levels of functioning. Zigler (1969) has suggested a motivational deficit to account for the discrepancy between the retarded person's apparent competence and his actual performance. In fact, a whole body of the literature (e.g. McManis, 1969 ; Milgram, 1973 ; Ellis, 1975) has been devoted to furnishing evidence on the <u>inferior</u> performance of retarded subjects despite mental age matching on some global measure of intelligence.

A limitation of this type of pilot study is the small number of subjects which comprise the experimental group - a factor which restricts both the types of statistical analyses that may be performed and the questions which may be posed but in this case <u>practical</u> considerations precluded a larger sample. This factor, combined with the ordinal nature of the data, precluded the analysis of the types of training in terms of the actual number of gains made. Although an analysis of variance was used to compare the number of gains made on the three scales, due to the small number of subjects, significant differences could not be demonstrated. There are few studies in the literature to which the results of this study relate. Previous studies have most frequently attempted to train the object permanence scale - usually with more success than in the present study, and Henry's unpublished study appears to be the only other one to train the imitation scales. Although the results of the training in object permanence of the present study are comparable with Kahn's (1976), the mean increment in the number of scale steps obtained by his 4 subjects was larger. One possible explanation for this might be because Kahn's training was more intensive and lasted for a longer duration - as he trained only object permanence. Also his subjects were considerably younger than those in the present study, and were generally higher functioning. In contrast to the present study, Kahn did not find evidence for long-term retention of all the training items - which is an important consideration.

It seems that in the case of most previous studies, the subjects were both younger and less severely mentally handicapped (e.g. Kahn, 1976 ; Henry, 1977), therefore these results would not be expected to be directly comparable - rather, they represent an independent contribution to the literature.

In conclusion, the present study, in addition to replicating others in providing evidence that object permanence may be successfully trained in severely mentally handicapped children, provided evidence that gestural imitation may also be successfully trained. Individual differences in responsiveness to both types of training preclude the formulation of general predictive statements on the outcome of such training for the severely handicapped population in general. Each individual must be assessed and trained according to his or her own cognitive profile.

7.5 Summary

(i) A small group of severely mentally handicapped children were given training on the object permanence, vocal and gestural imitation scales of the Uzgiris-Hunt Scales.

(ii) Compared to control subjects, more experimental subjects improved on the object permanence and gestural imitation scales, but not on the vocal imitation scale.

(iii) Evidence was provided that the increments gained in object permanence and gestural imitation occurred during, and as a result of, the training. A high correspondence was found between the teachers' and experimenter's records of the frequency of subjects' successful responses.

(iv) The success of the training in object permanence was mainly attributable to improvements in one individual. In the case of gestural imitation, the type of training interacted with individual differences between subjects.

(v) It was noted that the ordinal nature of the Uzgiris-Hunt Scales makes data analysis in terms of increments problematic. Also the scoring system does not indicate whether an individual has passed all preceeding scale steps. More research is therefore required to confirm the ordinality of scales other than the Object Permanence Scale both in normal and mentally handicapped children. The sequence of steps in the Gestural Imitation Scale especially, requires validation.

CHAPTER EIGHT

DISCUSSION AND CONCLUSIONS

8.1 Introduction

The investigation reported in this thesis addresses two main questions about the cognitive development of severely mentally handicapped children. The first question was whether their sensorimotor abilities develop in synchrony and show a pattern similar to that produced by normal infants or whether intellectual deficits exist in particular areas. The second question was whether training a small group of severely retarded children on Uzgiris and Hunt's Vocal and Gestural Imitation and Object Permanence Scales would raise their level of cognitive functioning.

The literature reviewed in Chapter 2 described many studies which employed the Uzgiris-Hunt Scales - mostly to study communication with mentally handicapped children. Despite their number and the variety of topics, the Uzgiris-Hunt Scales have not been used to investigate the structure of sensorimotor intelligence in severely mentally handicapped children, or to compare their profiles of abilities with those of a normal population.

8.2 Summary of Main Findings

The above questions, together with a number of subsidiary issues were examined in the course of the investigation, and were reported in Chapters 4, 5, 6 and 7.

In Chapter 4 the general results of the administration of the Uzgiris-Hunt (1975) Scales to 45 severely mentally handicapped children were reported. Their performance profile across the Scales was examined for synchrony among the developing abilities. Highly significant variability was found, suggesting that development measured by the Uzgiris-Hunt Scales is far from synchron ous in these severely mentally handicapped subjects. The scales which appeared to be contributing most to the overall variability were the two Imitation and Object Permanence Scales which showed very depressed scores. In contrast, Means-ends and Schemes abilities were relatively superior.

Positive correlations of moderate strength were found among scale scores, except in the case of the two Imitation scales. No relationship was found between the subjects' chronological age and their overall performance on the Scales. A small but significant relationship was found between subjects' age and their performance on the Means-ends and Spatial Relations Scales. Interpretation of the correlations for Gestural Imitation was problematic.

It was tentatively argued that these children may be relatively superior in those aspects of sensorimotor intelligence which rely more heavily on motor development and contributions from the experience of objects in the environment. In contrast, they may be considerably deficient in precursors to symbolic development and the capacity for representation and language.

Chapter 5 presented a comparison of the profiles obtained with this sample of severely mentally handicapped children with those produced by Uzgiris and Hunt (1975) for normal infants. This comparison was important because it is not known how the Scales relate to one another, since they have not been standardised and the performance of normal infants has not been examined for synchrony. In order to compare the two samples, subjects were classified according to sensorimotor sub-stages - a procedure which simultaneously provided a control for level of development.

The two populations were found to differ on the Gestural and Vocal Imitation Scales, on the Object Permanence Scale and to a lesser extent on the Causality Scale. Factor analysis of the two sets of results revealed a difference in the structure of sensorimotor intelligence between the two populations. The normal subjects' performance could be accounted for by just one factor. However, two factors were obtained for the mentally handicapped subjects, one factor loaded heavily on Vocal Imitation and to a lesser extent Gestural Imitation while all the other sensorimotor abilities, including Gestural Imitation to some extent, loaded on the second factor. Therefore, it was concluded that sensorimotor intelligence in severely mentally handicapped children does not progress strictly in accordance with Piaget's stage theory. Vocal imitation was a separate ability and gestural imitation was either at the earliest sub-stages or completely absent.

The analyses described in Chapter 6 were carried out in order to control for two important explanations of the results. Potentially confounding factors were subjects' motor or physical disabilities and whether they were institutionalised or living at home with their parents.

In a previous study by Rogers (1977) the poor performance of profoundly mentally handicapped children on imitation tasks was attributed to their institutional environment. A second reason for assessing subjects' motor development was to examine how it correlated with performance on each of the Uzgiris-Hunt Scales. A check on the reliability of the results was also made by comparing results obtained for children from two different institutions.

The results showed that subjects' depressed scores in gestural imitation were not related to their motor development. In fact, all scales except the imitation scales correlated with motor scores. Another finding was that motor development was in advance of subjects' general level of cognitive development.

A similar pattern of scale scores was found for both home-reared and institutionalised children - thus it was possible to reject the hypothesis that the deficit in imitation could be attributed to institutionalisation.

Overall, a similar pattern of results was found for subjects attending different institutions. Further support for the proposition that deficits in imitation are characteristic of the severely mentally handicapped came from a re-examination of Kahn's (1976) data, which also showed deficits of a comparable size in the two Imitation Scales and Object Permanence Scale, although Kahn had not examined his subjects' performance for relative strengths and weaknesses across the Scales.

On the basis of these results and in view of the theoretical significance of imitation and object permanence for training programmes a small pilot-training study was designed. Chapter 7 presented an account of this pilot-study, which involved training a small group of the subjects on the Vocal and Gestural Imitation Scales and on the Object Permanence Scale. A control group received no extra training but merely their usual individual programmes devised for them by their teachers. At the end of the three training blocks all subjects were re-assessed on all of the Uzgiris-Hunt Scales.

Significantly more experimental than control subjects gained on the Object Permanence and Gestural Imitation Scales but gains were not obtained on the Vocal Imitation Scale. Successful training of gestural imitation and object permanence reflected individual differences in the sensorimotor profiles of the children, some of whom showed increments.

There was also evidence for durability of the effects of training and for cognitive transfer effects to untrained scales.

It was concluded that training severely mentally handicapped children on Uzgiris and Hunt's Gestural Imitation and Object Permanence Scales could lead to increments on these scales. However, these gains can only be expected for certain individuals.

In summary, the main contribution of this study was to offer a description of the structure of sensorimotor intelligence in severely mentally handicapped children. A major implication is that as these individuals encounter greatest difficulty with pre-symbolic aspects of cognition such as gestural imitation and object permanence, intervention should be as early as possible and especially aimed at promoting childrens' competence in these areas, to furnish them with the cognitive structures thought necessary for the acquisition of language.

8.3 The Relationship between the Results of this Study and Previous Piagetian Research

As pointed out earlier, although other studies have not attempted to provide a characterisation of sensorimotor intelligence using the Uzgiris-Hunt Scales, support for the discovery of depressed scores on the Imitation Scales may be found from examination of the mean scale scores reported by several authors.

Examination of the mean scale-score reported by both Kahn (1976) and Dunst et al. (1981) showed that their mentally retarded subjects also gained relatively low scores on both Imitation Scales although neither author commented on this aspect of their results. Furthermore, in Dunst et al.'s study object permanence scores were lower than other scale scores. Rogers (1977) also found her profoundly retarded subjects had difficulty with Piagetian imitation tasks, although she attributed this to institutionalisation. Since so few investigators have administered all of the Uzgiris and Hunt's Scales to mentally handicapped children, this empirical support is impressive.

As Lobato et al. (1981) have noted, despite the large number of severely and profoundly retarded persons who fail to acquire an adequate communication system -

> "there has been relatively little analysis
> of the relationship between retardation and

> language development at the prelinguistic, gestural levels at which severely and profoundly retarded people frequently function".
> (1981 ; p. 489).

The literature reviewed earlier did suggest that there is a relationship between the later sensorimotor stages and communication development in mentally handicapped children (e.g. Woodward and Stern, 1963 ; Kahn, 1975 ; Greenwald and Leonard, 1979 ; Lobato et al., 1981). Both vocal and gestural forms of communication were behind general sensorimotor development. (Woodward and Stern, 1963 ; Greenwald and Leonard, 1979 ; Lobato et al. 1981). Furthermore, Bates et al. (1979) found that the vocal and gestural imitation scales predicted language development.

Kahn's (1983) finding that the Vocal and Gestural Imitation Scales and the Object Permanence Scale predicted performance on the A.A.M.D. Adaptive Behaviour Scale, and linguistic ability (measured by the REEL) lends impressive support for the interpretation of the significance of the deficit found in subjects' scale profiles that has been found here. Mahoney, Glover and Finger, (1981) found a high correlation between vocal imitation and linguistic ability in Down's Syndrome children. They also found language to be more delayed than overall cognitive development in their subjects. The vocal behaviour of Down's Syndrome infants has been observed to differ from that of normals in both quality and quantity and smiling and eye contact are less frequent and appear later (Cicchetti and Sroufe, 1976).
Therefore, there appears to be an overall pattern that mentally handicapped children show depressed development in vocalisation and imitation. Furthermore, there is the suggestion of a definite link between these aspects of development and language development.

Curcio's (1978) findings also have some relevance to these results. Curcio's data on a small group of autistic children suggested depressed performance in gestural imitation. Re-interpretation of his data also revealed a similar profile of abilities to that found in the present study, with subjects performing best on the Means-ends scale. Curcio (1978) suggested this pattern of development may be characteristic of populations with a high level of CNS pathology. The results of the present study provide evidence that this may indeed be the case.

Perhaps the reason that the results of the present study appear to be incompatible with the conclusions drawn by Woodward (1959) and

Rogers (1977), (i.e. that their subjects' development followed Piaget's stages) is a matter of interpretation. In both studies stage congruence was far from perfect, yet both Woodward and Rogers interpreted their results as being generally consistent with a developmental-lag position. Another reason for the apparent inconsistency between the results of this study and those of Woodward (1959) is that Woodward did not include spatial or temporal aspects of sensorimotor intelligence, or causality or imitation - those areas which the present study found deficient. Therefore, the findings of this study are consistent with the overall pattern of findings in the literature, not only in relation to severely handicapped children but also in relation to other mentally handicapped populations. However, the finding of such a dramatic vocal and gestural imitation deficit may be confined to the more severe categories of mental handicap.

Vocal Imitation was somewhat independent of other sensorimotor abilities. This result has support from Uzgiris (1975) in relation to normal infants and from Dunst et al. (1981) in relation to moderately retarded infants :

> "one could hypothesise that the cognitive processes involved in the acquisition of vocal imitation are quite different from those for other sensorimotor abilities - at least among the mentally retarded children".
>
> (1981 ; p.141).

In Dunst et al.'s (1981) study the only scale with which Vocal Imitation showed any association, was Gestural Imitation.

Consistent with studies of normal infants (e.g. Siegel, 1981) significant correlations were found between motor development and performance on most of the Uzgiris-Hunt (1975) Scales. However the correlation between motor development and vocal and gestural imitation was, in contrast, very small. Motor development appeared to be in advance of sensorimotor intelligence, as has been shown by Woodward and Stern (1963). These authors found motor development in severely retarded subjects also to be in advance of speech development, perhaps consistent with the pattern of findings in the present study since vocal imitation may be implicated in speech development.

In the training study, the increments made by the experimental subjects were not as large as those reported for Kahn's (1975) four subjects. However, this may be because Kahn's subjects were relatively young and they may not have been so profoundly retarded. A comment may be made here on the utility of the Uzgiris-Hunt Scales, as a research tool. One difficulty with the Scales as a research instrument concerns their ordinal structure which precludes statistical comparisons of the number of gains made during training. This problem was overcome by including a larger control group which did permit statistical tests comparing the number of subjects in the two groups who made gains. Kahn (1975) did not carry out any statistical analyses on his data, an omission which appears fairly common among training studies of this kind and this is an obvious limitation on the inferences to be drawn from the actual measures.

As there is no literature on training severely mentally handicapped children on the Vocal and Gestural Imitation Scales, the results of this study can be compared only with the unpublished results of Henry (1977). Henry reports large gains from the parental training of young, pre-school retarded children on all of these scales. Unfortunately Henry's (1977) subjects are a different population from the older, institutionalised subjects of the present study. It is difficult to know whether the success of training in vocal imitation in Henry's study is due to the younger age of her subjects or because they were less retarded. Explanations for subjects' lack of response to training in vocal imitation will be explored later. The question of the utility of the Uzgiris-Hunt Scales will now be considered in more detail.

(i) The Utility of the Uzgiris-Hunt Scales in Relation to the Severely Mentally Handicapped

The Uzgiris-Hunt Scales applied to severely handicapped populations show advantages over other types of tests, but also some weaknesses due to lack of standardization and normative information.

An advantage is that the scales measure functioning in the earliest months of life and unlike many tests are therefore applicable to the severely handicapped population. Second, the scales are truly developmental, in contrast to many other tests which, despite giving credit for higher-level responses, as Robinson and Robinson note, assume:

> "that the same basic intellectual operations generally are manifested at all levels and that essential changes occur mainly in the complexity of the material with which these operations can cope".
>
> (1976 ; p. 260).

Perhaps the most useful aspect of these scales in relation to the mentally handicapped is that they enable assessments in a number of areas of cognition. As this study has shown, development in mentally handicapped children may not proceed in synchrony in all areas. Thus, the scales may be most informative and useful for indicating weaknesses in individual profiles. The paradox is that the research literature has completely ignored this question and the main advantage of these scales is diminished because little normative, developmental data is available.

It is difficult to understand why the question of the integration and organisation of development across domains has received so much theoretical attention, yet research has focused almost exclusively on the sequential aspect of development particularly in object permanence. Perhaps Piaget's own disinclination to give attention to the establishment of norms and to the question of individual differences has been a determining influence. It is ironic that Wachs (1970) pointed out the utility of the Uzgiris-Hunt Scales in their ability to indicate strengths and weaknesses in a retarded child's scale profile, yet, over ten years later the necessary normative information is still not available to enable this evaluation to be carried out. Dunst (1980) has made an admirable attempt to provide estimated developmental ages in order to make the scales clinically useful, however much more data is required in order to organise scale items into successive levels of development, with confidence.

Despite the usefulness of the Uzgiris-Hunt Scales in furnishing a comprehensive cognitive profile, it would be erroneous to assume that sensorimotor scales provide an adequate description of all aspects of development in mentally handicapped children. This is not the case. A complete assessment should also provide information on a child's sensory and perceptual ability, their motor control and special disabilities, social development and self-help skills and whether they have emotional disturbance.

As reported in Chapter 7, during this study it was observed that subjects' performance did not always reflect their competence. Thus, in the case of these individuals, a cognitive assessment may not necessarily be synonymous wth providing a description of their everyday behaviour. This is reminiscent of Inhelder's (1966) observations of the behaviour of the mentally retarded for which she coined the terms 'oscillation' and 'viscosity'. It seems that severely mentally handicapped individuals are more prone to regressing to earlier behaviours, than is the case in normal development.

Therefore, although the Uzgiris-Hunt (1975) Scales have great value in classifying those behaviours that may be thought to reflect early intelligence, they do not give an index to those pathological, stereotypic behaviours so prevalent in profoundly mentally handicapped populations. Instead, they provide a more positive picture of the cognitive capabilities of these individuals in normative terms. In the clinical setting other comprehensive types of assessment, such as those mentioned above will be required.

The question which now needs to be addressed is 'what type of model of cognitive development in this population do these results suggest?' 'Do the results indicate intellectual deficits or do they suggest that the development of central intellectual processes are uniformly disrupted?' This question will now be explored.

(ii) Some Implications for Theories of Cognitive Development in the Severely Mentally Handicapped

The results of this study have implications for the 'developmental versus difference' debate. They suggest that the structure of sensorimotor intelligence in severely mentally handicapped children is qualitatively different to that of normal children and cannot simply be described in terms of a developmental lag. This is consistent with the conclusion drawn by Weisz and Yeates (1981).

There has been some confusion surrounding the 'developmental versus difference' debate due to over-generalisation of Zigler's (1969) developmental-lag theory. This has been taken to apply to more severely handicapped individuals whose etiologies include organic impairment (Weisz and Yeates, 1981). In fact, Zigler (1969) made it explicitly clear that his developmental-lag theory was intended to describe the development of only those individuals who suffered from cultural-familial retardation. Despite this, studies have not attempted to compare sensorimotor intelligence in normal infants and profoundly retarded children in order to identify differences between the two populations. It is possible that this is because Woodward's (1959) early, well-known study suggested a developmental-lag description of sensorimotor development in severely retarded children. It may be as a result of the wide acceptance of this assumption by developmental theorists, that few attempts have been made to investigate possible differences in the structure of sensorimotor development between the two populations. Certainly one reason for this neglect of the profoundly retarded has been due to the lack of assessment instruments applicable to this population. A large body of research has investigated the mental functioning of moderately retarded individuals. However, etiologies have been so mixed that samples have included both cultural-familial and organically determined retardation. This factor may account for inconsistency in previous findings. This confounding of results due to failure to select either organic or non-organic samples has continued up to the present day.

Another major problem which has impeded research in this area has been the methodological difficulties involved in comparing normal and retarded populations. Comparisons have involved matching pairs of individuals apparently according to mental age definitions of I. Q., which have frequently been arrived at through sampling performance on tasks requiring little conceptual ability. (Zigler and Balla, 1982). Such studies have then found retarded persons inferior in their reasoning and problem-solving ability. The attempt to "match" retarded and normal persons on an individual basis yet in a global fashion is a rather spurious procedure.

Finding a satisfactory basis for comparison of the profoundly retarded and normal children is problematic. There appears to be no obvious or ideal basis for such comparisons. Despite the shortcomings of "stage" matching employed in the present study, it has demonstrated the viability of this method and instead of comparing two samples in terms of measuring differences between pairs of matched individuals, it has permitted comparison between two populations. Furthermore, instead of comparing the two samples on two or three reasoning tasks, all domains thought to comprise sensorimotor intelligence were sampled in a repeated measures design. Not only could it be suggested that the methodology of this procedure is rather more refined, but the theoretical foundation of the intellectual measures render the results of the comparison rather more substantial than the erratic sampling of a variety of psychological processes which has been the procedure adopted in past studies.

Thus, one contribution of this study is the new methodology it incorporates. However, despite its methodological and theoretical strengths the procedure of "stage" allocation was not without its shortcomings. These however, are only theoretically problematic because the retarded subjects' profile of abilities is so uneven that they did not really fit a stage-like model of development. Stage allocation did provide a satisfactory method of matching the two samples at five successive levels on three scales.

In contrast to previous studies in this area of Piagetian research, such as those of Woodward (1959), Kahn (1976), Rogers (1977) and Dunst et al. (1981) this study is the only one to have compared its results with those obtained with normal infants. Thus no assumptions have been made about either the unified nature of development or the correspondence between steps among the Uzgiris-Hunt Scales. Therefore, unlike previous studies which merely assumed they were contributing to our understanding of the nature of sensorimotor intelligence in the profoundly retarded, the results of this study permit us to be confident that findings do indeed reflect a distinct pattern of development for these children.

The finding of important intellectual deficits is compatible with the Soviet view of mental retardation. Although Luria (1963) mainly investigated retarded persons with organic lesions and therefore applied defect theory to these individuals, he did assume that all truly retarded persons were defective in their neurological functioning, especially in higher cognitive functions in which he believed the verbal system to play a crucial role. As Zigler's developmental theory applies only to retarded persons without organic lesions the two positions are not contradictory.

Developmental-lag theory may be applicable to persons with cultural-familial retardation, but the results of this study lend support to a 'difference' or 'defect' explanation of intellectual development in more profoundly handicapped individuals where organic impairment is implied.

8.4 Discussion of Theoretical Implications

The discussion which follows is relevant not only to understanding intellectual development in the severely mentally handicapped, but also for a greater appreciation of 'critical functions' in normal development. As Bates et al. (1977) have pointed out, data from a defective population provides an approximation of the "critical test" of which cognitive abilities are required for the development of symbolic representation, communication and language, according to the logic that those abilities which are absent in such persons are likely to be functionally important to overall cognitive development.

We are now in a position to explore the theoretical issues which arise from these results. The following theoretical speculations apply only to questions raised by this investigation and should be regarded as such. In most instances more research will be required to provide empirical support for suggestions made. Most of the issues to be examined have broader implications for developmental psychology.

Although imitation seems to be a choice candidate for influence from the social world, in the past its cognitive basis has been emphasised and only recently has more attention been given to the interpersonal, social situation within which it evolves. Two distinct approaches to imitation may be identified, one emphasizing the cognitive operations of understanding the observed act, the other emphasizing its communicative context and interpersonal interaction. (Uzgiris, 1981b).

Despite recent interest as to whether imitation is an innate tendency (e.g Meltzoff, 1981 ; Meltzoff and Moore, 1977), theoretical importance has been attributed instead to the nature of developmental changes in imitation and their significance in intellectual development. Both James Mark Baldwin (1895) and Guillaume (1971) related development in imitation during infancy to changes in the infants' understanding of self and appreciation of other persons. Piaget extended their ideas and concentrated on relating development in imitation to overall intellectual development.

To understand the appearance of imitation is to understand how shared meanings emerge between adult and infant in his first year of life. As Newson (1978) notes -

> "a code of communication must be evolved de novo, as it were ; and this poses a different problem from that in which one is

merely concerned with the specification of some mechanism for translating from one established code into another".
(1978 ; p. 32).

From his detailed observations of mother-infant interaction Newson (1978) has drawn the following conclusions :

Both participants must be able to perform discrete, distinguishable actions or gestures which can function as signals, i.e. they must possess a repertoire of such displays and must be sensitive to the displays or signals of the other. It has been suggested that communication and meaning develops from the repeated interweaving of these signals in familiar alternating, turn-taking sequences or "conversation-like" exchanges where bursts of activity are alternated with attention to the other person's activity. In the case of vocal imitation, vocal contagion represents the first development, and later mutual imitation occurs when the infant will imitate another, if that person first imitates the infant at the moment he is articulating a sound. Thus, the infant and his caretaker operate in a turn-taking or alternating sequence where each person either first vocalises or performs a gesture and then attends to the action of the other. At this stage the infant will only imitate that which he can already produce, thus at this stage imitation is an attempt to prolong an event which is perceptually familiar but is only understood or 'known' by reproducing it when it is perceived.

It is this type of exchange which the early items of the two Imitation Scales appear to be measuring. It might be argued that the subjects' lack of responsiveness in this context reflected their relatively new relationship with the examiner, however their apparent disinclination or lack of motivation to engage in such exchanges was confirmed by their caretakers, who were no more successful in eliciting reciprocal responses than was the examiner.

It is difficult to decide whether the capacity to imitate presupposes an appreciation of self and others, mutuality, intentionality and shared meaning or whether these emerge out of interaction and reciprocal exchange. Morehead and Morehead (1974) have suggested that intentionality and the ability to distinguish between the actions of self and those of others have important implications for the development of imitation. This suggestion resembles the view of Baldwin (1906) who considered imitation to be central in the development of the self-concept. Baldwin (1906) argued that imitation led not only to a conception of 'self' but to a changed conception of others. Uzgiris (1981b). has outlined two distinct views of imitation - one emphasising the cognitive, the other the social.

According to a cognitive approach, the model represents a cognitive challenge and the imitative act is a mechanism for learning i.e. imitation is an accommodatory aspect of adaptation. This is the concept of imitation held by Piaget (1951). If an infant's assimilatory schemes are insufficient for comprehension then imitation provides the vehicle for resolving the puzzlement produced by the model. One interpretation, according to a Piagetian analysis, might be that inability to imitate implies that the accommodatory aspect of adapting to the environment is more greatly impaired in the severely mentally handicapped.

As imitation is related to comprehension of the gesture it reflects and is an index to the cognitive level of the infant. A contrasting approach lays emphasis on the 'similarity' principle established between the infant and the model - the imitative act provides a means for achieving congruence between two individuals. According to this approach 'similarity' is a central aspect in a social encounter and the content of the modelled acts are not important and imitation is not stimulated by puzzlement but by "apprehension of mutuality" and shared understanding. (Uzgiris, 1981b, p. 3).

It seems reasonable to suggest that both views have a contribution to make in understanding the development of imitation. Clearly, imitation does take place in a social context - a factor which Piaget paid little attention to. It seems important to appreciate this larger context and to view imitation as a complex process which may serve different functions in different contexts and at different periods of development. It may not be necessary to separate 'cognitive' and 'social' accounts, or as Uzgiris states - to separate development in inter-subjective and objective understanding. Greater weight may be given to the child's initiation into a social word without losing sight of Piaget's account of the development of fundamental, underlying cognitive structures.

It should be noted that the two imitation scales are somewhat distinct from the other scales because of their social, interactive nature. The administration of these scales is necessarily embedded in a social-interactive context. Mentally handicapped subjects were unable to participate in the type of communicative dialogue that success on these scales requires. Undeveloped social awareness may provide another potential insight into the reason for the subjects' deficiency. Or, alternatively this may be yet another symptom of the subjects' deficient cognitive development. Disentangling early social development from early cognitive development however, is difficult; indeed the two may well be inter-dependent and closely related.

Any analysis of imitation would be incomplete without considering the mental operations which might be involved in the execution of the imitative act. It seems likely that the information-processing mechanisms which enable imitation of simple gestures to take place must involve a translation of visual or auditory input into a motor analogue. A more advanced type of imitation, according to Piaget is the imitation of "invisible" gestures e.g. facial gestures, which are thought to involve intermodal co-ordination. (Piaget, 1952). As the infant cannot see himself perform facial gestures (such as mouth opening or tongue protrusions) and cannot directly compare his matching response within the modality of presentation of the model, it might be assumed that invisible imitations require intermodel co-ordination.

One possible explanation then, for these results might be that intermodal co-ordination has been disrupted in severely mentally handicapped children. However, the majority of the subjects had not reached the level of development when imitation of invisible gestures might be expected according to Piaget's theory. This presents a theoretical problem in accounting for the subjects' inability to pass even the earliest items in both Vocal and Gestural Imitation which do not require intermodel co-ordination. From an examination of the critical actions of the early items of the two Imitation Scales, it appears that some response to the model presented, be it vocal or gestural, is required. Therefore, subjects' lack of reciprocation may reflect inability to reciprocate or lack of sociability or social awareness. As Bates et al. (1979) have noted imitation is far from being a passive environmentally driven process, but is rather an active process within the person's control. Bates et al. (1979) stress the motivational aspect of imitation and the active process of "selection of models" which is almost always done by the imitator rather than the human model. They suggest that the achievement of a 'match' is a process requiring sophisticated perceptual-motor analysis :

> "We have evidence that the child is carrying out such an analysis from the gradual selection of certain properties or features of the model for his first approximations in matching; the correction procedures he employs in perfecting his match; the sequence in which features are selected".
>
> (1979; p. 333).

Bates et al. consider a 'good' theory of imitation to be critical for an adequate account of human cognitive development and even suggest: "The capacities underlying imitation are clearly part of our innate apparatus for the acquisition of culture". (1979 ; p. 333).

Bates et al. (1979) believe imitation to be a specialised behaviour of our species. If, as Bates and Uzgiris believe, the development of imitation (Uzgiris, 1975) especially vocal imitation depends on biological and maturational factors, then this could provide one explanation for subjects' lack of response to training. Kopp (1979) has noted that the view that humans are born with complex, genetic pre-adaptions for social communication and interaction, is gaining increasing acknowledgement. If, as Kopp and others believe "biological factors mediate sensorimotor behaviours" (1979 ; p. 16) and genetic pre-adaptions are operative throughout much of the first year of life - it is possible that this has implications, particularly for the development of vocalisation. Perhaps in the case of older mentally handicapped children plasticity of the vocal system is confined to the first few years of life. If it is the case that vocalisation is subject to critical periods of development, then this would provide an explanation for subjects' failure to gain increments in this ability, despite continuous training. As most of the subjects were well into late childhood and even puberty they may have passed that phase of development when the vocal system is most amenable to training.

Lenneberg, Rebelsky and Nichols (1965) investigated the emergence of vocalisation during the first three months of life in infants of congenitally deaf parents. They found that babies of the deaf made as much noise and went through the same developmental sequence of vocalisation, with identical ages of onset (e.g. for cooing) as control subjects of normal parents. Lenneberg also cites evidence for critical periods and age limitations for the acquisition of language which indicates that primary language cannot be acquired with equal facility from childhood to adulthood, as recovery from aphasia is much better for children than for adults and is directly related to the age at which the insult was incurred. Even in deaf infants babbling occurs between 4 and 12 months of age, although they cannot hear their own vocalisations, they naturally make noises (Lenneberg, 1967). Later however deaf children gradually cease to vocalise.

Therefore it is possible that severely mentally handicapped children vocalise more, early in life and that failure to develop further cognitively results in the 'dropping out' of earlier behaviours. The possible existence of critical periods in development does not imply that these damaged children would necessarily benefit from training early in life.

Implications of Recent Research for Interpretting Uzgiris and Hunt's Imitation Scales

The capacity for deferred imitation presupposes the internalisation of past imitations and means that the infants' actions are liberated from the immediate perceptual world. It is out of such internalised imitations or internalised images that the capacity to construct mental representation is said to develop.

Piaget's description of the developmental sequence of imitation appears to have empirical support (e.g. Giblin, 1971 ; Paraskevopoulos and Hunt, 1971 ; Uzgiris, 1972 ; Wachs, Uzgiris and Hunt, 1971) despite the discovery of neo-natal imitation of some facial movements (e.g. tongue protrusion, mouth opening) finger and hand movements, in the first few weeks of life (Dunkeld, 1977 ; Maratos, 1973 ; Meltzoff and Moore, 1977 ; Jacobson and Kagan, 1978). The finding of neonatal imitation does not necessarily invalidate Piaget's developmental sequence, as it may represent a temporary phenomenon which disappears. Uzgiris (1981) refers to neonatal imitation as innate action patterns which decline a few months later. Uzgiris' (1981) view appears consistent with the explanation proposed by Mounoud and Vinter (1981) who argue that neonatal imitation involves a distinct level of coding. Mounoud and Vinter's (1981) suggestion that the development of imitation may reflect distinct levels of translating reality, whereby neonatal imitation is qualitatively different from later imitation, reflecting a different level of representational ability, seems to provide an attractive explanation for the phenomenon.

Mounoud and Vinters' (1981) explanation is attractive as it does not challenge Piaget's belief that the capacity to construct internal representations is an outgrowth and the ultimate achievement of imitation. As such it provides a compromise between Piaget's theory and Moore and Meltzoff's (1976) position. Moore and Meltzoff (1976) argue that internal representation should be viewed as an innate capacity and the basic building block of infant cognition and they account for the phenomenon of neonatal facial imitation by suggesting that babies can create a 'supramodel' representation of visual stimuli.

In either of the above cases Piaget's description of the development of imitation may still hold, with the qualification that he did not document or refer to <u>early</u> neonatal imitation. Therefore, in spite of the controversy surrounding neonatal imitation there appears to be adequate justification for basing intervention programmes on Piaget's account of the developmental sequence of imitation.

The controversial issue is whether or not as Piaget believes the sensory modalities are independent at birth and gradually become co-ordinated, enabling development in the infant's imitative ability, which in turn underlies and is a precursor to mental representation (Piaget, 1952 ; Piaget and Inhelder, 1969). Our knowledge at its present stage does not permit us to answer this question.

The evidence and theories reviewed above do seem to suggest however, that imitation may be an innate ability, and that as others have argued (e.g. Butterworth, 1981) neonates are much more perceptually sophisticated than Piaget's theory allows for. According to Butterworth (1981) there is an "innate link between seeing and hearing" (p.164). If this is so then speech perception which is involved in vocal imitation or vocalising in response to a model may not require the infant to construct correspondence between audition and vision. (Kuhl and Meltzoff, 1982), it may automatically be available to the non-retarded infant. It is possible that this innate mental ability may be impaired in children with extensive brain damage, or may have disappeared after the first few years of life. If this were so, one implication might involve intensive training for the consolidation of such imitative behaviours very early in life.

Two other issues arise that concern (i) the notion of imitation as a "prerequisite" behaviour and (ii) its significance and function in the development of symbolic representation. According to Piagetian theory facial imitation does not occur until the infant can establish a correspondence between his visual perception of another's facial expressions and his own unseen, facial movements. In other words, some form of cross-modal coding may be necessary. Although facial imitation is viewed by Piaget as an important achievement, evidence for internal representation depends upon deferred imitation i.e. when an infant can imitate gestures no longer perceptually available.

The concept of "prerequisite" is implicit in Piagetian theory, since the development of systems depend on previously available structures. According to Piaget it is dependent on and shaped by underlying cognitive structures. Thus, a prerequisite is a crucial ability and in Piaget's theory imitation is of central importance in the symbolic function which includes all mental activity involved in re-presenting reality - including imagery, symbolic play, drawing, dreaming and language. The onset of symbolic behaviour is, for Piaget "indicated by the ability to re-present objects or events and their related action-schemes". (Piaget, 1952). The development of the "index" (i.e. shared features) through imitation, takes place during sub-stages IV and V and is the primary precursor, or source of the symbolic function. Imitation furnishes the infant with his first signifiers, which enable him to "re-present" actions of the model or events no longer available to perception. It is out of the broader symbolic function that language develops, which is viewed as a special, but not separate, aspect of symbolic behaviour (Piaget, 1952).

Therefore in theory, imitation has an important role in cognitive development - in fact Piaget suggests that its development parallels the development of intelligence itself. If imitation is of central importance in the development of higher cognitive functions, then the discovery of a deficit in this capacity in severely mentally handicapped children, implies that central processes in the intellectual development of these individuals is disrupted - hence the inability of the majority to progress past the sensorimotor stage and to acquire language and representational thought.

The Significance of Object Permanence in Cognitive Development

The finding of depressed scores in object permanence and to a lesser extent causality is compatible with the above explanation.

An important aspect to the construction of reality or objectification of reality by the child, involves the construction of invariants. One of the most important is the construction of the permanent object. The attainment of the object concept implies that the infant recognises that objects continue to exist beyond the limits of the perceptual array - i.e. when they can no longer be seen, felt or heard. Acquisition of the object concept is viewed by Piaget as a development essential to representational processes and memory. It is constructed in relation to causality and the co-ordination of these schemas enable the formation of an objective, spatio-temporal world endowed with permanence. Attainment of the object concept therefore marks the transition from an egocentric state where objects are seen as being directed by the self, to a state where reality becomes objectified. The ability to distinguish between self and not self is a significant example of early intelligence and imitation, acquisition of the object concept and appreciation of causality all appear to contribute to this process. Piaget writes :

> "This distinction between the actions of self and those of others is obviously important for imitation and moreover, the ultimate socialization of thought and language".
> (Piaget, 1954).

Of the six areas of sensorimotor intelligence measured by the Uzgiris-Hunt (1975) Scales imitation and object permanence are the only abilities to have been given the status of precursors of symbolic development by Piaget, the other areas all seem to entail "sensori-motor" actions.

It follows that the disruption of conceptual and linguistic development in this population may be because earlier, prerequisite abilities have failed to develop. Interpretation of the results will now be discussed in relation to other findings on intellectual functioning in the severely mentally handicapped.

8.5. Implications for and Relationship to the Literature on Cognitive Deficits in the Severely Mentally Handicapped

The aforegoing discussion has emphasized the theoretical significance attributed by some writers to imitation and object permanence in the development of symbolic aspects of intellectual functioning. It follows that these results may provide one possible insight on the failure of these individuals to develop language and the capacity for abstract thought. Failure to develop these higher cognitive functions hardly seems equivalent to the existence of 'specific' intellectual deficits. Disruption of the capacity for symbolism and representational thought would result in a generalised impairment of higher cognitive functions.

O'Connor (1977) has argued that in severe subnormality all higher cognitive functions are disrupted. He states that in the case of the severely subnormal, neuropathology characteristically affects the cortex e.g. through biochemical, congenital anomalies, or birth accidents which result in extensive lesions:

> "In all subnormality therefore, neuropathology is nonspecific or sufficiently extensive to affect all functions. It also occurs before specialisation of function and therefore affects all functions by retarding them".
> (1977 ; p. 67).

Robinson and Robinson (1976) have suggested that ...

> "... there is no real indication that specific deficits exist in any sizeable proportion of mentally retarded individuals. Furthermore, neither Piaget nor Inhelder gives any theoretical reason to expect such deficits".
> (1976 ; p. 258).

It may be that what appears a specific deficit early in development during the sensorimotor period may have profound consequences for development resulting in a general impairment.

What evidence there is suggests first, that the severely mentally handicapped are especially deficient in short-term memory, which shows a fast decay rate. (Hermelin and O'Connor, 1960). Most of the evidence appears however to concern language and encoding. O'Connor (1977) agrees with Luria that retarded persons have difficulty in translating stimuli from one channel to another (or as Luria expressed it -

the transfer of signals from one system to another). Hermelin and O'Connor state :

> "the verbal system and those activities which involve coding, classification and the use of symbols seem particularly affected".
>
> (1960; p. 37).

The previous discussion presented many views on the status of vocal and gestural imitation as precursors to the predominantly verbal operations which have been found deficient in the retarded by O'Connor (1977) and Luria (1966). Thus there appears to be some agreement regarding the effects of mental handicap on intellectual functioning.

It has been noted that Piaget's (1954) theory presupposes adequate resolution of the attainments of the previous stage. It follows, that the original source of deficiencies in the mentally handicapped may derive from development during the sensorimotor period. Support for this proposition derives from Luria's (1982) writings :

> ".... sometimes fundamental changes in development may be called forth by disturbances of very particular and seemingly insignificant functions, if these particular functions are of great importance for the further formation of complex mental activity of the child".
>
> (1982 ; p. 87).

Luria believed that the retarded suffer from a major defect in the verbal system which in Soviet theory is responsible for regulating behaviours. He argued that the inertness of the retarded person's verbal system relative to the motor system led to a functional dissociation of the two systems. Furthermore, the weakness of the verbal system influenced the significative function of speech, causing severe disruption in the retarded person's capacity for abstract thought and his ability to generalise.

If vocal and gestural imitation are important for the development of speech and language, then the results of this study are compatible with Luria's work. The finding that subjects were relatively more advanced in means-ends, schemes and motor abilities is compatible with Luria's view that retarded children have less difficulty with tasks involving perceptual-motor processing but considerable difficulty with tasks involving verbal-conceptual processing.

Implications for the Severely Mentally Handicapped from a Developmental Perspective.

In recent years knowledge about the precocity of the neonate has undergone major changes. Evidence is rapidly accumulating that early cognitive development undergoes a process involving early organisation, dissociation and re-organisation of interco-ordinated functions, during the first few months of life. (Maratos, 1973). Neonatal abilities include well-developed visual perception, sensory discrimination and intersensory co-ordination. The level of innate organisation which connects the neonate to his environment was previously underestimated by theorists such as Piaget. For example Trevarthen (1974) showed that the preverbal gestural communication abilities of neonates are already co-ordinated for achieving highly specialised goals. As Maratos (1973) argues mutual imitation between the neonate and his mother provides a special mode of communication before smiling and vocalisation develops. If, as Maratos believes, the first occurrence of imitation provides the basis for its later re-occurrence, then it is possible that the innate mechanisms and organisations which permit neonatal imitation to take place, are not intact at birth, in severely mentally handicapped children.

Consideration of how neonates imitate - of the mechanisms and organisations which permit neonatal imitation to take place may lend an important dimension to understanding why severely mentally handicapped individuals show a relative deficit in this ability. For babies of 3 weeks old to imitate mouth movements they must for example be able to perceptually discriminate tongue protrusion from mouth opening. Visual acuity and finely tuned perceptual discrimination suggested by this ability indicates that the neonates' perceptual system is able to take up quite detailed information specified in the stimulus array. A Gibsonian theory of direct perception could accommodate the existence of such sophisticated perceptual abilities of babies, rather than a constructionist theory such as Piaget's.

Recognition or discrimination of facial expression is thought by some theorists such as Trevarthen to be a fairly specialised ability of our species and one in which humans are vastly superior compared to other species. It is possible that the sophisticated organisation of the perceptual system found in the neonate, is impaired in severe mental handicap, at least as far as attention to and perceptual discrimination and recognition of faces is concerned. The Imitation Scales are the only ones in Uzgiris and Hunt's series that involve face perception and fine discrimination of mouth movements, which lends credibility to this possibility.

For babies to imitate tongue protrusion or mouth opening, visual information must be translated into structurally isomorphic, but unseen proprioceptive output. Sensory input must be co-ordinated with motor output, before information can be transferred between sensory and motor systems. Such a co-ordination may therefore normally be present in the first few weeks of life. (Meltzoff & Moore, 1977).[1] It has been suggested that for the neonate to detect visual-proprioceptive equivalences there must be a body schema that authorises the match. (Meltzoff, 1981; Mounoud & Vinter, 1981). Meltzoff (1981) suggests that the neonate has an innate body schems which guides his construction of matches between a visual model and the corresponding part of his own body. Mounoud & Vinter (1981) suggest this takes the form of a 'sensory' representation which mediates between perception and motor output, providing "partial perceptual representations both of his own body and of external objects". (1981; p. 228).

Therefore, the apparent capacity of normal infants for imitation and cross-modal coding suggests they have some type of representational capacity. The implication of this for mentally handicapped children who encounter difficulty in imitating, may be that their difficulty reflects impairment in their ability to encode information, perform cross-modal coding and represent events in general. For Piaget imitation _is_ a manifestation of the infant's intelligence and the gradual co-ordination of seperate modalities underlies progress in imitative ability. If Mounoud & Vinter's (1981) suggestion that the pre-formed organisations and intersensory co-ordinations with which the newborn starts life, reflect a qualitatively different level of coding and organisation to that

1. Some controversy has recently arisen over failures to replicate this.

which is later constructed, is correct, then the existence of neonatal imitation does not invalidate Piaget's account. Both Maratos (1973) and Mounoud & Vinter (1981) believe that initial intersensory co-ordinations become temporarily dissociated, but are reconstructed as sensorimotor co-ordinations a few months later. The two types of imitation are thought to reflect two levels of encoding, first perceptual representation and later a progressively modified, constructed form which culminates in conceptual representation, indexed by deferred imitation, which also depends upon memory.

Some support for the above explanation from a neuro-ontogenetic approach may be found in the writing of Gibson (1981), who suggests that neonatal abilities such as imitation may be sub-cortically controlled, perhaps in the brain stem. Sophisticated neonatal abilities may reflect more global, undifferentiated forms of behaviour which depend on rudimentary sensory representation. Later developments in the capacity for cross-modal coding and imitation are mediated by increasing cortical involvement. Therefore, when considering the mechanisms underlying imitation it is important to distinguish between neonatal imitation and the later appearance of more differentiated forms, as they may involve fundamentally different cortical functions.

An important issue arising from this concerns whether or not severely mentally handicapped infants evidence neonatal imitation. One possibility might be that disruption of this innate ability inhibits its later appearance, or alternatively, severely handicapped neonates might evidence early pre-formed organisations, but once dissociated, fail to construct later, more sophisticated forms. This is an important question which future research might address - long-term case studies would be particularly illuminating.

Whether representation derives from imitation and an organised body schema, or whether imitation depends on existing representational capacities, the consequences of a deficit in imitation for the mentally handicapped involves serious impairment of cognitive and behavioural development. Either they will be impaired in their capacity for representation, or the development of this capacity will be impaired.

Although the subjects in the present study evidenced only a relative deficit in vocal imitation, gestural imitation was completely absent in the majority of subjects. This may reflect the severity of their mental handicap and it may be that with increasing severity of handicap, the greater the impairment in imitative ability. However, given the hierarchical organisation of cognitive abilities, less impaired individuals might even become skilled in their imitative abilities, indeed they might habitually depend upon modelling to facilitate the acquisition of new behaviours and to avoid trial and error learning. There is some evidence that this is the case, Down's Syndrome children are particularly renowned for their frequent use of imitation. (eg. Greenwald & Leonard, 1981). However, if, as Inhelder (1966) suggested 'fixation' occurs at different developmental levels, then an individual might be able to imitate, but not carry out higher-order problem solving operations. If Piaget is correct in his account of the significance of imitation as a mechanism which precedes the acquisition of the symbolic function, then difficulties in encoding information, representation, language and memory might be anticipated, even in the mildly mentally handicapped. There is some evidence that the mentally handicapped do have deficits in cross-modal coding and language. (O'Connor & Hermelin, 1958; 1963).

Thus at all levels of mental handicap relative deficits in the development of the symbolic function may be observed, however, future research is required to verify this.

More direct consequences of disruption in the ability to imitate for severely mentally handicapped concern imitation as a 'vehicle' for learning. In addition to its theoretical significance, imitation provides a strategy for acquiring many different types of skills and greatly facilitates their rapid acquisition. Training programmes on which many of the mentally handicapped depend in order to acquire even basic self-help skills, typically rely heavily on imitation as a means by which structural identity or similarity may be established between the trainer and subject. Direct imitation of a modelled behaviour is a much more economic and effective means of establishing a target behaviour than the lengthy process of shaping and prompting.

It might be anticipated that for the mentally handicapped child impairment in the ability to imitate would have direct consequences for his behavioural development in general, impeding his acquisition of skills, socialisation and acquisition of culture. Imitation provides an example of a behaviour that has evolved to exploit information in the world, because it involves modelling the behaviour of others. Severely mentally handicapped children who are deficient in this mechanism of learning are likely to evidence a wide range of behavioural deficits. If imitation is an innate ability, then its ecological validity is emphasized. As an evolutionary stable strategy, imitation is important, not only in the maintenance, but in the elicitation of social interaction between the infant and other human beings. (Maratos, 1973).

At a more sophisticated level of communication, if a mentally handicapped individual cannot understand the propositional nature of gestures as signs with an objective reference or meaning, he will not be able to acquire any kind of signalling system or sign language.

Finally, if as Piaget believes, imitation provides the basis for the development of imagery, representation and symbolic thought, then disruption of this hierarchical process in severely mentally handicapped children might be expected to have profound consequences on higher cognitive processes, including language and memory. Thought assumes the capacity to represent absent events. Without this capacity, objects and events cannot be evoked, remembered or mentally manipulated; action cannot be planned or events anticipated. One can speculate that the precursors of mental imagery derive not from perception alone, but from the child's own attempts at establishing a correspondence between his own behaviour and that of others. As imitation might be viewed as the primary precursor of symbolic development and deferred imitation as the first evidence for representation, then a relative deficit in the ability to imitate provides a developmental account for the difficulties the mentally handicapped encounter at different stages in their symbolic and linguistic development.

8.6 Possible Explanations for the Deficits in Imitation and Object Permanence

The question which needs to be addressed is why should organic lesions have a differential effect on intellectual functions, so that those functions which are believed to be involved in the development of symbolism and representation and such higher cognitive functions as language, are affected to a greater degree than other aspects of early development?

Any explanation must be speculative until empirical evidence becomes available. The attempt to provide an answer to this question could be approached from two angles. One line of investigation might ask 'through what processes (e.g. cross-modal coding) or mechanisms are imitative acts accomplished and are these functions differentially impaired in this population, with the result that they are 'unable' to carry out such operations?'

O'Connor and Hermelin's (1958) emphasis on the importance of cross-modal coding provides perhaps one potentially fruitful line of explanation - it is possible that these children may not be able to translate information from one modality into another or as Luria (1966) suggested, they may have difficulty in visual-motor correspondences. However as discussed earlier, Meltzoff and Moore (1977) suggest the ability to detect inter-modal equivalences is innate, and furthermore Kuhl and Meltzoff (1982) have found that neonates recognise the auditory-visual correspondences involved in speech perception which they interpret as evidence for the intermodal representation of speech. If this theory is correct then it would not so much be the case that these children cannot perform the necessary mental operations but rather the innate ability to recognise auditory-visual equivalences had been disrupted through brain damage early in development. This would also account for subjects' lack of improvement in vocal imitation in response to training. Whatever is involved in vocal imitation, there seems to be something intrinsic to it to distinguish it from other sensorimotor aspects of intelligence.

In the case of gestural imitation, translation of visual information into motor output is not necessarily equivalent to cross-modality encoding, but some form of visual, spatial coding must be necessary. Modality of input does not appear in this case to have been a critical factor as impairment in the capacities for spatial and temporal encoding are implicated by subjects' apparent failure to process visual and auditory input. Evidence on defects in cross-model coding is contradictory, however (Robinson and Robinson, 1976), although O'Connor and Hermelin (1971) have found some evidence of a temporal coding deficit in retarded persons.

It seems likely that severely mentally handicapped children may show disruption in coding and processing information especially with high order integrative functions; however the complexities of this explanation are beyond the scope of this thesis. A perhaps more elementary and profound question might enquire, 'Why do human infants imitate adults?' What moves or motivates them to imitate? Such an analysis might provide a better understanding of basic propensities which appear deficient in this population.

Although Vygotsky's views are compatible with Piaget's, he emphasises the significance of socio-cultural experiences to which the human infant is exposed :

> "Within a general process of development, two qualitatively different lines of development, differing in origin, can be distinguished : the elementary processes, which are of biological origin, on the one hand, and the higher psychological functions, of socio-cultural origin, on the other. The history of child behaviour is born from the interweaving of these two lines".
>
> (1978 ; p. 46).

According to Vygotsky (1978) all functions appear twice on different levels, first on the social level (inter-psychological) and then internally on the individual level (intra-psychological). Thus, the child's psychological functioning is mediated through social reality. For example Vygotsky (1978) describes how an infant's attempt to reach an object may become a pointing gesture because of the meaning attributed to the action by another. (See also Lock, 1978).

If the influence of the social world on development of the individual is taken into account it is easy to appreciate why so much attention has been given to the socially depriving effects of institutionalisation. According to Zigler (1966), with increasing length of institutionalisation retarded children become less outer-directed, less imitative, less sensitive to verbal cues and less visually alert to their surroundings than non-institutionalised retarded children. The deficit in imitation could quite plausibly have been a consequence of institutionalisation and these behaviours could have disappeared from the childrens' repertoires. It is possible that the deficit in imitation may not apply to a younger population.

Alternatively, the deficiency in imitative ability and social responsiveness could provide an explanation on why the children have become institutionalised in the first place. One can speculate whether this basic deficiency is merely a symptom of profound mental handicap, or whether it provides a psychological explanation for their arrested cognitive development. In the case of these subjects, their lack of imitation and responsiveness is not a simple function of institutionalisation, the effects of which may interact with the severity of handicap, the age of the child, and individual differences. Reasons for the deficiency may be subtle - as noted above imitation may be present in younger populations and then disappear.

The work of Bates et al. (1975 ; 1977) may also provide some insight into this issue. Any explanation for the deficit in imitation may perhaps need to take into account the social context from which it develops - the apparent motivation of normal infants to be initiated into this social world and concepts such as 'intentionality'. Perhaps there must be at least some recognition on the infant's part that other people are imitable. It may be that these children lack the basic level of social awareness possessed by the normal infant.

A stronger case could be made for the thesis that imitation is important both ontogenetically and to the human species (Baldwin, 1906), by taking an evolutionary perspective. Reviews of studies on sensorimotor development in higher primates (Chevalier-Skolnikoff, 1977 ; Parker and Gibson, 1977) conclude that non-human primates show inferior performance on imitation scales relative to any other sensorimotor scales (e.g. Means-ends, Object Permanence, Spatial Relations). Bates et al. (1979) have argued that non-humans show nothing like the motivation of the human child, to imitate new behaviours just for the sheer pleasure of it. Bates et al. conclude -

> "that an increase in the capacity and the motivation to imitate may have been a critical factor in the evolutionary leap into human-like culture, including language".
> (1979 ; p. 337).

One explanation at a phylogenetic level might be that late evolving higher, cortical functions are more vulnerable to disruption and therefore show greater impairment in children suffering from organic lesions. Another explanation which actually does not necessarily contradict the former proposition, at the ontogenetic level of analysis, might be that abilities which emerge later in development, i.e. imitation may be more likely to be disrupted. It was clear from Uzgiris and Hunt's (1975) data on normal infants that success on even the earliest items of the imitation scale did not occur until Stage III of the sensori-motor period and it was the last ability to develop. Thus, the above account has some credibility.

Clearly, more research is required to elucidate both the pre-requisites of the capacity for imitation and the mental operations it involves. Furthermore, there is a lack of studies which have addressed the profound question of 'Why do infants imitate?'. 'What prompts them to do so?' It may be that whatever underlies the intent of the infant to imitate and to be like others is innate and is a rudimentary index to, or early manifestation of, the beginnings of intelligent behaviour itself.

The results of this study do not permit us to draw any definite conclusions as to why subjects failed to imitate. The weight of evidence does suggest that an innate ability or predisposition has been disrupted.

Is Motor Development necessary for Cognitive Development?

Another of the findings of this study suggested a relationship between motor control and performance on most of the Uzgiris-Hunt Scales. The results of this study cannot provide a test of whether cognitive development can proceed in the absence of motor activity. More research, preferably longitudinal studies would be required. However, they do lead one to challenge the question of whether motor activity is of such central and crucial importance for the development of sensorimotor intelligence, especially in view of the finding that the motor development of the subjects in this study was well in advance of their cognitive development and general level of sensorimotor intelligence.

Although motor competence is not equivalent to "action" the subjects in this study performed best on those scales which were largely "action" dependent. From Bates et al.'s "critical test", outlined earlier, which emphasises the crucial importance of these abilities absent in defective populations, it follows that as the subjects in this study were relatively less deficient in action-based aspects of sensorimotor functioning, then the significance of symbolic development and internal representation is emphasised. It is possible that these aspects of development may not be as dependent on action and motor experience, as Piaget believed.

However, more research is required to test Piaget's emphasis on the role of "action" in cognitive development. A number of authors have indeed questioned Piaget's assumptions on this issue and indeed Kopp and Shaperman (1973) have produced evidence of normal conceptual development in a thalidomide child who had received no experience in object manipulation (see also Kagan, 1971 ; Meltzoff and Moore, 1977).

8.7 Suggestions for Further Research

One problem encountered was the difficulty of conducting a quantitative study with those individuals whose handicaps are extremely varied. To be certain of obtaining generalisable results a larger sample of subjects would be necessary. First of all, therefore, these results require replication, particularly with respect to the pilot-training study. Results also require replication with younger, severely mentally handicapped children. More research is also needed to determine whether similar results are obtained with mild to moderately mentally handicapped children.

The ordinal construction of the Uzgiris-Hunt Scales made quantitative analysis a problem. In future research, data analysis might be greatly facilitated if these scales were standardised and developmental age-norms made available. This would be useful for both researchers and clinicians alike. It would also permit inter-scale comparisons and scale steps to be placed in correspondence with one another. This would allow assessment of individual children's profiles. across all seven scales. It would also enable a child's progress to be measured quantitatively.

A great deal of past research has been concerned exclusively with the confirmation of Piaget's sequences of sensorimotor development in normal and retarded development. This study stands in contrast to this tradition because it is the first to have demonstrated the existence of structural deficits in sensorimotor intelligence in severely mentally handicapped children. More studies might investigate structural deficits in the mentally handicapped using more refined methodologies to compare populations and to control for normal development, than has been the case in past studies. An important issue raised by this study concerns whether the severely handicapped are deficient in imitation from birth or whether neonatal and early imitation exists, but fails to reappear.

This study has shown how fruitful a Piagetian approach to the investigation of early intellectual development in mentally handicapped children, may be. It has demonstrated the utility of sensorimotor ordinal scales in the elucidation of cognitive development in this population. However, this would not have been possible without the additional statistical analyses that had to be performed because no norms were available. The scales seem to have great potential utility, but more research is required, not only to validate all scale steps, but also to refine and quantify them. Although the scales may provide a rich cognitive description, they do not assess all aspects of development and other sensory and perceptual assessment strategies are needed. The perceptual sophistication of normal infants was not fully appreciated by Piaget, thus there is a need for more up-to-date assessment techniques which may also be used in relation to the mentally handicapped. Other types of assessment could then be employed in conjunction with the Uzgiris-Hunt (1975) Scales.

The findings of this study have drawn attention to and underlined the importance of and significant role which the development of imitation has in intellectual development. More research is needed to clarify the mechanisms and processes involved.

If vocal and gestural imitation are dependent upon biological mechanisms which may be subject to critical periods of development, then perhaps the main practical implication of these findings concerns the importance of early intervention in these abilities. There seem to be some aspects of language which must be established during circumscribed periods of development (Lenneberg, 1967). Attempts could be made to engage mentally handicapped infants in intense and repeated turn-taking reciprocal sequences of vocal and gestural exchange. In normal development such exchanges occur naturally between mother and infant, however it may be that in the case of mentally handicapped children, their infrequent or unsynchronised level of responding may interfere with these important early interactions. This study could be extended by future research which might examine the effects of training very young severely mentally handicapped children in imitation, who might benefit more than older children studied here.

8.8 Conclusions

The pattern of results obtained from two sources - the factor analysis and the motor-cognitive intercorrelations suggested some dissociation between the imitation scales and other sensorimotor scales of which the latter appeared to depend on motor skills to a greater extent. These results are theoretically compatible with Luria (1966) and O'Connor's (1977) findings on the dissociation between verbal-conceptual abilities and perceptual-motor abilities in the severely mentally handicapped.

The attempt to train a small group of severely mentally handicapped children in vocal and gestural imitation and object permanence indicated that some individuals may benefit from training on the Object Permanence and Gestural Imitation Scales but the attempt to train vocal imitation was unsuccessful. The possibility that imitation may be an innate, biological predisposition could account for failure to train vocal imitation and the finding that individuals who improved in gestural imitation had passed at least one item on the scale before training began.

In conclusion, this study contributed towards increasing our understanding of the nature of sensorimotor intelligence in severely mentally handicapped children, in whom the precursors to early symbolic development and representational thought appear to be especially, disrupted. Evidence for synchrony among the constituent abilities of sensorimotor intelligence was found for normal infants, but not for the severely mentally handicapped children.

These findings were interpreted as evidence that sensorimotor development in severe mental handicap cannot be described simply in terms of developmental-lag theory since it is structurally different from that observed in the development of normal infants.

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APPENDIX 'A'

Chapter 3

Tables I-VII

SEQUENCE OF STEPS AND CRITICAL ACTIONS FOR THE UZGIRIS-HUNT SCALES

From "Assessment in Infancy : Ordinal Scales of Psychological Development (Uzgiris and Hunt, 1975). Courtesy of University of Illinois Press, London.

Table I. - Sequence of Steps and Critical Actions in the Development of Visual Pursuit and the Permanence of Objects

1. Momentary perceptual construction of an object is implied by a sustained attempt to follow an object visually.
   Situation 1: Follows a slowly moving object through a complete arc of 180° with smooth accommodations.
2. A momentary organization of central processes to include a perceptually absent object is implied by maintenance of orientation in the direction in which an object was last seen.
   Situation 2: Lingers with glance on the point where a slowly moving object disappeared.
3. Some guidance of behavior by central processes which incorporate perceptually absent objects is implied by reconstruction of a whole object on the basis of a small visible portion of the object.
   Situation 3: Searches for a partially hidden object.
4. Guidance of behavior by central processes which differentiate somewhat the organization of actions from constructions of perceptually absent objects is implied by turning of the glance in the direction from which a presently absent object has appeared before.
   Situation 2: Returns eyes to starting point when a slowly moving object disappears.
5. Guidance of behavior by central processes which differentiate the constructions of perceptually absent objects from actions previously directed at them is implied by search for a perceptually absent object.
   Situation 5: Finds an object hidden under a single screen.
6. Guidance of behavior by more differentiated constructions of objects is implied by correct search for a perceptually absent object in the face of potentially
   Situation 5: Finds an object hidden under one of two screens by searching directly under the correct screen.
7. Guidance of behavior by constructions of objects differentiated from their previous spatial locations is implied by correct search for a perceptually absent object in the face of a greater number of potentially confusing cues.
   Situation 5: Finds an object hidden under one of three screens by searching directly under the correct screen.
8. Greater persistence of central processes pertaining to constructions of objects is implied by maintenance of search for a perceptually absent object when a single action does not reveal the object.
   Situation 7: Finds an object hidden under a number of superimposed screens.
9. Further persistence and differentiation of central processes pertaining to constructions of objects is implied by ability to deduce the location of an object from observing the spatial displacement of a container with the object.
   Situation 8: Searches in box top and then under the screen for an object hidden by an invisible displacement under a single screen.
10. Increasing persistence of the constructions of objects is implied by ability to deduce the location of an object from observing the spatial displacement of a container with the object in the face of potentially confusing cues.
   Situation 8: Searches in box top and then directly under the correct screen for an object hidden by an invisible displacement under one of two screens.
11. Persistence of the constructions of objects and guidance of behavior by these differentiated constructions is implied by ability to deduce the location of an object from observing the spatial displacement of a container with the object to different positions in space.
   Situation 8: Searches in box top and then directly under the correct screen for an object hidden by an invisible displacement under one of two screens al-
12. Guidance of behavior by enduring constructions of objects differentiated from their spatial locations is implied by ability to deduce the location of an object from observing the spatial displacement of a container with the object to a greater number of different positions in space.
   Situation 8: Searches in box top and then directly under the correct screen for an object hidden by an invisible displacement under one of three screens.
13. Even greater persistence of the differentiated constructions of objects is implied by continued guidance of behavior by these constructions in the face of a number of *successive* displacements of an object within a container, when only the container is seen to be displaced, and the concomitant displacements of the object have to be inferred.
   Situation 9: Finds an object hidden by a series of successive invisible displacements by searching along the path that the container with the object was observed to take.
14. Persistence of the constructions of objects and their mobility is implied by ability to infer the spatial displacements of the object hidden in a container in reverse of the order in which the displacements were observed.
   Situation 9: Finds an object hidden by a series of successive invisible displacements by searching under the last screen first and then retracing the path of the container.

* From Assessment in Infancy. Urbana. 1975.

Table II. Sequence of Steps and Critical Actions in the Development of Means for Obtaining Desired Environmental Events

1. Coordination between two schemes permits a rudimentary differentiation of means and ends as evidenced by commencement of eye-hand coordination leading to visual exploration of the hand.
   Situation 10: Hand-watching behavior is observed.
2. Some differentiation of means and ends is implied by immediate repetition of schemes which accidentally produce an interesting result.
   Situation 13: Attempts to keep a toy in motion by repeated hand or leg movements.
3. Greater differentiation of means and ends is implied by the singling out of a scheme as means for multiple ends, evidenced by progress in achieving visually directed grasping.
   Situation 14: Grasps toy when both hand and the toy are in view.
4. Further progress in the use of a scheme as means for multiple ends is evidenced by attainment of visually directed grasping.
   Situation 14: Grasps toy with just the toy in view.
5. Some anticipatory differentiation of means and ends is implied by execution of one scheme preparatory to the execution of another.
   Situation 15: Quickly drops one or both objects already held in the hands before reaching for a third.
6. Some anticipatory adaptation of means (particular actions) to ends is implied by exploitation of perceived relationships between objects for desired ends.
   Situation 16: Pulls a support to obtain a toy with or without demonstration.
7. Further anticipatory differentiation of means and ends is implied by use of common behavior patterns as means for multiple ends.
   Situation 17: Uses some form of locomotion to retrieve a toy needed in play.
8. Further anticipatory adaptation of means (particular actions) to ends is implied by more discriminate exploitation of relationships between objects.
   Situation 16: Resists pulling the support when the object does not rest directly on it.
9. Some anticipatory construction of alternate means for a given end is implied by exploitation of perceived characteristics of a situation in order to obtain a desired object.
   Situation 18: Uses a string tied to an object to obtain the object on a horizontal surface with or without demonstration.
10. Further progress in anticipatory construction of means adapted to an end is implied by the use of an extension of an object as means while the object (the end) is not directly in view.
    Situation 18: Uses a string tied to an object to obtain it while it is not in the direct line of sight, pulling the string vertically with or without demonstration.
11. Additional progress in anticipatory construction of means adapted to an end is implied by exploitation of other objects as extensions of one's body.
    Situation 19: Uses a stick to obtain a toy out of reach on a horizontal surface with or without demonstration.
12. Anticipatory coordination of an end and appropriate means is implied by evidence of foresightful behavior in the face of a problem situation.
    Situation 20: In the problem of putting a long necklace into a tall container, foresees the likely fall of the container and adopts a successful approach from the start.
13. Perceptual recognition of hindrances toward an end implies representation of the end, of the means, and of the applicability of specific means.
    Situation 21: Does not attempt to stack a solid ring mixed in among other rings onto a peg.

Table III. Sequence of Steps and Critical Actions in the Development of Vocal Imitation

1. Some differentiation of the vocalizing scheme is implied by instances of non-distress vocalization.
   Situation 25: Cooing is observed.
2. Some rudimentary standard for infant's own vocalizations is suggested by apparent recognition of "own" sounds.
   Situation 26: Increases mouth movements and/or smiles upon hearing "own" sounds.
3. Further facility in recognition of familiar sounds is implied by matching own vocalizations to the familiar ones just heard.
   Situation 26: Vocalizes similar sounds upon hearing "own" sounds.
4. Recognition of familiar sound patterns is implied by vocal response to such sound patterns.
   Situation 28: Vocalizes some sounds upon hearing "own" sound patterns (babbling).
5. Further facility in recognition of familiar sound patterns is implied by matching own vocalizations to the familiar patterns just heard.
   Situation 28: Vocalizes similar sound patterns upon hearing familiar ones.
6. Inability to accommodate to a novel sound pattern is implied by vocalization of familiar sound patterns in response to novel ones.
   Situation 29: Vocalizes, but not similar sounds, upon hearing novel ones.
7. Some accommodation to novel sound patterns is implied by approximation of the novel sounds through repeated attempts.
   Situation 29: Vocalizes sounds similar to novel ones presented through gradual approximations.
8. Further plasticity of the vocalizing scheme is implied by reproduction of novel sound patterns without overt groping.
   Situation 29: Vocalizes novel sound patterns directly.
9. Greater plasticity of the vocalizing scheme is implied by direct repetition of new words.
   Situation 30: Repeats most simple new words.

Table IV. Sequence of Steps and Critical Actions in the Development of Gestural Imitation

1. Some recognition of a familiar body movement is implied by a selective response to it.
   Situation 33: Makes a gestural response upon seeing a familiar gesture.
2. Further facility in recognition of familiar body movements is implied by matching of own movements to the ones presented.
   Situation 33: Makes the same gesture upon seeing a familiar gesture.
3. Inability to accommodate to a novel body movement is implied by only partial imitation of such movements.
   Situation 34: When shown the gesture of hitting two blocks together, responds by hitting a block on the floor or in the examiner's hand.
4. Some accommodation to novel body movements is implied by imitation of such movements through gradual approximations.
   Situation 34: Imitates the hitting of two blocks together after overt groping.
5. Further plasticity of motor schemes is implied by immediate imitation of a novel body movement.
   Situation 34: Imitates the hitting of two blocks together directly.
6. Facility in accommodating to novel body movements which the infant can see himself perform is implied by immediate imitation of such novel movements.
   Situation 35: Imitates several novel gestures which he can see himself perform.
7. Inability to accommodate to novel body movements which require representation of own body parts is implied by failure to reproduce "invisible" gestures.
   Situation 36: Responds with some movement, but does not succeed in imitating a facial gesture.
8. Representation of own body parts is implied by imitation of an "invisible" gesture.
   Situation 36: Imitates at least one facial gesture.
9. Increased facility in accommodating to novel body movements and in representation of own body parts is implied by ready imitation of "invisible" gestures.
   Situation 36: Imitates more than one facial gesture.

Table V. Sequence of Steps and Critical Actions in the Development of Operational Causality

1. Momentary control over a source of input is made possible by coordination between two schemes.
   Situation 10: Hand-watching behavior is observed.
2. More definite control over a source of input is made possible by immediate repetition of efficacious actions.
   Situation 13: Immediate repetition of an action resulting in an interesting input is observed.
3. Generalization of efficacious actions is implied by evidence of "procedures."
   Situation 37: Cessation of an interesting spectacle evokes a "procedure."
4. Some appreciation of centers of causality outside the self is implied by direct action on such centers.
   Situation 34: Touches the examiner's hand after demonstration of hitting two blocks;
   or
   Situation 39: Touches the examiner's hand and/or container after demonstration of shaking an object in a container;
   or
   Situation 40: Touches the examiner's hand or the toy after a demonstration of spinning it.
5. Further appreciation of centers of causality outside the self is implied by substitution of request for direct action on another person.
   Situation 40: Hands the toy back to the examiner after a demonstration of spinning it;
   or
   Situation 41: Hands a mechanical toy to a person to be started again after it stops.
6. Further objectification of causality is implied by behavioral recognition of direct ways for activating objects.
   Situation 41: Attempts to activate a mechanical toy himself after a demonstration.
7. Greater objectification of causality is implied by spontaneous behavioral construction of direct ways for activating objects.
   Situation 41: Attempts to activate the mechanical toy himself directly.

Table VI. Sequence of Steps and Critical Actions in the Construction of Object Relations in Space

1. Some accommodation to two loci of input in space is implied by successive shifting of the glance between two objects.
   Situation 42: Alternates glance slowly between two visual targets.
2. Some anticipation of two loci of input in space is implied by rapid alternation between two objects.
   Situation 42: Alternates glance rapidly between two visual targets repeatedly.
3. Further construction of loci of input in surrounding space is implied by correct localization of perceived inputs.
   Situation 43: Localizes source of sound correctly.
4. Further accommodation to distances in surrounding space is implied by accurate approach to near objects.
   Situation 14: Grasps an object directly when within reach.
5. Construction of the movements of objects in surrounding space is implied by following of rapidly moving objects.
   Situation 44: Reconstructs the trajectory of a falling object and directs the eyes to about where it must have come to rest.
6. Further construction of the movements of objects in surrounding space is implied by localization of rapidly moving objects even when portions of their trajectories are obstructed from view.
   Situation 44: Leans forward to search for a dropped object in the direction in which it fell.
7. More complete construction of three-dimensional objects is implied by appreciation of their rotation in space.
   Situation 45: Recognizes the reversal of an object.
8. Construction of some interrelationships between objects in space is implied by behavioral utilization of these relationships.
   Situation 46: Uses one object as a container for another.
9. Further construction of the interrelationships between objects in space is implied by behavioral anticipation of natural forces acting on objects.
   Situation 47: Builds a tower by placing one block in equilibrium over another.
10. Further construction of the surrounding space is implied by behavioral anticipation of the effects of natural forces acting in it.
    Situation 18: Uses a string as an extension of an object vertically, compensating for gravity.
11. Representation of familiar space is implied by memory of the usual locations of objects or persons in it.
    Situation 49: Indicates knowledge of usual whereabouts of familiar persons and recognizes their current absence.

Table VII. Sequence of Steps and Critical Actions in the Development of Schemes for Relating to Objects

1. Incidental use of objects in the exercise of a scheme.
   Situation*: Mouthing.
2. Appearance of momentary attention to the object involved in the exercise of a scheme.
   Visual inspection.
3. Systematic use of objects in the exercise of schemes.
   Hitting.
4. Beginning of differentiation of schemes as a result of interaction with different objects.
   Shaking.
5. Shift of attention from the exercise of schemes to investigation of the properties of objects.
   Examining.
6. Selective application of schemes depending on the properties of objects.
   Differentiated schemes.
7. Acquisition of new schemes as a result of studying various properties of objects.
   Dropping and throwing.
8. Beginning of appreciation of the social uses of objects.
   Socially instigated behaviors.
9. Beginning of the representation of objects is implied by reference to them in a shared interaction.
   Showing.
10. Representation of objects in a symbolic system is indicated by verbal expressions of recognition.
    Naming.

Mean for all critical actions:

APPENDIX 'B'

Chapter 4

RECORD FORMS FOR THE UZGIRIS-HUNT SCALES

B.1 - B.6

From Assessment in Infancy : Ordinal Scales of Psychological Development (Uzgiris and Hunt, 1975). Courtesy of University of Illinois Press, London.

SAMPLE EXAMINATION RECORD FORMS

B. 1

SCALE I: THE DEVELOPMENT OF VISUAL PURSUIT AND THE PERMANENCE OF OBJECTS

Name:

Birthdate:

Date of Examination:

Situation	Presentation (*Suggested number of presentations for each situation is indicated in parentheses*)						
	1	2	3	4	5	6	7
1. *Following a Slowly Moving Object through a 180° Arc* (3–4)							
a. Does not follow object							
b. Follows jerkily through part of arc							
c. Follows smoothly through part of arc							
**d*. Follows object smoothly through complete arc							
Other:							
2. *Noticing the Disappearance of a Slowly Moving Object* (3–4)							
a. Does not follow to point of disappearance							
b. Loses interest as soon as object disappears							
**c*. Lingers with glance on point of disappearance							
**d*. Returns glance to starting point after several presentations							
e. Searches around point of disappearance							
Other:							
3. *Finding an Object Which Is Partially Covered* (3)							
a. Loses interest							
b. Reacts to the loss, but does not obtain object							
**c*. Obtains the object							
Other:							
4. *Finding an Object Which Is Completely Covered* (3)							
a. Loses interest							

Situation	Presentation (*Suggested number of presentations for each situation is indicated in parentheses*)						
	1	2	3	4	5	6	7
b. Reacts to loss, but does not obtain object							
c. Pulls screen, but not enough to obtain object							
**d*. Pulls screen off and obtains object							
Other:							
5. *Finding an Object Completely Covered in Two Places* (2)							
a. Loses interest							
b. Searches for object where it was previously found							
c. Searches for object where it is last hidden							
Other:							
6. *Finding an Object Completely Covered in Two Places Alternately* (3–5)							
a. Becomes perplexed and loses interest							
b. Searches haphazardly under one or both screens							
**c*. Searches correctly under each of the screens							
Other:							
7. *Finding an Object Completely Covered in Three Places* (5–7)							
a. Loses interest							
b. Searches haphazardly under some or all screens							
**c*. Searches directly under correct screen							
Other:							
8. *Finding an Object after Successive Visible Displacements* (3–5)							
a. Does not follow successive hidings							
b. Searches only under the first screen							
c. Searches under screen where object was previously found							
d. Searches haphazardly under all screens							
e. Searches in order of hiding							

SCALE I (*continued*)

SITUATION	PRESENTATION (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
f. Searches directly under the last screen in path							
Other:							
9. *Finding an Object under Three Superimposed Screens* (2–3)							
a. Loses interest							
b. Lifts one or two screens, but fails to find object							
**c*. Removes all screens and obtains object							
Other:							
10. *Finding an Object Following One Invisible Displacement* (3)							
a. Loses interest							
b. Reacts to loss, does not search							
c. Searches only in the box							
**d*. Checks the box and searches under the screen							
**e*. Searches under screen directly							
Other:							
11. *Finding an Object Following One Invisible Displacement with Two Screens* (2)							
a. Searches only in box							
b. Searches under scree[illegible] where object was previously found							
**c*. Searches directly under correct screen							
Other:							
12. *Finding an Object Following One Invisible Displacement with Two Screens Al[illegible]nated* (3)							
a. Loses interest							
b. Searches haphazardly under screens							
**c*. Searches directly under correct screen							
Other:							
13. *Finding an Object Following One Invisible Displacement with Three Screens* (5–7)							
a. Loses interest							
b. Searches haphazardly under all screens							

SCALE I (*continued*)

SITUATION	PRESENTATION (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
**c*. Searches directly under correct screen							
Other:							
14. *Finding an Object Following a Series of Invisible Displacements* (4–6)							
a. Searches only in E's hand							
b. Searches only under first one or two screens in the path							
**c*. Searches under all screens in the path in the order of hiding							
**d*. Searches directly under the last screen in the path							
15. *Finding Object Following a Series of Invisible Displacements by Searching in Reverse of the Order of Hiding* (2)							
a. Searches only under last screen							
b. Searches haphazardly under all screens							
**c*. Searches systematically from the last screen back to the first							
Other:							

B. 2 SCALE II: THE DEVELOPMENT OF MEANS FOR OBTAINING DESIRED ENVIRONMENTAL EVENTS

Name:

Birthdate:

Date of Examination:

SITUATION	PRESENTATION (Suggested number of presentations for each situation are indicated in parentheses) 1	2	3	4
1. *Appearance of Hand-Watching Behavior* (1); also Scale IV-1				
a. Hand-watching is not observed				
**b.* Hand-watching is observed				
Comments:				
2. *Achievement of Visually Directed Grasping* (3); also Scale V-3				
a. Reaches for, but does not grasp object				
**b.* Grasps object when both hand *and* object in view				
**c.* Grasps object by bringing hand up to object				
d. Grasps object by shaping hand in anticipation of contact with object				
Other:				
3. *Repetition of Actions Producing an Interesting Spectacle* (2); also Scale IV-2				
a. Shows interest				
b. Intensifies arm movements and activates occasionally				
**c.* Repeats arm movements systematically and keeps toy active consistently				
d. Only tries to grasp object				
Other:				
4. *Letting Go of an Object in Order to Reach for Another* (3)				
a. Reaches for third object while holding the others				
b. Reaches for third object with filled hands and drops one in the process of reaching				
**c.* Drops one of the objects prior to reaching for third				
Other:				
5. *Use of Locomotion As Means* (2)				
a. No attempt to retrieve object, continues play				
b. Indicates desire for object, but does not try to retrieve it				
**c.* Moves to regain the object and resumes play using it				
Other:				

SCALE II (*continued*)

SITUATION	PRESENTATION (Suggested number of presentations for each situation are indicated in parentheses) 1	2	3	4
6. *Use of the Relationship of Suppport* (2)				
a. Reaches for object on the support				
b. Tries to get object by climbing				
c. Appeals to another person to get the object				
**d.* Pulls the support after demonstration				
**e.* Pulls support without demonstration				
Other:				
7. *Understanding of the Relationship of Support* (1-2)				
a. Pulls support expecting to obtain object				
b. Pulls support, but reaches for object at same time				
**c.* Does not pull the support without the object on it				
Other:				
8. *Use of String Horizontally* (2)				
a. Reaches for the object, ignoring string				
b. Manipulates the string, but does not pull it enough to get object				
**c.* Pulls string and gets object after demonstration				
**d.* Pulls string and gets object without demonstration				
Other:				
9. *Use of String Vertically* (2-3)				
a. Indicates desire for object, ignoring the string				
b. Drops string to floor and becomes unhappy				
c. Plays with the string itself				
d. Pulls the string, but not sufficiently to get the object				
**e.* Pulls string and obtains object after demonstration				
**f.* Pulls string and obtains object without demonstration				
Other:				
10. *Use of Stick as Means* (2)				
a. Plays only with stick				
b. Reaches for object, disregarding stick				
c. Plays with stick and object, does not get object closer				
**d.* Uses stick to get object after demonstration				
**e.* Uses stick to get object without demonstration				
Other:				
11. *Foresight in the Problem of the Necklace and the Container* (2-3)				
a. Does not try to put necklace into container				
b. Attempts to put necklace in, but fails repeatedly				
c. Succeeds in putting necklace in after several unsuccessful attempts				

Situation	Presentation (*Suggested number of presentations for each situation are indicated in parentheses*) 1	2	3	4
d. Invents a method which is successful after a failure				
*e. Adopts a method which is successful from the first				
Other:				
12. *Foresight in the Problem of the Solid Ring* (2–3)				
a. Does not stack rings				
b. Uses force in trying to stack solid ring repeatedly				
c. Attempts to stack solid ring once and avoids it subsequently				
*d. Sets aside the solid ring without attempting to stack it				
Other:				

B.3. SCALE III: THE DEVELOPMENT OF IMITATION: VOCAL AND GESTURAL

Name:

Birthdate:

Date of Examination:

IIIa. Vocal Imitation

Situation	Presentation (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
1. *Use of Vocalization Other than Crying* (1)							
a. Only vocalizes distress sounds							
*b. Vocalizes (coos) when not distressed							
Comments:							
2. *Response to Familiar Vocalizations* (2–3)	List vocalizations presented:						
a. Shows no interest							
b. Listens, does not vocalize himself							
*c. Positive response to infantlike sounds							

Situation	Presentation (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
*d. Vocalizes in response to E's infantlike sounds							
e. Vocalizes similar sounds, but does not shift to match E							
f. Vocalizes similar sounds and shifts to match E							
Other:							
3. *Response to Familiar Sound Patterns* (2–3)	List vocalizations presented:						
a. Shows no interest							
b. Listens, does not vocalize himself							
*c. Positive response to familiar sound patterns							
*d. Vocalizes in response							
e. Vocalizes similar sounds in response, but does not shift to match E							
*f. Vocalizes similar sound patterns and shifts to match E							
4. *Imitation of Familiar Words* (2–3)	List words presented:						
a. Listens, does not vocalize							
*b. Vocalizes, but sounds fail to match model's							
*c. Imitates familiar words							
Other:							
5. *Imitation of Unfamiliar Sound Patterns* (2–3)	List vocalizations presented:						
a. Shows unhappiness or cries							
b. Shows no interest							
c. Listens, does not vocalize himself							
*d. Vocalizes, but not similar sounds							
*e. Vocalizes with sounds becoming gradually closer approximations of model's							
*f. Vocalizes with sounds similar to model's immediately							
Other:							
6. *Imitation of New Words* (6–7)	List words presented:						

B. 3

SCALE III (*continued*)

SITUATION	PRESENTATION (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
a. Listens, does not vocalize							
b. Vocalizes, but not similar sounds							
c. Imitates by gradual approximation							
d. Imitates a few words immediately							
**e.* Imitates most simple words immediately							
Other:							

IIIb. GESTURAL IMITATION

SITUATION	PRESENTATION 1	2	3	4
1. *Systematic Imitation of Familiar Simple Schemes* (2–3)	List actions presented:			
a. Shows interest, but no attempt to imitate				
**b.* Performs some action consistently, does not imitate				
**c.* Imitates				
Other:				
2. *Imitation of Complex Actions Composed of Familiar Schemes* (2–3)	List actions presented:			
a. Attends, but makes no attempt to imitate				
b. Performs some action consistently, does not imitate				
**c.* Attempts to imitate, but does not approximate on successive attempts				
**d.* Imitates by gradual approximation				
**e.* Imitates model immediately				
Other:				
3. *Imitation of Unfamiliar Gestures Visible to the Infant* (2–3)	List gestures presented:			
a. Shows interest, but no attempt to imitate				
b. Performs some action consistently, but does not imitate				
c. Imitates by gradual approximation				

SCALE III (*continued*)

SITUATION	PRESENTATION 1	2	3	4
**d.* Imitates immediately				
Other:				
4. *Imitation of Unfamiliar Gestures Invisible to the Infant* (3–4)	List gestures presented:			
a. Shows interest, but no attempt to imitate				
**b.* Performs some action consistently, does not imitate				
c. Imitates by gradual approximation				
**d.* Imitates at least one invisible gesture immediately				
**e.* Imitates most invisible gestures immediately				
Other:				

B.4

SCALE IV: THE DEVELOPMENT OF OPERATIONAL CAUSALITY

Name:

Birthdate:

Date of Examination:

SITUATION	PRESENTATION (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3
1. *Appearance of Hand-Watching Behavior* (1); also Scale II–1			
a. Hand-watching is not observed			
**b.* Hand-watching is observed			
Comment:			
2. *Repetition of Actions Producing an Interesting Spectacle* (2–3); also Scale II–3			
a. Shows interest in object			
b. Intensifies arm movements and activates occasionally			
**c.* Repeats arm movements systematically and keeps object active consistently			
d. Only tries to grasp object			
Other:			

SCALE IV (*continued*)

SITUATION	PRESENTATION (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3
3. *Use of Specific Action as "Procedure"* (1–2)			
a. Shows interest only during spectacle			
b. Shows excitement, but no dominant act during pauses			
**c.* A dominant act during pauses suggests a "procedure"			
d. Reaches for object only			
Other:			
4. *Behavior in a Familiar Game Situation* (2–3)			
a. Shows no interest			
b. Remains passive during pauses			
c. A dominant act during pauses suggests a "procedure"			
d. Performs part of the act during pauses			
e. Touches E and waits during pauses			
Other:			
5. *Behavior to a Spectacle Created by an Agent* (1–2)			
a. Shows interest only during spectacle			
b. Shows excitement, but no dominant act during pauses			
**c.* A dominant act during pauses suggests a "procedure"			
**d.* Touches E and waits during pauses			
e. Attempts to imitate E			
Other:			
6. *Behavior to a Spectacle Created by an Agent Acting on an Object* (2–3)			
a. Shows interest only during spectacle			
b. A dominant act during pauses suggests a "procedure"			
**c.* Touches E or the object and waits			
**d.* Gives object back to E			
e. Attempts to activate object			
Other:			
7. *Behavior to a Spectacle Created by a Mechanical Agent* (1–2)			
a. Plays with object only			
b. Makes object perform its activity manually			
c. Touches E or object and waits			
**d.* Gives object back to E			
**e.* Attempts to activate object mechanically after demonstration			
**f.* Attempts to discover a way to activate object mechanically before demonstration			
Other:			

SCALE V: THE CONSTRUCTION OF OBJECT RELATIONS IN SPACE

Name:

Birthdate:

Date of Examination:

SITUATION	PRESENTATION (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
1. *Observing Two Objects Alternately* (2–3)							
a. Looks at one object only							
**b.* Alternates glance slowly between objects							
**c.* Alternates glance rapidly between objects							
Other:							
2. *Localizing an Object by Its Sound* (5–7)							
a. Does not turn to sound							
b. Turns to sound in one direction only							
c. Turns to sound, does not locate its source							
**d.* Localizes the source of sound visually							
Other:							
3. *Grasping a Visually Presented Object* (2–3); also Scale II–2							
a. Moves arms in the direction of object, does not touch it							
b. Clasps arms in front of the object							
c. Touches object, but fails to grasp it							
**d.* Grasps object							
Other:							
4. *Following the Trajectory of a Rapidly Moving Object* (3–4)							
a. Does not follow object, continues to look at E's hand							
b. Follows some, but does not locate object							
**c.* Follows object and locates it visually only when it lands in view							
d. Searches with the eyes for object when it lands out of view, but does not lean							

SCALE V (*continued*)

Situation	Presentation (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
*e. Leans to search for object in the direction where it must have landed							
Other:							
5. *Recognizing the Reverse Side of Objects* (2–3)							
a. Grasps object with no sign of appreciation of reversal							
b. Withdraws hands and appears surprised at reversal							
*c. Grasps object, but turns it around immediately or by comparing both sides indicates appreciation of reversal							
Other:							
6. *Using the Relationship of the Container and the Contained* (2–3)							
a. Does not put objects in; only touches those inside							
b. Takes objects out, does not put any in							
c. Puts objects in and takes them out one by one							
*d. Puts or drops objects in, reverses container to get them out							
Other:							
7. *Placing Objects in Equilibrium One upon Another* (2–3)							
a. Does not try to build tower							
b. Approximates two objects, but does not leave the second on the first							
*c. Builds a tower of at least two objects							
Other:							
8. *Appreciating Gravity in Play with Objects* (2–3)							
a. Does not attempt action							
b. Acts without showing appreciation of gravity							

SCALE V (*continued*)

Situation	Presentation (*Suggested number of presentations for each situation is indicated in parentheses*) 1	2	3	4	5	6	7
*c. Acts with appreciation of the force of gravity							
Other:							
9. *Exploring Fall of Dropped Objects* (1–2)							
a. Does not systematically drop objects							
b. Drops several objects repeatedly, does not look at where they land							
c. Drops several objects repeatedly and looks to see where they land							
Other:							
10. *Making Detours* (2–3)							
a. Loses interest in objects							
b. Attempts to reach for the object using the same path as object							
c. Goes directly around the barrier, thus making a detour							
Other:							
11. *Indicating Absence of Familiar Persons* (1)							
a. Does not comprehend question							
b. Goes to the usual location of the person							
*c. Indicates knowledge of absence by gesture or word							
Other:							

B.6 SCALE VI: THE DEVELOPMENT OF SCHEMES FOR RELATING TO OBJECTS

Name:

Birthdate:

Date of Examination:

Schemes Shown	For Example:	Objects Presented to Infant 1 Rattle	2 Doll	3 Plastic Fish	4 Foil	...	15
a. Holding		___	___	___	___	...	___
*b. Mouthing		___	___	___	___	...	___
*c. Visual inspection		___	___	___	___	...	___
*d. Simple motor schemes:							
1. Hits or pats with hand		___	___	___	___	...	___
2. Hits surface with object		___	___	___	___	...	___
3. Hits two together		___	___	___	___	...	___
4. Shakes		___	___	___	___	...	___
5. Waves		___	___	___	___	...	___
Other:		___	___	___	___	...	___
*e. Examining		___	___	___	___	...	___
*f. Complex motor schemes:							
1. Slides		___	___	___	___	...	___
2. Crumples		___	___	___	___	...	___
3. Swings		___	___	___	___	...	___
4. Tears or stretches		___	___	___	___	...	___
5. Rubs or pats		___	___	___	___	...	___
Other:		___	___	___	___	...	___
*g. "Letting go" actions:							
1. Drops		___	___	___	___	...	___
2. Throws		___	___	___	___	...	___
Other:		___	___	___	___	...	___
*h. Socially instigated actions:							
1. Drinks		___	___	___	___	...	___
2. Wears		___	___	___	___	...	___
3. Drives		___	___	___	___	...	___
4. Builds		___	___	___	___	...	___
5. Hugs		___	___	___	___	...	___
6. Dresses		___	___	___	___	...	___
7. Sniffs		___	___	___	___	...	___
8. Making "walk"		___	___	___	___	...	___
Other:		___	___	___	___	...	___
*i. Showing		___	___	___	___	...	___
*j. Naming (List name used by infant)		___	___	___	___	...	___

APPENDIX C

Chapter 5

C.1 Criteria used for Stage Classification by Uzgiris & Hunt.

C.2 Correlation Matrices for Retarded and Normal Subjects : Stages II to VI.

Constructed Items to Identify Piaget's Stages used in Uzgiris and Hunt's Stage Classification

	Scale	Critical Response
Stage II - Primary Circular Reactions A		
(a) Cooing	IIIA	1b
(b) Following ring	I	1d
(c) Finger-sucking	Not included among items in final scale	
Stage II - Primary Circular Reactions B		
(a) Mouthing rattle	VI	b
(b) Hand-watching	II	1b
(c) Looking at rattle	VI	c
(d) Localising sound	V	2d
(e) Grasping rattle	II	2c
Stage III - Secondary Circular Reactions		
(a) Musical toy	II	3c
(b) Jumping-jack response of "repeats pulling of cord"	IV	3c
(c) Use of "procedure"	IV	4c
Stage IV - Differentiation of Means and Ends		
(a) Getting container	II	5c
(b) Removing one screen	I	4c
(c) Dropping one object to pick up another	II	4c
(d) The response "examines" with at least three different toys	VI	e

	Scale	Critical Response
Stage V - Discovery of New Means and Tertiary Circular Reactions		
(a) Phenomenon of fall	VI	g
(b) Shaking after trial and error	IIIB	2c
(c) Putting beads in after trial	II	11c
(d) Using string after demonstrations	II	9e
Stage VI - Invention of New Means Through Mental Combinations		
(a) Immediate use of string	II	9f
(b) Immediate use of stick	II	10c
(c) Nested boxes		
(d) Necklace and container	II	11c

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	

STAGE II

OBJECT	0.0820	OBJECT	-0.3378	OBJECT	99.000	OBJECT	-0.4504	OBJECT	0.6305	OBJECT	0.0000
WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)
MEANS	SIG .393	VOCAL	SIG .136	GESTURAL	SIG .***	CAUSAL	SIG .076	SPACE	SIG .020	SCHEMES	SIG .500
MEANS	-0.1177	MEANS	99.0000	MEANS	0.5650	MEANS	0.0314	MEANS	0.0588		
WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)		
VOCAL	SIG .343	GESTURAL	SIG .***	CAUSAL	SIG .029	SPACE	SIG .457	SCHEMES	SIG .419		
VOCAL	-0.1293	VOCAL	-0.2263	VOCAL	-0.4848						
WITH	N(10)	WITH	N(10)	WITH	N(10)						
CAUSAL	SIG .335	SPACE	SIG .223	SCHEMES	SIG .049						
CAUSAL	-0.3103	CAUSAL	0.2263	SPACE	-0.3556						
WITH	N(10)	WITH	N(10)	WITH	N(10)						
SPACE	SIG .153	SCHEMES	SIG .225	SCHEMES	SIG .113						

RETARDED

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KENDALL CORRELATIONS 11/02/83 PAGE 3

FILE NONAME (CREATION DATE = 11/02/83)
SUBFILE NORM

- - - - - - - - - - - - K E N D A L L C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - - - -

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT	0.7559	OBJECT	0.6261	OBJECT	99.0000	OBJECT	0.8853	OBJECT	0.1181	OBJECT	0.8083
WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)
MEANS	SIG .007	VOCAL	SIG .030	GESTURAL	SIG .***	CAUSAL	SIG .002	SPACE	SIG .010	SCHEMES	SIG .005
MEANS	0.7184	MEANS	99.0000	MEANS	0.8365	MEANS	0.8571	MEANS	0.8001		
WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)		
VOCAL	SIG .014	GESTURAL	SIG .***	CAUSAL	SIG .003	SPACE	SIG .002	SCHEMES	SIG .005		
VOCAL	0.6885	VOCAL	0.8029	VOCAL	0.8607						
WITH	N(9)	WITH	N(9)	WITH	N(9)						
CAUSAL	SIG .019	SPACE	SIG .007	SCHEMES	SIG .005						
CAUSAL	0.8365	CAUSAL	0.7778	SPACE	0.8001						
WITH	N(9)	WITH	N(9)	WITH	N(9)						
SPACE	SIG .003	SCHEMES	SIG .006	SCHEMES	SIG .005						

NORMALS

C.2

STAGE III

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT	0.1053	OBJECT	0.5684	OBJECT	99.0000	OBJECT	-0.2588	OBJECT	-0.0334	OBJECT	0.4676
WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)
MEANS	SIG .351	VOCAL	SIG .021	GESTURAL	SIG .***	CAUSAL	SIG .183	SPACE	SIG .454	SCHEMES	SIG .044
MEANS	0.0278	MEANS	99.0000	MEANS	0.0000	MEANS	0.6513	MEANS	0.4534		
WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)	WITH	N(10)		
VOCAL	SIG .461	GESTURAL	SIG .***	CAUSAL	SIG .500	SPACE	SIG .013	SCHEMES	SIG .050		
VOCAL	-0.3947	VOCAL	-0.3525	VOCAL	0.0548						
WITH	N(10)	WITH	N(10)	WITH	N(10)						
CAUSAL	SIG .090	SPACE	SIG .120	SCHEMES	SIG .423						
CAUSAL	0.0000	CAUSAL	-0.0583	SPACE	0.3721						
WITH	N(10)	WITH	N(10)	WITH	N(10)						
SPACE	SIG .500	SCHEMES	SIG .420	SCHEMES	SIG .102						

<u>RETARDED</u>

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<u>KENDALL CORRELATIONS</u> 11/02/83 PAGE 3

FILE NONAME (CREATION DATE = 11/02/83)
SUBFILE NORM

- - - - - - - - - - - - - - - K E N D A L L C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - - - - - -

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT	0.7951	OBJECT	0.8985	OBJECT	0.8174	OBJECT	0.8557	OBJECT	0.8526	OBJECT	0.8618
WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)
MEANS	SIG .001	VOCAL	SIG .001	GESTURAL	SIG .001	CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001
MEANS	0.7129	MEANS	0.6448	MEANS	0.8792	MEANS	0.8652	MEANS	0.7977	VOCAL	0.8307
WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)
VOCAL	SIG .001	GESTURAL	SIG .003	CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001	GESTURAL	SIG .001
VOCAL	0.8478	VOCAL	0.8022	VOCAL	0.8758	GESTURAL	0.7584	GESTURAL	0.7227	GESTURAL	0.7967
WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)	WITH	N(16)
CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001	CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001
CAUSAL	0.8236	CAUSAL	0.8862	SPACE	0.8516						
WITH	N(16)	WITH	N(16)	WITH	N(16)						
SPACE	SIG .001	SCHEMES	SIG .001	SCHEMES	SIG .001						

<u>NORMALS</u>

STAGE IV

RETARDED

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT WITH MEANS	-0.0445 N(8) SIG .445	OBJECT WITH VOCAL	0.0000 N(8) SIG .500	OBJECT WITH GESTURAL	99.0000 N(8) SIG .***	OBJECT WITH CAUSAL	0.1952 N(8) SIG .280	OBJECT WITH SPACE	0.1029 N(8) SIG .379	OBJECT WITH SCHEMES	0.2057 N(8) SIG .268
MEANS WITH VOCAL	-0.5658 N(8) SIG .039	MEANS WITH GESTURAL	99.0000 N(8) SIG .***	MEANS WITH CAUSAL	-0.2739 N(8) SIG .201	MEANS WITH SPACE	0.1443 N(8) SIG .328	MEANS WITH SCHEMES	-0.8179 N(8) SIG .006	VOCAL WITH GESTURAL	99.0000 N(8) SIG .***
VOCAL WITH CAUSAL	0.6198 N(8) SIG .032	VOCAL WITH SPACE	-0.3518 N(8) SIG .145	VOCAL WITH SCHEMES	0.4523 N(8) SIG .087	GESTURAL WITH CAUSAL	99.0000 N(8) SIG .***	GESTURAL WITH SPACE	99.0000 N(8) SIG .***	GESTURAL WITH SCHEMES	99.0000 N(8) SIG .***
CAUSAL WITH SPACE	-0.2108 N(8) SIG .267	CAUSAL WITH SCHEMES	0.4216 N(8) SIG .107	SPACE WITH SCHEMES	-0.1111 N(8) SIG .371						

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FILE NONAME (CREATION DATE = 11/02/83)
SUBFILE NORM

- - - - - - - - - - - - - - K E N D A L L C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - - - - - -

NORMALS

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT WITH MEANS	0.9149 N(26) SIG .001	OBJECT WITH VOCAL	0.8923 N(26) SIG .001	OBJECT WITH GESTURAL	0.9271 N(26) SIG .001	OBJECT WITH CAUSAL	0.5635 N(26) SIG .001	OBJECT WITH SPACE	0.8806 N(26) SIG .001	OBJECT WITH SCHEMES	0.9530 N(26) SIG .001
MEANS WITH VOCAL	0.8833 N(26) SIG .001	MEANS WITH GESTURAL	0.8848 N(26) SIG .001	MEANS WITH CAUSAL	0.5660 N(26) SIG .001	MEANS WITH SPACE	0.8428 N(26) SIG .001	MEANS WITH SCHEMES	0.9236 N(26) SIG .001	VOCAL WITH GESTURAL	0.9176 N(26) SIG .001
VOCAL WITH CAUSAL	0.5386 N(26) SIG .001	VOCAL WITH SPACE	0.9346 N(26) SIG .001	VOCAL WITH SCHEMES	0.8931 N(26) SIG .001	GESTURAL WITH CAUSAL	0.5303 N(26) SIG .001	GESTURAL WITH SPACE	0.9101 N(26) SIG .001	GESTURAL WITH SCHEMES	0.9249 N(28) SIG .001
CAUSAL WITH SPACE	0.5472 N(26) SIG .001	CAUSAL WITH SCHEMES	0.5688 N(26) SIG .001	SPACE WITH SCHEMES	0.8583 N(26) SIG .001						

STAGE V

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT	-0.1733	OBJECT	-0.6587	OBJECT	-0.3651	OBJECT	-0.4629	OBJECT	0.0323	OBJECT	-0.4743
WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)
MEANS	SIG .278	VOCAL	SIG .013	GESTURAL	SIG .118	CAUSAL	SIG .062	SPACE	SIG .456	SCHEMES	SIG .067
MEANS	-0.3462	MEANS	-0.4557	MEANS	0.2140	MEANS	0.8235	MEANS	0.2631	VOCAL	0.6583
WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)
VOCAL	SIG .127	GESTURAL	SIG .076	CAUSAL	SIG .246	SPACE	SIG .003	SCHEMES	SIG .210	GESTURAL	SIG .019
VOCAL	0.2568	VOCAL	-0.5371	VOCAL	0.0877	GESTURAL	0.3381	GESTURAL	-0 4243	GESTURAL	0.0000
WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)	WITH	N(9)
CAUSAL	SIG .204	SPACE	SIG .036	SCHEMES	SIG .394	CAUSAL	SIG .150	SPACE	SIG .088	SCHEMES	SIG .500
CAUSAL	0.2390	CAUSAL	0.5367	SPACE	0.1633						
WITH	N(9)	WITH	N(9)	WITH	N(9)						
SPACE	SIG .218	SCHEMES	SIG .055	SCHEMES	SIG .306						

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KENDALL CORRELATIONS 11/02/83 PAGE 3

FILE NONAME (CREATION DATE = 11/02/83)
SUBFILE NORM

- - - - - - - - - - K E N D A L L C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - -

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT	0.8927	OBJECT	0.8967	OBJECT	0.8983	OBJECT	0.7505	OBJECT	0.9312	OBJECT	0.8047
WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)
MEANS	SIG .001	VOCAL	SIG .001	GESTURAL	SIG .001	CAUSAL	SIG .002	SPACE	SIG .001	SCHEMES	SIG .001
MEANS	0.8326	MEANS	0.9113	MEANS	0.7320	MEANS	0.8893	MEANS	0.7753	VOCAL	0.9312
WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)
VOCAL	SIG .001	GESTURAL	SIG .001	CAUSAL	SIG .004	SPACE	SIG .001	SCHEMES	SIG .002	GESTURAL	SIG .001
VOCAL	0.8272	VOCAL	0.8772	VOCAL	0.8387	GESTURAL	0.7505	GESTURAL	0.9139	GESTURAL	0.8636
WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)	WITH	N(12)
CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001	CAUSAL	SIG .002	SPACE	SIG .001	SCHEMES	SIG .001
CAUSAL	0.7423	CAUSAL	0.6518	SPACE	0.7987						
WITH	N(12)	WITH	N(12)	WITH	N(12)						
SPACE	SIG .002	SCHEMES	SIG .008	SCHEMES	SIG .001						

NORMALS

STAGE VI

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT	0.7127	OBJECT	-0.7396	OBJECT	0.0962	OBJECT	0.8321	OBJECT	1.0000	OBJECT	0.0000
WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)
MEANS	SIG .033	VOCAL	SIG .031	GESTURAL	SIG .405	CAUSAL	SIG .018	SPACE	SIG .008	SCHEMES	SIG .500
MEANS	-0.8895	MEANS	-0.0772	MEANS	0.5930	MEANS	0.7127	MEANS	-0.1782	VOCAL	0.3203
WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)
VOCAL	SIG .009	GESTURAL	SIG .419	CAUSAL	SIG .056	SPACE	SIG .033	SCHEMES	SIG .323	GESTURAL	SIG .202
VOCAL	-0.6923	VOCAL	-0.7396	VOCAL	0.0000	GESTURAL	0.0000	GESTURAL	0.1962	GESTURAL	0.0962
WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)	WITH	N(6)
CAUSAL	SIG .035	SPACE	SIG .031	SCHEMES	SIG .500	CAUSAL	SIG .500	SPACE	SIG .405	SCHEMES	SIG .405
CAUSAL	0.8321	CAUSAL	0.1849	SPACE	0.0000						
WITH	N(6)	WITH	N(6)	WITH	N(6)						
SPACE	SIG .018	SCHEMES	SIG .321	SCHEMES	SIG .500						

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FILE NONAME (CREATION DATE = 11/02/83)
SUBFILE NORM

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NORMALS

VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR		VARIABLE PAIR	
OBJECT	0.8642	OBJECT	0.6868	OBJECT	0.7568	OBJECT	0.8670	OBJECT	0.6477	OBJECT	0.6931
WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)
MEANS	SIG .001	VOCAL	SIG .001	GESTURAL	SIG .001	CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001
MEANS	0.5742	MEANS	0.8315	MEANS	0.9425	MEANS	0.7888	MEANS	0.8335	VOCAL	0.6352
WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)
VOCAL	SIG .003	GESTURAL	SIG .001	CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001	GESTURAL	SIG .002
VOCAL	0.5483	VOCAL	0.5659	VOCAL	0.7107	GESTURAL	0.7852	GESTURAL	0.8182	GESTURAL	0.8200
WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)	WITH	N(19)
CAUSAL	SIG .006	SPACE	SIG .006	SCHEMES	SIG .001	CAUSAL	SIG .001	SPACE	SIG .001	SCHEMES	SIG .001
CAUSAL	0.7678	CAUSAL	0.7703	SPACE	0.8662						
WITH	N(19)	WITH	N(19)	WITH	N(19)						
SPACE	SIG .001	SCHEMES	SIG .001	SCHEMES	SIG .001						

APPENDIX D

Chapter 6

THE BAYLEY SCALES OF INFANT DEVELOPMENT : MOTOR SCALE

From Bayley's (1969) Manual of the Bayley Scales of Infant Development. The Psychological Corporation.

Table Motor Scale Items Arranged by Situation Codes

A: Held upright in arms
1 Lifts head when held at shoulder
2 Postural adjustment when held at shoulder
8 Head erect: vertical
9 Head erect and steady
14 Holds head steady
18 Head balanced

B: Prone—crib, playpen, or table
3 Lateral head movements
4 Crawling movements
12 Elevates self by arms: prone
33 Prewalking progression

C: Supine in crib—extremities
5 †Retains red ring
6 *Arm thrusts in play
7 *Leg thrusts in play
10 Lifts head: dorsal suspension

C¹: Supine in crib—turning
11 Turns from side to back
19 *Turns from back to side
28 *Rolls from back to stomach

D: Sitting—hard surface
13 Sits with support
17 Sits with slight support
23 Sits alone momentarily
27 Sits alone 30 seconds or more
29 Sits alone, steadily
31 Sits alone, good coordination

Uncoded (0-3.9 months)
15 *Hands predominantly open

E: Cube behavior—grasp (Situation Code H on Mental Scale)
16 †Cube: ulnar-palmar prehension
21 †Cube: partial thumb opposition (radial-palmar)
32 †Cube: complete thumb opposition (radial-digita

F: Gaining vertical position—with help of person
20 Effort to sit
22 Pulls to sitting position
36 Pulls to standing position

G: Manipulative capacity
24 *Unilateral reaching
26 *Rotates wrist
39 †Combines spoons or cubes: midline
44 †Pat-a-cake: midline skill

H: Pellet behavior (Situation Code J on Mental Scale)
25 †Attempts to secure pellet
30 †Scoops pellet
35 †Pellet: partial finger prehension (inferior pincer
41 †Pellet: fine prehension (neat pincer)

I: Upright progress to walking
34 Early stepping movements
40 Stepping movements
42 Walks with help
43 Sits down
45 Stands alone
46 Walks alone

* May be observed incidentally. † May be presented during administration of Mental Scale.

J: Gaining vertical position—by furniture
37 Raises self to sitting position
38 Stands up by furniture

K: Stands up from floor alone
47 Stands up: I
57 Stands up: II
71 Stands up: III

Uncoded (4-14.9 months)
48 †Throws ball

L: Walking skill—pull toy
49 Walks sideways
50 Walks backward

M: Balance
51 Stands on right foot with help
52 Stands on left foot with help
58 Stands on left foot alone
60 Stands on right foot alone

N: Stairs
53 Walks up stairs with help
54 Walks down stairs with help
64 Walks up stairs alone: both feet on each step
66 Walks down stairs alone: both feet on each step
72 Walks up stairs: alternating forward foot.
80 Walks down stairs: alternating forward foot

O: Walking board
55 Tries to stand on walking board
56 Walks with one foot on walking board
62 Walking board: stands with both feet
67 Walking board: attempts step
74 Walking board: alternates steps part way

P: Jumping from floor
59 Jumps off floor, both feet
77 Jumps over string 2 inches high
81 Jumps over string 8 inches high

Q: Walks on line
61 Walks on line, general direction
65 Walks on tiptoe, few steps
68 Walks backward, 10 feet
73 Walks on tiptoe, 10 feet
75 Keeps feet on line, 10 feet

R: Jumping from height
63 Jumps from bottom step
69 Jumps from second step
70 Distance jump: 4 to 14 inches
76 Distance jump: 14 to 24 inches
78 Distance jump: 24 to 34 inches

Uncoded (15-30+ months)
79 Hops on one foot, 2 or more hops

† May be presented during administration of Mental Scale.

From Bayley's (1969) Manual.

APPENDIX E

Chapter 7

INSTRUCTIONS FOR THE PRESENTATION OF ITEMS TRAINED

EII TRAINING METHOD :

INSTRUCTIONS FOR PRESENTATION OF ITEMS TRAINED :

Object Permanence

Item No. :

1. Following a slowly moving object through a complete arc of 180° with smooth accommodations

Take a brightly coloured object and hold it about 8 inches away from the child's face, at eye level. Shake the object or vary the focal distance from the child's face until he fixates on the object. When fixation has been obtained slowly move the object in a lateral arc of 180° across the child's visual field. Represent item starting from the opposite side.

If the child fails to fixate on the object

Take a brightly coloured squeezy toy. Hold it at eye level and bring it into the child's visual field squeeze it making it emit a sound as the additional auditory input may draw the child's attention. Once eye contact has been accomplished, proceed as above.

2. Noticing the disappearance of a slowly moving object

Take a brightly coloured object and move it at eye level across the child's visual field, making it disappear. Bring the object round, behind the child slowly, and make it reappear (from the other side). Move the object in the same direction for every presentation.

If the child loses interest in the object as soon as it disappears : Instead of making the object disappear completely from the child's view leave it in view. On subsequent trials gradually leave less of the object in view so that it only partially disappears thus maintaining the child's lingering glance. Continue until the object has been made to disappear completely.

3. Searching for a partially hidden object

Take the child's favourite toy (such as a doll) and a screen. Hold the toy out to the child until he reaches for it. If necessary shake the toy or give it to the child to play with for one or two seconds. As soon as the child demonstrates interest in or desire for the toy, quickly place it, within easy reach under the screen, so that part of the toy is visible.

If the child loses interest and does not reach for the object

Uncover the toy and touch it, drawing the child's attention to it. Use prompts and help the child to touch the object. Once the child starts to reach for the uncovered objects, quickly cover it.

4. Finding an object which is completely covered

Take any toy which the child finds attractive. Ensure that the child wants the toy and as he starts to reach for it, quickly cover it with a screen, making sure it is still within his reach.

(a) If the child fails to obtain the object from under the screen, or fails to remove the screen (perhaps due to poor motor control)

Use prompting by guiding the child's hand and/or uncovering the object. Help him succeed. If the child shows no intention of reaching for the object : try using an object which emits a sound, so that the child becomes aware of its presence, although it is hidden from sight.

(b) If the child shows no desire for the object

Try substituting the object, until the child shows interest in the object. If this fails, attempt to encourage the child to play with the object, then rapidly cover it up.

(c) If the child obtains a partially hidden object but not a completely hidden object, commence with the object half covered and progressively cover up more of it, allowing the child to obtain it each time until it is completely hidden.

5. Finding an object completely covered in two places

Place two differently coloured screens in front of the child. Take a toy that interests him and hide it under one of the screens. If necessary prompt the child and encourage him to find it. Represent twice and then switch to hiding the toy under the other cloth.

6. Finding an object which is hidden in two places alternately

Directions are the same as in 5, only hide the object alternately under each screen. If the child searches for the object where it was previously found, uncover part of the object so that he appreciates its new hiding place and encourage him to reach for it. Repeat until child searches in alternate hiding places.

7. Finding an object hidden under one of three screens by searching directly under the correct screen

Ensure that the child is interested in the object. Hide the object under one of the screens and if necessary encourage the child to reach for it by pointing at the correct screen. If the child succeeds in finding the object on the second presentation hide it under one of the other screens. If necessary assist the child in searching under the correct screen. Vary the selection of hiding places, so that the order of screen selection is random.

If the child becomes frustrated from having the object repeatedly taken away, pick up the object as soon as the child removes the screen or allow the child to play with the object for a short time.

8.* Finding an object after following successive visible displacements

Take an object which the child desires and move it in a straight path either from left to right or right to left so that the object disappears under each screen and reappears in the space between screens. Leave the object under the last screen. Make sure that the child is following this procedure and sees the object reappear. If the child loses interest: try substituting objects and if necessary use a chocolate button. Wave the object in front of the child until he attempts to grasp it, then quickly commence the above procedure. It may be necessary to work fairly quickly to ensure the child watches the whole procedure. Use verbal prompting to help maintain child's attention and to encourage the child to reach.

---

* Not included in the scaling analysis.

8. <u>Finding an object under 3 superimposed screens</u>

For children who liked chocolate a tiny piece of chocolate was used. Cover the piece of chocolate with one screen then loosely wrap it with the other 2 screens so that they can't all be swept off together. Make sure the child is watching this procedure. Then encourage him to obtain the chocolate.

(a) <u>If child pulls all screens at once</u>

Take 2 nested containers and one screen. Place the piece of chocolate on the table, cover it with one small container (upside down) with the child watching cover this with the larger container and finally place the cloth over.

(b) <u>If the child starts playing with the screens or containers</u> rather than being intent on finding the chocolate, each time he picks up a screen take it away from him, keeping it out of sight until he finds the chocolate. The child should only be allowed to have the chocolate when each screen has been removed individually.

9. <u>Finding an object following one invisible displacement under a single screen</u>

Take a small object (i.e. miniature doll) or a chocolate drop and a small box or container (these should not be attractive in themselves). Place the object into the box whilst the child watches, then hide it under a screen. Then turn the box over, and bring it back into view, leaving the object behind, under the cloth. Show the child that the box is empty. Use prompting by pointing to the object (which is under the cloth) together with verbal queries as to where the object is.

<u>If the child does not succeed</u> Show him a demonstration of the procedure i.e. put the object into the box, turn it over, this time in view and let him see the object before covering it with a screen.

10. <u>Finding an object following one invisible displacement with two screens</u>

The presentation of this item follows the procedures for item 10, except a second cloth is placed in front of the child and the object is hidden under this for two presentations. The hiding place is then switched to the first screen.

If the child does not search under the correct screen go back to the procedure for item 10, allowing the child to see the object being tipped out of the box, underneath the screen.

11. Finding an object following one invisible displacement with 2 screens alternately

Follow the same procedures for item 10, using the box to produce the invisible displacements, only hide the object under the two screens alternately, placing the empty box in between the two screens.

If the child always searches under the screen where he last found the object, show him that the object is hidden under the other screen and use verbal prompts to encourage him to remove the cloth himself and obtain the object. If this doesn't work use a physical prompt to assist the child to obtain the object.

12. Finding an object following one invisible displacement with three screens

Take 3 different pieces of cloth and place them in front of the child. Put a small object into a box and make it disappear under any one of the screens. Turn the box upside down and withdraw it from under the cloth. Re-present by hiding the object under one of the three screens at random. If the child does not search under the correct screen, follow the procedure for step 4a.

13. Finding an object following a series of invisible displacements

Place 3 screens in front of the child. When you have got the child's attention place a small object in the palm of your hand, then close it. Pass your clenched hand underneath the first cloth, (move always in the same direction, e.g. from left to right) making it disappear. Ensure that the child is still watching - you may have to proceed fairly quickly, in order to maintain the child's interest. Then make your clenched hand reappear in the space between the first and second cloth, then disappear under the second cloth and so on. Ensure that the child does not catch sight of the object in your hand. Leave the object under the third and last screen. On successive presentations move in the same direction.

If the child searches under the wrong cloth Leave the object under the first cloth without going any further, and allow the child to find it. On the second presentation, leave the object under the second cloth. Using prompts (e.g. both verbal and physical) help the child to find the object. Repeat this until the child can succeed unaided. Finally, using prompts help the child to succeed when presented with 3 invisible displacements.

14. Finding an object following a series of invisible displacements by searching in reverse order

If the preceding step has been successfuly trained an expectation that the object is to be found under the last screen, should have been established. Place the 3 cloths in front of the child. Ensure that the child is attending and looking at the object. As in step 14, close your hand over the object, and pass your hand under each cloth, allowing it to reappear in the spaces between the cloths, making sure that you move in the same direction as in step 14. This time, instead of leaving the object under the last screen in the path, leave it under the first cloth, but continue moving your clenched hand as if it still held the object. When you reach the final screen, pause momentarily with your hand under the cloth, then show the child that your hand is empty. Use a verbal prompt i.e. "where is it...., give it to me".

If the child searches only under the last cloth and does not look under the second and first cloths

Show the child that the object is not under the second cloth but is under the first cloth i.e. demonstrate a reversed search. Represent the item by first presenting step 14 in order to re-establish the expectation that the object will be under the last screen.

Vocal Imitation

1. Cooing is observed

Not trained.

2. Responding positively to cooing sounds

As all subjects had achieved this step prior to training, it was not necessary to train this step.

3. Vocalising similar sounds upon hearing "own cooing"

(e.g. ah, ooh, ahya, eeyu).

Play with the child to initiate happy, playful interaction.

When the child is smiling, but not vocalising, and you have established eye contact, present the model vocalisation. (Your face should be about 6" away from the child's and at the same level specified at the top of child's programme). Pause and encourage child to respond by looking intently at him and at his mouth. Represent model with the aim of establishing a reciprocal exchange.

If the child does not vocalise in response and remains passive

During the pauses between presentations attempt to excite him by tickling and verbal encouragement e.g. "You say it" and repeat presentations. Observe and record any vocalisations the child makes during the session. If necessary use prompts (e.g. touch child's lips. Reward any vocal response.

4. Vocalising similar sounds upon hearing own familiar "babbling" sounds (e.g. ma-ma-ma, bababa, dadada)

Procedure the same as for item 3.

5. Vocalising similar sounds upon hearing own sounds (babbling or words) and shifts to match model

Procedure the same as for item 3.

6. Vocalising in response to unfamiliar sound patterns

Procedure the same as for item 3.

7. Vocalising in response to unfamiliar sound patterns or new words through gradual approximations. Procedure the same as for item 3.

8. Imitating unfamiliar sound patterns or new words directly

(e.g. br, zzz, vee-ree-ree etc.)

Procedure the same as for item 3.

9. Imitating most new words directly (e.g. umberella, ladder, circus, squirrel, etc.)

The procedure for this item follows the same procedures as other items in the scale, however instead of representing the same word, take a picture book and place it opened in front of the child. Point to an object and when the child is looking at it present the appropriate label. On the next presentation point to another object and present the word for it - which should be unfamiliar to the child.

Gestural Imitation

1. Consistent physical responding to examiners presentation of a familiar simple scheme (e.g. patting legs, clapping, waving).

   Play with the child for a few minutes. Ensure that he is not applying the scheme which you are going to present. When you have his attention perform the action two or three times. Pause and look expectantly at the child and his hands. Use verbal prompts e.g. "Now you do it". If necessary use a physical prompt. If this is not successful try applying the scheme to an object which interests the child (e.g. patting a doll). Reward any physical response, then represent model in an attempt to establish an exchange.

2. Imitating a familiar simple scheme

   Procedure is the same as for item 1.

3. Attempting to imitate a complex action composed of familiar schemes (e.g. banging two pegs together ; shaking a tin containing blocks).

   Procedure is the same as for item 1.

4. Imitating model (complex familiar actions, unfamiliar gestures or unfamiliar invisible gestures) through gradual approximations

   Procedure is the same as for item 1.

5. Immediately imitating a complex action composed of familiar simple schemes

   Procedure is the same as for item 1.

6. Immediately imitating an unfamiliar gesture visible to the child (e.g. opening and closing hand, drumming fingers, patting legs).

   Procedure is the same as for item 1.

   If the child does not perform the unfamiliar gesture : present a familiar gesture (e.g. if the child can clap hands but cannot apply this to patting legs). Then when the child is responding, represent the unfamiliar gesture.

7. Making a response to an unfamiliar, invisible gesture (e.g. eye blinking, raising eyebrows, protruding tongue).

Procedure is the same as for item 1. This item was not directly trained as the final aim was to elicit imitation of the model.

8. Imitating one invisible gesture immediately

Procedure for this mainly followed that described for item 1. Facial gestures were presented quite close to the child's own face i.e. about 6" away. The trainers were instructed to create a game-like social exchange which generally involved tickling and playing with the child.

9. Imitating several invisible gestures immediately

The procedure for presenting this item was identical to that indicated for item 8, except new facial gestures unfamiliar to the child were presented once a gesture had been learnt.