A DEVELOPMENTAL ASSESSMENT OF VISUAL PERCEPTION FOR PRE-SCHOOL CHILDREN

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ABSTRACT

An assessment of Visual Perceptual skills for children of pre-school age (three to four-and-a-half years) was designed. Twenty-one subtests utilise three-dimensional play material where possible to maintain the interest and involvement of young children. Requirements for comprehension of verbal instructions are minimised, as is the necessity for accurate movement responses, making the assessment suitable for use with children who have delayed development and who may have Special Educational Needs such as physical disabilities, language disorder, or learning difficulties, and with non-English speaking children.

Normative data was collected from a preliminary standardisation sample of one hundred children aged from two-and-a-half to four-and-a-half years.

The Assessment was also administered to twenty children for whom English was not their mother tongue and forty-five children designated as having Special Educational Needs who suffered from a variety of handicaps. Those children whom their teachers suspected of being perceptually impaired were accurately identified by the Assessment. A small group of Down's Syndrome children were also tested, and most were found not to have a specific impairment in visual perception when this was compared to their general level of cognitive development.

Good evidence of test-re-test and inter-rater reliability was demonstrated.

Validation was established by correlation with existing measures of visual perception.

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A NOTE ON GENDER

The question of gender received considerable thought during the writing of this study. It is felt to detract from the main substance of the argument to use the clumsy "he or she" in each reference to an individual, and to alternate the gender by the paragraph, or even by the chapter, can confuse and annoy the reader. It is accepted that reference to the child as "he" will incense some feminists, but nevertheless this convention has been adopted. The tester, who is more likely to be female than male has been referred to as "she". Sincere apologies are extended to anyone who is offended by this designation.

CHAPTER 1

INTRODUCTION

Visual-perceptual skills are fundamental to an individual's ability to lead a normal life within a normal environment.

The trend in the 1960's to attribute a high proportion of learning difficulties to perceptual dysfunction began to lose credibility when studies of perceptual-motor training failed to result in improvements in reading skills (see Zarske, 1982, for a review). However, a number of more recent studies continue to link academic skills with perceptual functioning, as in the early stages of learning to read (Solan and Mozlin, 1986), and in the development of mathematical ability (Cohn-Jones and Seim, 1978, Mangina, 1980). Axner (1985) in an unusually long-term study reported that academic achievement was still adversely affected at ten years of age in certain children identified as having perceptual difficulties in the pre-school years.

More important, however, than its somewhat controversial relationship with academic skills, is the effect of visual perception on our social skills and daily living activities.

Much of our enjoyment of the world of nature and art depends on our visual perceptual skills and a vast amount of sensory input informing us about our environment is visual. Almost everything we do in daily life requires perceptual ability to some degree in order to perform with competence according to socially accepted standards of behaviour in fundamental skill areas such as eating, dressing and finding our way around the house or locality. Socially, visual perception is advantageous for reading the non-verbal language in facial expressions and in contextual clues which enhance our ability to understand situations and relate to other people.

There is a need for teachers and therapists working with young children to be able to assess the child's performance on perceptual tasks without having to refer to psychologists or the use of sophisticated test instruments, which are in any case often not available to grass-roots workers without specific training in their administration and interpretation.

The purpose of this project is to devise an assessment to identify children with deficient visual perception at an early age. If perceptual impairment can be detected in the pre-school years, then appropriate intervention in the form of remedial programmes can be implemented to improve the child's abilities before entry to infant school, where increased demands are made on perceptual skills. The assessment, known as the Pre-school Visual Perception Assessment or P.V.P.A. consists of a series of activities using play materials which interest and motivate the young child.

Basic standardisation data was obtained on a sample of one hundred normal children, with additional data on fifty-five children with developmental handicaps, and twenty children for whom English was a second language.

Outline of the Study

The study sets out to design an assessment battery for the examination of perceptual abilities in children of pre-school age or a corresponding developmental level. It does not claim to have produced a final version of the test suitable for publication, as a full standardisation would require a far larger sample well beyond the resources of one Ph.D. student. This, therefore, is to be regarded as a preliminary standardisation, or 'experimental edition' which it is hoped to refine and develop for publication in the future.

The feasibility of such an assessment was questioned by many sceptics during its gestation, and the study demonstrates that a simple, easily administered measure using activities which children find enjoyable <u>can</u> discriminate between young children with a perceptual impairment and those without, and <u>is</u> a viable method of assessment of visual perception for children of pre-school age or an equivalent level of development.

The early chapters examine the nature of perception, tracing the main historical theories from which our current state of knowledge has evolved. A discussion of perceptual development in normal children leads into an examination of the literature relating to perceptual impairment in children.

The rationale for the development of the test reviews the deficiencies in assessment materials currently available, and the consequent need to devise a more suitable tool to access young children's perceptual knowledge.

The process of development and preliminary standardisation of the test is described, with evidence of validity, test-re-test and inter-rater reliability.

The data from the standardisation sample is compared with the test results from two groups of children, one group for whom English was not their mother tongue, and a second group of children with a range of handicaps, some of whom were suspected of having impaired visual perception, and were identified as such by the test.

The administration manual, illustrations of the test materials and tables for analysis of the scores are contained in the Appendix.

CHAPTER 2

WHAT IS PERCEPTION?

Despite the many volumes devoted to the subject of perception concise definitions are elusive. Von Fieandt (1966) defines perception as "an experienced sensation" (p.3-4), a sensation being "a change in the environmental condition of our receptors." Allport (1955) extends the definition, though in rather more nebulous terms as being: (p.14)

> . . . something to do with our awareness of objects or conditions about us. It is dependent to a large extent upon the impressions these objects make upon our senses. It is the way things look to us, or the way they sound, feel, taste or smell, but perception involves an understanding awareness - a 'meaning' or a 'recognition' of these objects.

For the purposes of this study, which focuses on visual perception, the definition of Frostig and Maslow (1973) will be adopted, i.e. (p.176): "the ability to recognise and discriminate between visual stimuli and to interpret those stimuli by associating them with previous experience."

Rock (1975) defines the parameters of perception as lying between the fields of sensory and cognitive processes. He writes: (p. 24)

> Investigators of sensory processes (e.g. vision) are concerned with the psychophysical relationship between stimulation and sensation, and with the physiological mechanisms that mediate sensation. Thus they search for the physical and physiological correlates of sensory experience but tend to focus on less complex aspects of sensation than investigators in perception.

On the other hand:

> Investigators of cognitive processes are concerned with the problems that begin where perception ends, i.e. begin with the perceived object as given. They are interested in processes such as recall, recognition, association, attention, abstraction, concept formation, understanding and meaningful learning, problem-solving and thinking.

Perception, Sensation and Cognition

Sensory Handicaps

It is evident that visual impairment will affect visual perception, just as a hearing loss affects an individual's ability to perceive auditory stimuli. In fact, in an earlier experiment carried out by the writer (Howard, 1977) it was felt that officially undiagnosed impaired vision had a direct bearing on the erroneous perceptual judgements of some of the cerebral palsied children participating. It is not always easy to separate visual ability from visual perception. Many cerebral palsied children have concomitant visual disorders (Woods, 1972, Breakey et al, 1974), yet teachers may be unaware of the precise nature and effect of these, and indeed it is very difficult to achieve an accurate assessment of the vision of some handicapped children. Some may even have an intermittent visual disorder which may not manifest itself on the occasion of the test. Visual disorders may, therefore, go undetected. This study is concerned with pre-school children, and it is particularly possible that visual problems in children of this age may exist undiagnosed, with visual perception being affected as a result.

Perception and Cognition

Since all aspects of performance are influenced by age, intelligence and past experience, which vary so enormously from one child to another, it is hardly surprising that it is difficult to distinguish precisely between perception and cognitive abilities in young children. Indeed, the emergence of the term "spatial cognition" in recent years has highlighted just this growing awareness of the extent to which cognitive processes are involved in functions that were previously regarded as perceptual in nature. The distinction, if it can be defined, is the extent to which responses are the immediate result of information being received through sensory channels (that is, perceptual input), rather than the responses being critically influenced by cognitive processes which rely on memory, reasoning and strategies developed through thought.

Whilst perception and cognition clearly cannot be separated entirely, it is nevertheless useful for the teacher or therapist to have some idea of where a child's major difficulties lie. Some children with significant learning problems do not exhibit difficulties on tasks of a primary perceptual nature indicating that their difficulties lie mainly in the cognitive domain. Others demonstrate problems with perceptual tasks, and whilst on the basis of disordered perceptual input their learning difficulties may present a superficially similar impression of learning disability, their difficulties may be attributed to a perceptual rather than cognitive disorder.

It is not easy, in a real life situation, to adequately control the variables which separate perceptual from cognitive abilities. In a psychology laboratory sophisticated experiments can be designed but it is not necessarily appropriate to extrapolate their findings to apply to behaviour in functional situations. Teachers work with children in classrooms, and must be equipped with tools for assessment of their abilities and remediation of their difficulties in such environments.

The Pre-school Visual Perception Assessment was therefore developed to enable teachers to examine visual perceptual abilities in as objective a way as is felt to be possible within the limitations of their working environments given the delightful but capricious nature of young children.

Historical Overview of Perceptual Theory

Historically, the early perceptual theorists were philosophers and their rudimentary state of knowledge of the physiology of the nervous system left wide scope for the imagination of those who wished to delve into the complexities of the perceptual process.

Descartes, writing in the 1600's is noted for his discussion of the mechanisms of sight and feeling. He observed the visual image on a bull's retina and reasoned, therefore, that the eye operated in a similar way to the camera obscura. He also theorised about the functioning of the mind, which he believed to be located in the pineal gland in the brain, considering the mind to be the locus of all feeling.

Many other writers among them Locke, (1690), Berkeley (1709) and James (1890) believed that all thoughts and knowledge must have their origins in sensory experience. Everything, therefore, must be learned through experience, and the newborn baby arrives in the world without the ability to make sense of anything, but must gradually build up, like a dictionary, a vocabulary of meaningful events.

Helmholtz, writing in the 1860s coined the terms "nativist" and "empiricist", which effectively sum up the dichotomy which characterised the main threads of the controversy on the nature of the perceptual process.

Earlier this century, the Gestalt psychologists, spearheaded by Wertheimer, Kohler and Koffka, proposed a revolutionary theory of perception, refuting the work of the Structuralists, who attempted to analyse sensations into their component parts, believing that this would lead to an understanding of the process of perception.

Wertheimer's paper, published in 1912, put forward the notion of phenomenal movement, explaining it in terms of mechanisms of perceptual organization by suggesting that physical processes occur in the brain, rather like a short circuit, to connect the two areas of the sensory cortex where the respective stimuli are received, and organise the input into a meaningful pattern. (In this case the stimuli were two lines flashed alternately, creating the effect which is utilised in animated cartoons.) As animals and babies were observed to make perceptual judgements in accordance with Gestalt rules of organisation, it was concluded that the processes underlying such phenomena were innate and not dependent on previous experience. The Gestalt movement went on to formulate 114 laws of perceptual organisation, itemised by Helson in 1933 and subsequently further summarised by Allport (1955).

The evidence advanced by the Gestalt school explaining <u>how</u> perception occurs has not stood the test of time, but, as this review later indicates, we owe much to the Gestalt theorists for their description of the figure-ground phenomenon, and how certain elements in the perceptual field become grouped together to enable us to perceive form, pattern and meaningful figures.

The legacy of the Gestalt Psychologists is encapsulated in the catch-phrase 'the whole is more than the sum of its parts', but there are a number of principles of perceptual organisation which determine how the elements of a figure tend to belong together. Some of these principles have been incorporated into the design of the Pre-school Visual Perception Assessment. The following description of these Gestalt principles draws on source material from Bruce and Green (1990) and Wright et al. (1970).

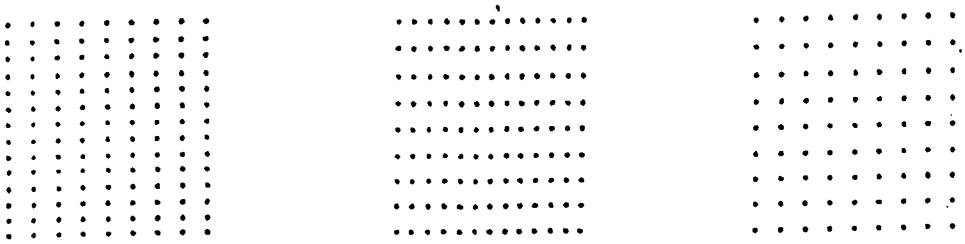
1. Proximity

The proximity of elements within a figure helps to determine how the figure is perceived. Figures 2.1(a), 2.1(b) and 2.1(c) all consist of dots of the same size, yet the impression gained from Figure 2.1(a) is of dots arranged in vertical columns, whereas in 2.1(b) the arrangement of dots appears to be in rows. In Figure 2.1(a) the space between the dots is less in the vertical dimension than in the horizontal, with the reverse being the case in 2.1(b). In Figure 2.1(c) where the dots are spaced equally in the horizontal and vertical dimension, neither columns nor rows dominate. There is thus a tendency for us to group together elements of the figure which are close together.

2. Similarity

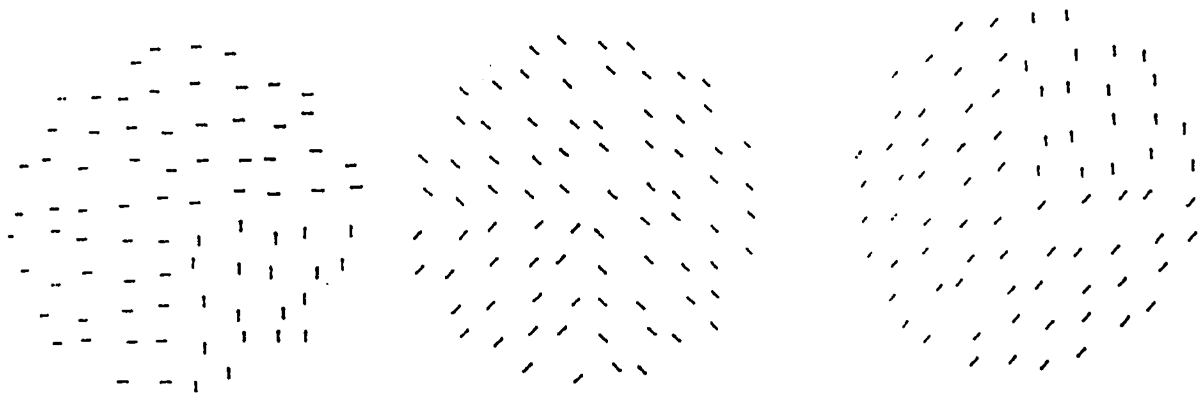
Elements which are similar also tend to be grouped together. The designs used by Olson and Attneave (1970) to investigate this phenomenon illustrate the principle, with Figures 2.2(a), 2.2(b) and 2.2(c) having a quadrant with lines in a different orientation which is easy to spot. In Figure 2.2(d), where the lines in the odd quadrant are curved, it is a little less easy to identify the region which is different, and in 2.2(e) and 2.2(f), where the configuration, but not the slope of the elements differ, the 'odd section out' is found only on careful examination of the figure.

Figure 2.3 demonstrates how similarity can take precedence over proximity information. The dots give the impression of being arranged in columns even though the horizontal distance between

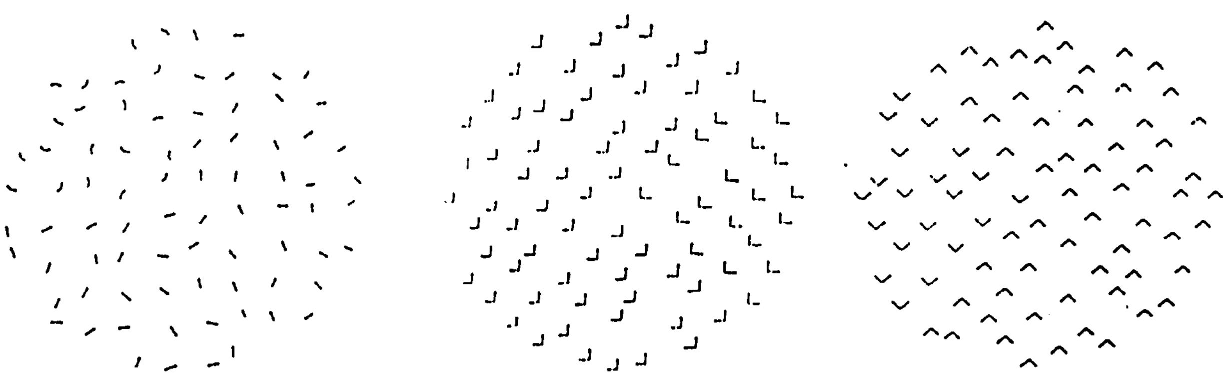


a b c

Figure 2.1. Examples of the effect of proximity on the perception of a figure



a b c



d e f

Figure 2.2. The effect of similarity on perception (Olson and Attneave, 1970)

them is less than the vertical, but the brightness of the similarly coloured dots dictates the groupings we perceive.

3. Common Fate

Elements which move together are seen as part of the same figure. A camouflaged animal can be identified when it is seen to move and the work of Johannson (1975) demonstrates scientifically the principles used by the Black Light Theatre for many years. He showed how a person dressed totally in black in a dark room could be recognised as such when he had small lights attached to his joints. When he stood still, only a pattern of lights could be perceived, but when the actor walked about he was perceived as a moving human figure. Subsequent work has demonstrated that we can identify the sex and approximate size of an individual from this pattern of moving lights (Kozlowski and Cutting, 1977). The drab coloured mouse, which is scarcely noticed in a dim corner of the room thrusts itself on our consciousness as it scuttles away, and the moving ribbons of news headlines superimposed on the television screen clearly demonstrate the technological utility of this powerful principle.

4. Good Continuation

This principle can be illustrated by Figure 2.4, which is perceived as two curved lines which cross, though it could equally well have been formed by two V-shaped figures. In Figure 2.5 shapes which in themselves have nothing in common are grouped together, combining the laws of proximity and good continuation.

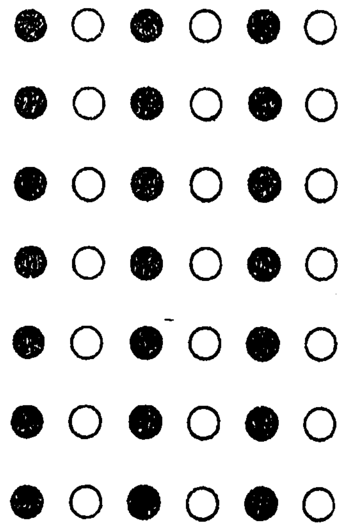


Figure 2.3. Similarity (in the brightness of the dots) has priority over proximity in the perception of form.

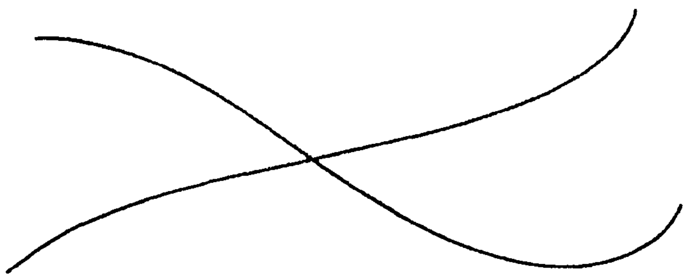


Figure 2.4. An example of good continuation. The shape is seen as two crossing lines rather than two V-shapes.

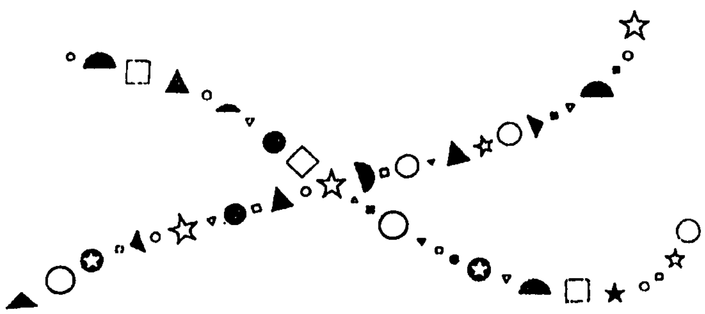


Figure 2.5. Good continuation and proximity determine the perception of a form even though the shapes constituting the lines are dissimilar.

5. Closure

We tend to group together lines which constitute a meaningful figure. This principle is seen to come alive when watching a cartoonist at work and even when in practice some elements are completely omitted, we are able to perceive the nature of the completed form. One of the sub-tests in the Pre-school Visual Perception Assessment is based on the principle of perceptual closure, illustrated in Figure 2.6.

The principle of closure can have distressing and dangerous consequences for people with hemianopia, who may believe they see a completed figure or scene to the visually deficient side, though this may not exist. This can lead to inappropriate movement responses with potentially unfortunate consequences.

6. Relative Size, Surroundedness, Orientation and Symmetry

Generally speaking, the smaller of two areas will appear as the figure perceived against the larger background. Figure 2.7(a) appears as a black cross against a white background, with the effect appearing more pronounced if the background fully surrounds the figure, as in 2.7(b). There is a tendency for vertically-oriented figures to be perceived more readily and 2.7(c) can be perceived as either a white or a black shape. Symmetrical shapes are also perceived more easily, as 2.7(d) appears to show meaningless lines which take on form when arranged round a vertical axis as in 2.7(e). Symmetry, orientation and the fact that the shapes are surrounded by a white background gives perceptual salience to the shapes in

Figure 2.6. An example from the 'Incomplete Pictures' sub-test of the Pre-school Visual Perception Assessment which utilises perceptual closure.

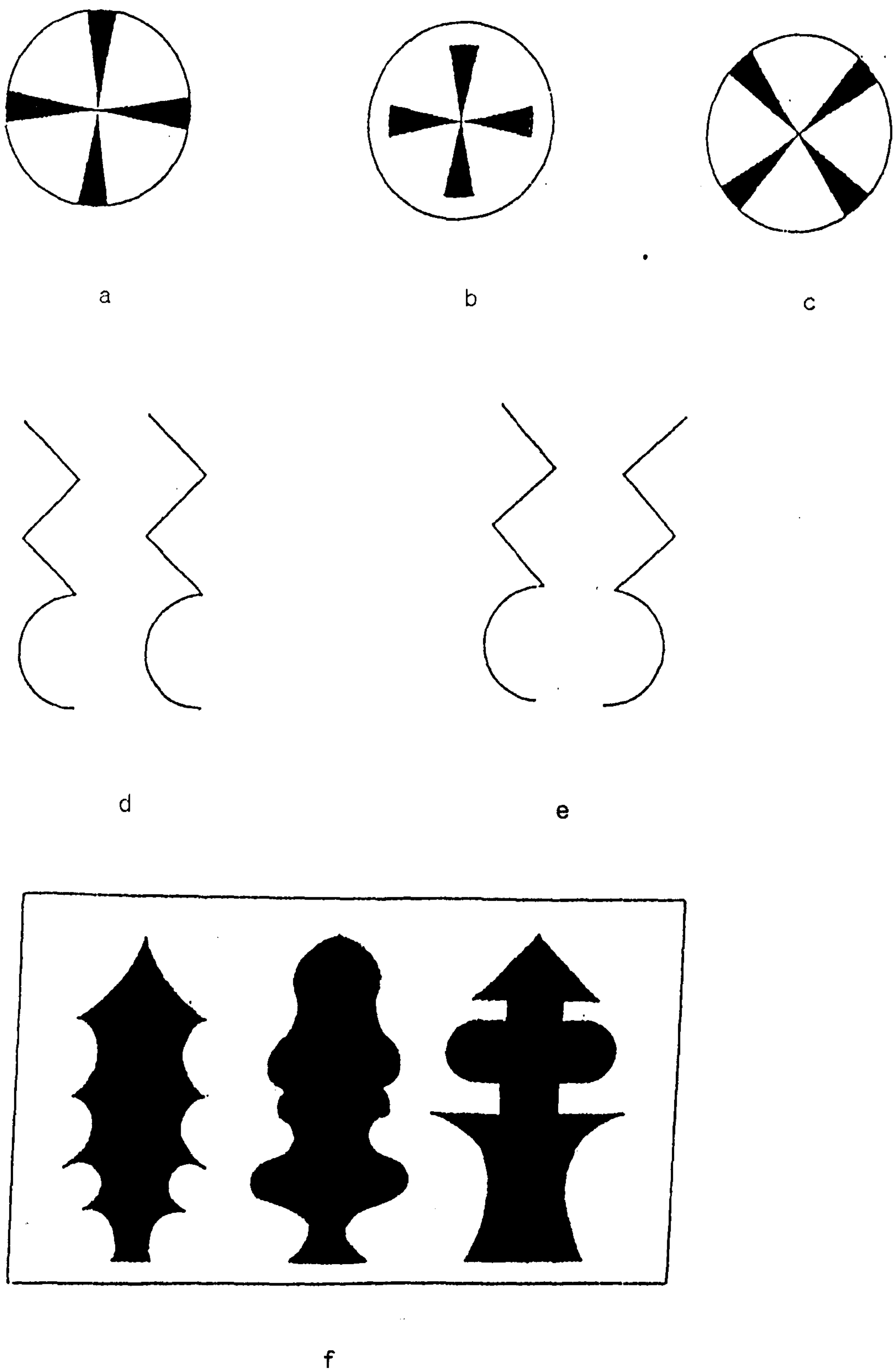


Figure 2.7. Examples of relative size, surroundedness, orientation and symmetry.

Figure 2.7(f), although a number of clever ambiguous designs, such as Rubin's faces and vase (Figure 2.8) and the old or young woman (Figure 2.9), demonstrate that things, especially in pictorial representation, may not always be what they first appear. Most notably the artist Max Escher shows how figure-ground reversibility and other perceptual phenomena can be exploited in pictures which prove continually fascinating, as in Figure 2.10.

Perception as a Psychological Process

The physiological aspect of perception is well documented and will not be detailed here. Descriptions of the mechanism of the sensory receptors in the eye (the light sensitive rods and cones in the retina,) and the complex network of neural pathways by which the nerve impulses are relayed to the sensory cortex of the brain can be found in Gregory (1966), Bruce and Green (1990) and Thompson (1967).

What happens when the nerve impulses reach the brain, exactly how they are interpreted, not merely registered as 'received sensations' but imbued with meaning, remains a subject for conjecture, though various theories have been suggested.

It is certain that the appearance of an object does not correspond exactly to the patterns of stimulation on the retina, nor at the sensory cortex, as even babies can make judgements about the size of objects with regard to their distance (size

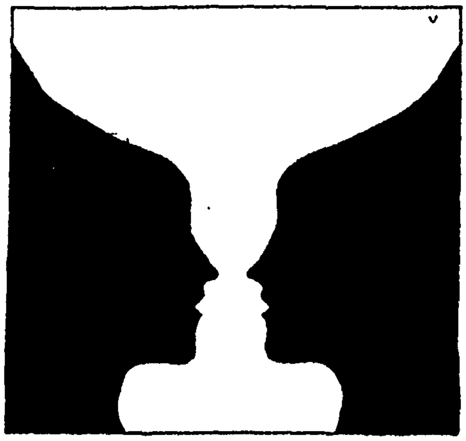


Figure 2.8

Figure 2.9

Figures 2.8 and 2.9. Examples of ambiguous designs with reversible figure and ground.

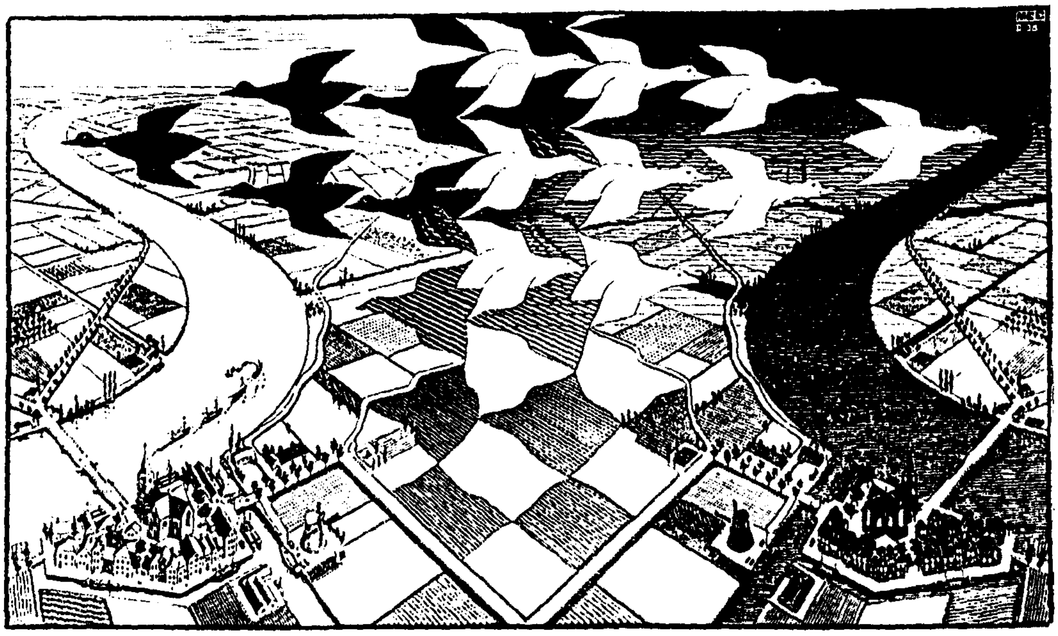


Figure 2.10. Figure-ground reversibility in art. Max Escher's 'Day and Night.'

constancy) when the size of the stimulus on the retina is calculated to remain the same (Bower 1966). This perceptual constancy applies not only to the size and distance of objects but also to their shape.

Whilst the many theories of visual perception are extremely interesting, it is not necessary, fortunately, to know exactly how perception occurs in order to work with children who may have problems. Many of us drive cars without an intimate knowledge of the construction or function of the engine, and even the mechanic who carries out repairs does not need to know the formulae for combination of the various raw materials which make up the components. Whilst we certainly need to know which perceptual abilities we are assessing and attempting to improve, the precise physiological and neurological processes involved in perception are the province of the neuropsychologist rather than that of teachers and therapists.

As Allport (1955), writes:(p.245) "It is safer, and perhaps ultimately more profitable, to attempt to describe perceptual phenomena than to attempt to explain them."

The physiology of perception is a vast topic in itself, and it is not proposed here to delve into the physical process of how a stimulus is registered and interpreted by the sensory mechanisms. It is sufficient for the present discussion to say that there must be a stimulus, and that stimulus must be of a sufficient size or intensity to be registered by one or more of the sensory receptors. The perceptual process requires the receptors to have adequate acuity for sensation. People with impaired acuity may need a more intense stimulus in order to perceive, or may be able to utilise alternative or additional sensory channels, as many stimuli are "multi-dimensional" in that they are simultaneously registered by several different sensory channels. Individuals with visual defects learn to rely more heavily on auditory cues, for instance, and the importance of visual information to supplement imperfectly received auditory input is obvious when considering people with a hearing loss. The extent to which deaf people misunderstand or misinterpret what they hear can be quite considerable, resulting in frustration, amusement or acute embarrassment.

It is usual for a stimulus to be registered by one or more of the sensory systems (visual, auditory, tactile, olfactory, gustatory or proprioceptive). Areas of sensation and perception are not independent of each other and frequently more than one system is involved in experiencing a sensation, providing complementary information about the stimulus. Whilst an excess of information from different sources may be redundant, conflicting information from the different sensory modalities can be extremely confusing when the stimulus does not possess the expected characteristics. It would be incongruous if, for instance, we saw mouth-watering food but were unable to smell it, or heard and saw a fire but could not feel its warmth. Wearing prism goggles which distort the field of view can be extremely disconcerting, as is reaching out for an object in a supposed position, only to find it is not there. Even tiny babies, below the age when manipulating everything within reach becomes compulsive, showed signs of distress under such conditions (Bower et al., 1970b). Multi-sensory input, therefore, is a fundamental and extremely important aspect of the perceptual process.

Basic Requirements of the Perceptual Process

The theoretical framework underlying this assessment approach is that described by Wedell (1973). Pre-requisites for the visual perceptual process are:

1. Intact receptors (eyes) with adequate visual acuity.

Clearly, visual impairment is likely to have an adverse effect on an individual's visual perceptual ability. It may be possible to compensate for some visual disorders, and some can be corrected with spectacles, but children with a severe visual handicap need to be specifically taught to use their residual vision in order to make sense of their fragmented perceptions (Chapman and Stone, 1988).

2. Efficient sensory pathways (optic nerves) for the information to be transmitted to the brain.

3. Attention

The individual's attention must be drawn to what is to be perceived (features of a stimulus which attract attention being intensity, novelty, movement and repetition). The stimulus must also be sufficiently compelling to hold the subject's attention in the face of distraction from other sources.

4. <u>Arousal</u>

The individual's state of arousal must be sufficient to enable him to be aware of the stimulus (drowsiness, drugs, and absence seizures all lower the state of arousal and detract from the ability to perceive).

5. <u>Cue selection</u>

Selective attention to those aspects of the sensory input which we want to notice (figure ground) and knowledge of the significant features of the stimulus, which distinguishes it from those elements redundant to perceptual requirements, is necessary.

In order for accurate perception to take place there must be a stimulus which can be discriminated from its surroundings. The ability to select out what is to be attended to is referred to as figure-ground discrimination and is a fundamental aspect of the perceptual process.

Problems with figure-ground perception occur when there is too much stimulation, e.g. when there is a high level of ambient noise from chattering children in the classroom and a child is expected to tune in to the voice of the teacher through the hub-bub. Visual figure-ground confusion can arise at all levels from a visually "busy" and therefore confusing picture to too much print on a page for the inexperienced reader to be able to find his place when he has lost it.

In the above examples one presupposes that the child knows what he is trying to sort out from the distracting background; the familiar voice of the teacher, for instance, or the shape of certain words on the page. Figure-ground discrimination is not always as straightforward, since we have to know what are the significant features of the things we want to notice which distinguish them from the background, a process known as cue selection.

Even as adults, we may <u>see</u>, but not perceive if we are not aware of the significant features of the stimulus. For example, someone went out for a walk on Ilkley Moor to find a stone with primitive carvings, known as the 'Swastika Stone'. The carvings, however were weathered and rather indistinct and could easily be confused with natural markings. On his return, when asked if he had found it, his reply was "I don't know. I saw plenty of stones, but I didn't really know what I was looking for."

It is a first priority, therefore, to ensure that children are actually attending to the stimulus, or they will not be in a position to recognise and select the significant features for meaningful processing.

6. <u>Memory</u>

In order to formulate an appropriate response to the sensory information, it has to be interpreted in the light of previous experiences stored in memory. Only then can it have real meaning for the perceiver. This is why the auditory localising responses of the neonate, though occurring at a higher level than reflexes, still cannot be described as perceptual. Wertheimer (1961) used a clicking sound to elicit localisation, but the child has, we assume, no memory to draw on to interpret the clicks. In fact, in the case of auditory memory, this must be open to question, as the foetus can, without doubt, hear inside the womb, and may very well have memories of this auditory stimulation after birth. Visual memory, however, cannot pre-date birth.

A baby has very limited experience and therefore little information in memory with which to compare the new sensory input. Some perceptual abilities, though, appear to be, if not innate, not acquired through sensori-motor experience as Piaget's theories would suggest. Decarie (1969) cites the vicarious experience of thalidomide children which appears to be adequate for conceptual development in children with unimpaired intellectual capacities, though Murphy and Vogel (1985), also reporting anecdotally, described the reverse. Slater and Morison (1985) demonstrated form constancy in babies only a few hours old, with no movement experience to draw on, but whereas the ability to make some simple perceptual discriminations is doubtless innate, perceptual skills must be developed and refined through practical experience and exploration of the world.

Incoming information, therefore, must be compared with that already stored from previous experience. Handicapped children, especially those with severe physical impairments are deprived of many experiences, being unable to participate in certain activities, and also have fewer of the experiences they can encompass because it takes them so much longer to do things which normal children perform with incredible speed and repetition. Experiences are remembered best if they have some meaning for us, so that we can attach them to an established framework already in our memory. We can extend the conceptual field and accommodate new ideas and experiences into the concepts we already have, but only if they have some common ground with what we have experienced before, rather like a game of Scrabble, where we can put new words in the centre of the board to fill in gaps, or build them on round the edge, as long as they have at least some element in common with what is there already.

The ability to evaluate new information by comparing it with that held in memory depends on the ability to recall it when required. It is of no value having information in memory if it cannot be recalled, as in the case of an individual with amnesia (Luria 1975).

7. <u>Effector Mechanisms</u>

We can only know whether a person has perceived something in a particular way if they either tell us, or demonstrate by their response through performance. Effector mechanisms, manipulative skills or expressive language must therefore be adequate to enable them to convey to us that they understand the sensory input in a particular, expected way.

In the young child, this response can be idiosyncratic, and his ability to attend to the task is subject to his moods and current interests, which may be different from those of five minutes before. It is also influenced by external factors such as room temperature, an unfamiliar environment and the person who is observing the response. When dealing with severely handicapped children this poses real problems for the teacher, knowing at what level to pitch input when response capabilities are so very limited, and responses themselves sometimes non-existent or at best equivocal. Is the child perhaps not capable of understanding what we are attempting to teach? Or is he utterly bored by such puerile stuff and cuts off, not regarding it as worth his while making the enormous effort required to respond?

When an enormous physical effort is required from a child to produce a response that most people take for granted (the operation of a computer switch, for instance) the reward must make the effort worth while. It is by no means easy to motivate many of these children. The teacher must have access to assessment and teaching materials with child-appeal to interest severely handicapped and inaccessible children and enable objective observations about the child's knowledge to be made. Rapidly advancing technology provides increasingly more computer programs and devices to enable the most severely handicapped child to interact with the computer, toys and other aspects of his environment, with his own effector response to the stimulus. Most children can be enabled to make such a response. Motivating them to do so, and providing a sufficient range of activities and materials to maintain their interest in teaching situations is a constant challenge to the teacher.

Summary

This chapter has reviewed the contribution of the major theories of perception and aspects of visual perception which form the underlying constructs for the Pre-school Visual Perception Assessment.

CHAPTER 3

PERCEPTUAL AWARENESS AND PERCEPTUAL DEVELOPMENT IN THE YOUNG CHILD

The nativist-empiricist argument is now of little more than historical interest, having been resolved by compromise as the body of knowledge increased. It is now commonly accepted that the neonate has the ability to make perceptual responses, though these must be added to and refined as the infant's experiences widen and his sensory and motor abilities mature and develop. There is thus clearly a developmental dimension in perception, as even the strongest advocates of the nativist theories acknowledge that the significance of much of the incoming information can only be learned through experience. Memory and learning are therefore important cumulative factors in the development of perception.

It has been demonstrated that a newborn baby has perceptual awareness. Wertheimer, in 1961, for instance, elicited sound localization from a baby who turned its head towards the sound source whilst still in the delivery room. Such a reaction certainly indicates response to sound, yet the sound itself cannot really be said to be perceived as the infant has no experience with which to give meaning to the sound. Only when there is a differential response, such as smiling and showing excitement when he hears the bath water running, can we really be sure the sound is perceived. The response elicited by

Wertheimer, therefore, is really more of an orienting response, useful as a starting point, as having turned to the sound, the baby is then is a position to begin to learn something about what caused it and why it might be rewarding to look towards sound sources in future.

MacFarlane (1975) carried out a most interesting experiment in infant olfaction, and demonstrated that babies less than a week old were able to identify the smell of their mothers, responding by turning their heads away from a smell of another baby's mother and towards that of their own mother. This meaningful interpretation of a sensation can truly be termed perception.

It used to be thought that touch was the earliest of the senses to develop, and educated the visual sense. Piaget stresses the importance of the sensori-motor period for active learning about the environment, but whilst the importance of multi-sensory stimulation in the early months cannot be minimised, active movement experience serves as a supplement to vision (Held 1965).

The delay in all aspects of development in the early months which is seen in blind babies underlines the importance of vision as the primary sensory modality (Sonksen et al., 1984). Sounds have no temporal endurance, whilst the practical value of the sense of touch is limited to objects within reach, as unlike sound and vision, the tactile sense cannot span space. The implications for children with delayed mobility are obviously serious, as such children cannot explore the environment beyond their reach, and may subsequently demonstrate a deficiency in the understanding of visual space (Wedell et al., 1972).

The human infant's visual system is incompletely developed at birth. He can accommodate and focus only up to distances of about eight inches (Haynes et al. 1965). Braddick et al. (1979) and Banks (1980) demonstrated that young babies had the ability to accommodate to a much finer degree than was previously thought. Visual function develops rapidly, so that by four months of age acuity and accommodation reach adult levels, and even before this, babies are clearly capable of making perceptual judgements for exploratory purposes (Von Hofsten, 1983).

The developmental literature contains many reports of experiments on the visual perception of babies. Investigations into infant perception by Fantz (1961), Gibson and Walk (1960) and Bower (1966) demonstrated that very young babies have the ability to make perceptual judgements. We know the young child sees, but we have little notion as to what is actually perceived, as perceptual function can only be demonstrated by recourse to a motor response, and as neonates have a relatively limited repertoire of non-reflex responses at their disposal, they have few resources with which to demonstrate their comprehension. Practical problems of investigating the perceptual responses of neonates are considerable, not the least being the amount of time the newborn baby spends sleeping.

Stechler et al. (1966) and Bower et al. (1970a) circumvented the logistic problems sufficiently to investigate visual response to a rapidly approaching object in babies between six and twenty days old. The infants' eyes widened and they raised their heads and arms in a flexor pattern (unlike that of the startle response), indicating that purposeful avoidance responses are present very early in life.

Babies of less than a week old are capable of visual attention (Hershornsen, 1964) and tracking (Barton and Ronsch, 1971). Studies with premature infants a few days old demonstrate visual ability in babies of upwards of 28 weeks' gestation (Dubowitz et al., 1980), though the writer's experience of working with premature infants is that babies born before 28 weeks often have severe visual defects. This observation is supported by the work of Van Hof Van Duin et al. (1989) who reported visual impairments in over half their sample of babies of very low birth weight, many of whom were born pre-term.

<u>The Development of Visual Perception</u>

The development of the processes underlying visual perceptual abilities has attracted considerable attention from researchers. The field, however, is so vast that the evidence accumulated to date leaves many gaps in our understanding of the processes involved, and the present state of our knowledge resembles a half-completed jigsaw puzzle.

There are several different aspects of visual perception which may be examined independently in well-designed laboratory experiments. In the classroom however, it is difficult, if not impossible, to adequately control the many variables in order to assess aspects of visual perception as separate entities. Frostig's Developmental Test of Visual Perception (Frostig et al. 1966) attempted to examine discrete areas of perceptual functioning, though, as subsequent research demonstrated, without success (Corah and Powell, 1963, Ward, 1970, Boyd and Randle, 1970). However, such attempts to fragment the various subskills of visual perception for detailed scrutiny are largely unnecessary, as normal requirements of daily living do not usually make demands on isolated aspects of visual perception.

For the purpose of examination of the literature, and discussion of the theoretical constructs underlying the design of the test in the present study, aspects of visual perception will be examined under separate headings, though their interdependence in perceptual awareness in a given situation is substantial.

The following skills are widely referred to in the literature as being subskills relating to the wider construct of 'visual perception':

1. Visual discrimination skills, to include:
   a) Form constancy
   b) Matching
   c) Recognition of pictures
   d) Figure-ground perception
2. Perception of depth and distance

3. Size constancy

4. Visual closure

5. Spatial relationships

1a. The Development of Form Perception

Form perception is the process by which we see objects as distinct from other objects.

Experiments to investigate whether form perception is innate or learned in infancy indicate that the Gestalt rules of Common Fate and Good Continuation operate from a few weeks of age (Bower, 1965b, 1966).

Slater et al. (1983), working with children aged from seven hours to nine days old, observed an ability to discriminate geometrical shapes, and infants as young as one week obviously saw the virtual object presented by Bower et al. (1970b) as an object distinct from its background and they expected to be able to touch it. They also seemed to be able to discriminate between objects and their two-dimensional representations such as photographs (Fantz, 1961), though they may well reach for the photograph, perceiving it as an object to be grasped in its own right (Dodwell, et al. 1976, Bower et al. 1979).

The work of Fantz (1961) has clearly demonstrated infant preferences for more complex designs, evidence of discrimination of simple from complex forms and an interest in face-like representations rather than geometrical patterns.

Object and shape constancy are important components of visual perception. It is essential to realise that a bus is still a bus whether seen from the front, back or side. All give different retinal images, but are all aspects of the same object.

Shape constancy has been demonstrated in sixty-day old infants (Bower, 1966). Experiments on orientation in infants have concluded that quite young babies recognise objects in various orientations (e.g. Bower, 1966, Dunkeld and Bower, 1980). It appears, however, that though babies may be able to show such discriminations in experimental situations when their attention is focused with few distractions, they may not be able to attend to such factors in the environment. When bombarded with the stimuli of everyday life, they may be less able to discriminate the orientation of objects which have less uniformity than a cube. Piaget (1955) illustrates this orientation specificity in his description of his son's recognition of his bottle, when it was viewed from the top and the side at seven months, though he did not recognise it when it was presented by the base. At four months of age, babies could distinguish the upright orientation of the human face, a familiar figure, but could not differentiate between the different orientations of geometrical figures which had no meaning for them. Recognition of the vertical dimension emerges first, followed by the horizontal, the oblique and diagonal orientation (Jeffrey, 1966, Katsui, 1962, Rudel and Teuber, 1963).

Children with perceptual problems are sometimes not able to recognise an object as the same thing in different orientations, especially when viewed from an unusual angle. This concept of form constancy, however, has to be modified when the child is learning to read. Then the concept of something being the same whatever its orientation is no longer appropriate, and reversal confusions of letters such as b,d,p and q are still quite common at six years of age, though Asso and Wyke (1971) maintain that it is easier to copy letters than to match them and Cratty (1979) suggests that the tendency to confuse letters may differ according to how the child is asked to identify them. In Gibson's experiment on the discrimination of letter-like forms (Gibson et al. 1962), there was, predictably, a developmental trend towards accuracy of matching, the younger children making more reversal errors and selection of upside-down forms than the older ones, though the four year olds showed an ability to match the shapes to a certain extent, and the task was considerably more difficult than the discrimination of letters of the alphabet from each other, involving rotations and 'squashed shapes'.

When an object changes its orientation, the memory factor is introduced, and if a child cannot remember the original object or form then he will not recognise it in any orientation. Bower (1974) cites evidence of infants' ability to remember events and behaviours from day to day, but memory depends upon how important the information is to that individual.

Linn et al. (1978) investigated the ability of ten month old infants to discriminate between altered forms with a five-second delay interposed between stimulus and comparison, and found them capable of this. Kagan and Hamburg (1981) demonstrated that an infant's ability to remember an unfamiliar event which occurred more than five seconds previously is poor, at least until the child is ten months old, although Rose (1981) reported that whilst children of six and nine months can remember visual stimuli, only the nine month olds could cope with distractions in an intervening period and still remember the material.

Investigations of the shape constancy ability of children are numerous and show a developmental trend in increasing visual discrimination ability with age, as may be expected. An interesting longitudinal study by Taylor and Wales (1970) examined the concept of 'sameness' in relation to shape and orientation in a group of three and four year old children. The three year olds in their sample tended to select a comparison stimulus as the same when it was fairly close to the standard. The next stage reflected some insights into the similar attributes of the various comparisons, and in the third stage careful selection of the one correct comparison card was made. At this age, language becomes a variable in that instructions about the task are usually given verbally and the child has to comprehend and interpret them in order to perform the task adequately. (Most of the studies previously cited depend on conditioned responses to learning in pre-linguistic children.)

1b. Development of the Matching Concept

At about a year old, babies are attracted to the similarity of objects. If presented with an object where another similar one is within reach, they will often pick up the second object, showing them both proudly to any available audience. Whilst everyone familiar with young children will have observed this attraction to similarity, it has been corroborated experimentally by Sugarman (1981), Starkey (1981) and Smith (1983). Berg (1972) quotes an example of a toddler, not yet able to talk, but squealing with delight at seeing another child in the street wearing identical shoes.

Whilst young children have the ability to discriminate 'same' and 'different' and use this skill in practical situations, like selecting items of food from non-edible items or choosing what they actually want to eat from what is presented, it is many years before they are able to find the 'odd one out' on request. Speer and McCoy (1982) found that even three year olds were not capable of understanding the words 'same' and 'different'. This may partly be an effect of the task presented, which may not have captured the interest of young children. The writer has found most normal three year olds able to select the one that is different (or 'not the same'), though the difference to be spotted must not be too subtle, and a few very simple training trials may be necessary to give the idea of what is required. Children with delayed or disordered language, however, have enormous difficulty with this concept, even though attempts may have been made to demonstrate and explain non-verbally. Laxon (1981) in fact, found that 'same and different' tasks involving a manipulative response were easier for young children than those requiring a 'yes/no' judgement, which is always the approach the writer would adopt when working with children under five, as they prefer to become physically involved with an activity rather than sit still and answer questions.

The ability of young children to make judgements of similarity is often related to their ability to scan the display. Vurpillot (1968) illustrates this with an elegant experiment in which eye movements were recorded as children scanned pictures for comparison. The younger children tended only to attend to the central area of the display, and make impulsive decisions. As they grew older, more careful examination of the detail of the display was made, with a resulting improvement in accuracy of judgement.

Sigman and Coles (1980) however, noted that three year olds in their sample often looked at the area of the pattern which was different, but then gave an incorrect answer. Obviously it is necessary to scan the appropriate area of the display in order to spot an anomaly, but without insight into what they are really looking for, and the ability to select out the relevant cues, merely 'looking' is not sufficient to perceive.

The nature of the stimulus variables available in matching tasks may influence the child's ability to match and sort objects. Young children are noted to prefer the attribute of colour, and match this in preference to shape, with a developmental trend towards a preference for shape over colour (Suchman and

Trabasso, 1966). The same investigators commented that a preference for colour reflects a more impulsive response on the part of the child, involving less scanning of the material and therefore a more immature response. Subjectively, the writer has noticed this preference for colour over shape in children with significant visual defects.

Day and Bissell (1978) encouraged four year olds to explain the reason for 'same' and 'different' judgements, and felt that this requirement made them think more carefully to give a sensible reason. It also probably slowed down the impulsive responders, giving them time to think more carefully to give a sensible reason, a strategy which is well-known to teachers of children with learning difficulties.

1c. Picture Recognition

Young children are fascinated by picture books from a few months of age, though when looking at a book with a very young baby it is not easy to know whether a picture is recognised as a representation of the real object or enjoyed for its colour and general visual effect. Hochberg and Brooks (1962) in a most interesting and diligent experiment where a young child was deliberately brought up in an environment almost devoid of two-dimensional representations, found him perfectly able to identify drawings of objects when first exposed to them at the age of nineteen months, suggesting that picture recognition develops without specific teaching. De Loache (1979) also found five-month old infants able to recognise both colour and black and white photographs of a familiar object. Certainly, in the writer's experience, relatively understimulated children without perceptual disorders or mental retardation have little difficulty in recognising pictures at the appropriate age with a minimum of exposure to pictorial representation.

1d. Figure-Ground Perception

The perception of form depends on the differentiation of the figure from its background and also the discrimination of the different parts of the figure.

Children who have suffered brain damage often have great difficulty in dissociating an object from its background, and seem unobservant because they do not notice things that other children pick up readily. Young children tend to perceive the whole of a pattern without attending too much to the details. They have considerable difficulty in finding hidden figures (Gollin, 1960) especially when these are enclosed within the contours of another figure (Ghent,1956). Overlapping figures where the outlines intersect but do not share the same contours are easier to perceive, and Ayres (1972) employs a progression from overlapping to embedded figures in her Figure Ground Test for children with learning disabilities, which was used in this study as a validation measure for the Pre-school Visual Perception Assessment. Detailed parts of the figure as a whole are perceived simultaneously yet in relation to each other (Wohlwill, 1963).

Aspects of part-whole perception were investigated by Dworetski (1939), Elkind et al. (1964), and Prather and Bacon (1986), all of whom showed children of various ages pictures made up of other figures as part of the outline, for example, a figure of a bird was compiled from fruit and vegetables. The four year olds in Elkind's sample perceived the elements of the figure more easily than the wholes which they grouped together to represent, but the perception of the whole figure improved with age up to nine years, though the component parts remained easier to perceive. Prather and Bacon (op. cit.) used photographs of objects placed together to represent another object, such as pieces of fruit arranged in the shape of a person. Their findings, that three year olds could name both the parts and the wholes of the simple pictures but not the more complex ones was explained in terms of the possible linguistic limitations of young children who may not have a wide enough vocabulary to describe some of the objects represented.

Gollin's work in the recognition of incomplete pictures (Gollin, 1960), reveals an interesting insight into closure and redundancy. The younger the children, the more lines were required for the figure to be identified. Children of three-and a-half years, however, could be trained to improve their performance with practice in the identification of similar types of figures.

2. Depth and Distance Perception

Until ten years ago the major influences on research in this field were Gibson and Walk (1960) and Bower (1966). In the 1960's there was also much interest in the investigation of sensory deprivation and its relation to perceptual and visual-motor ability, often studied by examining the individual's ability to reach or perform actions within the circumscribed area of peri-corporal space. The effect of restriction of active movement (Held and Hein, 1963, Held, 1965, Feldman and Acredolo, 1979, Foreman et al. 1990), is an area of particular relevance to the development of perceptual abilities in physically handicapped children, some of whom have severely limited ability to perform active and purposeful voluntary movements (Howard 1977.) More recently, work on spatial cognition has investigated the interaction between movement and the development of spatial awareness (e.g. Bertental et al. 1984, Lord and Hulme, 1987, Burton, 1990), though this new field of work, which involves the movement of the individual in the environment and the <u>cognitive decisions</u> resulting from that movement experience, goes beyond the parameters of distance and depth <u>perception</u> as reviewed in this section.

Distance perception is obviously closely related to the child's visual acuity, which improves in the first few weeks of life, and a number of workers who have examined aspects of spatial perception in babies varying in age from a few weeks to a few months have noted considerable ability to discriminate distance and depth.

Distance perception in newborn infants was investigated by

McKenzie and Day (1972), using length of visual fixation as a measure of discrimination. They found that, regardless of the object's image, visual fixation time increased after a change in the stimulus distance, recovery from habituation indicating that the infants, aged from six to twenty weeks, were aware of the change in distance. They paid less attention to objects more than a metre away, suggesting that the more distant objects were out of focus, or possibly were of less interest because they were so far beyond the child's reach.

Several experiments investigating both size and distance perception have used the infant's reaching behaviour as a criterion of the judgement of distance. Cruikshank (1941) noted that a considerable amount of reaching in infants occurs when the object is beyond their reach and puts this down to being due to a lack of distance perception in the child. Bower (1966), however, points out that the child may, in fact, be aware of the distance of the object but have less information about the length of his own arm, which will alter as he grows. Alternatively, the child may have some intention other than extending its arm to reach for and grasp the object. Certain movements of the hand prior to reaching, and expressions of disappointment from the child if he had expected to reach it, could have provided clues to this variable if they had been studied.

Bower's experiments with cubes of different sizes displayed at two distances showed that the infants in his study demonstrated size and depth constancy in three-dimensional situations but ignored distance cues in a two-dimensional slide presentation (Bower, 1966). He later developed the experiment to identify those cues that the infant responded to. The infants were obviously not responding to retinal image size in the three-dimensional presentations but investigations for motion parallax (monocular testing) and binocular parallax using stereoscopic glasses to view stereograms, indicated that motion parallax was the most effective cue to depth perception, with binocular parallax providing some information but resulting in more errors than the motion parallax condition. A third group viewed slides providing pictorial cues but neither binocular nor motion parallax. These appeared to provide no information about depth at all and the infants responded as often to the stimulus picture of the cube which had the same projected image as to the standard itself, which was actually larger and farther away.

The series of investigations initiated by White (1971) of infants' responses to approaching objects has been developed and extended by Bower et al. (1970a) and Ball and Tronick (1971). White found that only babies above eight weeks old blinked as an object plummeted down a tube, apparently coming to hit them in the face. In Bower's experiments, real objects, producing a displacement of air, a variable that had been eliminated by White, caused the infants to take avoiding action. These results were obtained on babies of less than two weeks old, but were not accompanied by the blink reflex reported by White (1971). Bower's study did find, however, that very young babies tested in the supine position used by White were too sleepy to respond, and they therefore put the babies into seats which supported them in a more upright position. A modified response was elicited by presentation of an object apparently increasing in size (Bower, 1974). Further experiments by Bower and his team (1970a) established that it was indeed distance and not retinal size which caused the infants to react as they did. Ball and Tronick (1971) also found that infants between two and four weeks of age could distinguish between objects on a collision course with the face and those which were approaching on a trajectory which did not imply collision.

The "Visual Cliff" experiments conducted by Gibson and Walk (1960) established that infants between six and twelve months of age could distinguish the deep side from the safer, shallow side of the visual cliff. Because the experiment required the infants to crawl (or refuse to crawl) over the cliff, the children had to be old enough to possess locomotor skills. Whilst depth perception in newborn animals appeared to be innate, such information could not be inferred from Gibson and Walk's experiments with human infants. Campos et al. (1970) put pre-locomotor infants on the visual cliff and monitored their heart rates. Their findings noted acceleration of the heart rate over the deep side of the cliff, indicating fear, in their older group of infants with a mean age of fifteen weeks. Their younger group, aged around eight weeks, showed cardiac deceleration, indicating attention rather than fear, but the change in their heart rate was interpreted by the experimenters as a registration of the change in depth. Schwartz et al. (1973) also observed cardiac deceleration and orienting in their younger group who were approximately five months of age, older than both the groups in the Campos study.

Distance perception is closely liked with size constancy and children gradually develop the capacity to make accurate judgements at greater distances, as will be noted in a later section.

There has been a considerable amount of interest in the size-distance perception of infants. Though a number of rather old studies have examined depth perception in animals (eg. Lashley and Russell, 1934, Walk et al. 1957), there is a gap in the literature between the infant studies which rely on operant conditioning techniques and the studies on children who have some language comprehension.

Carr (1935) tested stereopsis in two to five year old children, asking them which of several objects on a stereogram appeared closer. The two-year-olds were correct in only 33% of the presentations. It appeared as if the five year olds were almost always correct and that distance perception was related to age, and this is supported by the work of Collins (1976) who also reports a developmental trend in judgements of distance. It has been demonstrated on a number of occasions, however, that children's responses vary with the way the question is worded and the young children's errors in Carr's study may have their origins in linguistic incomprehension rather than perceptual errors.

Whilst binocular vision provides valuable cues to distance perception, it is nevertheless possible to obtain adequate information monocularly (Walk and Dodge, 1962, Bower, 1966).

3. The Development of Size Constancy

Although there is no doubt that Bower's babies in the experiment already discussed (Bower, 1966) exhibited size constancy and were able to discriminate between retinal image size and objective size, it should be noted that the actual sizes of his stimuli were widely different - cubes measuring 30 and 90 centimetres. The proportion of incorrect responses was also quite high, whether by accident, inattention or real confusion on the part of the babies is purely speculative. Similarly, Cruikshank's (1941) study indicates that although the babies showed preference for the small rattle within reaching distance, under six months of age a fairly high percentage of reaches were nevertheless made towards both the large and the small rattles beyond the babies' reach. After six months the babies seem to have more accurate distance judgements and no longer confused retinal and real size.

The babies in Field's (1976) study showed this level of judgement a month earlier, at five months old. This could be an artefact of sample means or a result of the different samples. Cruikshank's sample were infants in an institution which, especially during war time and almost fifty years ago, was unlikely to have been a very stimulating environment. As she refers to children of nine to ten months who could move about in their beds it implies that they were confined to their cots for most of the day. Such restrictions are likely to have a detrimental effect on both perceptual and cognitive development.

Bruner and Kolowski (1972) also noted that babies under six months were able to discriminate between a small, graspable object and one that is too large to grasp, though still within reaching distance. Their data is not broken down into types of responses at various ages, but as their sample consisted of only ten children, such information would be too idiosyncratic to be meaningful.

Studies on the development of size constancy in children indicate that quite young children exhibit "real" as opposed to "apparent" size constancy. Until Bower's (1966) studies, almost all investigators had been satisfied with beginning their studies with four to five year old children. Beyrl (1926) however, employed subjects between two and ten years. From ten years of age, according to Beyrl, constancy is almost perfect.

Teightsoonian and Beckwith's children (1976) were aged from eight to ten years, and they worked with distances from 11.5 to 15 metres. Their study seems to be complicated by asking the subjects to create their own units of judgement to reflect the size ratios of the stimulus objects. They point out, however, that variation of background and viewing conditions can dramatically affect results, They suggested that two criteria should be set:

1. That experiments should be in a natural setting and
2. That an experiment should present the standard judgement at several distances.

Amongst the studies using child subjects which satisfy these two criteria are those of Beyrl (1926), Jenkin and Feallock (1960) and Rapoport (1969). Of these studies, two showed no change with age for children between three and fourteen years (Jenkin and Feallock) and between five and nine years (Rapoport). Jenkin and Feallock demonstrated constancy in children and over-constancy in adults. Rapoport found under-constancy in children and constancy in adults, (though over-constancy could have been present but undetected). Both studies used small standard sizes (heights of four inches or less) and short distances (twenty feet or less). The generality of their findings is therefore limited. The study that did demonstrate constant development is that of Beyrl, whose data indicates a large and orderly change for judgements of a single standard, from marked under-constancy in two year olds to near constancy in ten year olds and adults.

Rapoport (1969) developed an elegant experiment in size constancy which did not rely on verbal report. Five model railway tracks were placed on a table side by side. Each track had an engine drawing a tender with an isosceles triangle mounted on top. The trains were at different distances and the triangles varied in size. The child had to bring the train with the largest (or smallest) triangle towards him, then the next largest (or smallest), until all the trains were called home. A pre-test made it possible for the experimenter to include only those triangles, in each child's case, which could be discriminated in terms of size, at the same distance. In order to succeed the child had to take into account the apparent height and distance. An errorless performance would correspond to perfect constancy, whilst errors which involved the selection of a triangle smaller but nearer would indicate some influence of the size of the retinal image and therefore an underestimation. In this experiment all the subjects underestimated. It was more marked in the children than in the adults, but did not change between the ages of five and ten.

The phrasing of a question, or the way it is understood, and perceptual set, or expectations, are known to affect perceptual judgements in general. Size constancy judgements are particularly affected by the above factors, as there are two alternative ways of assessing the size of an object, according to retinal (apparent) size or objective size. It seems likely that experiments with young children who have limited comprehension of language may be especially vulnerable to misinterpretation of instructions, though Rapoport (1967) set up an experiment to control this factor. She established an experimental setting in which she could adjust the size of a variable triangle situated at eight or ten metres from the subject. There were two alternative instructions: 'objective' instructions to make the variable the same real size as the standard, and 'phenomenal' or apparent size instructions to make the variable appear to be the

same size as the standard. With five to seven year old children no difference was found in using the different instructions. However, from nine years of age, constancy was greater with the objective instructions and the discrepancy between the two situations increased with age. The apparent size did not change with age, though the objective size increased, but even under this condition the investigator did not find any over-constancy. Amongst other factors affecting the degree of constancy, Wohlwill (1963) mentions the influence of the repetition of judgements, motivation, the intrinsic difficulty of the judgement and the form of the instructions. An objective instruction, according to Wohlwill, which requires a response in terms of the actual physical height of the object, is much more likely to lead to over-constancy than a phenomenal instruction which requires the subject to respond in terms of the apparent height.
Gilinsky (1955) also asked people to make both objective and retinal comparisons. Objective instructions gave matches in size which increased with distance, exceeding size constancy, while retinal instructions gave matches in size which decreased as distance increased. Leibowitz and Harvey (1967, 1969) have similarly shown that in size matching, objective instructions produce quite different results from apparent (retinal) judgements.

Vurpillot (1976) concludes, after a review of the literature relating to size constancy: (p.69-70)

> It seems therefore that as a perceptual phenomenon, approximate constancy is manifested at an early age although under-constancy is the rule. In the very

young child this constancy only applies within a restricted distance from the subject - about four metres - and accuracy falls away rapidly as the distance increases, the size of the retinal projection determining responses involving distant objects. As the child grows older the perceptual phenomena become increasingly subject to the influence of intellectual processes, and the changes in performance with age seem to us to be much more a matter of how the child approaches the task and interprets the instructions than of any perceptual change.

4. Visual Closure

There is a paucity of research relating to the development of closure as described by the Gestalt psychologists, though it is an important factor in the perception and recognition of objects when, for instance, one object is partially hidden by another.

Research on closure in young children has concentrated on the recognition of two-dimensional stimuli such as shapes and objects. Gollin (1960), working with children aged from two-and-a half to five years, found even the youngest children able to recognise drawings of familiar objects with some contour lines deleted, and training in the recognition of completed outline drawings reduced the amount of representation required for subsequent recognition of incomplete drawings. However, it appears to depend less on the quantity of lines in a drawing, than on the presence of certain distinctive or significant features of the type emphasised in cartoon or caricature drawings which facilitates the identification of a picture (Gollin, 1962, Spitz and Borland, 1971, Murray and Szymozyk, 1978).

Abravanel (1982) focused on young children's recognition of shapes as perceived from subjective contours, where a shape of the same colour as the background is apparently superimposed on other figures which themselves provide only partially complete contours between the subjective shape and the background. Visual closure is therefore required to fill in the gaps and perceive a shape. Half of the three year olds in their sample perceived the figure as seen by adults, with an improvement in scores with age up to seven years. It appears, therefore that young children are able to use closure in much the same way as adults, though their previous experience with shapes or hidden figures will have an effect on their recognition ability.

5. Spatial Relationships

Piaget's work on spatial relationships in topological perspective-taking is widely known (Piaget and Inhelder, 1956), though of perhaps greater relevance to this study are his observations on the development of the object concept and the use of one object as a tool with effect to another object (Piaget, 1953, 1955). The realization that one object can exist inside another and experimentation with the relationships between objects in space is an important aspect of development acquired through active exploration in the first few years of life.

Piaget's emphasis on the importance of sensori-motor experience ties in with more recent work on spatial cognition, investigating the development of understanding of the relationships between the child and objects in space. This usually involves the subject moving or being moved in the environment to locate objects and demonstrate this spatial awareness (Acredolo et al. 1984, Bertenthal et al. 1984,). In that the nature of the problems to be solved involves cognitive decisions about spatial relationships, this field of investigation goes beyond the bounds of the present study. It is, however, an area of investigation which promises much for our future understanding of the processes involved in spatial perception.

Summary

This chapter has outlined the process of normal visual perceptual development in the young child. Particular aspects are, inevitably, 'spotlighted' by the literature, with emphasis on certain ages and stages of development, and with scant coverage of other areas. Many gaps in our knowledge remain and there is still much for us to discover about this fascinating area of the development of young children.

CHAPTER 4

WHAT IS THE EFFECT OF IMPAIRED VISUAL PERCEPTION FOR A YOUNG CHILD?

There is a vast literature on adult visual perception, (see, for instance, Bruce and Green, 1990, Stiles-Davis et al. 1988) but relatively little on the functional aspects of perceptual skills, especially in young children. What then are the consequences in terms of life skills and educational achievement of being able or not able to perceive like other children at three or four years old?

Disorders of figure-ground perception can complicate activities of daily living which most people take for granted. Children have been observed struggling to separate disliked food items from those they want to eat when the contents of the plate are submerged under gelatinous brown gravy, and picking out fish bones can be an insuperable task for someone with perceptual dysfunction or poor vision. Locating objects amongst a clutter of other things on a desk top or in a cupboard is often difficult. It may not be impossible, given time and persistence, but meanwhile the perceptually impaired individual acquires a reputation for being slow or inefficient. Inability to gain information from pictures is characteristic of children with disorders of figure-ground perception. Whilst some individuals may indeed fail to perceive the symbolic representation in any picture, treating them as simply pieces of coloured card suitable for chewing, bending or tearing, others are aware of and able to perceive clear coloured pictures or photographs, perhaps even line drawings, but cannot understand the situational content of a busy picture, though they may be able to identify some objects within it, leading the inexperienced observer to assume that the picture is 'understood'.

Of the studies describing perceptual impairment, many have been carried out on children with additional handicaps, usually cerebral palsy, e.g. Levine et al. (1962), Rosenblith (1965), Wedell (1960a and b) Abercrombie et al.(1964), Howard and Henderson, (1989).

Although now dated, the comprehensive investigation of perceptual and visual-motor skills in cerebral palsied children carried out by Abercrombie et al. (1964) remains a classic in the field. Their study found a correlation between WISC I.Q. and degree of motor handicap in both spastic and control groups of children (their control group had physical handicaps which were not of neurological origin). Athetoid cerebral palsied children still had problems with the execution of tasks, but seemed more aware of what was expected of them (such as drawing a line through a tunnel on the Frostig test), whereas the spastic children had more difficulties in grasping the nature of the task. Unfortunately, the nature of the strictly scored test which they used would place all children with impaired hand function at a disadvantage. Dunsdon (1952), in contrast, found greater problems in athetoids than in spastics in her results of the administration of the Bender Visual-Motor Gestalt Test using an amanuensis and eye-pointing methods for those without the motor control to manipulate a pencil. However, as her conclusions have not been confirmed by subsequent studies, it seems more than possible that her methods of test modification gave unreliable results.

Newcomer and Hammill (1973) examined the visual perception of children with motor handicaps which did not involve damage to the brain. They found visual perception and motor development to be relatively autonomous systems, and the physically handicapped children did not have primary perceptual problems. However if tests of "visual perception" which involve a motor component such as the Bender Visual-Motor Gestalt Test (Bender, 1938) are used, the child may present with visual motor problems which though a direct result of his physical impairment, have been known to be interpreted as perceptual. Newcomer and Hammill stress the importance of examining visual perceptual and visual motor skills separately. Visual motor disorders may, indeed, reflect deficiencies of visual perception, but equally perceptual skills may be unimpaired.

Bortner and Birch (1960) also provided experimental evidence in support of the above theories. They found that brain-damaged patients who were unable to make correct reproductions on block design tests could select the correct design from a group of alternatives in preference to their own attempt when asked to choose the one most like the original model.

Visual-motor disorders are noted to be particularly high in cerebral palsied children, but their high incidence in this category of children needs to be placed in perspective with their occurrence in the general population. Rutter et al. (1970) noted that 5% of their control group were severely clumsy, and Brenner et al. (1967, 1968) found the incidence of visual-motor disorders in the normal school population to be 6.7%. Chapman and Wedell (1970) reported that 12% of boys and 5% of girls aged seven to eight years of age in ordinary schools had some difficulty with the formation of letters. The criterion for clumsiness is generally taken to be the retardation of gross motor or manipulative ability by two or more years.

Adult hemiplegics often exhibit visual motor problems (e.g. Bortner and Birch, 1960) and the category of children designated as "minimally brain damaged " in the U.S.A. also often present with visual-motor problems which may constitute more of a problem than their physical inco-ordination. Levine et al. (1962) conducted tests of visuo-spatial discrimination in brain-injured, emotionally disturbed and normal subjects. Their findings were that there were no significant differences between the discrimination abilities of the normal and emotionally disturbed groups, but the brain-injured group had much impaired spatial abilities, the degree of inferiority being related to the number of neurological signs exhibited.

Brittain (1976) has suggested that the shape of the paper may have some bearing on the normal child's ability to copy shapes.

He gave differently shaped paper to nursery school children and found that, although they were unable to copy a triangle on square paper, they could easily manage it on a triangular sheet. Abercrombie et al. (1964) noted the tendency for some of their subjects to follow the shape of the frame rather than copy the dot-joining patterns of the Frostig Test, and young children may be affected by background influences. Since drawing a triangle involves the formation of oblique lines, using the edge of the paper as a guide may facilitate performance in a task that is normally above the age level of nursery school children according to Olson (1970). Brain damaged children in Rudel and Teuber's (1971) pattern walking task were also noted to have visual-motor difficulties with diagonals in walking a diagonal path. Keogh and Keogh (1967) found similar problems in walking diagonals with educationally subnormal children, but adults with acquired brain damage walked the diagonal paths without difficulty.

Landmark (1962) describes a child who could not copy a given shape freehand, but could manage it when she used a ruler, as she could move the ruler around until it "looked right". In schools for physically handicapped children many examples can be seen of children who can type adequately and recognise letters perfectly well, but produce illegible writing full of reversals and perceptual distortions. Wedell (1973) comments on the demands placed on memory when writing, as opposed to visual copying, is involved. Many cerebral palsied children with adequate hand function are able to make a reasonable tracing of letter shapes, including changes of direction, and though orientation errors in copying certainly occur, they are less prevalent when a model is available to copy from. Children who have visual motor problems have much greater difficulty in reproducing a design from memory than normal children. These findings support the results of studies of simultaneous and successive presentation in matching tasks discussed by Bryant (1974). Investigations of short-term memory in children with Down's Syndrome have highlighted their delay in this area of development (Sinson and Wetherick, 1973, Alban Metcalfe and Stratford, 1986).

Studies of adult samples (Bortner and Birch, 1960, Schalling and Cronholm, 1968) indicate that visual motor difficulties beyond those that can be accounted for by motor impairment are not merely a feature of delayed development as they are not completely compensated in adulthood. Bardach (1970) for instance, discusses the increased length of time required for teaching cerebral palsied people to drive and reviews some of the problems involved in teaching them.

Those studies examining children with visual perceptual impairment but no apparent additional handicap nearly all describe children of school age, clearly seeking to relate perceptual difficulties to academic achievement, and therefore look for causal factors in the low achiever. Children who have reading difficulties and who, on investigation, are found to have poor visual perception do not prove conclusively that there is a causal relationship, or even a contributory one, between impaired perception and poor reading, as both may be symptoms of the same cause. Examination of the functional abilities of children with perceptual difficulties is wide open for research, and studies of pre-school children are non-existent. Very few studies relate to functional abilities, even in children with visual-motor problems. Writers on the topic of 'clumsy' children note that perceptual disorders are a frequent concomitant, (e.g. Gordon and McKinlay, 1980, Hulme and Lord, 1986, Lord and Hulme, 1987, 1988, Henderson, 1987), and certainly an inability to perceive effectively will result in disorders of executive function. They refer to a catalogue of problems, including difficulties with dressing, especially fastenings on clothes and shoe laces, use of a knife and fork, poor drawing ability, untidy writing and the inability to write on a line, reversal of letters and numbers, reproducing them incorrectly in the written form, and confusion of the sequence of letters in words. These skills, however, are seldom well developed in the pre-school child, and therefore cannot be described as 'problems' for an age group in which skilled performance in these areas is not yet to be expected. It is clearly necessary to look at what it is realistic to expect of a three or four year old before claiming he has problems in an activity which is still too advanced for a child of his age. Gordon and McKinlay (op. cit.) refer to the necessity for a detailed analysis of the child's abilities in all areas - language, perception, motor organisation, emotional maturity and activity levels, although the difficulties of such comprehensive assessment with young children are not touched on. According to Frostig et al. (1961) the period of most rapid development of visual perceptual skills is between three and seven years. There is therefore clearly a developmental dimension to be considered when assessing the perceptual abilities of younger children.

The ability to organise one's body and other objects in space with respect to other objects and other people is of fundamental importance in daily life. Whereas this ability inevitably involves executive functions and is not, therefore primarily perceptual, the effect of a severe visual perceptual disorder is often revealed through clumsy behaviour or inappropriate decisions resulting from incorrect interpretation of the sensory input. Cruikshank (1976) quotes the example of a boy who returned with a small unposted letter because (p.160) he "could see that it would not fit the (normal-sized) opening in the box". Everyone who has worked with perceptually disordered individuals can relate similar anecdotes. The ability to dress oneself, for instance, requires a considerable feat of orientation of the self together with organisation of the garments to avoid putting on clothes inside out, upside down or back to front.

It is this ability to use perceptual information in life situations which is really important in practice. It is of limited practical use being able to accurately estimate the width of one's car or electric wheelchair if this information cannot be used to effectively negotiate objects or other vehicles.

One of the few studies which acknowledges the importance of functional skills, and attempts to improve them by presenting training tasks analogous to real-life activities is that of Giles and Wedell (1974). They set up a comparative study of two motor skills training programmes with a pre- and post-test designed to simulate daily living activities such as carrying a loaded tray in a crowded dining room, and reaching between 'obstacles' such as glasses of water on the table for a more distant object (the salt). Whilst, however, the tasks were carefully designed to simulate life situations as closely as possible, the emotional stress-causing factors such as the presence of other people and the fear of making a mistake in a group cannot be controlled or adequately replicated. The results of the motor training programmes, one a Kephart based perceptual-motor programme and the other a conventional P.E. curriculum did not demonstrate the superiority of one method of training over the other in the remediation of clumsy behaviour.

In the majority of studies of visual perception, it is not easy to extrapolate the findings to real-life situations. Howard and Henderson (1989), however, devised an experiment to examine the spatial perceptual skills of young cerebral palsied children in terms of their ability to estimate the size of a space (such as a doorway or gap between items of furniture) in relation to their body with a walking aid or wheelchair if appropriate. This task was specifically designed to simulate the child's ability to move in the environment and the need to be aware of the size of the space required to avoid bumping into things. Children with athetoid cerebral palsy were found to be superior to spastics in their spatial judgements, though their degree of motor impairment was more severe. They were, however, less capable than children who had no brain damage or movement difficulty who were matched for age and intelligence. This study concluded that perceptual impairment was more prevalent in children with spastic cerebral palsy than athetoids, indicating a possible relationship with the area of damage in the infant brain.

Whilst at the boundaries it is difficult to dissociate perception, cognition and visual-motor abilities, as each influences the others, it is certainly true that perceptual impairment will affect functional abilities, as discussed in this chapter. Clearly, the diagnosis of perceptual impairment is important for the teacher, clinician and occupational therapist, and as there is no satisfactory assessment available at present for the objective observation of perceptual abilities in young children, it was decided to develop a simple, robust test, focusing on aspects of visual perception discussed in this chapter through simple interactive play activities.

CHAPTER 5

WHY DO WE NEED ANOTHER TEST?

Over the past twenty years the use of the standardised, norm-referenced psychometric test has fallen into considerable disrepute amongst psychologists. There has been a much needed move away from the reliance on I.Q. scores as predictors of academic achievement as used in the 11-plus selection process in the 1950's, and more recently, as an indication of under-achievement, leading to a child's placement in Special Education.

Certainly, the predictive value of tests of various kinds has been severely questioned, with good reason. In some cases, predictions were made about the assumed development of abilities that the test itself was not capable of examining. The Frostig Test of Developmental Perception (Frostig et al. 1966), for instance, has been much criticised for claiming to be able to predict reading failure, with little long-term success (Colarusso et al. 1975). Whilst visual perceptual ability, which the Frostig Test purports to assess, will undoubtedly have some bearing on a person's ability to read at a fundamental level (it is obviously necessary, for instance, to be able to discriminate the letters from the background of the page and from each other,) reading is such a complex process involving language, decoding and the conceptual ability to comprehend what is written, that it is impossible to predict reading ability on the basis of one such small component. It may have been more appropriate to suggest that those children who performed badly on the 'Eye-Hand Co-ordination' sub-test might turn out to have untidy handwriting! The notion that academically underachieving children can be identified by early screening is questioned by Gillham (1978), and tests such as the Frostig and I.T.P.A. (Kirk et al. 1968) have come under attack for their assumption that the abilities which they tap are those which underlie basic educational skills (Zarske, 1982). However, it is also important to bear in mind that there is so much more to the development of the individual that we must not be restricted to merely seeking those children who may have difficulties in academic terms. A delay in development of motor skills or daily living activities may have the effect of curtailing a child's ability to lead a normal life far more than would any limitations on his academic achievements.

Many tests previously in common use have been discredited as being lacking in terms of validity, reliability, or both though some continue to be utilised in spite of their technical inadequacies.

Tests are manifestly vulnerable to misuse by deviation from the standard procedure for administration, particularly if the results are subsequently quoted as if the test had been given correctly. Indeed, incorrect interpretation of the results may occur irrespective of whether or not the test was correctly administered.

In the darker days not too long ago, well within the writer's recollection, tests and testing remained the sole province of psychologists who seemingly endowed their 'tools of the trade' with mystical properties which were seldom revealed to the grass-roots worker. A not uncommon scenario would be for a psychologist to remove a child from a classroom to return later with information about his abilities which entirely corroborated the teacher's knowledge about the child. It could be argued that a psychological test was not necessary to provide this information, but on the other hand, everyone finds it reassuring to have their views confirmed, and certainly no harm was done. Occasionally, however, a child would be so over-awed by the unfamiliar person that even within the cosy ambience of the psychologist's room, performance was well below his ability level and it has even, sadly, been known for such a child to be labelled 'severely mentally retarded' when his classroom performance demonstrated otherwise. The psychologist's report carried more weight than the teacher's and with the limited time available, reasons for a child's underachievement on the tests were not always investigated. The test results were placed in the child's file and subsequently used as a basis for decision of the child's future placement. (This is not fiction!)

Test scores were frequently expressed in a manner that was not optimally meaningful or helpful to those working with the child. An approximate mental or developmental age in a particular area is often more easily understood by parents, and indeed, by some teachers and ancillary workers, than a score expressed as a quotient, which may have served to preserve the mystique and enigma of the psychologist's province but did little to promote an easy discourse about the child's problems and their remediation with people who felt threatened and intimidated by the technical jargon.

The desire for and current trend towards closer working relationships between psychologists, teachers, ancillary staff, paramedical professionals and parents has accompanied a move away from psychometric testing by psychologists. There has also been a degree of devolution of the testing procedure from the use of the restricted test which required extensive training in its administration and interpretation, to the introduction of simpler assessment instruments which do not require professional training in order to use them. Such procedures can be employed by teachers or therapists, enabling the psychologist's invariably limited time allocation to be utilised more constructively in discussion and advising on strategies for intervention.

Whilst the main volume of criticism of tests has been directed against the traditional norm-referenced variety, criterion-referenced tests and developmental checklists, which are often used as the basis for a remedial curriculum, are not without their critics, even amongst their own authors (Kiernan, 1987).

Undoubtedly there are many drawbacks with tests, which have been over-valued in the past, but there has been a tendency, especially amongst the new generation of psychologists anxious to promote good working relationships with their fellow professionals and parents, to 'throw out the baby with the bath water'. However, if the use of tests were to be abandoned altogether, a most valuable resource would be lost. Used judiciously and as a part of a wider assessment procedure, a good test related to real-life situations is an indispensable asset. Berger and Yule (1987), amongst others, advocate their continued use.

For young children who have aroused someone's concern as to their developmental normality, a comprehensive assessment of their abilities is essential. When a young child is referred for multi-disciplinary assessment (the course of action suggested by the Warnock Report in 1978, when a developmental problem is suspected,) it is important to identify whether or not the child has indeed a problem, and which areas of development are affected. To establish whether there is a problem of developmental deviance, it is usual practice to compare a child's performance with his peer group. Gillham (1978) stresses the importance of age norms in this process (page 91): "in our culture....... the dimension of age level is fundamental to our perception of whether or not a problem exists". A child may, for instance, be suspected of being 'clumsy', but clumsy by what standards? A toddler does not have the refined motor control of a seven year old, and it is essential to have a method of measuring a child's abilities against others of his own age. If we are to have age norms, there must then be a way of comparing a child's present abilities with those norms, namely, a test of some kind. The format of the "Section V" assessment procedure as a preliminary to a Statement of Special Educational Needs under the 1981 Education Act requires a summary of the child's strengths and weaknesses, which can only be formulated with reference to the child's performance with regard to children of his own age. Such evaluation of the child's abilities needs to be based on valid evidence of a child's deficiencies, requiring a well-constructed index of developmental abilities with which to compare his performance. Tests can therefore be extremely useful for both diagnosis and teaching, but few really appropriate ones have so far been developed.

A child being assessed by a multi-disciplinary team will undergo assessments in various aspects of his development such as language, gross and fine motor function and cognitive skills. Various measures such as the Reynell Developmental Language Scales, (Reynell, 1977) Derbyshire Language Scheme (Knowles and Madislover, 1979) and developmental checklists for motor function will be utilised by speech, occupational and physiotherapists. Concrete evidence in the form of facts and figures must be assembled before a child can be labelled as 'having a problem'. An estimation of a child's visual perceptual abilities is an important part of this whole assessment process, as perception underlies so many activities fundamental to adequate performance in daily life.

There is, however, no procedure currently available which is able to examine the level of visual perceptual development of young children within a practical, structured play situation which can effectively compare their level of achievement with that of other children of their age, taking into account the variation in the pace of development within the normal population. Developmental checklists often lack definitive criteria and only provide age levels for the 'average' child without reference to the normal range of development.

In spite of the acknowledged reservations in the use of tests, some form of index of a child's visual perceptual skills is required. We therefore need a test.

<u>Difficulties Associated with Examining Visual Perception in Young Children</u>

Testing visual perception is fraught with pitfalls. We do not really know what an individual perceives. We can only deduce what he has perceived by observing his behaviour on tasks where he has to use certain information gathered from sensory (visual) input to make decisions and perform in an expected way. If he performs the task as expected, we can assume it was correctly perceived, though if he does not perform in the expected way, we cannot be certain, especially in the case of a young child, whether he is unable to do it, or has not perceived the demands of the task adequately. It is important that any test designed for young children has unambiguous demand characteristics.

Small children need to be interested and motivated by stimulating play materials in order to perform well in activities which are not of their own choosing. We know from studies of the development of play that certain repertoires will occur in a predictable sequence, e.g. they like fitting objects into containers, like building, and like matching objects, having a natural attraction to similarity (Sugarman, 1981, Starkey, 1981). As these are activities which most children enjoy and practice spontaneously in their play development (Newson and Newson 1979), it makes sense to utilise these in test situations where co-operation is fundamental. Babies are attracted towards dissimilarity, because they habituate to a stimulus and therefore look at a novel one more (Fantz 1961), but it is several years before they can 'find one different' on request. The linguistic concept of 'same' is established before 'not the same '(Speer and McCoy, 1982).

Whilst 'clumsy' children are frequently noted to have disorders of visual perception, (Hulme et al. 1982, Lord and Hulme, 1987), investigations of children with motor impairment seldom dissociate perceptual from visual-motor functioning, and training programmes for such children usually include exercises for the improvement of both perceptual and visual-motor skills (e.g. Kephart, 1971, Cruikshank et al. 1961, Frostig and Horne, 1964).

Most tests which purport to measure visual perception, in fact, place considerable demands on fine motor function by requiring the child to respond by drawing. This tends to disguise the cause of the problem, as it is not possible to infer from a drawing whether indeed the child has problems in perceiving a figure, or simply in reproducing it. Landmark (1962) cites the example of a girl who, when drawing a line, had to turn her ruler round to see when the line "looked right". Subtests in many more extensive measures such as the Croydon Checklist (Wolfendale and Bryans, 1976) and the Early Learning Assessment (Curtis and Wignall, 1981) contain pattern copying items involving drawing skills for the assessment of perceptual abilities. This obviously clouds the issue of perceptual assessment, as visual motor abilities, which are demonstrably not the same as visual perceptual skills (Leonard et al. 1988) are integral to the executive response required for such tasks.

Many tests of visual perception place a limit on the time allowed for completion of the item. In timed tests, children who are clumsy in addition to having perceptual difficulties are particularly penalised for slowness of response, often failing because they run out of time on tasks they might have been able to finish with persistence. Stratford and Alban Metcalfe's investigations (1983) concluded that in Down's Syndrome children, unlike normal children, there was no relationship between the time taken to complete the perceptual task and the children's accuracy. This is powerful supportive evidence against the use of timed tests for young or handicapped children unless there is a specific reason for measuring speed of response. Handicapped children may take longer to process information and come to a decision, but but they should be allowed time to complete the task if perceptual <u>ability</u> rather than speed is being assessed.

If a child requires an unusually extended period for task completion this may be recorded in the report.

It is particularly important to have norms available for young children, as many tests which are not norm-referenced have items which are too advanced for young children to perform. The writer has known of subjective and unstandardised assessments applied to young children who were subsequently described as 'having problems' with skills they would not normally be expected to perform until they were older. It is easy for staff, especially therapists who see a wide age range of children to overestimate the expected abilities of pre-school children who, though developing fast, still have a lot to learn.

Certain safeguards must be borne in mind when using tests. A test is, after all, only a way of sampling a person's behaviour at a certain moment in time. All kinds of pressures can affect a person's performance, and young children are a most vulnerable group where such influences are concerned. Such factors as unfamiliar surroundings or the presence of a stranger (the examiner), can cause emotional stresses in a young child which render their performance untypical of their usual behaviour, and the test administrator must make great efforts to establish rapport with the child and be reasonably confident that he is not ill, unduly anxious about anything, hungry, thirsty or in need of the toilet if anything approaching an optimum level of performance is to be elicited. With a young child, a one-off assessment, without extended opportunity for observation, though so often necessary because of the pressure of time, is not sufficient evidence to state that the child <u>cannot</u> do something, merely that he <u>did</u> <u>not</u> do it on this occasion, though a parent or teacher may be on hand to advise as to whether a child is performing in a typical manner.

A further value of a well-designed and appropriate test is the opportunity to observe how a child approaches the various tasks. Skilled clinical judgement of the manner of performance of a task is invaluable. Whether he passes or fails on any individual item provides far less information than observation of the problem-solving strategies employed in his attempt at performance. An analysis of the child's errors may provide insights which will not necessarily be available from test results and can be a most useful guide to planning intervention.

Information about all aspects of a child's development is often required to provide a profile of his strengths and weaknesses when it is suspected that he may have difficulties. Tests are available for language and gross motor development, but it is difficult to obtain reliable objective information about a child's level of perceptual development.

Perceptual functioning can only be assessed by observing the child's performance of activities which we assume measure perceptual functions. Some existing tests contain measures of perceptual functioning for young children, for example, the McCarthy Scales of Children's Abilities (McCarthy, 1972), but such tests, primarily designed to assess intelligence and general abilities, cover a wide age range and tend to be less sensitive at the lower end of the range, as there are fewer items at this level. There is very little material, even in assessments restricted to psychologists' use, applicable to very young children. Tests such as the McCarthy, whose real target population is older children who can understand language, require the use of specific linguistic instructions, which may be inappropriate for some young children who have inadequately developed language skills (a common feature in children whose other abilities are delayed).

There is therefore a need to minimise the requirement for language comprehension as assessment of the child's language skills is not relevant to the assessment of visual perception. If the child can understand the spoken word, so much the better for his ability to operate in the world, but he should be able to perform perceptual tasks without necessarily understanding verbal instructions. It is impractical to administer the test entirely without talking, as this would create an unusual interactive relationship with the child, but verbal instructions should be redundant to the implicit demands of the task. Poor language skills may be a symptom of more general retardation, of course, and this will need to be assessed separately to gain a complete picture of the child's performance in all areas. The perceptual assessment procedure must therefore be designed so that a child can perform the activities without needing to understand the verbal instructions.

It is obviously necessary for the child to co-operate as far as possible in the test situation, and to optimise co-operation in young children, materials must be interesting and inviting for them to play with. Bradley and Bradbard (1981) noted the enthusiasm with which four year olds participated in a task when allowed to manipulate the materials as compared with children who were not allowed to touch. Test materials which were really designed for older children do not necessarily have intrinsic appeal for little ones. Three year olds very much enjoy physical involvement with three-dimensional materials and most are only interested in paper and pencil activities for a very short period of time. It is useless to appeal to their better nature for co-operation on a boring task, or expect them to be motivated by the very concept of 'being tested' as one might with adults. Whilst young children may show good concentration on activities of their own choosing, their attention span is often much shorter when it comes to imposed activities. Test items must therefore be kept very short to sustain their attention, and easy enough, at least initially, for them not to have to make too much effort before positive motivation and a feeling of co-operation have been established. They also enjoy interaction with an adult, and often digress from the task in hand to chat about totally unrelated topics. Tests which incur a penalty for excess time taken are therefore unsuitable for this age group. The examiner has to be prepared to follow the child's interests to a degree, sharing the conversation enthusiastically. Failure to do so will undermine the rapport so essential for work with young children, and will therefore affect the child's motivation to co-operate and please the adult.

Screening for perceptual difficulties in the early years is neither realistic nor necessary (Lyndsay and Wedell, 1982), but some assessment, which must be norm-referenced so that appropriate expectations can be set for these young children, is needed for the pre-school child who is suspected of having problems. A test is required for use with children who have been observed to have difficulties. These difficulties may be in areas other than perception, but an assessment of visual perceptual abilities is, nevertheless, a valuable contribution to a profile of the abilities of such children, so that teachers are aware of a child's strengths and can build on them. A suitable test must be designed to make minimum demands on memory for specific play activities, though play opportunities which most children will have had, such as experience with simple educational toys and puzzles, may help the child to feel a comfortable familiarity with the test materials.

As no existing measure fits the requirements of examining visual perceptual skills of young children in a practical way to enable their performance to be compared with that of their peers, it was therefore decided to design a test to meet the particular needs of young children .

How is Visual Perception Currently Assessed?

Currently available assessments of visual perception fall into three main groups:

1. Items in developmental checklists.

2. Perceptual assessments which are developed within a school or therapy department and are unstandardised and subjective.

3. Items in restricted tests which are usually only available to psychologists or those specially trained in their administration.

In view of the shortcomings of the tests in all three groups, the Pre-school Visual Perception Assessment was devised. The problems associated with other measures, however, need to be examined.

1. Developmental Checklists.

A vast number of developmental checklists are available. At present, checklists of general development used by teachers and therapists are inadequate for the very precise requirements of identifying young children with developmental problems in specific areas such as perception.

Some checklists are intended as baseline and on-going assessments for programme planning for children with developmental problems e.g. Cunningham and Sloper, (1978), The Portage Program (Bluma et al, 1976), Simon (1981), and Hanson (1977). Others are assessments designed primarily for monitoring the development of normal children in nurseries. Those most easily available in Britain are the National Children's Bureau Guide (1977) and the Keele Pre-school Assessment Guide (Tyler, 1979) neither of which contain any information on validity or reliability, and no age norms by which to gauge whether a child deviates significantly from the average and therefore may have problems. The N.C.B.

charts, according to the authors Evans and Sparrow (1976), are intended to supplement existing measures which relate a child's level of functioning to his peer group, and they were devised on the criterion-referenced principle of a sequence of milestones. Such checklists have little to offer over and above the developmental curriculum most schools have devised for themselves, though they are a useful starting point for any establishments which do not already have such a framework.

Only one developmental checklist gives information on the normal variation of skill acquisition. This is the Denver Developmental Screening Test (Frankenberg and Dodds 1967), which incorporates information presented in a useful visual form on the percentile performance on each task for 25%, 50%, 75% and 90% of children. Though the test was standardised in Denver, Colorado, data obtained from a sample of Cardiff children may be used for reference if the test is used with British children (Bryant, 1979).

Assessments devised in the U.S.A. are usually better standardised (though on American children), and include some data on validity and reliability. They are, however, more difficult to obtain in this country, are often very expensive, and especially if specific wording is required for their administration, may not transfer well to a different culture.

Most developmental assessments cover five main areas :

1. Gross Motor
2. Fine Motor

3. Language

4. Performance/Cognitive abilities

5. Social skills.

There is seldom any attempt to chart the development of perceptual skills separately from general cognitive abilities and performance. Developmental checklists, though useful as guidelines in nursery curriculum planning, are of limited value in the process of assessment of developmental problems in children, as though mean ages for skill acquisition may be quoted (e.g. Cunningham and Sloper 1978), or broad age bands for a range of skills as in Portage (Bluma et al, 1976) they do not provide information about the normal variation in performance seen in perfectly normal children. Moreover, the criteria are often imprecisely specified, so that reliability regarding the child's performance must be in doubt, and different observers may come to entirely different conclusions. In particular, some parents, understandably wanting their child to perform as well as possible on an assessment, are inclined to credit their child with achievement of a skill when he has, perhaps, only succeeded on the criterion measure on isolated occasions. "Has done sometimes" is by no means the same as "can do", and a child being credited with success for a skill or behaviour which is not well established may lead to the setting of more advanced, possibly unrealistic goals in a teaching programme when consolidation of more basic skills may be more appropriate.

Assessments examining visual perceptual skills are rare. The Look and Think Programme (R.N.I.B. 1979) has its own assessment kit, but this is primarily intended for visually impaired children of school age. The language of administration is therefore too advanced for very young children, as are the concepts behind some of the items. It was never intended as a pre-school assessment, though some of the items in the teaching handbook are extremely useful as remediation activities for younger children. Curtis and Wignall (1981) have a section on visual perception in their Early Learning Assessment, and though this is known to be used in some Nursery Schools, it is intended to be given to children in their first year of Infant school, as is the Bury Infant Check (Pearson and Quinn, 1987). The Assessment in Nursery Education (Bate and Smith, 1978) is a useful though perhaps unwieldy tool for charting the development of individual children in Nursery School. It is, however, heavily dependent on the child's understanding of language, and whilst providing a useful framework for preparing reports on normal children, the difficulty of dissociating language comprehension from performance must detract from its usefulness in identifying the child with specific problems or special needs.

2. Unstandardised Assessments of Visual Perception.

Though usually unpublished, these are frequently used in schools and Occupational Therapy Departments as if they were reliable, well-validated and standardised measures (Boys et al., 1988). The writer has various examples of these, some of uncertain origin, where pass/fail criteria are specified regardless of the age of the child.

3. Restricted Tests.

The third group of assessments of visual perception is undoubtedly the most useful, though these are restricted tests mainly only available to psychologists.

The Frostig Developmental Test of Visual Perception (Frostig et al. 1966) is an exception to this, as it may be obtained by Occupational Therapists who undertake a special training course. Whilst it was extensively used in research in the U.S.A. for many years after its production, being accepted as the definitive guide to a child's visual perceptual development, in the past decade its validity has been severely questioned (e.g. Kavale, 1984) and it has fallen into disrepute. Certainly the five sub-test areas are not discrete aspects of visual perception but are heavily interdependent. Even if it was assumed to be a valid test, it has several problems when considered for use with very young children. Though it is intended for children as young as three years, and over a hundred three to three-and-a-half year olds were included in the standardisation sample, the writer has found that children with developmental difficulties could not sustain their attention for the duration of the test. Three year old normal children can, as demonstrated by their scores in the standardisation data, concentrate adequately to perform the test, but where children with suspected developmental problems are involved, failure to attend may be a symptom of inability to perform (a refusal, in effect, to attempt what they know they cannot do), or it may simply be a lack of interest or attention for a rather boring task which could be achieved if they could be persuaded to concentrate. For these young, easily distracted children refusal cannot necessarily be construed as failure, yet the Frostig Test is insufficiently flexible to present in a more appealing and motivating form. Its doubtful validity also makes any attempt at modification even more impossible to interpret meaningfully.

Other assessments of visual perception include the Ayres Sensory Integration Tests, (Ayres 1976), an extensive battery of tests mainly used by Occupational Therapists in the U.S.A. The training course is long and expensive, and few therapists in this country are trained in its use and therefore have access to the materials. The tests include Figure Ground, Position in Space, Space Visualization, Manual Form Perception, Design Copying and tests for motor co-ordination, laterality and tactile sensitivity. They were standardised on children of four years upwards, but are mainly targeted at children of infant/junior school age and are therefore largely unsuitable for pre-schoolers, though three of the measures were, in fact, used to validate the Pre-school Visual Perception Assessment. It was impossible, however, to gain the co-operation of children younger than four years, as the tests are somewhat boring and rise steeply in difficulty. Only the most able of the four year olds in the present sample enjoyed the tests and needed little encouragement to participate, and it would be impossible to use these tests with young children with developmental delay.

The Motor Free Test of Visual Perception (Colarusso and Hammill,

1972) has rather more potential as a perceptual assessment for four year old children, being easier than the Ayres tests, with fewer items less steeply graded. It is not easily available in Britain, however, and seems to be relatively little used in the U.S.A. if citation in research papers can be assumed to be an index of its usage. The rationale for its development, its validity and reliability appear satisfactory, though it is unfortunate that it was standardised on children from five years only. This test was also used as a validation measure for the Pre-school Visual Perception Assessment, and was certainly more appealing to young children in the standardisation sample than the Ayres material. Some of the three year olds were unable to concentrate on its two-dimensional line drawings, so it was not used in the present study for children younger than four years.

Two other tests developed for and by occupational therapists in the past few years for the assessment of perceptual dysfunction are standardised only for adults. The Rivermead Perceptual Assessment Battery (Whiting et al. 1985) and the Ontario Society of Occupational Therapists Perceptual Evaluation (Boys et al. 1988), have evidence of validity and reliability, but the nature of some of the materials, (e.g. matchboxes in the Rivermead Test) render its suitability for use with young children questionable without modification, even if norms for younger subjects were available. The Canadian measure is not yet commercially produced.

Summary

This chapter has reviewed the range of assessment materials available for use with young children, discussing the features which render them inappropriate for assessment of visual perception in pre-school children. The need for the development of an assessment which can meet all specified criteria is therefore established.

CHAPTER 6

DEVELOPMENT OF THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

This assessment was born out of need. There was no existing measure which was appropriate for examining the perceptual skills of young children in the writer's working situation in a Child Development Centre, where children attend for assessment and subsequent therapy and teaching.

The test is designed to examine visual perception in young children from two-and-a-half to four-and-a-half years old through play activities. It is intended for use in situations where previously norms and expected performance levels have been entirely subjective, dependent on the experience of the assessing teacher or therapist.

Test Specifications

The criteria used in designing the items incorporated those features, discussed in the previous chapter, which were found to be lacking in other assessments. Test items were developed according to the following criteria:

1. The materials must be intrinsically interesting and motivating to young children. They must be capable of being handled, as children find touching irresistible and instructions

requiring the child to look and not touch risk conveying a negative approach on the part of the examiner. All materials are therefore intended to be handled if the child wishes.

2. A corollary of the above point is that materials must be sufficiently robust to tolerate being played with. Surfaces of picture material must be resistant to dirty finger marks, and dribble-proof (many children with developmental problems still dribble beyond the age when normal children have ceased). Materials must also be large enough to be easily handled by clumsy fingers, with drawings sufficiently large and clear to be easily seen.

3. Young children have a relatively short attention span. Each activity in the test must therefore be of short duration, with plenty of novelty in successive items to hold the child's attention. It must be possible to take short breaks between items if required.

4. Timing of items is unimportant. No specific time limit should be imposed on any item. A child may temporarily digress from the activity to return to it successfully. It is usually possible to assess when a child is overfaced by a task or has no further interest in it. Certainly no penalties should be imposed for excessive time taken, though a note should be made of prolonged prevarication when a test report is written.

5. Language used in the instructions must be clear and simple.

Young children's comprehension of language varies a great deal with their experience, and the tester should be free to use whatever words, gestures or other means the child understands best to convey what is required. As far as possible, activities should have implicit demand characteristics, or should be demonstrable by modelling or gesture, so that a child with poor language comprehension is disadvantaged as little as possible. Too many tests depend on the child understanding scripted instructions to perform adequately.

6. The test should be easy to administer and score, as it is primarily intended for use by non-psychologists.

7. Visual perceptual skills are not effectively assessed by examining the child's ability to reproduce designs (Bortner and Birch 1960) though such tests as the Bender Visual Motor Gestalt Test have often been used for the purpose (Bender 1938). Failure on such tasks may be due to visual motor impairment, and is not necessarily an indication of primary perceptual deficit. It is therefore important that the motor demands of the test should be minimised. (This point is not, as may at first appear, incompatible with that in 2. above. The child is permitted to play with the equipment but accurate motor responses are not required for the test performance, so a child with a moderate physical handicap or severe visual motor impairment will not be at a disadvantage on the perceptual test.)

8. In existing tests, it is usual for a criterion of performance

to be defined, and for the child to be credited with a pass or fail on the basis of his or her performance. There is seldom any attempt to record the pattern of errors in the failure, or the strategies which lead to poor performance. The purpose of this test is to identify children who have deficient perceptual skills and analyse their errors so that remediation measures can be planned according to their particular strengths and weaknesses. Opportunity for recording error patterns and unproductive approaches to tasks must therefore be built in to the score sheet.

Initial Compilation of Materials

According to the above criteria items having face validity for visual perceptual content were assembled. Many of the tests were based on the observed play interests of normal children. They included several matching activities using both two and three-dimensional materials. In essence, the activities varied little from those a child is likely to encounter in the nursery, play-group, or at home if a range of educational toys is available. Presentation of the materials has been standardised to allow objective scoring of the child's performance.

The initial compilation was:

1. Object matching (four coloured objects).
2. Matching ten yellow objects.
3. Matching five coloured pictures of familiar objects (selected from E.S.A. Giant Picture Lotto).
4. Matching ten dinosaurs (plastic models).

5. Matching Boys. Ten outline drawings of boys performing different activities. (From pictures produced by the Invalid Children's Aid Association for the John Horniman School, 1974).

6. A five-hole wooden posting box with two irregular shapes.

7. The 'bedroom' card from Galt's 'Find It' game.

8. 'Find the Children' from 'Same and Different' (Presland, 1975).

9. Kiddicraft six-shape Posting Box.

10. Alphabet lotto (matching six letters).

11. Matching words.

12. Stacking castles.

13. Stacking ten graded rings.

14. Face and body reconstruction

These items, together with the Language Test described in Chapter 8 were subjected to trials on over a hundred children attending the Child Development Centre and on normal children in schools, day nurseries and at home, though all children did not attempt all items. Whilst in concept most appeared to be suitable, a number of revisions took place.

1. Items (numbers 3,5,6,7,8 and 10) which included commercially-produced materials were withdrawn, as it was noted that some games had been discontinued by the manufacturers, and there was a probability of this occurring with more of the equipment. In addition, as only parts of the games such as "Find It" were used, the eventual production of the test in any numbers would necessitate the purchase of complete sets of the games, including much redundant material, or negotiation with the manufacturers

for certain parts to be made available. Items similar in concept to those already tried out were therefore developed and drawn by colleagues who made no claims on the copyright. All pictures could then be reproduced by photocopying. Coloured pictures were hand-coloured using poster pens and all materials were mounted on heavy card and sprayed with a water-resistant plastic spray.

2. Certain gaps were identified, especially at the lower end of the test, where it was felt there should be several simple items to enable the examiner to establish rapport with the child and not to overface him with difficult tasks before he was well-motivated to co-operate. Easy activities would also help to identify children who had very severe problems. Further items were therefore devised to provide more extensive examination at a simple level. These included matching black-and-white outline drawings and object-to-picture matching.

3. Item no. 4 'matching dinosaurs' was deleted as it was felt that there were too many significant features the child could use to discriminate between animals to make it a reliable test.

4. 'Stacking castles' was withdrawn as it was too easy.

5. This version of 'graded rings' was withdrawn as it was quite difficult even for four year olds, and proved very difficult to score.

6. The body reconstruction was withdrawn as there were too many

possibilities for placement of the limbs in positions where it was unclear as to whether the child was making the figure assume an interesting position, or did not really know how the figure should be constructed.

The second version of the test consists of the following items, which are illustrated in the Appendix.

The Pre-school Visual Perception Assessment

1. Matching Objects.

This item is designed as a trial item to introduce the matching concept, required in subsequent items of the test. Four different coloured objects are to be matched to identical items presented to the child one at a time. The objects are: red shoes, yellow plastic spoons, blue cars and green bricks. These objects were chosen to be obviously very different and easy to match. Any child failing on this task can be taught how to match, and as all the objects are likely to be familiar to all children, verbal labels can be used in the teaching of the task, and by the child, to help him find the match.
Scores on this item are not included in the total for the test.

2. Matching Yellow Objects.

Ten yellow objects are to be matched to identical objects presented to the child one at a time. All ten objects remain on view throughout the presentation. The objects are: a large plastic brick, lemon, funnel, lorry, car, small wooden brick, toothbrush, spoon, pencil and comb. These objects were selected because it was felt that children who have severe perceptual problems or developmental delay (only severe problems would be detected by the test at this very simple level), may not know the names of some of the objects such as the lemon and funnel. They will therefore be matching the objects visually, rather than by using verbal labels as rehearsal techniques to locate the matches. Bright yellow objects were chosen as it was the easiest of the primary colours in which to obtain a similar shade and density. Blue, red and green objects, in particular, vary considerably in shade, and the intention of using all objects of the same colour was to eliminate colour matching.

3. Matching Coloured Pictures.

Four coloured pictures of familiar objects (shoe, cat, cup and teddy bear) are to be matched to identical pictures displayed on a board. The initial display of five pictures was reduced to four and the display changed to the pictures being presented in a square format, two above and two below, rather than in a line, as pilot studies had corroborated the work of Vurpillot (1968) demonstrating that some children did not scan as effectively when the pictures were arranged in a linear display.

4. Matching Outlines

Six black and white outline drawings of familiar objects were to be matched to sample, as in the previous items.

5. Matching Family

This task was originally designed as an object-to-picture matching activity, with small dolls to be matched to line drawings of Mummy, Daddy, boy, girl and baby. The item was subsequently revised as children were confused between the girl and Mummy and boy and Daddy dolls, as the dolls were smaller in size than the drawings, with the drawing of the girl being approximately the same size as the Mummy doll. It was therefore decided to make this item into a straightforward picture-matching task using two sets of the drawings without the dolls.

6. Matching Objects to Coloured Pictures (Photographs)

This item proved somewhat difficult to develop, as obtaining a good photograph of a small object without access to professional facilities was not easy. Eventually a set of professionally produced photographs of objects used for a speech therapy articulation test was obtained and though the copyright is held by the Speech Therapist, it was hoped that it would be possible to obtain copies in the future. Six photographs which could be easily matched to real, easily obtainable identical objects, a teaspoon, orange, cup, soap, toothbrush and small plastic pig were selected.

7. Matching Miniature Objects to Outline Drawings

A further item involving the interpretation of line drawings was felt to be necessary and a set of six drawings of farmyard animals was prepared, to be matched to plastic models of the same animals.

8. Matching Girls

A set of outline drawings of the same girl involved in various activities (standing, walking, building, waving, sitting, running) was prepared as a more complex picture-matching task.

9. Three-Hole Posting Box

After the foregoing items, which though very brief, included a substantial amount of picture material, a posting box toy was introduced as a more interactive piece of equipment for the child. Though a commercially produced item, this posting box, the Lock-a-Block made by Ambi Toys was felt to have considerable intrinsic play value, having a door which opens with a key and a creaking sound. Its main feature by which it differs from all other posting boxes, is that each face of a piece has the same shape as its respective hole, thus the round shape is a sphere, the shape for the square hole is a cube and the triangular shape a tetrahedron. Other posting boxes have pieces with triangular faces at the top and bottom but rectangular sides, which can be misleading to a young child. This toy has one drawback from the point of view of the assessment of shape-fitting, in that the edges of the holes for the pieces are coloured red, yellow or blue to correspond with the shapes to be fitted. As each shape is a different colour, the box could therefore be correctly completed by colour coding without reference to the shape. Experience with blind children who have a little residual vision has shown that they do, in fact, tend to use the box this way.

It was felt that this was a variable which could not be ignored.

A further set of shapes all the same colour (yellow) were therefore obtained by courtesy of the manufacturers, Europlastic of Amsterdam. These three pieces are presented after the box has been solved correctly using the different coloured blocks.

10. Stacking Graded Cups

Twelve Kiddicraft nesting cups are required to be built into graded towers of three. The child is presented with three cups of the same colour, and after demonstration, invited to build a tower. This remains in place whilst the other towers are built. For the first two towers, (red and blue) the cups are presented in the correct orientation for stacking. For the green and yellow towers the cups are presented a) on their sides, and b) inverted, so that the child has to perceive the change in orientation required to solve the problem.

11. Balls and Cups

The Kiddicraft toy "Wobbly Colours" is used for this test. The cups are arranged in a specific order in the baseboard and the child is invited to take them out then replace them. No mention is made of the colour matching aspect of the task, but the characteristics of the toy should be sufficient for the child to replace the balls in the recesses of the same colour.

12. Peg Towers

This is also a colour-matching task, but with an element of vigilance. One of each colour of Invicta "Big Pegs", six in all, are arranged in a prescribed sequence in a specially designed pegboard. The child is then shown how to place a peg of the same colour on top of each one in the board in order to build a tower. He must then place three further pegs of each colour to complete the task. This item is a useful assessment of the child's ability to concentrate on an easy task, but one that is longer than the previous ones, without adult prompting or intervention.

13. Face Puzzle

This item was developed from the idea of a 'manikin' used in a previous study (Howard, 1981), and from Reynell (1963). A wooden featureless face with separate wooden features was commissioned from a local manufacturer of wooden toys. The assembly of the face is first demonstrated to the child, then the pieces are removed and the child is asked to reconstruct the face.

14. Letter Matching

This item has two parts. The first, matching six letters well-spaced on a board is quite a simple task as all the letters are very different from each other. Children who only succeeded in matching four letters or less were, after pilot studies, found to be unable to cope with the more complex second part of the item, which involves matching letters with some similarity, including reversals. A dual scoring system was utilised for this test. The first (scored as Test 14) awarded one point for a correct letter choice and 0 for an incorrect one. The second method (appearing as 14a in analysis tables) involved the second part (complex letter matching) part of the test only. Two points were given for a correct response, but if an incorrect response involved the choice of a letter with some similar characteristics to the model, for instance reversal confusions such as b, d, and p or n and u, or a confusion of h and n or a and d, one point was given. An incorrect response not involving a 'similar confusion' scored 0.

15. Six-Hole Posting Box

This is the Kiddicraft posting box as used by Gubbay (1975) in his study on clumsy children. Whereas Gubbay used the lid of the box only as a formboard, the whole of the box was used in this test. Scoring is stricter than in the first "Lock-a-Block" posting box, orientation of the pieces being taken into account in the child's attempt to fit the pieces into the holes.

16. Superimposed Pictures

The work of Ghent (1950) suggested that children's ability to extract information from embedded pictures is indicative of their perceptual abilities. A series of overlapping pictures was therefore prepared by photocopying line drawings onto overhead projector transparencies and superimposing them, then copying again onto plain paper. Initially thirty-eight pages of pictures were prepared for this item. These were reduced to fifteen after pilot studies. The items vary in complexity from two superimposed pictures (nos.1 to 9), to three (nos. 10 to 12) and four pictures (nos. 13 to 15).

17. Puzzles

Practical experience with young children with learning problems has indicated that such children have particular difficulties in completing jigsaw puzzles. A number of straight-cut puzzles were therefore commissioned. The first set, consisting of three two-piece, one three-piece, three four-piece and one six-piece puzzle were produced in wood, and had simple, clear pictures of familiar objects. The child was told what the picture represented, but it was felt that he may be at a disadvantage if he could not visualise how the completed picture should look, or if he did not understand the name of the object. A second series was therefore produced, consisting of three puzzles of a wellington boot and five identical pictures of a soldier. Both sets were graded in difficulty, the first of the series being cut into only two pieces, with the others gradually increasing in complexity up to the most difficult soldier puzzle being cut into six equal pieces. The first puzzle in this series could be left in place for the child to refer to whilst working on the more difficult puzzles. The intention was to examine the child's performance on both types of puzzle to see which was the best indicator of perceptual deficiency.

18. Graded Rings

A set of sixteen coloured wooden rings stacked into four different coloured towers is shown to the child. The rings are then removed and the examiner replaces one tower as a model explaining the size grading aspect of the task. The child is then invited to replace the remaining rings. This item is very popular with children who often ask to do it again even if they have apparently no idea about the size-grading requirements.

19. Figure-Ground Puzzle

This puzzle was developed from the concept underlying Galt's 'Find It' game and Ghent's embedded figure task (1956). A picture of a street scene is painted on a wooden board and additional pieces of the same shape and colour as shapes on the board are presented to the child to be matched to the board. As some children in the pilot study were initially a little confused as to the nature of the task, an easier 'trainer ' puzzle, which is unscored, was developed. This takes the form of a lift-out formboard with the different coloured shapes being the windows and door of the house. The recesses in the puzzle are painted the same colour as the lift-out shapes. When the child has completed this puzzle it is therefore easy to convey to him that the second puzzle is similar to the first except that the pieces do not lift out, and the loose shapes have to be placed on top of the corresponding parts of the picture.

20. Incomplete Pictures

This concept arose from the work of Gollin (1960). Outline drawings of familiar objects were prepared, and parts of some of the lines were obliterated with typewriter correction fluid. The pictures were then photocopied. Extensive pilot testing was involved in the development of this item to make the pictures easy enough for young children to identify. The fragmented picture is shown to the child who is asked to name it. The completed picture is then revealed over the page, with opportunities for great jubilation if the child guesses correctly. Although language is required for this test, the child is only required to use single words to name the pictures, and all the objects are familiar and likely to be within the vocabulary of young children. A check on this is built into the task by following presentation of the fragmented picture by the completed drawing. If the child fails to identify the complete picture, it is possible that failure on the fragmented picture may be due to linguistic inability rather than inability to perceive the form of the object. If the second picture is correctly identified, it can be assumed that the child failed to perceive the shape in the fragmented picture. If the child gives the second picture an incorrect but associated name that he has also applied to the fragmented picture, then he may be credited with a correct response. e.g. sometimes children refer to the picture of the bird as a 'chicken'. If the second picture is also named 'chicken' it is possible that the word 'bird' is not known or used by the child. In this case the point would be credited. Identification of the complete picture is also a useful guide to the testing of non-English speaking children, who name the pictures in their own language. If both pictures are given the same name, there is a good chance that the picture has been recognised, and a note can be made of the child's word for the picture, for subsequent checking with someone who speaks the child's mother tongue. This method of testing has been found to be satisfactory for non-English speaking children in the absence of an interpreter.

21. Which is Different?

Sets of five objects are presented to the child in a prescribed lay-out and he is asked to find the one that is not the same as the others.

The Drawing Tests

Visual perceptual skills need to be examined in comparison to the child's abilities in the visual-motor domain. The simplest method of assessing visual-motor skills in young children is through drawing, and the shape and person drawing tests, described fully in the Appendix, were therefore devised. They were adapted from those appearing in developmental schedules such as Sheridan (1973), Portage (Bluma et al. 1976), Illingworth (1975), and the McCarthy Scales of Children's Abilities (McCarthy, 1972). The scoring criteria were modified to take account of the young age of the artists, and guidelines for scoring were drawn up from examples collected during the pilot study.

Pilot Testing for Administration

The second version of the assessment was pilot tested to confirm the suitability of the proposed order of administration of the sub-tests in the battery and to develop a standard method of presentation of the items. A scoring method and simple score sheets were also devised and refined until satisfactory. This pilot testing was carried out with fifteen children, five of whom had some kind of developmental problem and attended the Child Development Centre. The remaining children had no known developmental delay and attended nursery schools.

Standardisation of the test was carried out on one hundred normal children. Details of this sample are given in Chapter 7.

Scoring the Test

The method of scoring the separate sub-tests is described in the section on administration in the Appendix. The raw scores are entered onto the final page of the score sheet and the child's performance can then be compared with the raw score for his age group to see if he scores above the 10% criterion, and examined with respect to the means and standard deviations for other children of his age. Raw scores may also be converted to standard scores and entered on to bar charts to show the child's performance visually, as some individuals prefer to have a visual comparison, and standard scores may also be added together to give a total score for the test.

The 10% criterion is the point above which 90% of the children in the normal sample performed, and was selected as a cut-off point for 'failure' on any item. Other writers, e.g. Egan and Brown (1986) take a cut-off point at 80-90% and there was considerable deliberation about whether 90% was too low and a cut-off at 85% more appropriate. However it was felt that the hundred children in the research sample were selected for their normality. Any children suspected of having developmental problems were not included and the sample therefore was possibly not totally representative of the normal population, as in any random sample of a hundred children one may expect to encounter some who have special educational needs. As the group was felt to be possibly more 'normal' than a truly random sample, the assumption is made that they may be more proficient. The cut-off point for poor performance was therefore set a little lower down the scale in order to minimise the number of false positive scores. The 10% criterion score was obtained by ranking the scores of the 20 children in each age group and taking the score of the 18th child as the cut-off point. Children ranked 19 and 20 therefore scored below the 10% criterion on that sub-test. If a number of children scored <u>at</u> the criterion level (i.e. if several children scored at the same level as the child ranked 18) only those scoring below this, if any, were regarded as having 'failed' on that test.

It was decided to provide several alternatives for examination of the scores. For examiners requiring a quick pass/fail result, it is possible to compare the raw score directly with the 10% criterion score for the appropriate age group. This, however, is limiting, and gives little information about how the child performs with respect to his age group, merely showing how many sub-tests were 'failed'. A number of other commonly used tests show results as age equivalents which are related to the mean of the sample. This was felt to be insufficiently informative, especially with respect to the testing of children with developmental problems, as comparison with the score of an average child is meaningless. If they have problems they are, almost certainly, below average. What needs to be known is how much or how seriously. Their performance therefore needs to be examined with respect to the variance in the normal population. One test which is felt to provide useful information in an accessible form is the Denver Developmental Screening Test (Frankenburg and Dodds, 1967), where the mean, 25%, 75% and 90% success levels are marked on a chart. A visual display is felt to be of value so that the child's performance can be compared at a glance with others of the same age, without the necessity of wading through lists of figures which may not be processed adequately by a reader in a hurry or with only half their attention on the report. (In an ideal situation such things would not occur, but in practice they are not unknown.) It was therefore decided to provide the facility to convert all raw scores to standard scores and enter them on a bar chart which would also display the mean, standard deviation and 10% criterion for the age group.

Total Score

Although a scrutiny of the child's performance on the various sub-tests is essential for anyone requiring a detailed examination of visual perceptual abilities, it is accepted that a more succinct global score is useful for purposes of short reports and summary. Although much useful information becomes submerged in a total score, it is possible to obtain this by addition of the twenty standard scores from items two to twenty-one. (Item one is a trial item.) These may then be compared with tables as for the results of the individual sub-tests.

Any summary result or total score for a test of this nature inevitably camouflages a great deal of information, and so in this respect, a total score for the P.V.P.A. must be interpreted with caution. It is theoretically possible for a child to perform very well on some items and very badly on others, even scoring below criterion on more than five sub-tests, yet emerge with an average total score which would indicate that his visual perceptual skills were normal. Should a very uneven profile emerge, it would be important to examine closely the reasons for such an erratic performance, but use of the total score only could mask variability. Use of the profile of sub-test scores is therefore recommended when evaluating a child's performance on the P.V.P.A.

CHAPTER 7

BASIC STANDARDISATION OF THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

Five studies were carried out using the Pre-school Visual Perception Assessment. These were:

1. The Basic Standardisation sample of 100 children, which yielded normative data for comparison with the other groups. Validation studies were also carried out with this group.
2. A sample of children with Special Educational Needs.
3 A group of ethnic minority children who had limited English.
4. Test-re-test reliability study.
5. Inter rater reliability study.

Reliability studies are discussed in Chapter 9, and the Special Needs and Ethnic Minority groups are dealt with in Chapter 10. In order to place the validity and reliability studies in context, it is appropriate to discuss the methodology and results of the Basic Standardisation Sample at this point.

The Sample

The second version of the test was standardised on one hundred children aged from two years five months to four years seven months. The figure of one hundred was selected because it was felt that it gave sufficient opportunity for socio-economic and gender groupings at each of the five age levels. Ideally the standardisation sample would have been much larger, and a figure of a hundred children at each age level was initially considered. However, given the amount of time required for testing each child, not only with the perceptual and visual-motor measures but with validation tests, and the demands of setting up a sample and organising the contact time, all to be undertaken by one research student, five hundred children was felt to be well beyond the resources of time available, requiring approximately three years full-time testing for the Basic Standardisation Sample alone! It was decided, therefore, that one hundred children, (twenty in each age group) was more realistic. It is acknowledged that a much larger standardisation sample will be required before the Pre-school Visual Perception Assessment can be published.

Twenty children (ten girls and ten boys) from each six-month age group from two-and-a-half to four-and-a-half years were tested. They were socio-economically grouped according to the Registrar General's Classification using figures from the 1981 Census, though social classes I and II were amalgamated, as were classes IV and V and the figures for economically active members of the population only were used. Table 7.1. shows how social stratification of the children in each age group was derived.

The figures for economically inactive people and the Armed Forces (a quarter of the census figures) were subtracted from the total, which was then taken as 100% for calculation of the numbers of children required from each social class (see Table 7.2).

TABLE 7.1. SOCIAL STRATIFICATION

Registrar General's Classification of the Total Population, 1981
Economically Active Adults

Group 1	4.5}23.3
Group II	18.8}
Group III Non-Manual	9.1}35.3
III Manual	26.2
Group IV	12.2}16.3
Group V	4.1}
Armed Forces	2.4
Economically Inactive	22.7
	100%

TABLE 7.2. SOCIAL STRATIFICATION OF THE BASIC STANDARDISATION SAMPLE

Percentage of Economically Active (Excluding Armed Forces) taken as 100%		No. of boys and girls in each of five half-year age groups.
Groups I & II	(23.3) = 31%	3
III NM & M	(35.3) = 47%	5
IV & V	(16.3) = 22%	2
	100%	10

TABLE 7.3. MEAN AGE AND RANGE OF CHILDREN IN THE BASIC STANDARDISATION SAMPLE

(N=100)

AGE GROUP	MEAN DEVIATION FROM AGE LEVEL IN DAYS	RANGE
2 years 6 months	-1.7	-29 - +29 days
3 years	+9.25	-53 - +58 days
3 years 6 months	+2.4	-59 - +60 days
4 years	-3.5	-59 - +46 days
4 years 6 months	-8.7	-44 - +47 days

Children aged three to four-and-a-half years were all tested within two months of their birthday or "half-birthday." Those aged two-and-a-half were seen within one month of the required age, as pilot testing had shown that quite able children of two years three months were unable to co-operate in the formal testing situation. It seemed likely that if the age criterion which was applied to the other groups, of testing children within two months of the required age, was used with this youngest group, some children aged two years four months may be unable to participate effectively. This is consistent with Stratford's (1979) findings, that mentally handicapped children were not able to participate in formal testing situations where a mental age of less than 2.5 years was recorded. It was therefore decided not to include any child younger than two years five months in the Basic Standardisation Sample, and this necessarily lowered the upper age limit for this group to two years seven months to maintain a mean age of two years six months.

The mean ages of the children tested appear in Table 7.3.

The children were drawn from three nursery schools and six day nurseries in Lancashire and West Yorkshire. They were not the schools which had participated in the pilot testing of the materials, so no children had encountered the test previously. Ten children were tested in their own homes. Though mainly from urban areas, one day nursery was in a rural location, and two of the nursery schools were in small towns.

Letters describing the research were sent to all parents of children in the participating schools, with the consent of the Chief Education Officer for Lancashire and the respective District Education Officers. The letters had a tear-off slip for parents to return giving permission for their child to take part in the study. Children were selected according to their date of birth, socio-economic status and where visits to the child's school or nursery could be timetabled by the examiner. The first child to meet the criteria for any given cell was used. Where gaps occurred which could not be filled in the schools who had initially volunteered their co-operation, other establishments were approached, and in the case of the two younger age groups, a number were seen at home. These children were located through personal contact.

All the children in the Basic Standardisation Sample were "normal" in that none had been designated as having special educational needs or were attending speech, occupational or physiotherapy.

All the children were tested in a small, quiet room in their own school, or in their home. No other children were present during the testing, and distractions were minimised as far as possible. In the case of the children seen at home, the mother was sometimes present, but was asked not to assist the child in any way.

All standardisation testing was carried out by the author.

The administration of the Pre-school Visual Perception Assessment and drawing tests required about one hour, and together with the tests used for validation purposes, (i.e. the Language Assessment, Symbolic Play Test, McCarthy Scales sub-tests, Motor Free Test of Visual Perception and Ayres tests, described in Chapter 8) each child in the Basic Standardisation Sample was seen for a total of approximately two and a half hours, usually over three sessions. The younger children, for whom some of the validation tests were unsuitable, required a little less time for the testing procedure, but on the other hand it was necessary to spend more time putting them at ease in the testing situation, chatting to them and taking short breaks during the administration of the test. In almost all cases the Pre-school Visual Perception Assessment was administered in its entirety in one session. Occasionally routine timetabled events such as milk time or lunch necessitated the session being completed later in the day. Validation tests were administered on a separate occasion, with the Language Test, Play Test and McCarthy sub-tests being grouped together and the Motor Free Test of Visual Perception and the Ayres Tests requiring a further session.

Estimations of time spent in testing do not, of course, include the time required for organising the complex jigsaw of appointments with children within the designated period from their birthdays, or time spent in travelling.

Results of Testing the Basic Standardisation Sample

Sex

Although it was hypothesised that no difference would exist between the performance of boys and girls, the sample was controlled for sex. T-tests confirmed that there was no significant difference between boys and girls on any test with the exception of no. 20, Incomplete Pictures, where the t-value reached the 0.05 significance level. The boys' performance was superior to that of the girls, and it is possible that the girls were a little more shy in this, the only sub-test where verbalisation was required. (See Table 7.4.)

Social Class

On no test was there any significant difference between the performances of children in groups 1 and 2 (1 representing social classes I and II and 2 corresponding to class III non-manual and manual). On only one sub-test, no. 10, Graded Cups, social group 3 (consisting of children from classes IV and V) performed significantly worse than children in groups 1 and 2 ($F=4.30$, $p=<0.05$).

The reason for this is unclear. The stacking cups used in this sub-test are probably the commonest play item used in the battery. Most homes have a set, as they are cheap and readily available in toy shops, supermarkets and High Street multiple stores. It seems unlikely that experience with these toys is much more limited in social classes IV and V. If previous experience with similar play materials in the home is the reason for this

TABLE 7.4. RESULTS OF T-TESTS ON SCORES OF BOYS AND GIRLS

Test no.	Girls' Mean	Boys' Mean	T-value	
1	3.96	4.00	1.43	NS
2	9.74	9.94	1.45	NS
3	3.98	3.98	0.00	NS
4	5.88	5.88	0.00	NS
5	4.76	4.78	0.18	NS
6	5.94	5.96	0.28	NS
7	5.58	5.76	1.09	NS
8	4.18	4.06	0.34	NS
9	16.72	17.06	0.91	NS
10	9.62	10.16	0.93	NS
11	3.84	3.80	0.31	NS
12	5.42	5.48	0.22	NS
13	1.46	1.26	1.53	NS
14	11.14	11.98	0.97	NS
15	6.80	7.86	1.80	NS
16	16.64	17.06	0.33	NS
17	5.78	5.94	0.56	NS
18	6.52	6.68	0.05	NS
19	6.88	6.54	0.52	NS
20	7.02	8.00	1.99	*
21	4.78	5.40	0.85	NS
DRAWING	9.72	9.00	0.47	NS
PERSON	6.14	4.82	1.15	NS

For d.f. 98, t= 1.96, p <0.05 (*)

difference, then one would expect to see a difference in performance between the two social groups on other measures such as the Posting Boxes, and there is no evidence of this (though the ethnic minority children were noted to perform significantly worse than the English children on these tests).

Performance of Children in the Basic Standardisation Sample

The mean scores and standard deviations of the children in the Basic Standardisation Sample can be found in Table 12.4. (pages 304-308). The majority of the children scoring below the 10% criterion did so on only one sub-test (27%), or on two sub-tests (12%). Only six children 'failed' on three sub-tests, three on four sub-tests, four on five sub-tests and one performed below criterion on seven sub-tests.

The child who failed on seven sub-tests was a very shy child who, it was felt by her experienced nursery teacher, had underperformed. She liked to feel secure with an activity before she would participate fully, but her learning ability and perceptual and cognitive skills did not give the nursery staff cause for concern. She obtained a very low score on the Incomplete Pictures sub-test because of her reluctance to speak (most shy children can be persuaded to whisper, at least) but this little girl refused to be drawn, though her teacher was sure she would have known the answers.

The four children who scored below criterion on five sub-tests were very 'ordinary' and were not felt by their nurseries to have significant learning problems, though they were acknowledged to be 'plodders'. Though it was obvious during testing that they were not doing particularly well, the examiner was surprised to find that they had scored below criterion on so many tests. (The criterion, of course, was not established until after all testing was complete.) None, however, had features in common with the children with developmental problems with whom the writer was used to working.

It is interesting to note that the results of the drawing tests were in agreement with the visual-motor literature (e.g. Leonard al. 1988), as only two of the children who scored below criterion on the drawing tests were weak on the perceptual measures. The other children who scored below criterion on the two drawing tests failed either only one of the perception sub-tests or none at all, consistent with the belief that the skills required for drawing (visual-motor) are not the as those required for visual perceptual activities. It also serves to demonstrate that unlike some other so-called tests of 'visual perception' the P.V.P.A. is examining something other than visual-motor skills.

Further discussion of the performance of the Basic Standardisation Sample with respect to the other groups of non-English speaking children and those with Special Educational Needs will be found in Chapter 10. This chapter has served to set the scene for the discussion of validity and reliability in the ensuing chapters.

CHAPTER 8

VALIDITY OF THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

To establish the validity of a test it is necessary to address two questions:

1. Does the test measure what it sets out to measure?
2. How well does it measure it?

The various types of validity will be discussed in relation to the Pre-school Visual Perception Assessment.

1. Content Validity

This involves examination of the test to determine what aspects of visual perception are included in the test. The various aspects are discussed in Chapter 3, and all items of the test were designed with these sub-skills in mind, though it is not intended that items should attempt to examine any one aspect of visual perception in isolation.

The content validity of the test was appraised by eight experienced teachers of pre-school handicapped children, with high inter-rater agreement (87%) for the aspects of visual perception represented in each sub-test as shown in Table 8.1. This figure was derived by asking each of the teachers to complete a blank form of Table 8.1. after examination of the materials. Their opinions were compared with those of the author by totalling the numbers who agreed that a given aspect of visual perception was represented in a given item with those who did not (or conversely, those who thought that an aspect was not represented when the majority agreed that it was). From a total of 168 responses there was a consensus of 146 or 87% of the judgements. Some of the responses apparently at variance were because the teachers used different criteria for the degree of representation of a given perceptual attribute in an item. Figure ground discrimination, for example, clearly underlies all visual perceptual functioning but was not considered by the author to be a predominant feature of all test items. The point along the continuum where such a fundamental aspect is deemed to be represented in a given item is a matter of subjective judgement, and this subjective criterion of the degree of representation of figure-ground discrimination accounted for almost all 13% of the apparent dissention.

Difficulty Index

The difficulty index or difficulty value is, according to Goodwin and Driscoll (1980) the percentage of children who answer each item correctly. An easy test will have difficulty values of 80%. As a rule, norm-referenced tests aim for difficulty indexes around 50%. However, as the Pre-school Visual Perception Assessment is designed to identify those children who have particular problems, the difficulty value is intentionally high. If it was too low, the items would be overwhelmingly difficult for perceptually disordered children, who would lose interest and confidence and probably be unable (or refuse) to complete the test.

TABLE 8.1. ASPECTS OF VISUAL PERCEPTION EXAMINED BY SUB-TESTS OF THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT.

Sub-test no:	1. Matching Objects	2. Yellow Objects	3. Coloured Pictures	4. Outline Drawings
Form Constancy	X	X		
Matching	X	X	X	X
Picture Recognition				
Figure Ground				
Size Constancy				
Visual Closure				
Spatial Relationships				

Sub-test no:	5. Matching Family	6. Object to Photograph	7. Animals and Outlines
Form Constancy			
Matching	X	X	X
Picture Recognition		X	X
Figure Ground			
Size Constancy			
Visual Closure			
Spatial Relationships			

TABLE 8.1 (cont.)

Sub-test no:	8. Matching Girls	9. 3-hole Posting	10. Stacking Cups
Form Constancy		X	
Matching	X	X	
Picture Recognition			
Figure Ground			
Size Constancy			X
Visual Closure			
Spatial Relationships		X	X

Sub-test no.	11. Balls & Cups	12. Peg Towers	13. Face Puzzle	14. Letter Matching
Form Constancy				
Matching	X	X		X
Picture Recognition				
Figure Ground				
Size Constancy				
Visual Closure				
Spatial Relationships				

TABLE 8.1 (cont.)

Sub-test no:	15. 6-hole Posting	16. Superimposed Pictures	17. Straight-cut Puzzles
Form Constancy	X		
Matching	X	X	
Picture Recognition		X	X
Figure Ground		X	
Size Constancy			
Visual Closure			X
Spatial Relationships	X		X

Sub-test no:	18. Graded Rings	19. Shape Puzzle	20. Incomplete Pictures	21. Which is Different?
Form Constancy		X		
Matching	X	X		X
Picture Recognition			X	
Figure Ground		X		
Size Constancy	X			
Visual Closure			X	
Spatial Relationships	X			

Note: Distance and depth perception are omitted from the aspects of visual perception examined by the Pre-school Visual Perception Assessment as it was not felt to be practical to include them in what is essentially a 'table-top' test.

In order to discriminate between children likely to have real problems at a given age level and those whose scores were low simply because they were very young children attempting a difficult test, a criterion score for each age level was calculated. This was the score achieved by 90% of children at a given age level. Criterion scores appear in Tables 12.4. and 12.5. in the Appendix.

Age Differentiation

It is evident that an item which is easy for a four-year-old will be less simple for a two year old. All items were therefore examined in terms of their age differentiation, though some of the items, especially in the earlier part of the test, were easy for even the youngest children, as it is important to introduce them to the testing situation with simple, enjoyable items, which they see as 'games' through which they can gain confidence to attempt the more complex tasks.

Table 8.2 shows the means for the five age groups and the significance level of the linear trend as tested by the BSET program in Programmed Methods for Multivariate Data (Youngman, 1976).

It will be seen that all except one of the sub-tests demonstrate an age trend at a significant ($p <.05$) or highly significant level ($p <.01$). Most were highly significant, those only reaching the .05 level being the easiest tests, where even the youngest children scored very close to the ceiling, so that there was little improvement with age. Only one test, no.4, (matching black and white outline drawings) failed to reach significance on the linear trend test. The reason for this would appear to be that whilst most children achieved scores close to the maximum, with such low variance in the groups (standard deviations between .22 and .54) an occasional careless error can radically affect the mean score and variance for the whole age group.

TABLE 8.2. MEAN SCORES ACHIEVED BY CHILDREN AT THE FIVE AGE LEVELS ON THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

Test No.	2yrs 6m	3yrs	3yrs 6m	4yrs	4yrs 6m	Probability
1.	3.90	4.00	4.00	4.00	4.00	*
2.	9.45	9.90	9.95	10.00	9.90	*
3.	3.90	4.00	4.00	4.00	4.00	*
4.	5.85	5.75	5.90	5.90	5.95	NS
5.	4.70	4.40	4.80	4.95	5.00	**
6.	5.75	6.00	6.00	6.00	6.00	**
7.	5.25	5.45	5.75	5.90	6.00	**
8.	3.10	3.30	4.45	4.65	5.25	**
9.	15.60	16.85	16.86	17.35	17.80	**
10.	7.65	9.00	10.00	11.30	11.50	**
11.	3.60	3.80	3.80	3.90	4.00	*
12.	4.90	4.90	5.65	5.80	6.00	**
13.	0.90	0.95	1.40	1.70	1.85	**
14.	7.15	9.75	12.35	13.30	15.25	**
14a.	6.15	11.20	16.45	17.80	20.55	**
15	4.60	6.70	6.75	9.15	9.95	**
16.	11.15	14.30	18.05	19.80	20.95	**
17.	1.55	4.10	6.90	7.60	9.15	**
18.	3.25	3.60	6.55	8.70	10.90	**
19.	4.35	5.10	6.90	8.20	9.00	**
20.	5.00	6.60	7.95	8.65	9.35	**
21.	1.95	2.70	5.30	6.95	8.55	**

Probabilities refer to the significance levels of the Linear Trend Test.

* denotes a significance level of <.05 (f=2.70)

** " " " " " <.01 (f=3.98)

2. Criterion-Related Validity

This refers to the relationship between scores on the new test and other information obtained about the child from some other measure. Comparison with present performance is described as concurrent validity, whereas a prediction of future performance is known as predictive validity.

a. Concurrent Validity

A method of establishing concurrent validity widely used with new tests is correlation of results on the new test with performance on existing tests which purport to measure the same attribute. The Rivermead Visual Perception Test, (Whiting et al. 1985), for example, which was designed to assess perceptual skills in adults who have suffered brain damage, was validated against existing psychological tests of visual perception by a clinical psychologist. The scores of children in the standardisation sample of the Pre-school Visual Perception Assessment (P.V.P.A.) were therefore compared with their performance on other tests with a visual perceptual component which, nevertheless, are not viable substitutes for the P.V.P.A. As Anastasi (1961) comments, a new test must demonstrate some advantage over the existing measures in terms of speed, simplicity or cost. The only test which assesses perceptual skills for the whole of the age range of children for which the P.V.P.A. is intended is the McCarthy Scales of Children's Abilities (McCarthy, 1972), which has shown to have good evidence of validity summarised by Lynch et al, (1982). Apart from the fact that perceptual items constitute only a small part of the McCarthy Scales, (so the examination of perception is not particularly detailed), the McCarthy is a restricted test available for use exclusively by psychologists, whereas the P.V.P.A. is intended to be used by other professionals. A good correlation between performance on perceptual items on the two tests would however mean that information which was previously only available to teachers and occupational therapists second-hand, through psychologists' reports, could be obtained by using the P.V.P.A. without having to wait for a psychologist to visit. This saves valuable time and has the added advantage of allowing the person who is likely to be responsible for intervention to have the opportunity for direct observation of the child's performance in assessment, permitting insight into the problem-solving strategies utilised whether the child succeeds or fails.

Although the Scales contain a number of items which examine visual-motor functioning rather than perceptual skills, it was nevertheless decided to use the McCarthy as a validation measure. It was not felt to be necessary, nor did time permit the administration of the whole of the McCarthy Scales to the standardisation sample. The items which constituted the Perceptual-Performance Scale (Block Building, Puzzle Solving, Tapping Sequence, Draw-a-Design, Draw-a-Child and Conceptual Grouping) were used. The McCarthy was not administered to the twenty Ethnic Minority children because it is too dependent on language comprehension to be applicable to children with very limited English.

In addition to the McCarthy, which was given to all the children, those in the four and four-and-a-half year old age groups also took three of the tests from the battery of Southern California Sensory Integration Tests (Ayres, 1972) and the Motor Free Test of Visual Perception (Colarusso and Hammill, 1972), both of which have respectable reputations for validity (Ayres, 1965, Colarusso, 1972).

It was decided that an examination of language and symbolic play skills would be of interest as these would not necessarily be expected to correlate with visual perception. The Symbolic Play Test (Lowe and Costello, 1976) was chosen, as it is easy and quick to administer and enjoyable for the children. A language test was sought, but nothing entirely appropriate could be found suitable for the age range of the children. Among those considered were the English Picture Vocabulary Test (Brimer and Dunn, 1973) and the Test for the Reception of Grammar (T.R.O.G., Bishop, 1982). Neither were considered to be particularly suitable because they introduce a perceptual component, placing perceptually impaired children at a disadvantage (Hardman and Smith, 1984, Hollinger and Sarvis, 1984).

The Derbyshire Language Scheme (Knowles and Madislover, 1979) is often used with children who have developmental delay, and as it uses three-dimensional materials for much of the assessment, it seemed most promising. The Rapid Screening Test, however, was too superficial and the Detailed Test of Comprehension was not only too long but also involved a considerable amount of pictorial material. A short language test based on the Derbyshire Language Scheme principles was therefore devised, consisting of two, three, four and five information-carrying word constructions relating to a set of dolls and small toys which would easily fit into a sandwich box. All children in the Basic Standardisation and the Ethnic Minority children were given this test. No test of verbal expression was used as some children were shy and unwilling to talk, even though they may have had good verbal abilities.

Tables 8.3., 8.4. and 8.5. give the correlations of the P.V.P.A. with other tests of visual perception.

In a previous study (Howard, 1977), impaired visual acuity was felt to contribute to poor performance on perceptual tasks. In order to eliminate this possibility in the present study, it was planned to give the Kay Picture Test (Kay, 1983) to children who performed particularly badly on the P.V.P.A. Permission was obtained from the author to administer the Kay Test as a matching task, rather than asking the child to name the pictures. A book with four stimulus pictures on each page was prepared from the small book initially shown to children to familiarise them with the pictures. In fact, it was only necessary to give this test to one child who made markedly poor scores on the perception test. This little boy was found to have a severe visual defect and was subsequently referred to an ophthalmologist and dropped from the standardisation sample.

A number of studies of so-called 'visual perception' have been criticised in Chapter 5 for their use of measures which require visual-motor skills in execution of the tasks. It was felt that some measure of visual-motor abilities could be of interest for comparison with performance on the perceptual tests, so a series of drawing tasks was included. The child was asked to copy a short vertical line, a horizontal line, a circle, cross, square and triangle. Provision was also made for the child to trace the shapes if he was unable to reproduce them accurately. This was to see if perceptual difficulties rather than lack of motor control were responsible for poor reproduction of a shape. The children were also asked to produce a drawing of a figure (Mummy or Daddy).

Correlations between most of the tests were significant (see table 8.3) with the exception of some of the very easy visual perception sub-tests at the beginning of the battery because most children scored at or very near the ceiling of these items, producing an insufficient spread of scores for a test of correlation to be meaningful.

Significant correlations were observed between most of the other measures, including the drawing tests, symbolic play and language, which may not be expected to be associated with visual perceptual abilities. However, as the standardisation sample consisted of entirely normal children, developmental progression over the five age groups is to be expected at this period of rapid learning in a young child's life. As the children's

TABLE 8.3. CORRELATION OF SCORES ON THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT WITH DRAWING, SYMBOLIC PLAY AND LANGUAGE TESTS

P.V.P.A. Sub-test No.	Drawing	Drawing Mum/Dad	Symbolic Play	Language
1. Matching Objects	.20*	.14	.09	.13
2. Yellow Objects	.16	.08	.12	.25*
3. Coloured Pictures	.18	.14	.20*	.27**
4. Outline Drawings	.24*	.19	.15	.20*
5. Matching Family	.27**	.28**	.22*	.23*
6. Object to Photograph	.15	.09	.28**	.12
7. Animals & Outlines	.25*	.25*	.27**	.28**
8. Matching Girls	.50**	.49**	.34**	.42**
9. 3-hole Posting	.32**	.34**	.43**	.48**
10. Stacking Cups	.50**	.33**	.21*	.52**
11. Balls & Cups	.23*	.21*	.10	.28**
12. Peg Towers	.33**	.25*	.28*	.35**
13. Face Puzzle	.55**	.52**	.48**	.32**

Values of r: p <.05 , r=.20 (*)
p <.01 , r=.25 (**)

TABLE 8.3. (Cont.)

P.V.P.A. Sub-test No.	Drawing	Drawing Mum/Dad	Symbolic Play	Language
14. Letter Matching	.67**	.59**	.51**	.55**
14a. Letter Reversals	.66**	.59**	.49**	.54**
15. 6-hole Posting	.54**	.42**	.40**	.46**
16. Superimposed Pictures	.73**	.63**	.60**	.61**
17. Puzzles	.77**	.70**	.51**	.61**
18. Graded Rings	.54**	.46**	.39**	.41**
19. Shape Puzzle	.61**	.54**	.46**	.56**
20. Incomplete Pictures	.60**	.46**	.52**	.58**
21. Which is Different?	.63**	.56**	.48**	.61**

Values of r: p <.05 , r=.20 (*)
p <.01 , r=.25 (**)

TABLE 8.4. CORRELATION OF SCORES ON THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT AND PERCEPTUAL/PERFORMANCE SCALE OF THE McCARTHY SCALES OF CHILDREN'S ABILITIES

	McCarthy Scales of Children's Abilities Sub-tests					
	Block Building	Puzzle Solving	Tapping	Drawing	Draw a Child	Conceptual Grouping
1. Matching Objects	.18	.05	.11	.08	.14	.15
2. Yellow Objects	.18	.13	.09	.09	.10	.15
3. Coloured Pictures	.16	.11	.11	.13	.14	.15
4. Outline Drawings	.15	.12	.17	.09	.08	.22*
5. Matching Family	.25**	.17	.13	.14	.30**	.28**
6. Object to Photograph	.04	.09	.06	.06	.06	.04
7. Animals & Outlines	.38**	.20*	.24*	.19*	.26*	.37**
8. Matching Girls	.42**	.36**	.40**	.35**	.49**	.37**
9. 3-hole Posting	.35**	.22**	.26**	.21**	.32**	.38**
10. Stacking Cups	.44**	.34**	.29**	.42**	.36**	.47**
11. Balls & Cups	.23*	.15	.21*	.20*	.27**	.25*
12. Peg Towers	.31**	.21*	.23*	.28**	.33**	.29**
13. Face Puzzle	.42**	.43**	.40**	.42**	.56*	.37**

Values of r: p <.05 , r=.20 (*)
p <.01 , r=.25 (**)

TABLE 8.4. (Cont.)

	McCarthy Scales of Children's Abilities Sub-tests					
	Block Building	Puzzle Solving	Tapping	Drawing	Draw a Child	Conceptual Grouping
14. Letter Matching	.59**	.45**	.49**	.50**	.60**	.62**
14a Letter Reversals	.58**	.45**	.46**	.48**	.60**	.61**
15. 6-hole Posting	.52**	.43**	.40**	.47**	.49**	.48**
16. Superimposed Pictures	.67**	.47**	.62**	.56**	.67**	.63**
17. Puzzles	.66**	.61**	.61**	.57**	.73**	.71**
18. Graded Rings	.47**	.54**	.37**	.46**	.51**	.46**
19. Shape Puzzle	.48**	.48**	.51**	.48**	.59**	.60**
20. Incomplete Pictures	.62**	.40**	.50**	.46**	.48**	.61**
21. Which is Different?	.53**	.49**	.48**	.56**	.60**	.65**

Values of r: $p < .05$, $r=.20$ (*)
$p < .01$, $r=.25$ (**)

These tests were carried out on all children in the standardisation sample (n=100).

TABLE 8.5.

CORRELATION OF SCORES ON THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT AND SUB-TESTS FROM THE SOUTHERN CALIFORNIA SENSORY INTEGRATION TESTS AND THE MOTOR FREE TEST OF VISUAL PERCEPTION

	M.F.T.V.P.	Southern California Sensory Integration Tests		
		Space Visualisation	Figure Ground	Position in Space
1. Matching Objects	.00	.00	.00	.00
2. Yellow Objects	.08	.26	.06	.06
3. Coloured Pictures	.00	.00	.00	.00
4. Outline Drawings	.30*	.16	.09	.25
5. Matching Family	.31*	.03	.11	.21
6. Object to Photograph	.00	.00	.00	.00
7. Animals & Outlines	.08	.17	.02	.07
8. Matching Girls	.44*	.12	.15	.32*
9. 3-hole Posting	.23	.06	.19	.09
10. Stacking Cups	.25	.12	.10	.01
11. Balls & Cups	.04	.21	.14	.08
12. Peg Towers	.13	.10	.04	.01
13. Face Puzzle	.21	.02	.17	.06

Values of r: $p < .05$, $r = .30$ (*)
$p < .01$, $r = .39$ (**)

TABLE 8.5. (Cont.)

	M.F.T.V.P.	Southern California Sensory Integration Tests: Space Visualisation	Figure Ground	Position in Space
14. Letter Matching	.57*	.05	.32*	.35*
14a Letter Reversals	.52**	.01	.27	.36*
15. 6-hole Posting	.29	.16	.19	.03
16. Superimposed Pictures	.51**	.08	.44**	.49**
17. Puzzles	.67**	.05	.48**	.50**
18. Graded Rings	.49**	.13	.44**	.37*
19. Shape Puzzle	.39**	.04	.31*	.26
20. Incomplete Pictures	.16	.08	.41**	.34*
21. Which is Different?	.56**	.05	.42**	.38*

Values of r: p <.05, r= .30 (*)
p <.01, r= .39 (**)

These tests were carried out on children aged 4 and 4 years 6 months only (n=40).

achievements progress systematically across all areas of development, a high level of correlation with measures which may not be related to visual perception is unsurprising. In perceptually disordered children, correlations with language development and symbolic play may have been expected to be less. Indeed, there was a marked discrepancy between the scores on the perception test and the British Picture Vocabulary Scale in the Special Needs Sample, discussed in Chapter 10.

With regard to a visual motor skill such as drawing, which includes a perceptual component (one must be able to perceive the figure in order to reproduce it), some correlation would be expected, as poor perceivers would be unable to reproduce the drawings. An individual could, of course, have unimpaired perception but poor ability to reproduce what is perceived, and a child's scores on the different tests are likely to be of use in profiling such strengths and weaknesses.

As can be seen, correlations between the Pre-school Visual Perception Assessment and the sub-tests of the McCarthy Scales of Children's Abilities are significant with the exception of P.V.P.A. Tests 1 to 6 which lack a sufficient spread of scores for the reasons already discussed.

Correlations with the Motor Free Test of Visual Perception and the Southern California Sensory Integration Tests are generally lower, possibly because these were only carried out on the two older age groups, as they were much more difficult than the

McCarthy and quite unsuitable for the younger children in the sample. They were quite challenging even for the older children who often found it difficult to concentrate on these tests, though they had clearly enjoyed the P.V.P.A. which sustained their interest and attention. A surprising feature is the total lack of correlation between the Ayres Space Visualisation Test from this battery and any other measure. This is difficult to explain as the two other Ayres tests showed significant correlations with later items of the Pre-school Visual Perception Assessment which were more demanding for the older children. The manual for the Southern California Sensory Integration Tests does not quote evidence of validity or correlation between the tests, although it does state that children making impulsive responses could have "spuriously low" scores on Space Visualisation. Whilst providing normative data on children from four to eleven years on this test, and test re-test reliability data on four year olds, the details of the age distribution of the standardisation sample refer only to nine and ten year olds, whilst other sub-tests not used in this study show age distributions from four to nine years. As elsewhere in the manual it is stated that Space Visualisation is particularly suitable for testing younger children, it must be presumed that an error of omission exists in the manual regarding the standardisation data for this test.

A further method of determining concurrent validity is that of comparing the scores of contrasting groups of children. For this, it is necessary to test for a difference in scores of a sample of children demonstrating deficits in visual perception as compared to a group of children without such deficits.

A detailed examination of the performance of the Special Needs sample is given in Chapter 10, but Table 8.6. summarises the difference between two groups of children with Special Needs, one with and the other without perceptual impairment. It can be seen that the Perceptually Impaired group, though older and with a higher age equivalent on the British Picture Vocabulary Scale nevertheless performed significantly worse ($p < .01$) on the Pre-school Visual Perception Assessment.

TABLE 8.6. PERFORMANCE OF CHILDREN WITH SPECIAL NEEDS WITH AND WITHOUT PERCEPTUAL IMPAIRMENT ON THE BRITISH PICTURE VOCABULARY SCALES AND P.V.P.A.

		Perceptually Impaired Group (N=23)	Non-perceptually Impaired Group (N=20)
Chronological Age	Mean	5 yrs 10 mths	5 yrs 7 mths
	S.D.	25.57 mths	26.33 mths
B.P.V.S. Age Equivalent		4 yrs	3.5 yrs
No. of sub-tests below 10% Criterion on the P.V.P.A.	Mean	8.56	2.30
	S.D.	3.09	1.89

b. Predictive Validity

This type of validity has not been explored in relation to the P.V.P.A. because the children found to be poor scorers on testing in the Child Development Centre subsequently received therapy and specific remedial teaching to help them to overcome these problems. The writer's working situation was unsuitable for setting up an experimental situation with treatment and non-treatment groups. As a result of working with the children over a period of time, the problems are hopefully ameliorated, and certainly subjective impressions of children's improvement in visual perceptual skills were obtained.

Whilst not rigorous qualitative evidence, the following case illustrates this point. Joanna, who had cerebral palsy, had shown marked perceptual impairment in her early years compared with her twin sister. She was given the test at the age of four-and-a-half, when she had, in fact, just left the Child Development Centre and entered school. The session was filmed with the intention of using it to demonstrate the performance of a child with perceptual difficulties, however, Joanna performed within the normal range for her age group, and was by this time coping with the demands of daily living within the limits of her physical ability. It cannot, of course, be proved that the intensive input that she had received at an early age was responsible for her improved performance in perceptual tasks but it would appear reasonable to assume that it may have been a contributory factor.

A further subjective impression of predictive validity may also be gained from the fact that eight children from the Child Development Centre who were not part of the study, but who achieved low scores on the test shortly before school entry, when there was little time left for remedial intervention, were known to have difficulties in school within a few months of entering mainstream reception classes. Children who scored well on the test did not have such problems.

3. Construct Validity

This overlaps somewhat with the concept of concurrent validity already discussed, but it goes further, by examining the extent to which the test measures a theoretical construct such as visual perception. As Goodwin and Driscoll (1980) note, it is difficult to obtain evidence of construct validity, especially in tests relating to young children, although correlations with other measures which aim to examine the same construct are usually cited as supportive evidence of construct validity. The American Psychological Association (1985) confirms that the same evidence is applicable to both types of validity. This has been discussed in the previous section.

Summary

In this chapter, evidence of the validity and reliability of the P.V.P.A. is discussed. This, together with the results of the study on children with Special Educational Needs (Chapter 10) demonstrate its usefulness in identifying children with perceptual impairment in the developmental age range of two-and-a-half to four-and-a-half years.

CHAPTER 9

RELIABILITY OF THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

The reliability of a test usually refers to the consistency of scores obtained by the same individual examined on different occasions or when the test is administered by different people. Other types of reliability relate to the internal consistency of the items in the test.

The most relevant form of reliability for the Pre-school Visual Perception Assessment is that of test-re-test reliability, also known as the coefficient of stability. To determine this, the Pearson product moment coefficient was used to examine the consistency between the scores of thirteen children, one boy and one girl from each of the five age groups in the standardisation sample, plus three other three-year-olds (including identical twins) who were re-tested by the same examiner two weeks after the first administration of the test. The two week time interval between the two tests was selected as developmental changes can occur rapidly at this time in a child's life. The test-re-test sample was small owing to the logistics of returning to test children again after a specific interval. Socio-economic groups were not considered relevant here as the re-tested children provided their own controls.

Reliability coefficients for the sub-tests are shown in Table 9.1.

TABLE 9.1. TEST-RE-TEST RELIABILITY OF THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

Test no.	
1.	All children scored full marks
2.	" " " " "
3.	" " " " "
4.	r=.94
5.	Almost all children scored full marks
6.	All children scored full marks
7.	All children scored full marks
8.	r=.78
9.	r=.78
10.	r=.41
11.	All children scored full marks
12.	Almost all children scored full marks
13.	The only possible scores of 1 and 2 gave too small a range to correlate. Only one child achieved a different score on re-test.
14.	r=.91
14a	r=.91
15.	r=.96
16.	r=.96
17.	r=.86
18.	r=.79
19.	r=.81
20.	r=.83
21.	r=.94

Total score for the test: r=.98

Significance levels for r: (d.f. 11), $p < .05$, r=.55
$p < .01$, r=.68

A number of the sub-tests, especially those at the beginning of the battery were very easy for all the children in the reliability sample, none of whom were thought to have perceptual difficulties. All the children scored full marks on both occasions on these tests, so this data was not subjected to further analysis.

All children improved their performance on re-test by an average of 21 points on the total standard score, with the younger children making larger gains on re-test, which must be attributed to a practice effect. As the older children scored nearer to the ceiling of the test there was less scope for improvement.

Only one sub-test failed to reach a significant correlation on test re-test. This was number 10 (Stacking Cups), concerned with size-sequencing. It seems that the scoring system for this test may enable some children to achieve success by chance. Stacking Cups penalises children for a trial-and-error approach, but as only three cups are presented at a time, the likelihood of chance success is considerable.

It is accepted that different examiners may have an effect on a child's performance by the nature of their ability to motivate a child and by the degree of rapport established (Field, 1981). Examination of this variable, which may affect the reliability of the assessment, was addressed by carrying out two tests on fifteen children with a two-week interval, as in the test-re-test reliability study, but using different examiners. Seven other examiners used the test. All had professional contact with children. Four were teachers, one was a student teacher, one a nursery nurse and one a general practitioner. They were given a brief explanation of the test but no formal training, and worked entirely from the administration manual. This also served to detect any ambiguities in the administration directions. All reported finding the administration manual straightforward, the scoring system simple, and the test easy and enjoyable to administer.

From the total of fifteen children, either the initial test or re-test was carried out by the the author, who tested nine of the children first. The remaining six were first tested by the naive examiner to counterbalance the effect of examiners.

Correlations of the various sub-tests appear in Table 9.2. Only one sub-test failed to reach a significant correlation on re-test. This was no.14, which narrowly failed to reach significance ($r=.50$, the 5% significance level being .51). However, the alternative form of scoring this test, taking reversal errors into account and giving them a higher score than outright errors reached significance at .77. The overall improvement from one test to the next was similar to the test-re-test reliability children with a mean improvement of 18 points. Improvement over tests was not related to whether the author was the first or second tester.

TABLE 9.2. INTER-RATER RELIABILITY OF THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

Test no.	
1.	All children scored full marks
2.	" " " " "
3.	" " " " "
4.	" " " " "
5.	Almost all children scored full marks
6.	All children scored full marks
7.	r=.90
8.	r=.67
9.	r=.65
10.	r=.69
11.	All children scored full marks
12.	Almost all children scored full marks
13.	The only possible scores of 1 and 2 gave too small a range to correlate. Only two children achieved a different score on re-test.
14.	r=.50
14a.	r=.91
15.	r=.60
16.	r=.79
17.	r=.91
18.	r=.53
19.	r=.89
20.	r=.79
21.	r=.87

Total score for the test: r=.91

Significance levels for r: (d.f. 13), $p < .05$, r=.51
$p < .01$. r=.64

Some new tests are subjected to split-half reliability analysis, but the P.V.P.A. was not felt to be suitable for this. The battery is not intended to be homogeneous in nature, in fact, the reverse, as items were selected for their variety. The sub-test scores themselves could not be subjected to split-half examination as some, for instance the posting boxes, can be completed in any order the child chooses, and the sequence of his selection of pieces is not recorded. The battery is not arranged entirely in order of difficulty of the sub-tests, but the sequence is intended to retain the child's interest and attention, with some items involving more active participation than others, and longer items being followed by shorter tasks.

Summary

This chapter discusses evidence for the reliability of the P.V.P.A. Though sample sizes for the Test Re-test and Inter-Rater studies were small, the high levels of correlation between the two administrations constitute convincing evidence of the stability of the test with young children. Given the capricious nature of pre-school children, this surely indicates that the P.V.P.A. is a robust and reliable assessment tool.

CHAPTER 10

STUDIES OF ETHNIC MINORITY AND SPECIAL NEEDS CHILDREN

The Basic Standardisation Sample for the Pre-school Visual Perception Assessment is described in detail in Chapter 7. To summarise, the sample consisted of one hundred children who were not suspected of having Special Educational Needs. Boys and girls were equally represented in the sample, which was socio-economically grouped, and included twenty children from each six-month age group from two-and-a-half to four-and-a-half years.

The performances of the children in the Ethnic Minority Sample and the Special Needs Sample are here compared with the results from the Basic Standardisation Sample.

The Ethnic Minority Sample of Non-English Speaking Children

It had originally been hoped to demonstrate that the P.V.P.A. was not dependent on culture or language comprehension by the inclusion of a group of children for whom English was a second language. It was hypothesised that no significant difference would be revealed in the performance of these children and their English counterparts, as it was hoped to establish a culture-free and language-independent test.

In addition to the main sample of a hundred children, an additional group of twenty Ethnic Minority children was tested.

The Nature of the Ethnic Minority Sample

The twenty children were all of Asian origin, with both parents being recent immigrants from either Pakistan or Bangladesh. Most of the children were born in England, though a few had been born in Pakistan. Many had made extended visits to their mother country. Three-quarters were from homes where Urdu and Punjabi were spoken, and one quarter were Bengali speakers.

There were five boys and five girls from each of the four and four-and-a-half year age groups. These children were not socio-economically grouped because their fathers were frequently known to have taken jobs of a lower status than in their home country.

The children were located by approach to the Head Teachers of two nursery schools which were known to have a high proportion of Ethnic Minority children. The criteria for referral to participate in the research were:

1. The children must be aged within two months of their birthday (or half birthday) at the time the research was taking place.
2. They must come from homes where English is not the main language spoken, and they should not be fluent English speakers.

Only Ethnic Minority children in nursery schools were seen because it was not possible to gain access to younger children who seldom attend private day nurseries.

The parental consent form was translated into Urdu, and the study was discussed with the parents through mother-tongue speakers employed in the schools.

Language Assessment

All the children were also assessed on the language test devised along the lines of the Derbyshire Language Scheme for the Basic Standardisation Sample. A few had surprisingly good comprehension of English, though none had entered nursery school with more than a few words of English and all their mothers had extremely limited English. It is possible that some children had been exposed to spoken English on television or had heard it used by older siblings. However, the group mean scores on the language test for the Ethnic Minority children and the age equivalent groups of the Basic Standardisation Sample were 5.95 (S.D. 3.86) for the Ethnic Minority Sample and 13.38 (S.D. 1.92) for the Basic Standardisation Sample. A t-test showed a highly significant difference ($p < .01$) between the comprehension levels of the two groups ($t = 9.77$).

Although the Ethnic Minority children were attending nursery school, they all came from impoverished homes where stimulation in terms of provision of toys and adult input was known to be poor.

Results of the Ethnic Minority Sample

The scores for the Ethnic Minority children on the Pre-school Visual Perception Assessment were disappointingly low compared with the English children, with significant differences in performance being noted in 13 of the sub-tests, especially the more complex ones. (See Table 10.1.)

Eleven children scored below the 10% criterion on more than five of the sub-tests, and therefore could give cause for concern as to their visual perceptual abilities. The pattern of failure on the various tests was interesting however. A surprisingly high number of children (35%, n=7) failed on Test 4, Matching Black and White Outlines, eight (40%) failed on Matching Animals to Outlines, 45% (nine children) failed on the Three-hole Posting Box and 60% failed on the Six-Hole Posting Box, 30% failed on the Stacking Cups and 80% failed on the Puzzles. It is possible that these sub-tests are culture-related to the extent that all these children came from low-income homes where play materials were very scarce. The writer has considerable experience of home teaching in families in the same ethnic group, geographical area and income status, and play materials and books available in these homes tended to be fewer in number and less "educational" than those seen in British homes of a similar economic level. It was felt that these factors were a possible contribution to the poorer performance of the Asian children, in that the perceptual tasks were "context reduced" in the terms of Frederickson and Cline (1990), whereas in the homes of the indigenous sample, where provision of toys was more commonplace, the tasks would be more familiar and "context embedded". It would be most interesting to follow up the progress of these children in school, and details of the infant schools they entered have been retained for future use.

TABLE 10.1. DIFFERENCES BETWEEN ENGLISH AND ETHNIC MINORITY CHILDREN ON THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

TEST NO	ENGLISH MEAN (Age 4-4.5)	NON-ENGLISH MEAN	T-VALUE	
1	4.00	4.00	0.00	
2	9.95	10.00	0.70	
3	4.00	4.00	0.00	
4	5.93	5.60	2.92	**
5	4.98	4.70	2.85	**
6	6.00	6.00	0.00	
7	5.95	4.85	4.93	**
8	4.90	4.10	1.91	*
9	17.58	16.35	3.95	**
10	11.40	10.10	2.30	*
11	3.95	4.00	0.70	NS
12	5.90	5.70	1.25	NS
13	1.78	1.50	1.91	*
14	14.28	12.55	2.88	**
15	9.55	5.20	6.67	**
16	20.38	13.00	9.13	**
17	8.38	4.65	6.36	**
18	9.80	5.75	4.06	**
19	8..60	6.70	3.57	**
20	9.00	5.25	7.27	**
21	7.75	4.30	4.66	**
DRAWING	13.78	10.80	3.24	**
PERSON	9.95	3.00	5.13	**

For d.f. 58, $p < 0.05$ t= 1.67 (*)
$p < 0.01$ t= 2.39 (**)

The Pearson product moment correlation coefficient was computed for the Ethnic Minority children for the number of sub-tests failed and their scores on the language test. The resulting correlation was -0.58, significant at the 0.01 level, so clearly there is a relationship between the children's level of English and their performance on the P.V.P.A. However, although it cannot be claimed to be entirely language and culture independent, it is nevertheless felt to be a useful indicator of perceptual ability in children whose mother tongue is not English. The study of the Special Needs children, carried out some months later than the first two studies, used the British Picture Vocabulary Scale (Dunn et al., 1982) as an index of cognition for comparative purposes. It also, of course, reflects a child's comprehension of English, and is a well-standardised and validated test. It would have been interesting to compare the performance of the Ethnic Minority children on the B.P.V.S. and the visual perception measure, but unfortunately such data was not available for this group. It is possible that the simple language assessment, developed along the lines of the Derbyshire Language Scheme, examines comprehension of syntax, and therefore taps into language skills in a more extensive way than the B.P.V.S. which examines only vocabulary. It would be instructive to carry out a small scale study using the B.P.V.S. and the Language Assessment to ascertain their correlation, and perhaps then greater insight into the nature of the link between language and the P.V.P.A. could be established.

It could be inferred that the poor performance of the non-

English speaking children was due to an inability to follow the test instructions. However, although their scores were lower than those of the English children, very few children scored zero on any sub-test, and even on the one item where a verbal response was required (Incomplete Pictures) all children made at least one correct response, suggesting that they understood the nature of the task. Only three children did not score on Test no. 21 (Which is Different?), so it was clear that in general the concepts underlying the tests were understood.

The highest number of failures on a test was 17 (85%) on Test no. 16 (Superimposed Pictures), but the lowest score for the group on this test was 6, quite enough correct responses to establish that all children understood the task.

There are no comparable studies investigating perceptual abilities in Asian pre-school children in the British educational literature. However, the study by Clark et al. (1984) shows interesting parallels. Their study concerned problems of communication in Ethnic Minority children in their first year of infant school, with those of Asian origin performing considerably worse than children with an Afro-Caribbean background or those from the indigenous white population. The measure used by Clark and her team was the Pre-school Language Assessment Instrument (P.L.A.I., Blank et al. 1978a). Examination of this test shows it to have strong bias towards visual perceptual skills, and indeed the four "discourse levels" it uses are (Blank et al. 1978b):

1. Matching perception

2. Selective analysis of perception

3. Re-ordering perception

4. Reasoning about perception.

It was therefore felt that there may be considerable similarities between the Clark study and the Pre-school Visual Perception Assessment Ethnic Minority sample, but to confirm this the P.L.A.I. was administered to the two highest scorers on the P.V.P.A. and two of the Special Needs sample who scored below the 10% criterion on most sub-tests <u>but</u> who had a good score, by comparison, on the British Picture Vocabulary Scale. Though clearly one cannot draw conclusions from such small numbers, the results confirm the author's impressions that the P.L.A.I. is examining something totally different to the B.P.V.S. Table 10.2. summarises the results, with the children who performed well on the B.P.V.S. but poorly on the P.V.P.A. also being in the weakest category on the P.L.A.I. Perceptually competent children, on the other hand, performed well on the P.L.A.I. It is particularly interesting that one perceptually competent child scored at or below the level of the perceptually impaired children on the B.P.V.S. yet had far superior performance on the P.L.A.I., being in the highest possible category (A), whilst the perceptually impaired children were in the lowest (F). Whilst these comparisons cannot claim to demonstrate conclusively that the P.L.A.I. is examining perceptual skills, it is felt to be sufficient evidence to enable parallels to be drawn between the poor performance of the Asian children in the Clark (1984)) study and in the present investigation.

TABLE 10.2. COMPARISON OF GOOD AND POOR PERFORMERS ON THE P.V.P.A. WITH SCORES ON THE P.L.A.I.

Child no.	358	362	611	627
C.A.	4y 2m	3y 7m	4y 3m	5y 10m
P.V.P.A. Total score (Max. 400)	399	400	96	259
No. of sub-tests below 10% criterion	0	0	16	10
B.P.V.S. Raw Score	15	10	11	10
B.P.V.S. Age Equivalent	6y 8m	4y 5m	4y 10m	4y 5m
PLAI Category A = highest F = lowest	A	A	F	F

Although these results were felt to have most interesting implications for the pre-school education of Ethnic Minority children, it is not proposed to explore all possible reasons for this difference in performance. Many variables relating to language and cultural background come into play in investigations of ethnic minority groups, and the purpose for including these children in the study was to show that the test could be performed with a minimum of language comprehension. In fact this aspect of the study has raised more questions than it solved. It may, indeed, have been more appropriate to seek out a sample of deaf children, and this is a possible extension of the study in the future. Consideration was given to involving children with disordered language comprehension, but apart from the availability of relatively small numbers of these children, perceptual difficulties are commonly associated with language disorders, and the aim of demonstrating language independence would not therefore have been met. The Ethnic Minority sample is, after all, small, and further investigation of the findings with regard to this group is a possible subject for a research study in its own right.

Special Needs Study

The rationale for inclusion of a sample of handicapped children was two-fold:

1. To provide additional data to support the validation of the instrument as a test which is able to discriminate children having a disorder of visual perception from those who have not.

2. To develop some guidelines for the testing of children with handicaps.

It was seen that, in the Basic Standardisation Sample, apart from the age trend in the scores, there was not a great spread over the scores in terms of some of the children performing very well and others very badly. Scores on the visual perception measure correlated highly not only with the validation tests which measured perception but with tests of symbolic play and language. At first impression therefore it appears that the P.V.P.A. does not discriminate between perceptual abilities and the children's other abilities such as play and language. However, the standardisation sample were all selected for their normality, any children suspected of having developmental problems being excluded from the study. Age appropriate performance on all tests is therefore to be expected.

In order to demonstrate that the P.V.P.A. is, indeed, examining visual perception rather than other abilities, it was decided to test children with various types of developmental problems, including those with known perceptual disorders, to see if it would discriminate those with perceptual problems from those without.

To this end, seventeen schools were approached and asked to refer children suspected of having perceptual difficulties. Nine were mainstream schools, and eight were for children with special needs (three schools for children with physical handicaps, two schools for children with moderate learning difficulties and three schools for children with severe learning difficulties). There was one unit for children with language disorders in a mainstream school.

Schools were asked to refer children whom they suspected of having a perceptual disorder, bearing in mind that the P.V.P.A. was designed for developmental levels between two-and-a-half and four-and-a-half years.

Most of the children referred for testing were much older than the parameters of the P.V.P.A., though their functional level was usually somewhat lower than their chronological age.

Parental consent was obtained for all children participating in the study.

Special Needs Sample

Fifty five children with special educational needs were tested as part of the validity study for the P.V.P.A. They consisted of ten Down's Syndrome children (eight boys and two girls), twenty three children with perceptual impairments (16 boys and 6 girls), and twenty children with Special Needs but no perceptual impairment. Eleven of these were boys and nine were girls. Examination of the data from the Basic Standardisation Sample showed no difference in performance between boys and girls. No attempt was therefore made to control for sex, or for socio-economic groups. The children either had diagnosed handicaps or were suspected by their schools of having developmental problems of a sufficiently severe nature to warrant referral for statementing. Forty-five of these children already had statements of Special Educational Need under the 1981 Education Act. All the Special Needs children had English as their first language, and were all from the indigenous population so that the effects which resulted in apparent perceptual impairment in the Ethnic Minority Sample, whether linguistic or cultural in origin, were not represented in the Special Needs Sample.

Control for Cognitive Ability

It was clearly important to have some measure of a child's general cognitive abilities in order to demonstrate a specific delay in visual perceptual skills. Such a measure needed to be suitable for use by children with minimal motor function (it must therefore be possible to use eye-pointing as a method of indication), and should not necessitate a verbal response. It needed to be valid and reliable, with norms for British children, simple and not particularly time-consuming to administer, and should ideally meet the same criteria as were used in the design specification of the P.V.P.A. described in Chapter 5. Not surprisingly, such a measure could not be found!

It was finally decided to use the short form of the British Picture Vocabulary Scale (Dunn et al. 1982). This was used as a rule-of-thumb estimate of cognitive abilities, though it is accepted that this test relies heavily on language comprehension, and to some extent on visual perception, as it consists of pictures which must be perceived in order to be recognised. However, it was felt that if the children demonstrated a perceptual deficit when compared with a test such as the B.P.V.S. which already has a perceptual bias, this would lend further support to the validity of the P.V.P.A. The Peabody Picture Vocabulary Test (Revised), commonly known as the P.P.V.T.-R, on which the British version is based, is noted to correlate well with more sophisticated tests of intelligence and school achievement, (Dunn and Dunn, 1981, Kutsick et al. 1988), and other studies have used versions of this test for similar purposes. Given these reservations, therefore, the B.P.V.S. was considered to be the most appropriate measure of general ability for comparative purposes.

The child's age-equivalent scores on the B.P.V.S. (to the nearest half-year, see Table 10.3.) were used as his age group (from 2.5 to 4.5 years) for comparison with the Standardisation Sample of the P.V.P.A. Children scoring above the age-equivalent level of 4.5 years were allocated an age-level of 4.5, the ceiling of the test.

B.P.V.S. raw score levels were compared with P.V.P.A. age levels as follows:

TABLE 10.3. COMPARISON OF B.P.V.S. SCORES WITH AGE EQUIVALENTS AND AGE ALLOCATIONS FOR THE P.V.P.A.

B.P.V.S. Raw Score	B.P.V.S. Age Equivalent	P.V.P.A. Age Allocation
Below 5		2y 6m
5	2-6	2y 6m
6	2-10	3y
7	3-2	3y
8	3-7	3y 6m
9	4-0	4y
10	4-5	4y 6m
11	4-10	4y 6m
12 and above		4y 6m

All testing of handicapped children was carried out in their own school but in a room away from the distraction of other children.

The time spent with the Special Needs children in administration of the P.V.P.A. and the British Picture Vocabulary Scales, used as an estimate of the child's cognitive ability, varied with the nature of the child's difficulty. Some of the testing was completed in an hour, whilst other children required frequent breaks and spent a whole morning or afternoon with the examiner.

Revisions of the P.V.P.A.

During the testing of the Basic Standardisation Sample and subsequent analysis of the data it became evident that certain revisions would be required in a subsequent version of the perceptual assessment. It was decided at this point to include the revisions in the test administered to the Special Needs Sample.

All revisions were minor, mainly involving deletions of parts of items which had proved to be superfluous.

Drawing on data from the Basic Standardisation Sample, the following modifications were made.

Sub-test no 6. Matching Objects to Photographs

The item involving matching objects to photographs was not ideal, as all the objects were not identical to the photographs.
The problems in developing this item were referred to in Chapter 6, and the choice of objects was dictated by the availability of good photographs. As the photographs were not particularly suitable in any case, and the author did not hold the copyright, it was decided to have this item re-photographed with a number of items which were easily available commercially, and which were possibly even more familiar to young children than the ones previously used. They consisted of a cup, toothbrush, tennis ball, key, plastic duck and teaspoon, as illustrated in the Appendix.

It must be added that all children had scored full marks on the original version of this test and no-one appeared to be confused by the fact that the cup, in particular, was not identical to the one in the photograph.

Sub-test no. 16. Superimposed Pictures.

The number of sub-items was reduced from 16 items with 38 pictures to identify to 8 items consisting of 22 pictures, as it was felt to be unnecessarily long with even some of the normal children requiring encouragement to persevere. Analysis of the scoring pattern of the Basic Standardisation Sample, correlating each sub-item with the final score for the item showed that some of the pictures did not correlate well with the total, and were therefore not discriminatory. The scores for other sets of pictures correlated with the total, but children who succeeded on them were also correct on other sub-items, so the two sets of pictures were examining the same thing at the same level. Other items had good correlation, but were difficult and were identified by only a small proportion of able children. On these grounds, eight sets of pictures were eliminated, with items which correlated well with the final score for the sub-test being retained.

Sub-test no. 19. Shape Puzzle.

Two pieces were removed from the figure-ground test by careful scrutiny of the scoring patterns. The item originally included the identification of two traffic light pieces, though most children (88%) identified either both or neither of the pieces.

All children finding one but not the other identified the red rather than the green traffic light. The green light was therefore deleted.

A second piece, part of the roof gable, proved very difficult to identify, only 16% of the sample being able to find it. It was also deleted.

Sub-test no. 17. Puzzles

After the administration of the test to the Standardisation Sample, during examination of the data it became evident that the second and third puzzles in the Wellington Boot series had caused considerable confusion. Many children failed on one or more of this set when they were able to complete the Soldier series, and the two-cut (three-piece) and four-cut (four-piece with oblique cuts) Boot puzzles were felt to be much more difficult than their counterparts in the Soldier set with the same number of cuts.

It was also felt, as a result of experience, to be unnecessary to have two sets of puzzles where the model remains on view. If a child has problems of visualising how a picture ought to look in order to complete a puzzle, then one series of identical puzzles would suffice to highlight this difficulty. The Boot puzzle contributed only about one third of the total score for the card puzzles (three out of a total of eight puzzles, seven from a total of 24 cuts). It was therefore decided to eliminate the Boot puzzle, both to shorten this item and because the Boot was felt to be disproportionately difficult with respect to the

Soldier.

In Table 10.4. scores for the Soldier series of puzzles are compared with the scores for all puzzles in the card series. It was felt that since the figures differed so little, this justified discontinuation of the Boot series.

Comparison of the figures in the boxes shows the similarity between the two sets of scores. The figure pertaining to the full set of card puzzles, in the second box, tends to be lowered by the inclusion of the Boot, which the children found more difficult.

TABLE 10.4. MEAN SCORES FOR SOLDIER PUZZLE COMPARED WITH TOTALS FOR CARDBOARD SERIES

	TOTAL NUMBER OF PUZZLES COMPLETED			
	SOLDIER ONLY		CARD SERIES	
	raw score	standard score	raw score	standard score
from possible total of:	5	20	8	20
2 yrs 6 mths	0.79	3.16	1.35	3.38
3 yrs	2.00	8.00	2.95	7.38
3 yrs 6 mths	3.05	12.20	4.25	10.63
4 yrs	3.60	14.40	5.55	13.88
4 yrs 6 mths	4.75	19.00	7.00	17.50

The set of wooden puzzles was also revised, as two of the items had proved difficult. The telephone was completed by only 21% of the total sample, and the picture, in fact, was already obsolete as it depicted the now old-fashioned "G.P.O. standard issue" instrument. Given that these puzzles are intended to represent objects familiar to children, it was felt inappropriate to retain this picture, because many children now may never have seen a telephone like this. The cup puzzle was also deleted because only 14% of the total sample completed it successfully.

All score sheets of the children in the Standardisation Sample and the Ethnic Minority Sample, who were also tested on the second version, were re-scored to take account of the revisions and the data was re-analysed using the modified scores.

Results of the Special Needs Sample

The results of this sample of children were examined in various ways:

The Down's Syndrome group of ten children was considered throughout as a separate group for purposes of comparison with the other children, though the Down's Group was not, in itself, entirely homogeneous, as three of the ten children were noted to have perceptual impairment.

The remainder of the sample was divided according to the number of sub-tests below the 10% criterion, those with fewer than five scores below criterion being considered perceptually unimpaired, whilst those with more than five sub-tests below criterion were considered impaired.

Although forty-five children were tested, only forty-three were included in the data analysis. Two children were withdrawn from the sample as their results were felt to be unsatisfactory for the following reasons:

One child exhibited such difficult behaviour that, though testing was completed, the results were felt to be unreliable. Her inclination to throw the test materials into inaccessible places meant that the examiner had to try to judge the moment when she was about to cast the equipment, and pre-empt the action by removing the materials and presenting the next task. This was by no means easy to gauge, and it was felt possible that the child may have been able to proceed a little further with some tasks, which may have been prematurely withdrawn. Unfortunately, retrieving the materials and re-presenting them was not viable, as she made sure they disappeared behind either the radiator or large pieces of furniture. (The room was very cluttered and could not be re-organised.) This child's B.P.V.S. score was low (3, age equivalent 1 year 11 months), and her behaviour, according to the staff and her parents was entirely consistent with her usual performance. The second child who was withdrawn also had a B.P.V.S. score of 3 and was felt to be of too low a developmental level to understand most of the sub-tests of the P.V.P.A. His teacher felt that his performance was typical, and his general developmental level was accurately assessed by the B.P.V.S. at around two years. (As the mother of two-year old twins she was felt likely to be particularly well informed about this level of development.)

Comparison of Down's Syndrome with Non-Down's Syndrome Children.

The mean age of the Down's Syndrome group was higher than the C.A. of the rest of the Special Needs sample, though their mean B.P.V.S. age equivalent was a little lower, at 3y.4 months.

It can be seen from Table 10.5. that the Down's Syndrome group demonstrated little perceptual impairment when their perceptual scores were compared with their cognitive level as measured by the B.P.V.S. However, it is well documented that many Down's Syndrome children tend to have a particular delay in the area of language development (Gunn, 1985), so the B.P.V.S. may not be the most reliable indicator of the cognitive ability of Down's children. If anything, it may be expected to be an underestimate, so that perceptual scores compared to a B.P.V.S. age equivalent may show up fewer deficiencies in visual perception than if a different measure of cognitive ability had been used. The reasons for the selection of the B.P.V.S. as a cognitive index have already been discussed, and its shortcomings in the respect of an overemphasis on language must be given due consideration in the comparison of results. Bearing in mind this fact, any perceptual deficiencies in the Down's Syndrome group which show up on the perceptual test may be assumed to be entirely valid ones. According to the B.P.V.S., the performance level of the Down's group was a few months lower than that of the remainder of the Special Needs children with a raw score mean of 7.2 for the Down's group. This compared to 8.75 for the perceptually unimpaired group and 9.26 for the impaired group. T-tests found there to be no significant difference between the B.P.V.S. raw scores for the Down's children and the unimpaired (t=1.70) but a difference significant at $p < 0.05$ between the Down's group and the children with a perceptual impairment (t=3.19). The Down's group had a mean P.V.P.A. score of 4.4 failures, with a wide range of performance, three of the children performing below the 10% criterion on more than five sub-tests, failing on seven, eight and 16 sub-tests respectively. The other seven Down's children performed above the 10% criterion level, and three of the children scored above criterion on all sub-tests. With such a small sample of Down's children, only half the size of the other two groups, and with such a wide range of scores it is spurious to attempt to draw any conclusions about the perceptual abilities of children with Down's Syndrome in general, but it is clear that some of the Down's children in this particular group <u>did</u> have a perceptual impairment in comparison to their level of cognitive development whilst the majority did not. Stratford (1985) comments on the wide range of ability in these children, and the variability in the groups performance came as no surprise.

Five of the Down's Syndrome group had been known to the author since they were babies. Child 501, who had particular problems with the perception test had always had difficulties in the generalisation of learned skills, as, indeed, had child 507, who is a competent reader and has good levels of receptive and expressive language. It is interesting to draw parallels between the performance of 507 and 508, who attends mainstream school, and currently, at nine years old, is able to cope in a third year infant class, two years below his age level. Child 507 attends a school for children with moderate learning difficulties and is regarded as an unusually capable Down's Syndrome boy especially in learned skills, though his ability to generalise is still not as good as other children in his class with a similar level of academic performance.

TABLE 10.5. PERFORMANCE OF CHILDREN WITH SPECIAL NEEDS WITH AND WITHOUT PERCEPTUAL IMPAIRMENT AND WITH DOWN'S SYNDROME ON THE BRITISH PICTURE VOCABULARY SCALES AND P.V.P.A.

	Perceptually Impaired Group (N=23)	Non-perceptually Impaired Group (N=20)	Down's Syndrome Group (N=10)
Chronological Age	Mean 5 yrs 10 mths S.D. 25.57 mths	5 yrs 7 mths 26.33 mths	9 yrs 6 mths 13.88 mths
B.P.V.S. Age Equivalent	Mean 4 yrs 4 mths S.D. 7.44 mths	3.yrs 11 mths 11.40 mths	3 yrs 4 mths 9.73 mths
No. of sub-test Scores below 10% Criterion on the P.V.P.A.	Mean 8.56 S.D. 3.09	2.30 1.89	4.40 4.94

Comparison of perceptually impaired and non-impaired groups

These two groups emerged from the sample of Special Needs children already described according to the number of sub-test scores which fell below the 10% criterion, those with more than five sub-tests being considered perceptually impaired.

It can be seen from Table 10.5 that the ages of the groups are not too dissimilar, the mean age of the perceptually impaired group being 5 years 10 months (S.D. 25.73 months) and the mean age of the unimpaired group being 6 years 7 months (S.D. 26.33 months). T-tests revealed no significant difference between the ages of the two groups ($t=0.22$) Similarly, the mean B.P.V.S. raw scores showed very little difference, 9.26 (S.D. 1.45) for the perceptually impaired group and a mean of 8.75 (S.D. 2.43) for the unimpaired sample. The t-test result was again insignificant ($t=0.85$). The number of sub-tests on which the children performed below the 10% criterion was very different, however. The mean number of sub-tests failed in the perceptually impaired group was 8.57, whereas in the unimpaired group it was 2.30. T-test results were highly significant at $p < .01$ ($t= 7.87$). However, it was noted that for even the children who had no perceptual impairment, the mean number of sub-tests where performance fell below the 10% criterion was 2.30, far higher than in the Standardisation Sample, where the mean was only 1.14, with only 27 children failing on two or more sub-tests. In the Standardisation Sample the total number of scores falling below criterion was 114*, (a mean of 1.14 for the sample as a whole).

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*An explanation of this figure seems appropriate here. It may be presumed that the 10% criterion identified the bottom 10% of the Basic Standardisation Sample, and the mean number of failures should therefore be 10%. However, only children performing <u>below</u> the criterion score were deemed to have 'failed'. Those scoring <u>at</u> the criterion level did not fail, therefore if the lowest score for a given age group was, for example, 6, and three children scored 6, then the criterion would be deemed to be 6, with no children failing.

In the "perceptually unimpaired " group ten of the twenty children failed on two or more sub-tests. Considering that the age of the Special Needs Sample was far higher than the Basic Standardisation Sample, this group showed some evidence that perceptual problems may be present, though at a higher level than can be detected by a test aimed essentially at pre-school children.

Two of the "unimpaired" children were, in fact, thought by their teachers to show evidence of perceptual dysfunction, and these children will be discussed as case studies.

Examination of the mean total scores for the Special Needs children (Table 10.6.) illustrates the problems that the perceptually impaired children had in relation to the Standardisation Sample, with their mean score falling below that of the three year olds. Whilst the mean total score takes no account of the age of the children in relation to their performance, it will nevertheless be noted that there were no children aged less than three years in the Special Needs Sample, so their performance was well below even the youngest child's age level. The Down's Syndrome group can be seen to have performed better than the perceptually impaired group, with a mean total of 288 (Table 10.6.) and their overall performance, with a mean failure of 4.4 sub-tests, (Table 10.9.) shows their performance to be better than the perceptually impaired group (Table 10.7.), who had a mean failure of 8.56, but not as good as the Special Needs children without perceptual impairment (mean failure 2.30 sub-tests, see Table 10.8.).

TABLE 10.6. MEAN P.V.P.A. TOTAL SCORES FOR ALL GROUPS

Group	Mean Total	S.D.
Age 2.5	254	44.12
Age 3	283	40.58
Age 3.5	330	24.54
Age 4	354	29.12
Age 4.5	377	14.05
Down's Syndrome	288	59.11
Perceptually Impaired	260	48.68
Non-Impaired	320	33.63

Teacher's predictions

Nineteen children were suspected of having a perceptual impairment by their teachers. All these children were in special schools or units. Fourteen children were not suspected of having specific impairment, though they all had statements of Special Educational Need.

The case of 10 children attending mainstream nursery schools or infant reception classes was ambiguous, in that their teachers suspected a problem but could not define the precise nature of the difficulty. They therefore recommended them for participation in the research project hoping to establish whether or not the children had a specific deficit in visual perception.

Some of the teachers seemed only to have a vague concept of visual perception, and one claimed never to have heard of it! They did not therefore make a prediction about the child's perceptual status. The teachers of the Down's Syndrome children were not asked to predict whether these children had specific visual perceptual difficulties because, as the children were known to have a mental handicap with considerable delay in language development, it was felt to be asking rather a lot of the teachers to expect them to untangle the complexities of the child's learning problems to make a decision about whether a child had a specific visual perceptual impairment rather than a perceptual delay commensurate with his generally delayed development.

<u>Results of prediction</u>

Seventeen of the Special Needs children were found to have perceptual handicaps in comparison to their B.P.V.S. scores. All these children were correctly identified by their teachers. Sixteen children were found not to have problems according to the P.V.P.A. Fourteen of these were in the direction of their teacher's prediction.

Chi Square tests were carried out on the accuracy of the perception test in the identification of children thought by their teachers to have problems in the visual perceptual domain. The consensus between the results of the P.V.P.A. and the teacher's predictions was significant at $p < .001$, ($chi^2 = 32.36$).

TABLE 10.7. SPECIAL NEEDS SAMPLE WITH PERCEPTUAL IMPAIRMENT

Child number	Age level	B.P.V.S. raw score	C.A. yrs & mths	No. of tests below 10% criterion	Nature of Handicap
601	4	9	5.3	6	hydrocephalus
602	3.5	8	8.11	7	cerebral palsy
603	4.5	12	5.8	8	mosaic trisomy 8
604	4	9	5.0	7	cerebral palsy
606	4	9	8.10	6	head injury
610	3.5	7	11.3	6	hydrocephalus
611	3.5	11	3.10	16	cerebral palsy
613	4	9	6.1	7	delay
616	4.5	10	6.6	16	cerebral palsy
619	4	9	4.5	7	cerebral palsy
624	4.5	12	10.0	14	cerebral palsy
626	3.5	8	6.3	7	cerebral palsy
627	4.5	10	5.5	10	language disorder
629	4	9	4.2	9	clumsy
633	3.5	8	6.2	11	cerebral palsy
634	3	7	7.2	6	cerebral palsy
636	4.5	11	5.0	6	cerebral palsy
637	3.5	8	3.5	8	delay
639	3.5	8	3.5	9	delay
640	4.5	11	4.5	10	delay
643	4.5	10	5.11	9	cerebral palsy
646	3.5	8	3.6	6	visual handicap
648	4	10	4.1	6	delay
Mean	3y 11m	9.26	5.10	8.56	
S.D.	6 m	1.45	25.73 mths	3.09	

B.P.V.S. Age Eq. mean: 49.39 mths = 4 yrs 4 months S.D.: 7.44 mths

TABLE 10.8. SPECIAL NEEDS SAMPLE WITHOUT PERCEPTUAL IMPAIRMENT

Child number	Age level	B.P.V.S. raw score	C.A. yrs & mths	No. of tests below 10% criterion	Nature of Handicap
605	4	9	5.7	0	cerebral palsy
607	3	6	6.8	0	delay
608	3.5	13	3.4	2	arthrogryposis
609	3.5	9	3.9	5	arthrogryposis
612	3.5	9	3.8	5	arthrogryposis
614	4	9	9.3	4	cerebral palsy
615	4	9	8.6	1	language disorder
617	4	9	5.2	5	heart condition
618	3.5	8	5.3	3	delay
622	4.5	15	8.0	2	cerebral palsy
623	3.5	8	6.0	0	delay
628	3	6	7.2	2	cerebral palsy
630	3	7	9.5	0	delay
631	4.5	11	5.6	3	spina bifida
632	4	9	4.1	0	cerebral palsy
635	3	6	7.2	3	cerebral palsy
641	4.5	11	4.4	5	delay
642	4	9	4.3	3	language disorder
644	2.5	5	3.9	0	delay
647	3	7	3.1	3	visual handicap
Mean	3y 8m	8.75	6y.7m.	2.30	
S.D.	7m	2.43	26.33 m.	1.89	

B.P.V.S. Age Eq. mean: 46.65 mths = 3 yrs 11 months
S.D.: 11.40 months

TABLE 10.9. DOWN'S SYNDROME SAMPLE

Child number	Age level	B.P.V.S. raw score	C.A.	No. of tests below 10% criterion
501	4	9	6.9	16
502	3.5	8	6.4	7
503	3	6	8.4	0
504	3	6	8.11	3
505	3	6	9.3	0
506	3	6	9.11	2
507	4.5	10	9.3	4
508	4.5	10	9.2	4
509	3.5	8	8.11	8
510	2.5	3	7.11	0
Mean	3.45yrs	7.2	9.6	4.40
S.D.	0.69	2.2	13.88m	4.94

B.P.V.S. Age Eq. mean: 39.90mths = 3 yrs 4 mths
S.D. 9.73

Note: The B.P.V.S. age level and the age level used for comparison on the P.V.P.A. differed because of the way they were calculated. The B.P.V.S. age level was taken from the age equivalent quoted in the manual. The age equivalents used for comparison on the P.V.P.A. were these B.P.V.S. age equivalents rounded up or down to the nearest half year. Children scoring above the age equivalent for four-and-a-half years, (i.e. with a raw score of 11 or more) were allocated the age level of 4.5 for P.V.P.A. purposes, as this is the ceiling of the test. Similarly the one child scoring below 5 on the B.P.V.S. (age equivalent 1 year 11 months) was allocated an age level of 2.5 for the P.V.P.A. comparison.

These results indicate that the P.V.P.A. is therefore able to identify children with perceptual difficulties at the pre-school level with great accuracy.

Two children were predicted as suffering from a visual perceptual disorder who did not actually score below the 10% criterion on more than five sub-tests when compared with their age levels on the B.P.V.S. One boy, no. 630, in fact, was an unusual case as his strategies in the performance of the tasks indicated that he would have problems. However, he was almost nine-and-a-half years old, one of the oldest children in the Special Needs Sample, and yet had a very low score of 7 on the B.P.V.S. (age equivalent 3 years 2 months). Assessed as a three year old, his performance was not good, but he did not actually perform below criterion on any sub-tests. If his age level was adjusted to 4.5, at the ceiling of the P.V.P.A. then he performed below criterion on three sub-tests, still not sufficient to cause concern in a pre-schooler but a very worrying performance in a boy who is returning to mainstream school in a few months time owing to the closure of his present school. Analysis of his scoring pattern and observation of his strategies and considerable attentional problems suggested that here was a boy who had many learning problems, some of which were reflected in his difficulties with reading and number work. However, it was felt that he probably <u>did</u> have a deficit in certain areas of the visual perceptual domain, but at a higher level than that examined by the P.V.P.A. Use of the 10% pass/fail criterion for a child so far beyond the age range for which it was intended is somewhat artificial, and may not be sufficiently sensitive to identify problems in a child of this age. The 10% criterion, after all, identifies children in the lowest 10% of the normal population at the relevant age, and this boy's performance was well below the mean for the three year age group. However, analysis of error patterns may be a useful pointer to the value of the test, with careful interpretation, with children well above the ceiling age of the test, from whom we would normally expect an errorless performance.

The second child, no. 642, who performed better than predicted had been referred by her teacher soon after she began attending a special unit for children with language disorders when she was still only three years old. The testing took place four months later, by which time it was felt that her experienced teacher had ameliorated the little girl's problems in this area, as the curriculum in the unit placed considerable emphasis on perceptual skills. Indeed, at the age of four years three months, the child's B.P.V.S. age equivalent was 4 years , and the staff were extremely pleased with her rate of improvement in all areas of the curriculum.

Children with Neurological Handicaps

The medical diagnoses of the Special Needs children were examined after they were divided into perceptually impaired and unimpaired groups, and it was evident that 60% of the perceptually impaired group suffered from cerebral palsy or other neurological problems, whereas only 30% of the unimpaired sample had neurological involvement. The children were therefore re-allocated to groups of those with and without neurological conditions. Sixteen of the children with neurological problems had cerebral palsy. All of these were spastics. Two children were hydrocephalic, one had spina bifida with associated hydrocephalus, one was a head injury as a result of a traffic accident and one had a "clumsy child syndrome" reported to be of neurological origin. The children in the non-neurological group were heterogeneous in the extreme. Eleven children were described by their schools as having "delayed development" with no precise aetiology. This may reflect the very limited access schools in some areas are given to medical information of any kind about the children they teach. Some teachers had no idea about the nature of a child's disability, and it was necessary to search out the physiotherapist for information about the child's condition. Three children suffered from arthrogryposis, three had language disorders, two were visually handicapped, one had a heart condition and one a genetic chromosomal abnormality.

Table 10.10. shows that the mean ages (C.A.) of the two groups differ by 11 months, with the neurologically impaired group being older. The difference, according to a t-test, reaches significance at $p < .01$ ($t=2.42$) yet the neurologically impaired group performed below criterion on 6.68 sub-tests, far more than those without neurological impairment, whose mean failure was only 4.57. This difference is highly significant ($p < .01$, $t=9.15$).

These results are entirely consistent with other similar investigations into perceptual abilities in brain damaged individuals compared to those without brain damage, e.g. Menken et al. (1987), Whiting et al. (1985). Some studies, e.g. Levine et al. (1962) and Rosenblith (1965) showed that although the cerebral palsied children exhibited problems as a group, this was by no means true of all subjects, and both Wedell (1960a and b) and Abercrombie et al. (1964) concluded that perceptual impairment was not a general concomitant of cerebral palsy but was more likely to affect the spastic sub-group.

These studies, though old, remain equally valid today, though advances in medical knowledge have resulted in changes in the cerebral palsied population to the extent that it is no longer practical to carry out studies comparing groups of children with different types of cerebral palsy.

Fifteen of the 22 children in the neurologically impaired group performed below the 10% criterion on more than five sub-tests when compared with their B.P.V.S. age equivalent. Only two children scored above criterion on all sub-tests. These were both very bright cerebral palsied children who were working age-appropriately in their special school. One, a hemiplegic four year old was expected to transfer to mainstream infant school. The other child, a much more handicapped non-ambulant five year old was under consideration for transfer to mainstream.

The spina bifida child in the sample performed quite well,

TABLE 10.10. PERFORMANCE OF CHILDREN WITH NEUROLOGICAL IMPAIRMENTS ON THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

Child number	Age level	B.P.V.S. raw score	C.A. yrs & mths	No. of tests below 10% criterion	Nature of Handicap
601	4	9	5.3	6	hydrocephalus
602	3.5	8	8.11	7	cerebral palsy
604	4	9	5.0	7	cerebral palsy
605	4	9	5.7	0	cerebral palsy
606	4	9	8.10	6	head injury
610	3.5	7	11.3	6	hydrocephalus
611	3.5	11	3.10	16	cerebral palsy
614	4	9	9.3	4	cerebral palsy
616	4.5	10	6.6	16	cerebral palsy
619	4	9	4.5	7	cerebral palsy
622	4.5	15	8.0	2	cerebral palsy
624	4.5	12	10.0	14	cerebral palsy
626	3.5	8	6.3	7	cerebral palsy
628	3	6	7.2	2	cerebral palsy
629	4	9	4.2	9	clumsy
631	4.5	11	5.6	3	spina bifida
632	4	9	4.1	0	cerebral palsy
633	3.5	8	6.2	11	cerebral palsy
634	3	7	7.2	6	cerebral palsy
635	3	6	7.2	3	cerebral palsy
636	4.5	11	5.0	6	cerebral palsy
643	4.5	10	5.11	9	cerebral palsy
Mean	3y 11m	9.15	6.8	6.68	
S.D.	6 m	2.02	24.67 mths	4.51	

B.P.V.S. Age Eq. mean: 49.14 mths = 4 yrs 1 month
S.D.: 10.39 months

TABLE 10.11. PERFORMANCE OF CHILDREN WITH SPECIAL NEEDS WITHOUT NEUROLOGICAL IMPAIRMENT ON THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

Child number	Age level	B.P.V.S. raw score	C.A. yrs & mths	No. of tests below 10% criterion	Nature of Handicap
603	4.5	12	5.8	8	mosaic trisomy 8
607	3	6	6.8	0	delay
608	3.5	13	3.4	2	arthrogryposis
609	3.5	9	3.9	5	arthrogryposis
612	3.5	9	3.8	5	arthrogryposis
613	4	9	6.1	7	delay
615	4	9	8.6	1	language disorder
617	4	9	5.2	5	heart condition
618	3.5	8	5.3	3	delay
623	3.5	8	6.0	0	delay
627	4.5	10	5.5	10	language disorder
630	3	7	9.5	0	delay
637	3.5	8	3.5	8	delay
639	3.5	8	3.5	9	delay
640	4.5	11	4.5	10	delay
641	4.5	11	4.4	5	delay
642	4	9	4.3	3	language disorder
644	2.5	5	3.9	0	delay
646	3.5	8	3.6	6	visual handicap
647	3	7	3.1	3	visual handicap
648	4	10	4.1	6	delay
Mean	3y 8m	9.12	5.9	4.57	
S.D.	7m	2.02	21.11	3.34	

B.P.V.S. Age Eq. mean: 47.52mths = 4 yrs 0 mths
S.D. 9.73 months

failing on only three sub-tests. Whilst spina bifida children commonly have difficulties in visual perception especially if there is associated hydrocephalus (Miller and Sethi, 1971, Anderson and Spain, 1977), there is a wide range of ability amongst such children, and certainly no conclusions can be drawn from the performance of one child.

Child no. 628 was a very severely involved little girl, and the only one to indicate her responses by eye-pointing and nods. It was felt that her B.P.V.S. level of three years may have been an underestimate, but this was repeated after a week with identical results. The report written to her school reads: "She has little or no impairment in the area of visual perception considering her severe physical handicap and lack of sensori-motor experience. She appears to have compensated extremely well for missing out on this exploratory stage, and probably has very considerable potential if she can be helped to demonstrate it."

Child no. 622, who failed on two of the sub-tests, had been taught by the author as a pre-school child. Though she had a severe physical handicap she was a delightful, resourceful child, not without learning difficulties, but with the will and temperament to do her best to overcome them. At eight years old one would not, of course, expect any failures on a pre-school test, and the two scores below criterion reflected her particular difficulties in spatial relationships such as size grading.

Child no. 614 was also severely handicapped. He had no speech, and communicated with his own version of Makaton sign language and pointing. He also wore thick glasses and was clearly short-sighted, though how much this affected his ability to see the test materials was unclear. His other academic abilities were far below his age level, and it was felt that there was no greater cause for concern about his perceptual abilities than his general level of cognitive functioning.

These case studies illustrate the evidence presented above, demonstrating the ability of the Pre-school Visual Perception Assessment to identify children with visual perceptual deficits.

The testing of the Special Needs sample proved to be one of the most rewarding aspects of the entire project, as the teachers were so appreciative of the insights into their children's performance provided by the research. It also enabled ceiling points for discontinuation of testing to be set. (Previously, the normal sample had been too competent to require 'cut off' points in the test.) Some guidelines for testing children with Special Needs were also formulated, and these appear in the administration directions in the Appendix.

This chapter, describing the studies with Ethnic Minority and Special Needs children is regarded as strong supportive evidence for the validity of the Pre-school Visual Perception Assessment.

CHAPTER 11

DISCUSSION AND EVALUATION

The purpose of this study was to devise an assessment to identify perceptual impairment in children of pre-school age with whom the writer was working at the time of its inception. It was anticipated that the assessment would also be useful for older handicapped children whose functional level and assessment needs were at an equivalent level to children of pre-school age.

It is felt that the Pre-school Visual Perception Assessment has met its objectives, in that it is able to identify children with perceptual impairment. It is interesting and enjoyable for young children to perform and easy for the examiner to administer and score. Concurrent validity and reliability have been demonstrated. It is felt that not only has the study produced an assessment of real practical value to teachers and therapists, but it has raised a number of questions and research issues for future investigation.

The criteria incorporated in the design of the items were set out in Chapter 6, and it is now possible to reflect on the degree to which these criteria were met after use of the assessment materials on approximately three hundred occasions.

1. The assessment was planned to be interesting to young

children. Without exception, the children enjoyed performing the test. The author has never used an assessment measure which met with such approval from its young consumers. Even the child in the Special Needs Sample whose data was not included in the analysis (see page 167) greeted the presentation of the next item with squeals of enthusiasm. Many children asked to do the test again, or repeat certain items on completion, and whenever the examiner re-visited a school, previously tested children gathered round clamouring to play the "special games" again. All children involved in the test-re-test and inter-rater reliability studies were as enthusiastic on the second test as on the first, even though as "normal" children, most of the items were extremely easy for them. In contrast, some of the validation items were difficult to administer to the children in the Basic Standardisation Sample because they did not hold the children's interest long enough to complete the test.

2. The equipment must be sufficiently robust to withstand handling. After what must be considered fairly hard use of the material on over three hundred occasions, often with children who were handicapped and not the most careful of individuals, the material remains in good condition. The plastic and wooden components have been washed and disinfected many times, and the card materials, which were sprayed with a water-resistant plastic spray have been wiped over. The spray "varnish" on the cards has also meant that there is no evidence of none-too-clean fingers continually pointing at the correct response, leaving a grubby clue to indication, which has been observed on other well-used

tests. The card material, which used heavy 6-sheet board, was remarkably resistant to bending and the occasional attempt at chewing. A duplicate set of materials was available in case of loss or breakage, but none was required with the exception of replacement of the 'creak' on the door of the Lock-a-Block posting box. Other users of this item in schools have also noted the short life of the creaking mechanism, and the 'creak', though an amusing attribute of the toy, is irrelevant to the posting aspect of the task. As is noted later, this item is likely to be superceded in a subsequent edition of the assessment.

3. The items should be of short duration. This criterion was fulfilled. The one lengthy item, Superimposed Pictures, was reduced in length after administration to the Basic Standardisation Sample as described in Chapter 10. Most items take only one or two minutes to administer, and one occasionally has the feeling that the examiner spends more time in laying out the pieces and explaining what the child is to do than the child spends in performing the tasks!

4. No specific time limit was imposed on the items, but ceiling points for discontinuation of items which proved too difficult for some children were incorporated during the testing of the Special Needs Sample. It is clearly unproductive <u>not</u> to have a limit of some kind on the length of time a child is left to struggle, or become bored because they cannot progress further. The decision to remove an item and present the next (in effect, a "time limit") rests with the examiner, who should use the

suggested guidelines in conjunction with intuitive judgement about the child's ability to complete the item. Some children with severe physical handicaps were observed to struggle for several minutes with the placement of the puzzle pieces until they were positioned meticulously. These children vindicated the concept of no imposed time limit.

5. The test should have implicit demand characteristics and use clear and simple language, with the opportunity for demonstration of the items by gesture if a child has limited language comprehension. The first item in the test is a trial item involving a very simple matching task which can be taught if required. Subsequent matching items are then implicit.

As the Pre-school Visual Perception Assessment was used with children with disordered language comprehension, and with the Ethnic Minority children who, it was pointed out in Chapter 10, understood the nature of the tasks in the assessment, although their understanding of English was limited, it is felt that the criterion of the instructions being easy to understand and communicate was met.

The one sub-test which necessitates the child's use of language was performed effectively by two children who had no speech but some signing vocabulary. The Asian children with limited English sometimes used their mother tongue for this item, but the single word responses were easy to note and check later with a native speaker if an interpreter was not available at the time. The 'control' aspect of the completed picture appearing on the next page, to be identified by the child also helped to confirm the impression of the child's identification of the fragmented picture. Many children used gesture in addition to speech, for instance, for 'toothbrush' and others, who incorrectly named one picture as an aeroplane, a common error, used a 'flying' gesture. In spite of the linguistic demands of this item, therefore, there was, in fact, very little ambiguity.

6. The assessment should be easy to administer and score.

This feature was endorsed by the feedback from the seven examiners involved in the test-re-test study, who all found the test instructions clear and unambiguous, and the scoring system straightforward. They all reported having enjoyed using the test.

7. Whilst providing the opportunity for children with effective hand function to manipulate the test materials, the Pre-school Visual Perception Assessment was designed so as not to be dependent on the child's manipulation ability. Several children with severe degrees of physical handicap were assessed, and all managed to complete the test. One used eye-pointing coupled with a "yes/no" response, whilst two other children used fist pointing and pushed the materials round on the table with a closed hand. The accuracy of interpretation of these children's responses was not felt to be in doubt, and their performance agreed with that expected by their teachers. It is therefore felt that the P.V.P.A. can be confidently administered to children who have

little or no manipulative ability, although extra time must be allowed for this painstaking way of performing the assessment.

8. Finally, the opportunity to record the child's pattern of errors, both within the test as a whole and within items was felt to be effective. In reporting back to the schools attended by the Special Needs Sample, the examiner was able to indicate the type of concepts the child had difficulty with according to whether they fell below criterion on particular sub-tests. Many children, for instance, had difficulty with sub-tests involving size grading or shape. Within the sub-tests it was possible to look back after testing to ascertain whether, for instance, irregular shapes had been a particular problem with the posting box, or whether errors on the letter-matching task involved mainly reversal errors. It was possible to examine the strategies involved in building a tower of stacking cups, or matching the colours of peg towers. This error analysis provided insights into the child's abilities which a teacher would find valuable in defining objectives and planning programmes.

The Pre-school Visual Perception Assessment is felt to make a valuable contribution to the range of assessment material available for pre-school children and the equivalent level of development for delayed children. Its specifications enable it to be used with children with many different types of handicap, and it meets a need which no other assessment currently available can claim to do.

Validity for the Pre-school Visual Perception Assessment was demonstrated by correlation with other measures of visual perception which in some ways approximate to the new test. The similarity between the tests used for this purpose and the Pre-school Visual Perception Assessment is not great. Several of the validation measures were used at the very bottom of the age range for which they were intended, but if measures had been available which had great similarity to the P.V.P.A. there would not have been any need to develop a new test in the first place.

Reliability studies, though small in scale, demonstrate that the P.V.P.A. is reliable with the age range for which it was developed, from two-and-a-half to four-and-a-half years, an age group which is often regarded as being difficult to test.

It was stated in the introduction that this was only a preliminary study and did not claim to be a full standardisation of a finished test to publication standard. This was on account of the size of the project and limitations necessarily imposed by the involvement of one person for the development of the items and for all field-testing except inter-rater reliability studies within the time allotted for a Ph.D. study. Ideally, sample sizes would have been much larger, towards the figure of one hundred children at each age level, as the author originally envisaged, and more testers would have been involved in the data collection.

Such extensions of the work are possibilities for the future, and these, together with other developments are discussed below.

It is expected that the Pre-school Visual Perception Assessment will be published, following some minor revisions detailed below, and more extensive standardisation. The original impetus for its development came from a group of teachers and therapists who sought a method of perceptual assessment for young children. Disillusioned with the limited and now outdated Frostig Test they did not know what could be substituted. The Pre-school Visual Perception Assessment was designed for distribution and use, and certainly not just for the fulfilment of a research degree, and it is hoped that it will be of benefit to teachers in assessment nurseries and Child Development Centres, paediatric occupational therapists and most of all to the children they are helping.

Suggested Future Investigations

The writer has already found the Pre-school Visual Perception Assessment extremely useful in working with children with developmental problems.

This type of test, assessing visual perceptual skills in children of pre-school age using play materials is a unique venture, and its predictive validity in unknown. It is likely that in the testing of a large standardisation sample a number of children not previously reported as having special needs may be found to have perceptual impairment. The possibilities for long-term follow up of these children, some of whom may receive remedial intervention, should be explored. Axner and Stukat (1985) report the willingness of school staff to support children with perceptual disabilities, but note their difficulties in actually organising ways of "delivering the goods". The author's personal experience corroborates this, especially when other disabilities such as language disorder complicate the issue. No-one would pretend that amelioration of perceptual difficulties is easy, but a longitudinal study of children known to have problems in the pre-school to establish whether the difficulties persist through the school years, what effect they have on school performance and daily living activities, and what, if any remedial intervention was delivered would make a fascinating subject for investigation.

The reliability of the assessment was demonstrated with normal children. It would be instructive, however, to carry out reliability studies with Special Needs children, many of whom are even more capricious in their responses than normal pre-schoolers (Wishart and Duffy, 1990).

The aspect of the study which included the Ethnic Minority children, originally intended as a control for language comprehension, discussed in the previous chapter, raised many questions relating to the performance of ethnic groups, which is an extremely controversial issue. Reference was made in Chapter 10 to the possibility of following up the twenty Ethnic Minority children already tested. It would be most interesting to discover whether these children had compensated for their early delay in visual perceptual development which was evident from their performance on the P.V.P.A. in nursery school. It may also be instructive to extend the study to a larger sample of Asian children in nursery school to try to establish why this apparent delay in perceptual development occurs and what measures could be taken, possibly within the nursery school curriculum, to effect improvement in these children's abilities.

A further possibility for investigation would be the use of a most interesting extension of the Gollin Incomplete Figures Test, on which sub-test no. 20 (Incomplete Pictures) was based in concept. A team at Leicester University has developed a computerised version of the Gollin test, (Foreman and Hemmings, 1987) which slowly adds more detail to the fragmented outline of a familiar object until the subject is able to identify the stimulus. The team used the program with a small sample of nursery school children, and the writer plans to set up a study to compare the performance of children in the Special Needs Sample of the present project, especially those with perceptual impairment as assessed by the Pre-school Visual Perception Assessment with the performance of an additional group of nursery school children.

Some minor revisions will also be incorporated into a future edition of the Pre-school Visual Perception Assessment.

<u>Proposed Revisions</u>

The coloured lorries item in the "Which is Different" sub-test (no.21) should ideally comprise four blue lorries and one red one, as all other items in this section require selection of the odd one from a choice of five objects. There are currently only three blue lorries for the entirely practical reason that only three were available at the time of purchase. A future version would therefore consist of five vehicles.

The development of Item 9, the Lock-a-Block three-hole posting box is discussed in Chapter 6, where it was noted that the holes through which the shapes were posted were colour coded to correspond to the shapes. To control for this factor, a set of yellow pieces in all three shapes was obtained from the manufacturer, Ambi Toys in Amsterdam. Whilst this proved a reasonable solution, removal of the colour coding element altogether would have been preferable, as some errors may have been caused by children trying to colour-match incorrect shapes to the yellow hole. A recent addition to the Ambi Toys range is a simple, cylindrical shape sorter which uses the same three coloured shapes as the Lock-a-Block, but colour cues are eliminated as all holes have white surrounds. This toy does not have the fascination of unlocking the creaking door to remove the shapes, but it is felt to be a more practical alternative to commissioning sets of yellow shapes from the manufacturers, and avoids the 'decoy' element of one of the holes still being the same colour as the complete set of Lock-a-Block shapes. It is therefore the intention to substitute the Shape Sorter for the present version of Item 9.

A checklist of behaviours characteristic of children with perceptual difficulties is also a possible supplement to the work, together with a package of suggested training activities and materials for use in remediation.

Scoring Revisions

The development of a scoring system proved to be more difficult than expected, and in the case of two of the sub-tests, Letter-Matching and Puzzle Completion, alternative methods of scoring were used so that the one proving most satisfactory could be retained after analysis of the data.

More specific guidelines for scoring the Face Puzzle will be required. It is possible that a scoring template may need to be produced, or certainly a more detailed explanation of what is acceptable to score 1 or 2.

For most of the tests, scoring was straightforward with one point being awarded for each correct response. In the case of letter-matching, however, as it is normal for very young children to make errors involving reversal of letters and numbers, an attempt was made to allow for this, to try to discriminate between those who were confusing letters with some similarity and children who were unable to discriminate between more grossly different letter shapes. In the first method of analysis, (scored as Test 14), one point is awarded for a correct response and 0 for an incorrect one. In the second method (14a) two points are given for a correct response and one for an error involving reversal or orientation of letters (b,d,p, or n and u, or a confusion of h and n or a and d). Other errors are scored 0. In fact, analysis of the data did not reveal any significant difference between the two methods of scoring, and when the two methods were converted to standard scores, the results were very similar. (Table 11.1.)

TABLE 11.1. STANDARD SCORE MEANS FOR LETTER-MATCHING TESTS 14 & 14a

Age Group	Test no. 14	14a
2 yrs 6 mths	7.94	5.13
3 yrs	10.83	9.33
3 yrs 6 mths	13.72	13.71
4 yrs	14.78	14.83
4 yrs 6 mths	16.94	17.13

The first method, having the advantage of simplicity, is the one finally adopted. The score sheet (see Appendix) however, retains the option of the dual method of scoring, with space provided to record incorrect matches, as error patterns may be of interest for the examiner, providing an insight into the nature of a child's difficulties.

Problems encountered in the research

The aspect of the research which presented the most difficulty was finding a sample of children who exactly met the sex, socio-economic and age criteria, and organising visits to the respective nursery establishments to test the children within the required period with respect to their birthdays. As fourteen different establishments were contacted, and six Day Nurseries and four Nursery Schools were used in the basic standardisation, in addition to nine children tested in their own homes, juggling the visits to the various nurseries proved quite a feat of organisation. Most of the nurseries and schools were very co-operative and interested in the project. However, they also wanted immediate feedback as to how their children had performed, which it was really not possible to provide. It could only be said that they were 'normal'. In the early stages, of course, there was insufficient data collected to make any sort of comparison with the rest of the normal sample. The Special Needs Sample was equally widely dispersed, with seventeen schools in three Education Authorities providing the children. Whilst the travelling involved was time-consuming, the distribution of the samples over so many establishments helped to eliminate any bias which may have occurred if too many children from the same schools had participated.

Looking back, problems in the planning, development and organisation of the research were few, and the author can honestly say that the development of the Pre-school Visual Perception Assessment has been an enjoyable and rewarding experience, thanks to the co-operation of the many staff and children who became involved along the way.

EPILOGUE

The precise role of visual perception in learning disabilities is still not established, but perception does affect functional life skills such as eating, dressing, moving about our environment, driving and even crossing the road. This study identified visual perceptual deficits in young and handicapped children, endorsing the well documented evidence that children with neurological conditions such as cerebral palsy often have concomitant disorders or delay in visual perceptual skills (Abercrombie, 1964, Stratford, 1979, 1980, Wedell, 1973).

Young children are notoriously difficult to test, and in the past, assessments for pre-school children, which usually involve examination of some aspect of visual perception have not been renowned for their reliability as predictors of later school performance (Lyndsay and Wedell, 1982). However, the specific targeting of visual perceptual skills in under-fives through the medium of a "play" test is uncharted ground. Certainly we cannot put our heads in the sand and avoid assessment of young children who are suspected of having problems simply because they are difficult to test, and because the results may not be entirely reliable predictors of future performance. 'Future performance' should, in any case, not be confined to school achievement as success in life is by no means always related to academic attainments.

A child's progress in the school years depends not only on the environment but on many other factors which cannot be controlled, such as his own social adjustment and the influences and acceptance of the peer group, as Losse et al.'s (1991) elegant longitudinal study on clumsy children indicates.

A child with difficulties deserves help at any age or stage of life, and if a few false positives are collected on the way, and even if a few children are missed because our assessments are not yet sensitive or sophisticated enough to pick up all the children and all of the problems, at least the attempt will have been made to identify and help those in need. Paget and Bracken (1983) state that (p. 275): "false conclusions can be drawn that might affect these children in unforeseen ways" and advocate caution in the use and interpretation of tests. However it is clear that the more assessments that are developed and the more refined they become, the better we shall become at identifying children at an early age and setting in motion the wheels of remediation which will help them. This study is one more step along that path.

APPENDIX

Pre-requisites for Administration

The test should be administered in a quiet room, which should be comfortably warm, well lit, and as far as possible free from distractions. It is not, for instance, in the interests of eliciting a child's optimum performance to give the test in the corner of a busy nursery or classroom.

A small table and chair should be provided for the child, so that he can sit comfortably with his feet on the floor. The surface of the table should be plain and of a neutral colour. If it is highly coloured, patterned or very shiny, so that it reflects the light, then a neutral coloured covering should be used. The examiner should sit opposite the child, preferably also on a child-sized chair so that she does not overwhelm the child by appearing to 'tower' over him.

It is preferable for just the child and the examiner to be present, but occasionally the child may be too distressed to co-operate if separated from the parent or familiar adult. In such a case, an adult may be allowed to accompany the child but should be given instructions not to prompt, re-phrase the questions or otherwise assist in the administration unless requested to do so by the examiner.

The examiner should take a few minutes to relax the child and get to know him, if necessary by playing with toys unconnected with the test. They should also ensure that toilet needs are attended to before the test commences, as whilst it is possible to break off for such purposes if required, it may interfere with the child's interest and attention.

The test materials should be prepared beforehand, organised so that they are easily available in sequence, but should be placed out of view of the child. It is important that during the administration the items should follow each other in quick succession. If the child is kept waiting whilst the examiner searches for the next item, he is likely to become bored, with a resulting decline in concentration.

General Points Regarding Administration

The sub-tests are intended to be administered in numerical sequence, as those demanding minimal physical involvement, such as matching, are balanced at intervals by tests requiring the child to manipulate the materials. However, if a child refuses to co-operate on any part of the test, successive items may be presented, with the option of returning to the rejected items later.

The tests should be administered according to the directions given, though the language of the instructions is intended only as a guide and need not necessarily be quoted verbatim. The language used should sound natural and spontaneous, and if the wording suggested sounds stilted when spoken by the examiner then minor modifications should be made. It is most important to keep the language of instruction simple, and any changes made should not involve the use of more complex vocabulary or sentence constructions. This is not a test of language comprehension, and though the nature of the task is intended to be implicit from the presentation of the materials, with only a minimum of verbal instruction required, this must nevertheless be conveyed in simple vocabulary and short sentences. The examiner must also be flexible in the use of additional or alternative instructions, which may be delivered through language or gesture, to ensure that the child understands the nature of the task.

It is important to maintain a good rapport with the child at all times, and plenty of praise must be given for effort. The examiner should not give any indication to the child if he is not doing well on the test, as some children are inclined to give up if they feel defeated. If necessary, to sustain the child's interest and motivation, assistance may be given to complete an item if it is felt that the child has tried his best but is unable to succeed. (On the puzzle completion test, for instance, the child may be helped to complete a puzzle he has struggled with but found to be too difficult. Of course, no score should be awarded for any results achieved with assistance.)

The examiner must be sensitive to the child to know when to encourage a little further for a response, and when to stop and move on to another activity. Pushing a child too far beyond his interest and capability can result in a negative approach to other activities, but many reticent children will persevere given reassurance and encouragement.

As a general principle all children should attempt all test items. Even if some children are suspected of having problems but are known to be able to match, they should still be given the easier items to establish rapport and a positive attitude towards the activities. Guidelines for discontinuing items which a child finds difficult are given in the administration directions.

Scoring

The tests should be scored according to the score sheet and the raw scores entered onto the totals sheet at the end. It is then possible to proceed in two ways, depending on the reason for using the test. If the examiner merely requires to ascertain whether the child is "failing" on the test, or certain aspects of it, Table 12.4. (p. 304-308) showing 10% criterion scores should be consulted, and the child's raw scores compared with these. (The 90% criterion level is the point above which 90% of the normal children in the sample performed.) If the score falls below the 90% criterion on more than five sub-tests and the child's behaviour during testing was felt to be reasonably co-operative, then such performance on the test gives rise to concern about the normality of the child's visual-perceptual development. If, however, the examiner wishes to compare the child's performance in more detail with others of the same age, Table 12.4 also shows means and standard deviations for the different age groups. The raw scores may also be converted to standard scores using Table 12.1. A visual comparison of the child's performance can then be made by reference to Figures 12.39 to 12.43 (p. 314-318) entering the standard score on the graphs for each sub-test.

Guidelines for the Assessment of Children with Handicaps

Before beginning to test children with developmental handicaps it is essential for the examiner to be thoroughly familiar with the materials and method of administration of the Pre-school Visual Perception Assessment, and to have practised its use with "normal" young children. This applies to all tests used with handicapped children.

It is well-established that handicapped children have deficits in attention (Lunzer and Stratford, 1984), and the examiner who is not familiar with the administration process of this test will not be able to progress easily from one item to another. It is essential that children should never be kept waiting whilst the examiner fumbles for the next box of materials or takes time out to read the administration directions. The administration must proceed smoothly and with momentum from one item to the next, thereby maintaining the child's attention by the anticipation of the presentation of something new. A child who becomes bored by being kept waiting for the appearance of the next item is less likely to maintain interest when the materials are finally presented.

The Pre-school Visual Perception Assessment has been designed as being suitable, with the minimum of modification, for children with a variety of handicaps. However, the particular needs of children with different kinds of handicaps should be taken into account in the administration of the test.

Positioning the child

All children should be in a comfortable position to enable them to handle the material as freely as possible. The majority of children will be able to sit in an ordinary child-sized chair, or a specially adapted supportive chair. It is important to ensure that the child's feet rest on the floor, or are supported so that he has a stable base. This is necessary to avoid insecurity which may be generated by an unstable sitting position. In a few cases of children with particularly severe handicaps, (for instance, some forms of cerebral palsy,) extensor spasm may be induced by the child pressing against a foot rest, but these cases are rare, and the examiner will probably have been made aware of individual problems of this nature. Advice from a physiotherapist or the parents who have been taught how best to position the child will enable the best position for function to be selected. It is important for the child to feel secure in whatever position is chosen. Whilst sitting on a stool or chair without arms may be regarded as desirable from a physiotherapy point of view, the child should not be distracted from the performance of the test by anxiety about whether he will fall off the chair. The P.V.P.A. is not assessing 'sitting balance'!

Some children with cerebral palsy may be more able to use their hands effectively in a standing frame or prone board, as their arms can then be supported in a raised position by the table. Head control is also often better in a well-supported position. The use of a side-lying board, however comfortable for the child, is not recommended, as the materials must be presented in a vertical orientation, and it is not practical to perform many of the three-dimensional items from a sideways position!

Children who have limited use of the arms and hands, for instance children with spastic diplegia or hemiplegia, may need the materials to be positioned to one side, or further away so that they can point with a straight arm or a fist. It is clearly important to take account of the child's range of access, and place the materials where he has the best opportunity of reaching them. It may help some children if some of the larger picture materials are tilted towards the vertical orientation to bring them closer to the child's reach; some children, especially those with visual difficulties find a sloping table easier to use, as it brings the materials closer to their eyes.

Some children with visual impairments, especially with visual field defects, may deliberately turn their heads into what may seem to be unusual positions to view the equipment, and it may even appear that the child is not looking at what is in front of him. If central vision is disturbed, however, many children learn to compensate for this by positioning themselves to use peripheral vision. Such idiosyncrasies of behaviour will be well known to those acquainted with the child, but an unfamiliar examiner may be tempted to try to correct the head position. In this instance, it is preferable to re-position the materials to come within the child's visual field when the head is in mid-line. Asymmetrical head positions can influence movement throughout the body in children with cerebral palsy, and if possible the head should be maintained in a "normal" position. Clearly, however, this should not be at the expense of the opportunity to see the materials. It is important, of course, to distinguish between the child with a genuine visual field difficulty and those who habitually look anywhere but at what they are supposed to be doing! These children need to have their wandering attention repeatedly brought back to the task, though items should be discontinued according to the suggested ceilings if the poor attention is felt to be due to the child's inability to proceed further with the task. (Holt, 1991, however, suggests that these children should have more extensive ophthalmic investigation.)

For children with severely limited hand movements, eye pointing may be used successfully with most items in the Pre-school Visual Perception Assessment. The interpretation of eye pointing is not always easy. Some children have difficulty in controlling their eye movements, and may manage only a fleeting glance at the chosen item before control is lost, and it is therefore important to distinguish between this passing glance, as a selection, and a glance which encompasses all items in a scanning of the display.

It is usually advisable to reinforce the choice by such questions as "Do you mean this one?" (with occasional incorrect 'guesses' thrown in so that the child knows the examiner is not actually going to perform the test for him!) Most eye-pointers have a yes/no response of some kind, either with speech or 'eyes up' for 'yes' and sideways for 'no'. Some children may have variations on these responses (one child known to the author used 'eyes up' for 'yes' and down for 'no') and it is clearly important to establish the basis for the child's communication, however minimal this may be, hence the value of previous discussions with the parent or care-giver in this respect. It is also useful to be aware of any signs the child uses for the toilet, drink or other basic requirements of young children. In addition, testing carried out using eye-pointing methods, or even using manipulation with some severely handicapped children can be very time-consuming, extending considerably the normal length of time taken to administer the test. This is in the nature of testing handicapped children and must be anticipated. Breaks will almost certainly be needed for the toilet, change of position or a 'wriggle', or just for a break in the intensive concentration required, and the assessment may require more than one session. If possible, a break should be made just before a really interesting item, such as a posting box so that the child's interest and motivation can be easily re-directed on return to the test.

Handicapped children often tire more easily than 'normal' children, and especially for those with particular forms of physical handicap, enormous physical effort and control may be required to perform the simplest action such as pointing to a picture, which a non-handicapped child would do effortlessly. It is important not to overtire handicapped children by moving too fast through the assessment, and it may be necessary to pace the presentation to take into account the physical effort which may be involved. On the other hand steps must be taken to avoid boredom through the child being kept waiting, and the time interval should not be used as an excuse for the examiner to search for the next item! Any time between items which are demanding could be used to enhance rapport with the child, by casual conversation, or the provision of a drink or biscuit. The physical demands of such an interactive assessment may prove to be so exhausting for the child that it may become necessary to have a complete break and to continue the assessment at some subsequent session.

Instructions for Administration of the Sub-tests

TEST NO. 1 MATCHING COLOURED OBJECTS

MATERIALS REQUIRED: Box of four pairs of matching objects familiar to the child. (Fig. 12.11.)

Note: This is a training task. If the child fails to match the objects with a minimum amount of explanation or demonstration do not proceed with the remainder of the assessment. Teach the child how to match, if necessary, beginning with one object and building up to four, but if he cannot then perform the matching task with ease, the remainder of the test will prove too difficult and the session should be discontinued.

DIRECTIONS: Place one of each pair of objects on the table in front of the child. Keep other objects in the box so the child cannot see them. DO NOT NAME THE OBJECTS. Show the child the shoe. Say something like: "Show me one like this" (or "Find me one the same" or "Where's yours?") indicating the objects on the table. If the child does not respond, he may not be understanding the language. Try other forms of request (as above). If he still does not appear to understand the task, demonstrate with the first item, continue with the other objects, then present the first object again later.

Present the objects in the order on the score sheet.

TEST NO. 2 MATCHING YELLOW OBJECTS

MATERIALS: Box of yellow matching objects. (Fig.12.12.)

DIRECTIONS: Place one of each pair of objects on the table in front of the child, as above. Make sure the larger objects do not visually obscure the smaller ones. Retain the other objects in the box. Remove one object at a time to show to the child. DO NOT NAME THE OBJECTS. Explain that this game is like the last one, and he is to find another toy the same as the one you show him.

Present the objects in the order on the score sheet, replacing one of each pair in the box before presenting the next. The full range of objects should remain on the table throughout the presentations.

DISCONTINUE this item if the child fails five objects.

TEST NO. 3 MATCHING COLOURED PICTURES

MATERIALS: Large card of four pictures. Four small cards. (Fig.12.13.)

DIRECTIONS: Show the child the card with four coloured pictures. Say something like: "Look at these pictures". Allow the child to name the pictures if he wants to, but DO NOT NAME THE PICTURES FOR HIM. Present the small pictures one at a time in the sequence on the score sheet (teddy, cat, shoe, cup) and ask the child to find one the same. Remove each small picture after the child has made his selection.

If the child does not match the pictures and appears not to understand the task, teach it by naming the pictures, for example: "Here is a teddy. Find your teddy" or "Find another teddy". In this case, the child is no longer responding to the perceptual matching situation but to the verbal label of "teddy". He cannot therefore be credited with success in matching and scores 0, but if it is felt that he then understands the task, proceed with the rest of the assessment.

TEST NO. 4 MATCHING BLACK AND WHITE OUTLINES

MATERIALS: Large card with six drawings. Six small cards. (Fig.12.14)

DIRECTIONS: Present the card with six pictures. Allow the child to name the pictures if he wants to but DO NOT NAME THEM FOR HIM. Present the pictures one at a time in the sequence on the score sheet. Remove each small picture after the child has made his selection.

DISCONTINUE this item after four failures

TEST NO. 5 MATCHING FAMILY PICTURES

MATERIALS: Large card and five small cards. (Fig. 12.15.)

DIRECTIONS: Present the Family picture. Point to the figures saying something like: "Look, here's a picture of a family. Here's Mummy and Daddy, the little boy, the little girl and the baby". Allow the child to tell you about his family if he wants to.

Present the pictures to be matched one at a time in the sequence on the score sheet, saying: "Which one is the same as this?" or something similar. Remove each small picture after presentation.

DISCONTINUE after three failures.

TEST NO. 6 MATCHING OBJECTS TO PHOTOGRAPHS

MATERIALS: Card with six photographs. Box of objects to match. (Figs. 12.16. and 12.17.)

DIRECTIONS: Present the card with photographs. Do not name the pictures. Present the objects one at a time in the sequence on the score sheet, saying something like: "Can you find a picture of this?". Replace each object in the box before presenting the next.

DISCONTINUE after three failures.

TEST NO. 7 MATCHING MINIATURE OBJECTS TO OUTLINE DRAWINGS

MATERIALS: Card with six drawings of animals. Objects to match. (Fig. 12.18.)

DIRECTIONS: Present the picture and objects as for Test no. 6.

DISCONTINUE after three failures.

TEST NO. 8 MATCHING GIRLS

MATERIALS: Card with six girls engaged in different actions. Six small cards to match. (Fig. 12.19.)

DIRECTIONS: Present the large card to the child saying something like: "Look, here are some little girls. They are all doing different things." Present the identical small cards one at a time, saying: "Can you find one like this?" For the first card only, when the child makes a correct choice, reinforce by saying: e.g. "Yes, she's building with bricks isn't she?" If the child makes an incorrect choice, draw his attention to the building activity and ask him to try again. (Score 0 if a second attempt is required.) Do not correct subsequent errors.

DISCONTINUE after five failures. (Children who confuse standing figures often succeed on no. 5, the girl sitting down.)

TEST NO. 9. THREE-HOLE POSTING BOX

MATERIALS: Lock-a-Block posting box with six pieces, two of each shape. Three additional yellow pieces. (Fig. 12.20.)

DIRECTIONS: Remove the six coloured pieces and place them in a small container near to the child (so the balls do not roll away). Keep the three extra yellow pieces (one of each shape) separate. Encourage the child to replace the coloured pieces in the box. The order of replacement is unimportant. Score 2, 1 or 0 according to score sheet.

If a child inserts at least three of the six pieces without trial and error, leave the coloured pieces in the box and give the child the three additional yellow shapes to place.

DO NOT DISCONTINUE THIS ITEM. Even if a child does not score on this item, allow them to complete the posting box, by trial and error or with help if necessary, as this is an enjoyable and motivating task.

TEST NO. 10. STACKING CUPS

MATERIALS: Set of Kiddicraft nesting cups. (Fig. 12.21.)

DIRECTIONS: Build a red tower of 3 cups for the child, talking about building the tower, but not about the size grading aspect.

Dismantle the tower and present the cups, placing them in front of the child in the order:

small large medium

from the child's left to right. They should be the right way up for stacking.

Say: "Now you make the tower".

Score 3 if successful at the first attempt

2 if trial and error, self corrected, is used

1 if he requires a further demonstration, but is then successful.

Leave the red cups in place.

Present the blue cups, placing them

large small medium

from child's left to right.

Say "Let's build another tower". Don't name the colours.

Score 3 if successful at the first attempt

2 for success after trial and error.

Present the green cups on their sides so that the child has to work out the orientation. The cups need not be in a line but in an arbitrary cluster.

Score 3 for success

2 if trial and error is used

1 if the child orientates the cups but does not build a tower.

Present the yellow cups upside down, as if for nesting.

Encourage the child to build another tower.

Score 3 for success

2 for correct building using trial and error strategies

1 orientates cups but does not build tower successfully

1 nests cups

The towers may be used to check colour recognition if required.

red yellow green blue

DO NOT DISCONTINUE THIS ITEM. Even if the child is unsuccessful at size grading, many are able to score on the third and fourth towers, as they are allowed one point for the correct orientation of the cups. As the completed towers are required for checking colour recognition, build the towers correctly yourself if the child is not able to stack them.

TEST NO. 11. COLOUR MATCHING BALLS AND CUPS

MATERIALS: Set of Kiddicraft "Wobbly Colours." (Fig. 12.22.)

DIRECTIONS: Show the child the toy with the coloured cups arranged in the base:

child

blue	green
yellow	red

examiner

Say: "Let's take the balls out." Provide a small container to put the balls in. If the child also removes the cups, put them back in the base yourself. When the child has removed the balls say "Now can you put them back?" If the child replaces the balls in the correct coloured holes score 4.

If the child places the balls in different coloured holes and has not noticed that they should be colour matched, remove the balls and demonstrate. Say, for example: "Here is a red ball. It goes in the red hole. Look, it's the same colour." Complete the task yourself and remove the balls. Let the child try again.

If the child is successful after demonstration score 2.

If he still replaces the balls at random, or does something else e.g. rattles them or throws them without completing the task, score 0 and make a note of his behaviour.

DISCONTINUE only if the child persistently plays with the balls and shows no sign of replacing them in the the cups.

TEST NO. 12. PEG TOWERS

MATERIALS: Box of 18 large coloured stacking pegs (Invicta). Six-hole peg board. (Fig. 12.23.)

DIRECTIONS: Place one peg in each hole in the board from the child's left to right in the sequence: red, yellow, green, black, white, blue. Say something like: "Here are some pegs. We are going to build some towers." Place a second peg on each one already in position saying: "Look, here's a red one, it goes on top of the other red one" etc. If the child wants to place the pegs in this row, allow him to do so, but show him where each peg should be placed. If he is too quick for you and places a peg incorrectly <u>in this row only</u>, correct him by showing him where it should go. Give him the box with the remainder of the pegs saying: e.g. "Now let's make the towers bigger".

Score as follows:

Child colour matches, no trial and error. Score 6

Observe whether he a) selects all the same colour to build one tower at a time

b) takes pegs at random from the box and allocates them to the appropriate tower.

Child is only able to match colours by comparing pegs directly with other towers. He will sometimes place wrongly but self-correct. Allow him time to do this.

Child places pegs incorrectly and seems satisfied with their placement. If he places a peg wrongly and goes to get another from the box, say: "Do you think this is right?" (Pointing). Allow him to correct it and proceed with the task. Deduct one point for each peg corrected.

DISCONTINUE if a child places more than six pegs incorrectly. Teach the task if he still seems interested, otherwise discontinue. SCORE 0.

If the child starts off well but does not have the perseverance to complete the task, which requires quite a lot of concentration, make a note, and deduct the number of unplaced pegs from 6.

<u>TEST NO. 13.</u> <u>FACE PUZZLE</u>

MATERIALS: Wooden head shape with features (eyes, nose, mouth). (Figs. 12.24. and 12.25.)

DIRECTIONS: Assemble the face yourself saying: e.g."Here's a funny face. Look, here are the eyes, nose and mouth" (pointing to the features as they are mentioned). Take the features off again and mix them up on the table in front of the child. Make sure the painted side of the features is uppermost (i.e. none of the pieces should be turned over). Say: "Now you make the face".

Score 2 for a well-constructed face.

Score 1 if features are placed in approximately appropriate positions (e.g. eyes separated, placed above nose, mouth below nose) but the face looks odd because features are not placed with precision in relation to each other, or are placed extremely crookedly.

Score 0 if any features are placed in completely incorrect positions, e.g. nose below mouth.

It is common for children to place features upside down. The correct orientation of the eyes is unnoticed by the younger ones, many make a 'frowning' mouth rather than a smiling one, and the pointed end of the nose is frequently placed at the bottom. These errors were found to occur so often that there is no penalty, though it should be noted (preferably by a sketch) on the score sheet.

DISCONTINUE if a child is at a total loss as to what to do with the pieces, or does something entirely inappropriate such as throwing them on the floor. This type of behaviour usually indicates unwillingness to co-operate because the child cannot perform the task. Most children, in practice, put the features back onto the face even if they are randomly placed.

TEST NO. 14. LETTER MATCHING

MATERIALS: Card with six letters + six small matching cards; card with 12 letters and 12 small matching cards. (Fig. 12.26.)

DIRECTIONS: Present the first card with six letters saying: "Look, here are some letters. We are going to find the ones which are the same. Which is the same as this one?" (Show first small card). Present other small cards in the same way.

If the child is successful on five of the six matches, proceed to the second, more complex card saying, e.g: "Here are some more letters. There are lots more on this card. Can you do the same again? Which one is the same as this?"

Score according to the score sheet.

DISCONTINUE after two failures on part 1.

TEST NO. 15. SIX-HOLE POSTING BOX

MATERIALS: Kiddicraft Posting Box. (Fig. 12.27.)

DIRECTIONS: Present the posting box. Say: e.g."Now we have another posting box. Can you take the lid off?" Help the child if necessary as the lid can be stiff. If the child does not immediately take out the pieces, suggest that he does, then replace the lid and say: "Now can you put them back?"

Score 2 for each piece replaced in the correct hole in the right orientation. Score 1 if the child tries to place a piece in the correct hole but in the wrong orientation, 0 if he tries to place it in an incorrect hole even if he subsequently places it correctly.

DO NOT DISCONTINUE THIS ITEM. If a child attempts to place a piece in an incorrect hole and is becoming upset or frustrated because he cannot fit the piece in, the examiner should assist, if necessary fitting the piece in through the hole and encouraging the child to push it in to get the rewarding "clunk" as the piece falls into the box.

TEST NO. 16. SUPERIMPOSED PICTURES

MATERIALS: Book of pictures. (Fig. 12.29.)

Note: Two trial items are provided for this test. The superimposed pictures are displayed on the left hand side of the page, and these, together with additional pictures, are reproduced separately on the right hand side. Some children prefer to point to pictures on the right which they can see on the left, others just name the "mixed up" pictures. In this case, discretion must be exercised in interpreting and scoring, as children may not use precisely correct vocabulary, and any word which conveys that the child can pick out the picture on the left, even if it is mis-named, should be accepted. A bird, for example, may be referred to as a duck, a letter box as a Postman Pat box (or even a "Postman Pat thing" indicates that the letter-box has been discriminated). The words used by the child almost always indicate whether the child can really perceive the picture. If the response is ambiguous, however, the child can be asked to point to the corresponding picture on the right. Obviously totally unrelated words or arbitrary pointing to pictures on the right of the page suggest that the child is having difficulty with the task. Younger children and those with poor concentration or perceptual difficulties often seem able to identify only one of the pictures, and though they should be encouraged to look again to see if they can find another, this should not be pursued to the extent of causing the child anxiety. It is better to proceed to the next item if the child says he cannot see anything else.

DIRECTIONS: Present the book open at the first page and pointing to the superimposed pictures on the left say: "Here are some pictures which are all mixed up." Point to the right of the page. "The same pictures are over here but they are not mixed up. Can you see which pictures over here (point to the right) are over here as well?" (point to the left).

These instructions are somewhat complex linguistically, especially for children with delayed or disordered language. Any other verbal directions or gestures which the examiner feels may be helpful may be used to explain the task.

The first two items are trial items. If the child does not appear to understand, point to the left page and say: "What can you see here? Can you see a cup?" (Point simultaneously to the superimposed pictures on the left and the cup on the right, but make sure that the child is actually looking at the left, rather than responding to your mention of "cup" on the right.) Decide together whether you can see a cup on the left. Go through the other items on the right of the page in a similar way, then recap: "So over here (left) we can see a cup and an apple".

Turn over to present item 2 and proceed in the same way if the child still does not respond to your request to identify the pictures on the left.

If the child identifies only one of the pictures on the left (or fewer than are present if there are more than two) point to them again and say: "Can you see anything else?" Do not press the point too strongly if he says "No" and attempts to turn over.

Score according to the score sheet.

DISCONTINUE only if the child does not appear to understand the task. Most children are able to discriminate at least one of the pictures on each page, and will therefore score on most pages. If, however, the child has made no correct responses at all on the trial items and the first three test items, then this sub-test should be discontinued.

TEST NO. 17 PUZZLES

MATERIALS: set of 5 wooden and 5 card straight-cut puzzles. (Figs. 12.29. and 12.30.)

DIRECTIONS: Open the box saying something like: "Here are some puzzles. Do you like puzzles? I'm sure you're very good at them".

Series 1 - Wooden Puzzles

Place the two pieces for the bun as shown in Fig. 12.1. on the table in front of the child. Say: "These pieces make a picture of a bun (or cake). Can you make it?" If the child fails, say "Look, it goes like this" and complete the puzzle for him. He may attempt the puzzle again if he wishes, but should not be credited with a successful score after a demonstration, though a note can be made of this success.

Proceed with presentation of the other wooden puzzles in a similar way, placing the pieces according to the diagrams. (Figs. 12.2. - 12.10.) Give lots of praise, but do not help the child, or if he is reluctant to leave a puzzle which he cannot complete and asks for your help, finish the puzzle with him but do not credit him with success. Remove each puzzle after completion.

DISCONTINUE: If a child fails to place any pieces correctly in two puzzles in succession, discontinue the wooden puzzles and present the card series.

Also discontinue if he fails to complete three successive puzzles.

Series 2 - Card puzzles.

This series was produced because some children need to have a visual example of what they are trying to construct.

Present the two pieces of the Soldier puzzle as in the last series, laying out the pieces as in the diagram, and invite the child to make the picture. When this is complete leave it in position and say: "Now here is another soldier. Can you make this one as well?"

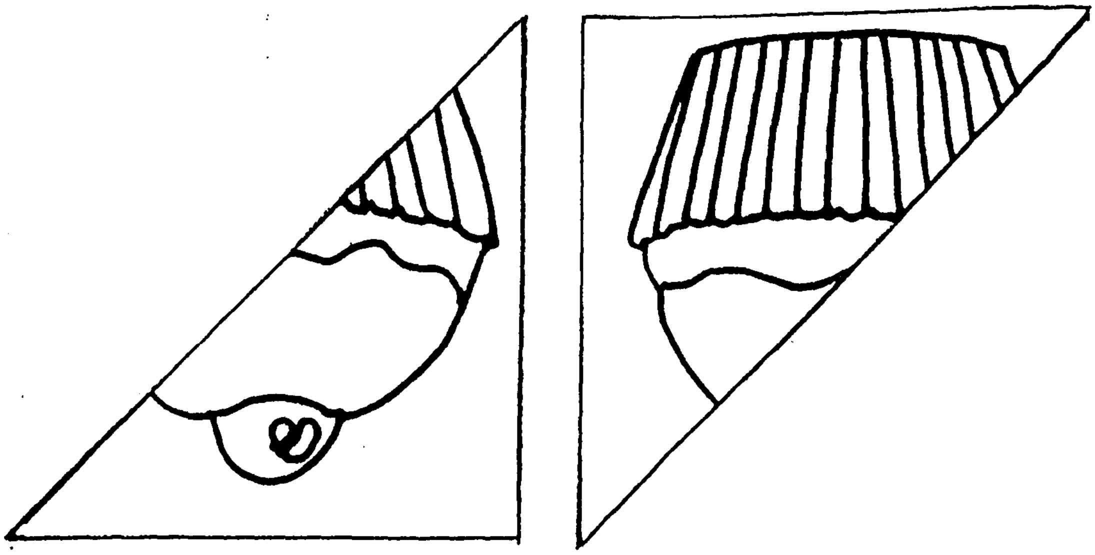
After completion of this puzzle, one of the finished pictures may be removed, but one should always remain on view for the child to refer to whilst constructing the next.

DISCONTINUE after three consecutive failures or if the child fails to place any pieces correctly in two puzzles.

Total the number of completed puzzles.

Presentation of pieces for the Puzzles Test

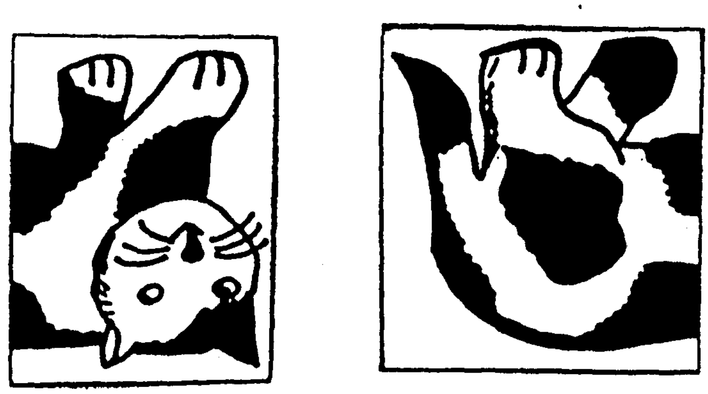
child



examiner

Figure 12.1 Arrangement of pieces for Bun Puzzle

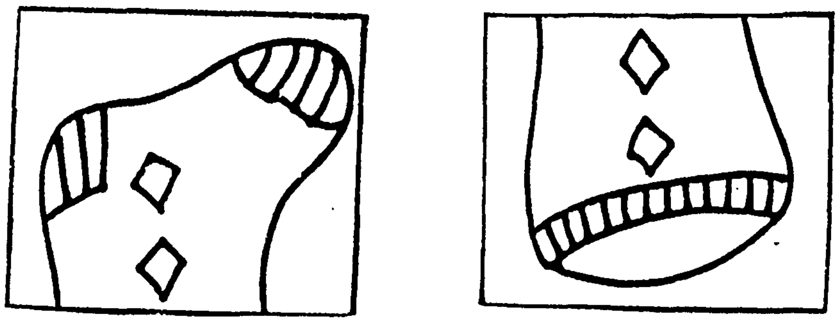
child



examiner

Figure 12.2. Arrangement of pieces for Cat Puzzle

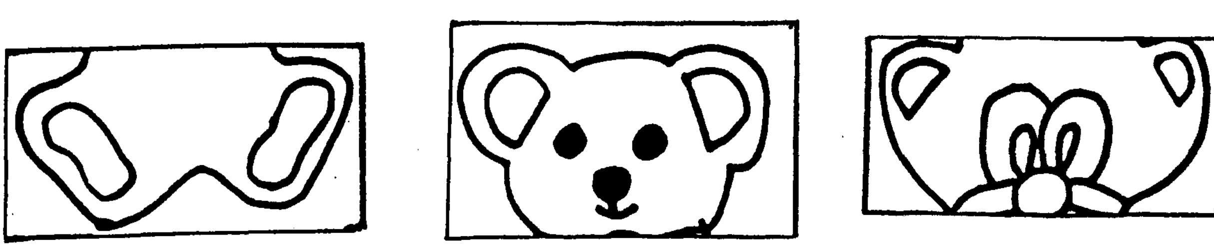
child



examiner

Figure 12.3. Arrangement of pieces for Sock Puzzle

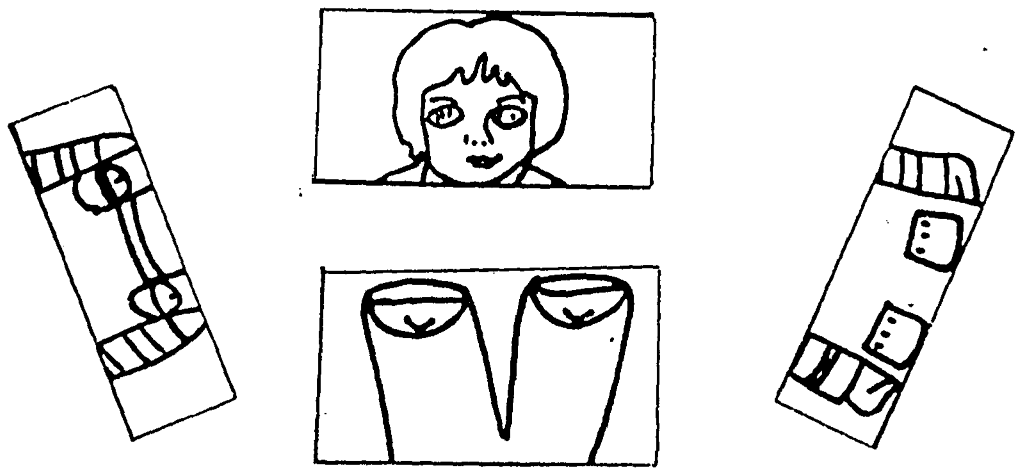
child



examiner

Figure 12.4. Arrangement of pieces for Teddy Puzzle

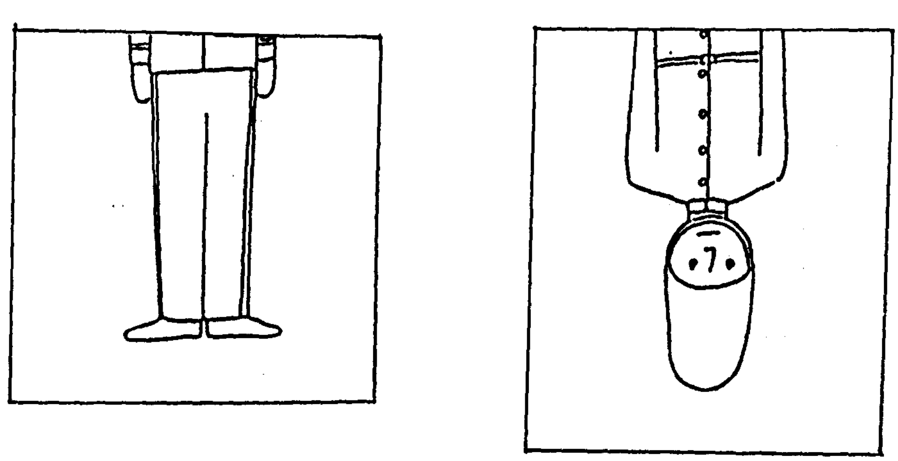
child



examiner

Figure 12.5. Arrangement of pieces for Boy Puzzle

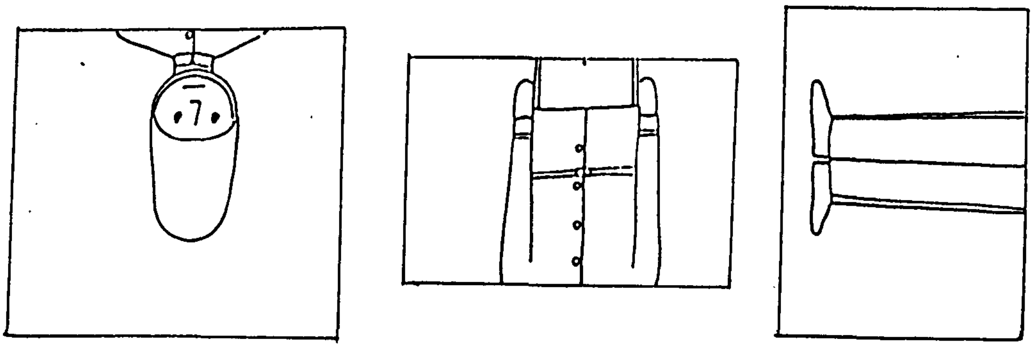
child



examiner

Figure 12.6. Arrangement of pieces for Two-piece Soldier Puzzle

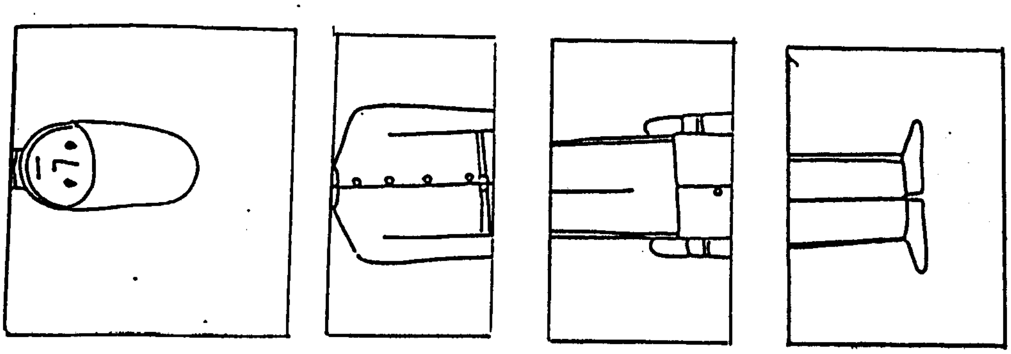
child



examiner

Figure 12.7. Arrangement of pieces for Three-piece Soldier Puzzle

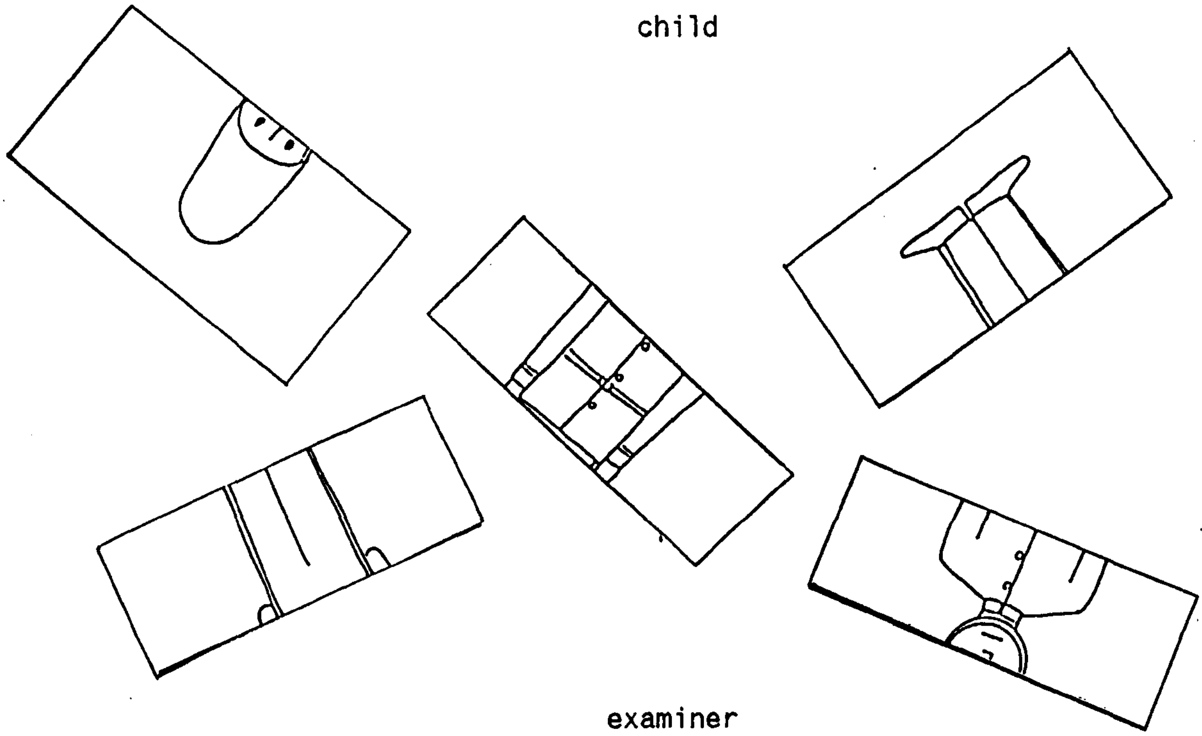
child



examiner

Figure 12.8. Arrangement of pieces for Four-piece Soldier Puzzle

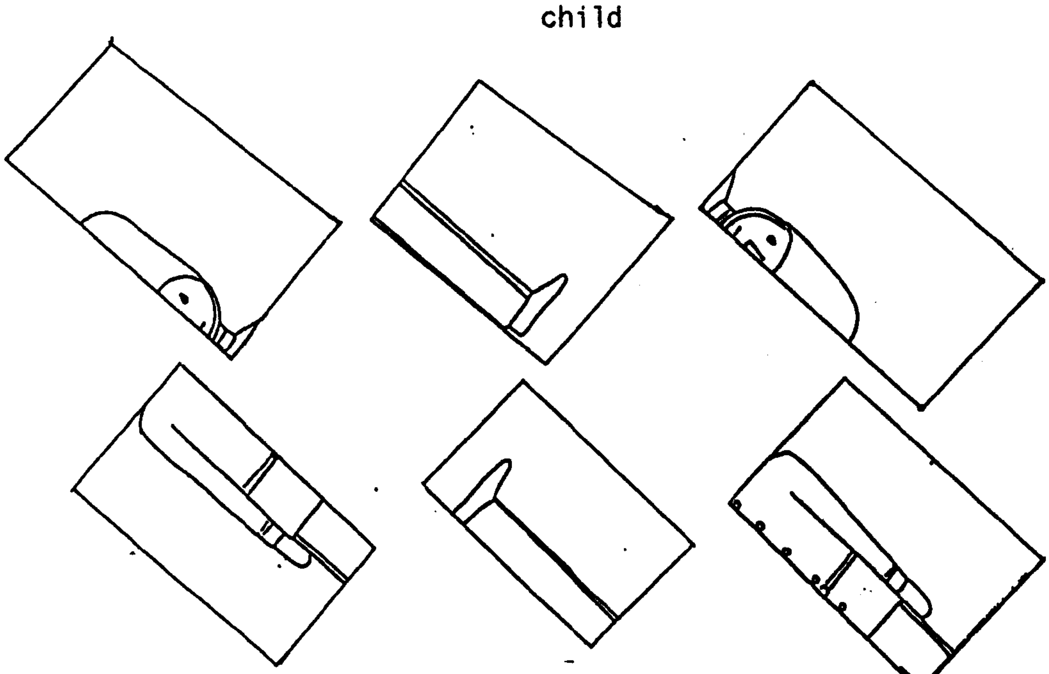
child



examiner

Figure 12.9. Arrangement of pieces for Five-piece Soldier Puzzle

child



examiner

Figure 12.10. Arrangement of pieces for Six-piece Soldier Puzzle

TEST NO. 18. GRADED RINGS

MATERIALS: Set of 16 stacking rings, 4 rings in each colour. (Fig. 12.31.)

DIRECTIONS: Present the ring stacking toy. (Make sure the toy is correctly assembled with the four colours arranged in size order.) Say: "Look at these rings." Hold them in position for a few seconds, then tip them off into a shallow container and mix them up. Demonstrate replacement of the green tower yourself, explaining: "Look, the biggest one goes at the bottom, then the next biggest, then the next biggest and the little one goes on top. Can you put the others back just the same?"

Let the child replace the red, blue and yellow towers.

Score 4 for each tower correct (1 for each ring correctly replaced in sequence, maximum score: 12).

DISCONTINUE only if a child indicates unwillingness to continue with the task. Many children are unable to grade the rings by size, but usually enjoy replacing them on the sticks, often matching the colours correctly. A child with a physical disability may need help with locating the ring over the stick, and such assistance should be provided where necessary, with the child selecting the rings. This is not a test of motor control, and the examiner should not hesitate to assist physically to avoid frustration.

TEST NO. 19. FIGURE-GROUND PUZZLE

MATERIALS: Trainer puzzle (house with inset shapes): picture board and set of shapes. (Figs. 12.32. and 12.33.)

DIRECTIONS: Present the trainer puzzle. Say: "Look, here's another puzzle". Tip out the pieces. Say: "Can you put the pieces back in?" Most children will be familiar with this type of inset puzzle and will not require further prompting. Next present the picture board, saying: "Here's another puzzle a bit like the last one, but there are no holes for the pieces, they just sit on top." If the child wants to talk about the picture, allow him to do so. Present the child with the first piece, the orange rectangle. Say: "Can you show me where this will go?" If the child does not respond or seems confused, show him how the piece fits on top of the orange door, saying: "Look, it's the same."

Remove each piece after the child has made his selection of where it matches. Allow the child to handle the pieces and place them on top of the picture, though he may prefer just to point to the same shape in the picture.

Score 1 for each piece correctly placed.

DISCONTINUE if a child fails all the first five shapes, otherwise proceed, as some children scan only part of the display (in spite of encouragement to look carefully), and may make correct responses in the area they are looking at.

TEST NO. 20 INCOMPLETE PICTURES

MATERIALS: Book of incomplete pictures. (Fig. 12.34.)

DIRECTIONS: Show the child the first picture. Say: "Here's a picture. It's not quite finished. What do you think it will be?" Repeat with similar instructions if required for successive pictures. Show the child the complete picture after each attempt. Praise all efforts. Accept immature pronunciations or approximations, and if a child gives a picture an unusual name, make a note and see if he describes the completed version with the same word. (It may be his idiosyncratic word for that object.) Check with someone who knows the child well if in doubt. Score 1 for each correct response. Note alternative responses.

DISCONTINUE only if the child has no speech or means of communication of the words required (signing, for instance, is acceptable as a response).

TEST NO. 21. WHICH IS DIFFERENT?

MATERIALS: Box of objects. (Fig. 12.35.)

DIRECTIONS: As you arrange the first set of objects on the table say: "I'm going to show you some things. You have to show me the one that is different". Place the four buses and the red car in a line on the table in front of the child as described on the score sheet. Point along the row saying: "Can you show me which one is different; which is not the same as the others?" If the child makes a wrong selection, names all the objects without selecting one, or does not respond, demonstrate: e.g. point to the objects saying: "This is a bus, bus, bus, car, bus. These are all the same. They are buses. This one (car) is not the same. It's a car. It's different."

DISCONTINUE AS FOLLOWS: Present items 2 and 3 whether the child appears to understand or not. If he fails on both these items, try item 6 (coloured lorries). If he still fails, DISCONTINUE the test. Otherwise present all 10 items.

It may be necessary, if you feel the child is making impulsive responses (some even try to respond before all the pieces are in position) to encourage him to slow down and look at all the pieces before making a decision.

ADMINISTRATION OF THE DRAWING TESTS

A booklet of figures must be prepared for each child using a thick black felt pen and a plastic stencil (the frame of a geometrical-shapes inset puzzle manufactured by Ambi Toys was used in the standardisation). A4 sized white matt paper is used for the booklet. The shapes used appear in Fig. 12.36. where for convenience they are all shown on the same page. In the test booklet only one shape appears on each page for the copying part of the test, with space for the child's attempt underneath. At the end of the booklet a number of pages have each shape drawn twice to enable the child to trace the figures if required.

The child is told he is going to do some drawing and is provided with a wallet of six coloured felt pens (Platignum Painting Sticks).

The first page showing a vertical line is displayed and the child asked: "Look, can you draw one like this?"

Scoring: 3 for a good reproduction, reasonably accurate

2 for poor reproduction, but recognisable.

(see Guidelines for Scoring the Drawings, below, for a more detailed explanation).

If the child cannot copy the figure, demonstrate it at the side of the example and allow him to imitate. If the resulting imitation is acceptable, score 1.

Repeat the above presentation for the remaining figures.

If the child is consistently unable to reproduce the figures accurately by copying or imitation, show him the page of figures with two sets of drawings and demonstrate how to trace over the lines of the figures on the top row. Allow the child to trace over the figures on the lower line. These attempts are not scored but may provide an insight into whether the child has difficulties in visualising how to set about reproducing a figure and organising himself to do it, or has problems with motor co-ordination even when the figure is given.

DISCONTINUE after two figures are failed when both copied and traced.

DRAWING A PERSON

Turn to a new page in the book and ask the child to draw his Mummy or Daddy. (If possible try to ascertain through conversation whether the child has both parents at home, as it is important not to cause distress by referring to an absent parent.)

DO NOT PRESENT if the child fails to score on the drawing shapes test. DISCONTINUE if the person drawing clearly lacks form, but allow the child the opportunity to scribble if he wants to.

GUIDELINES FOR SCORING THE DRAWINGS

1. VERTICAL LINE

To score 3 the line should be approximately vertical. Length is unimportant. Score 2 if line is more than 20 degrees from vertical. Try imitation if more than 45 degrees from vertical and score 1 if this results in an improvement.

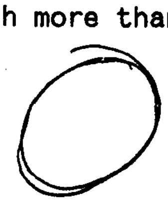
2. HORIZONTAL LINE

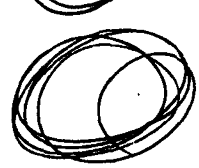
To score 3 the line should be approximately horizontal, length unimportant. Score 2 if more than 20 degrees from the horizontal. Try imitation if more than 45 degrees from horizontal and score 1 if the result improves on the first attempt.

3. CIRCLE

Should be approximately round. May overlap  and need not be quite joined to score 3. 

If oval, with length more than twice the width, score 2

Continuous circle scores 2 

circular scribble scores 0. 

4. CROSS

Score 3 if the intersection is at approximately 90 degrees (each angle must be at least 45 degrees).

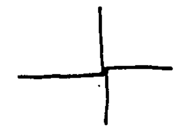
If there is only a short line for one arm (less than 1/4 of the entire arm) score 2. 

If there is a gap in the middle

Score 2.

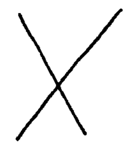
If cross is constructed of four separate lines

rather than two intersecting lines score 2.



If well-constructed but more like a diagonal cross

than a vertical, score 2.



4. SQUARE

Must have four sides.

Angles should be at least 60 degrees and the longest side should not be more than twice the length of the shortest to score 3.

If figure is otherwise acceptable (i.e. 4 lines, angles more than 60 degrees) but one or more lines are very disproportionate (twice the length of others) score 2.

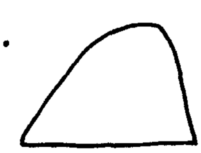
5. TRIANGLE

Must consist of three lines, approximately straight to score 3.

If one or more lines are very wiggly, score 2.

Size of angles and orientation of triangle is unimportant.

A straight line with a curve is unacceptable. e.g.



SCORING THE 'DRAW A PERSON' TEST

A maximum of two points can be given for each feature shown except where otherwise stated. Score 2 if feature is well drawn Score 1 if feature is poorly indicated.

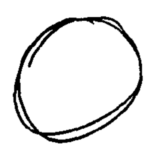
Occasionally extra points may be awarded where indicated.

It is important to bear in mind that this test is intended for pre-school children. The scoring is therefore more liberal than that used in some other tests of a similar nature.

HEAD

Score 2 if drawn round or oval (orientation of oval is unimportant.)

If very scribbly:
score 1.



BODY

Must be bigger than the head and may be oval, round or rectangular to score 2. Score 1 if consists of a single stroke (like a stick figure) or if smaller than the head.

HAIR

If present and carefully drawn (any style or length) score 2. A rudimentary indication (e.g. ) scores 1.

EYES

If two-dimensional, reasonably positioned and of similar size score 2. If overlapping, represented by a dot, of very disproportionate size (one more than twice as big as the other) or if they consist of circular scribble score 1. If there are more than two eyes, or only one in a full-face drawing score 0. (Profile drawings in children younger than five years are extremely rare.)

<u>NOSE</u>

If represented by a triangular shape (any orientation), a circle, or by two approximately parallel lines score 2. Score 1 for a dot or vertical line.

<u>MOUTH</u>

If drawn in two dimensions (i.e. with lips) or if teeth are indicated score 2. Score 1 if a single line, whether straight or curved (smiling or frowning).

<u>EARS</u>

Score 1 if both ears are shown.

<u>NECK</u>

Score 2 if shown in outline, 1 if represented by a single line.

<u>LEGS</u>

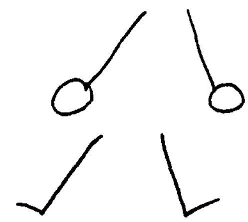
If two legs are shown, each represented by two lines or coloured in solidly (i.e. in two dimensions) score 2. If represented by a single line only, score 1. Score 0 if only one leg shown.

ARMS

If two arms are shown, score 2 if each is represented by two lines or coloured in solidly. If represented by a single line, score 1.

HANDS

If one or both hands are indicated in outline, e.g. score 2. Score 1 if represented by a single line:



FINGERS

Score 2 if the correct number of fingers is represented on either hand. Score 1 if one or more fingers are shown on either hand.

FEET

If two feet are shown with or without shoes, score 2 if outlined, 1 if represented by a single line, as for hands.

ADDITIONAL FEATURES

Two extra discretionary points may be awarded for additional detail or features, eg. buttons, knees, beard, tummy button, etc.

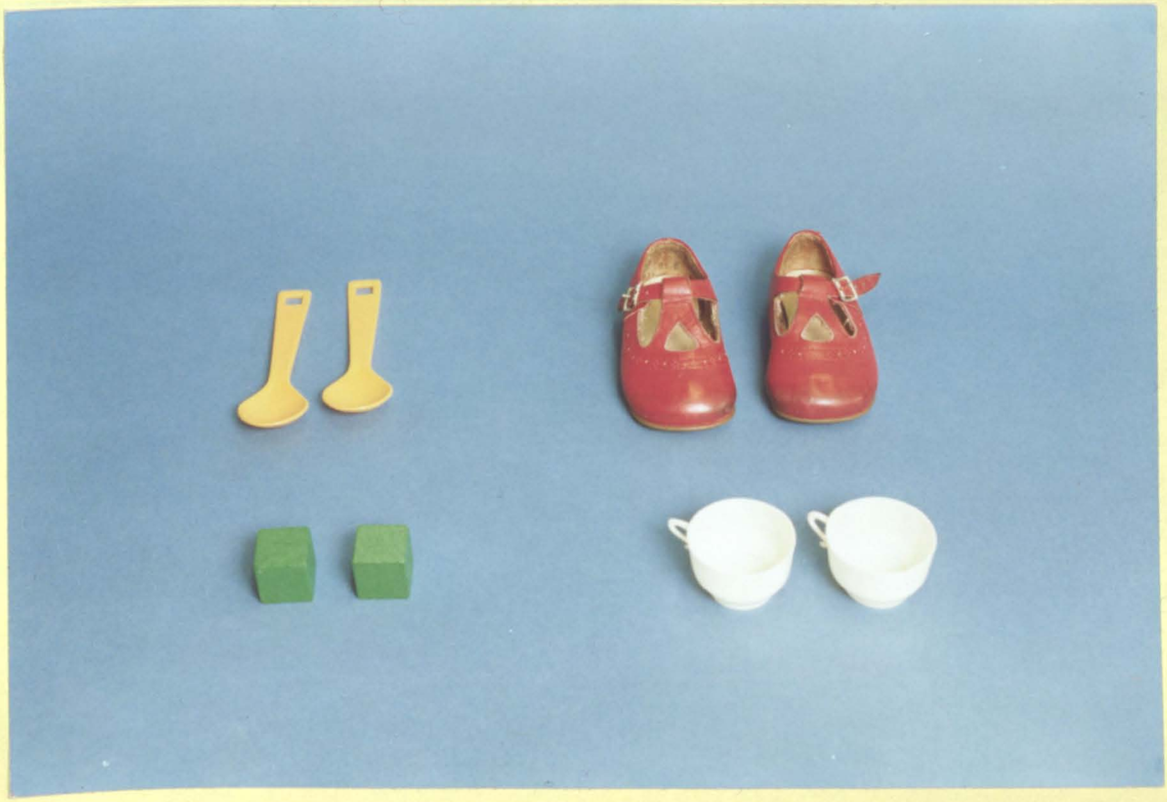


Figure 12.11. Test 1 Matching Coloured Objects

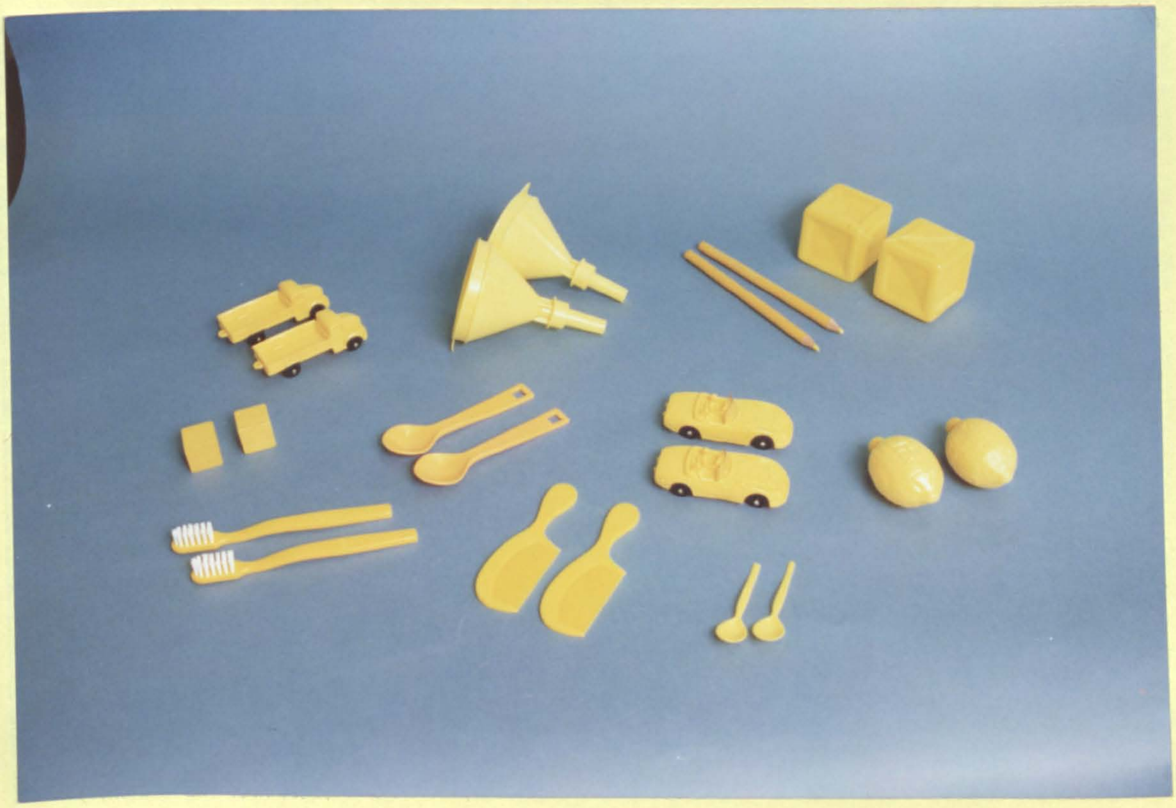


Figure 12.12. Test 2 Matching Yellow Objects

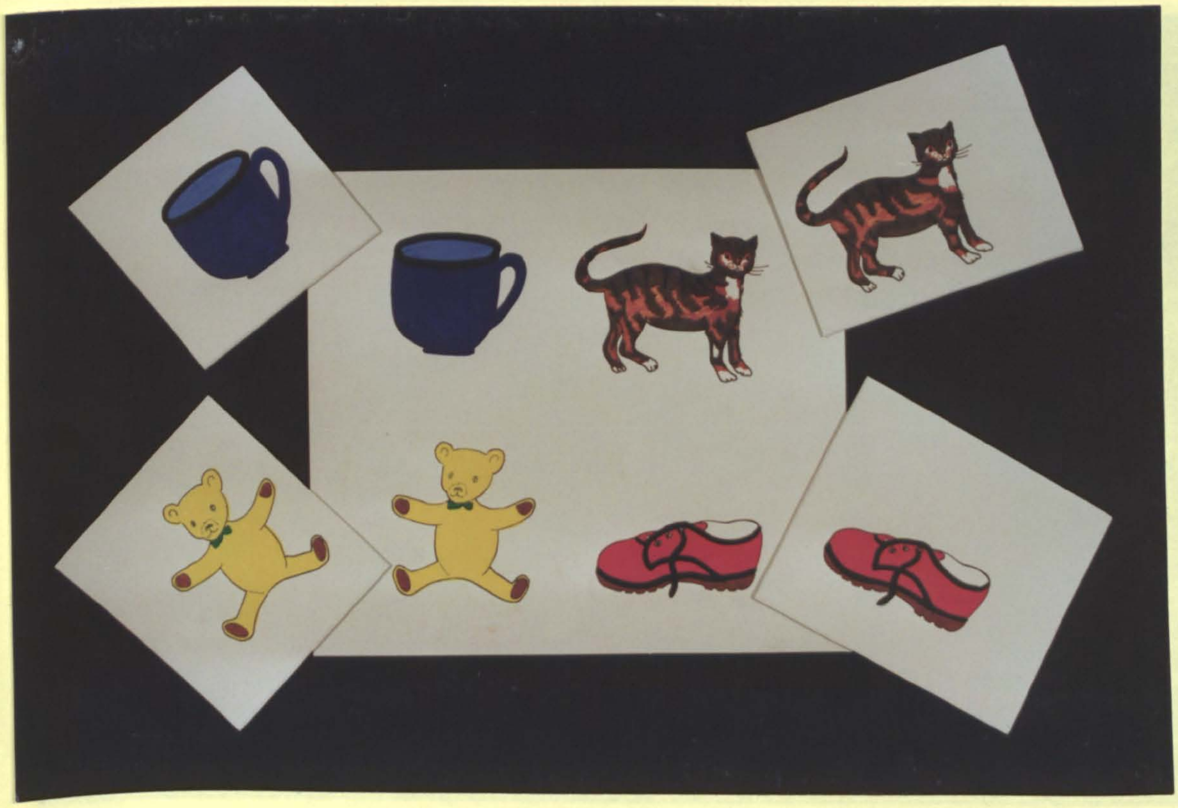


Figure 12.13. Test 3 Matching Coloured Pictures

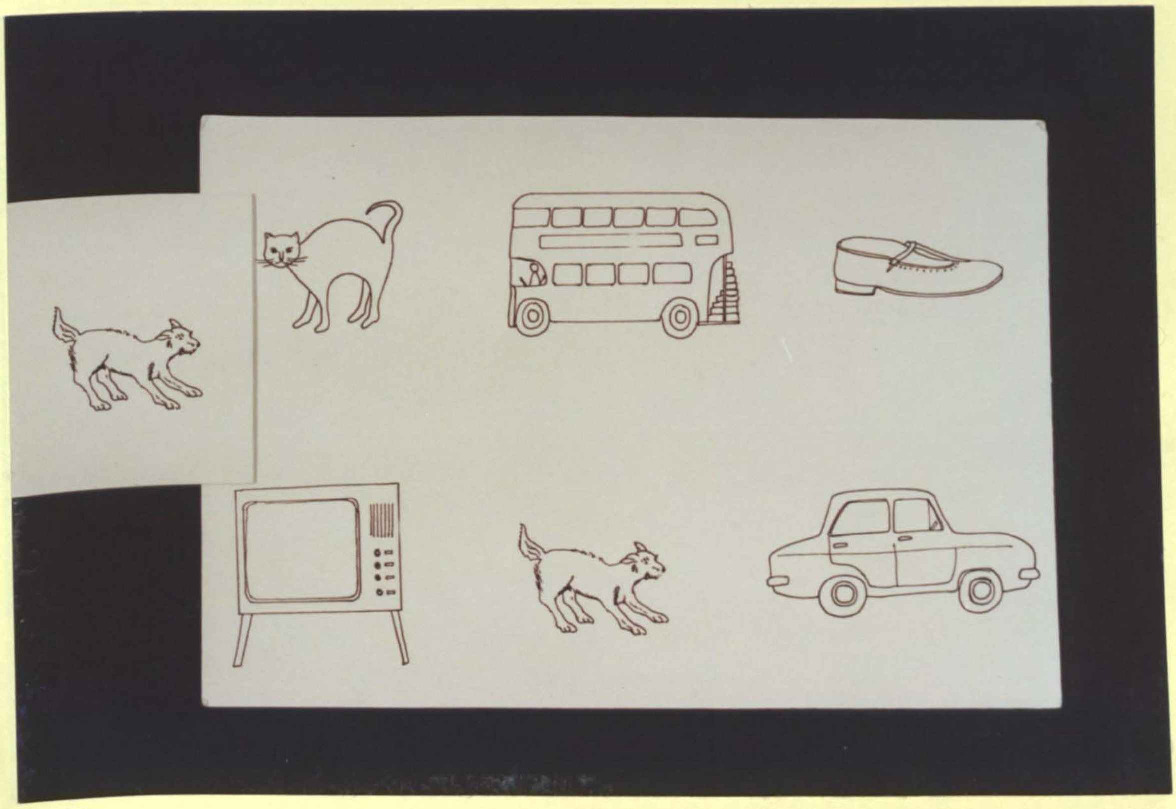


Figure 12.14. Test 4 Matching Black and White Outlines

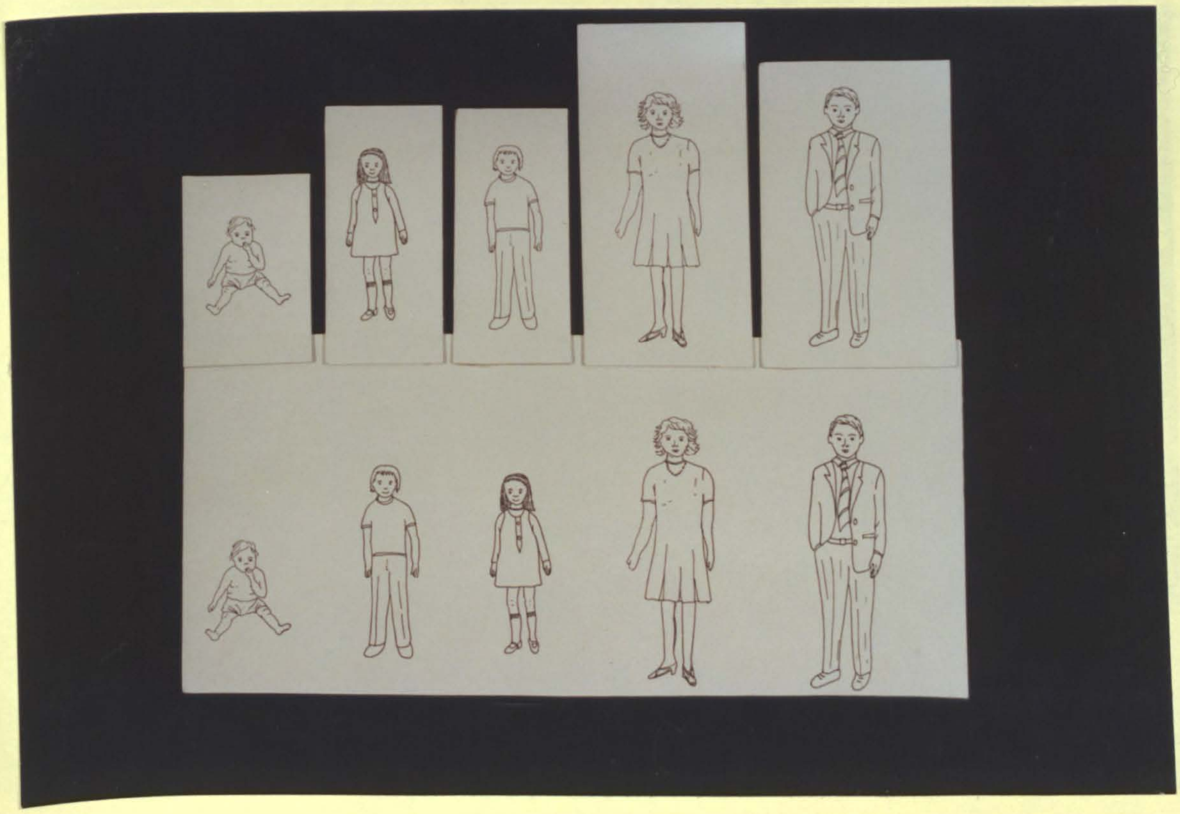


Figure 12.15. Test 5 Matching Family Pictures

Figure 12.16. Test 6 Matching Objects to Photographs
(original version)

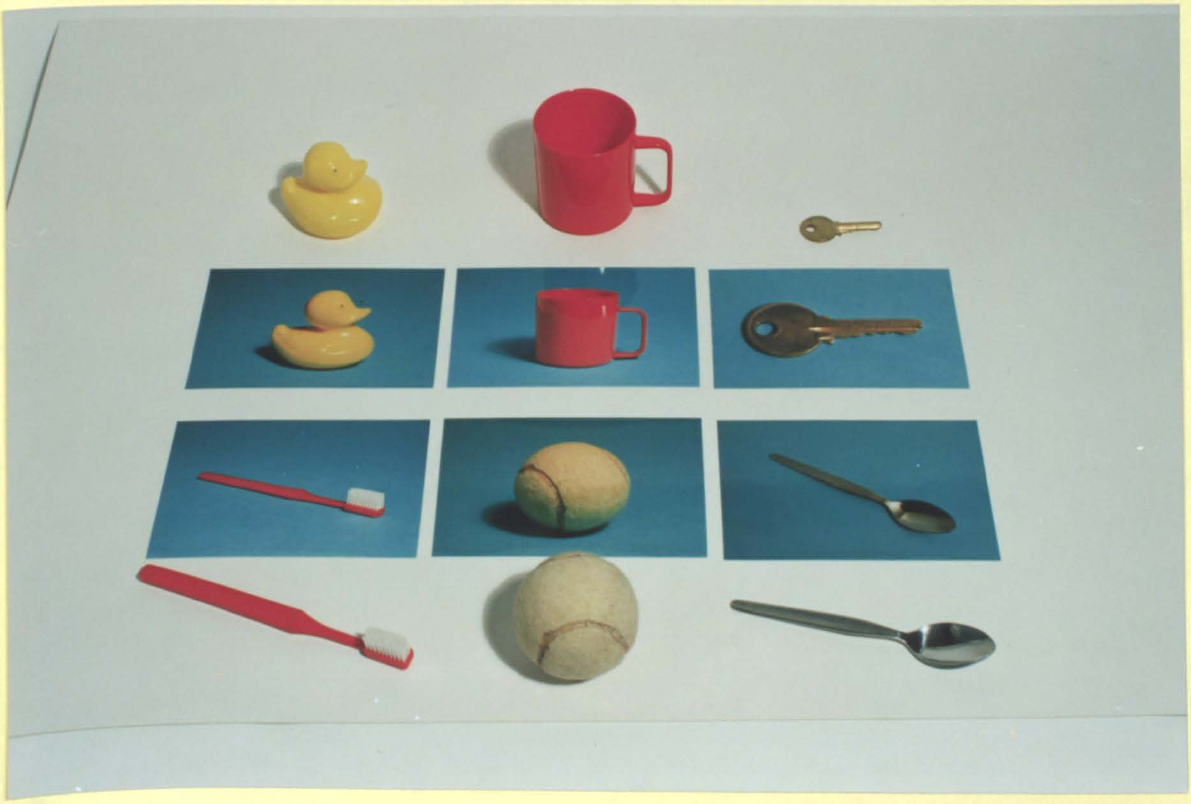


Figure 12.17. Test 6 Matching Objects to Photographs
(revised version)

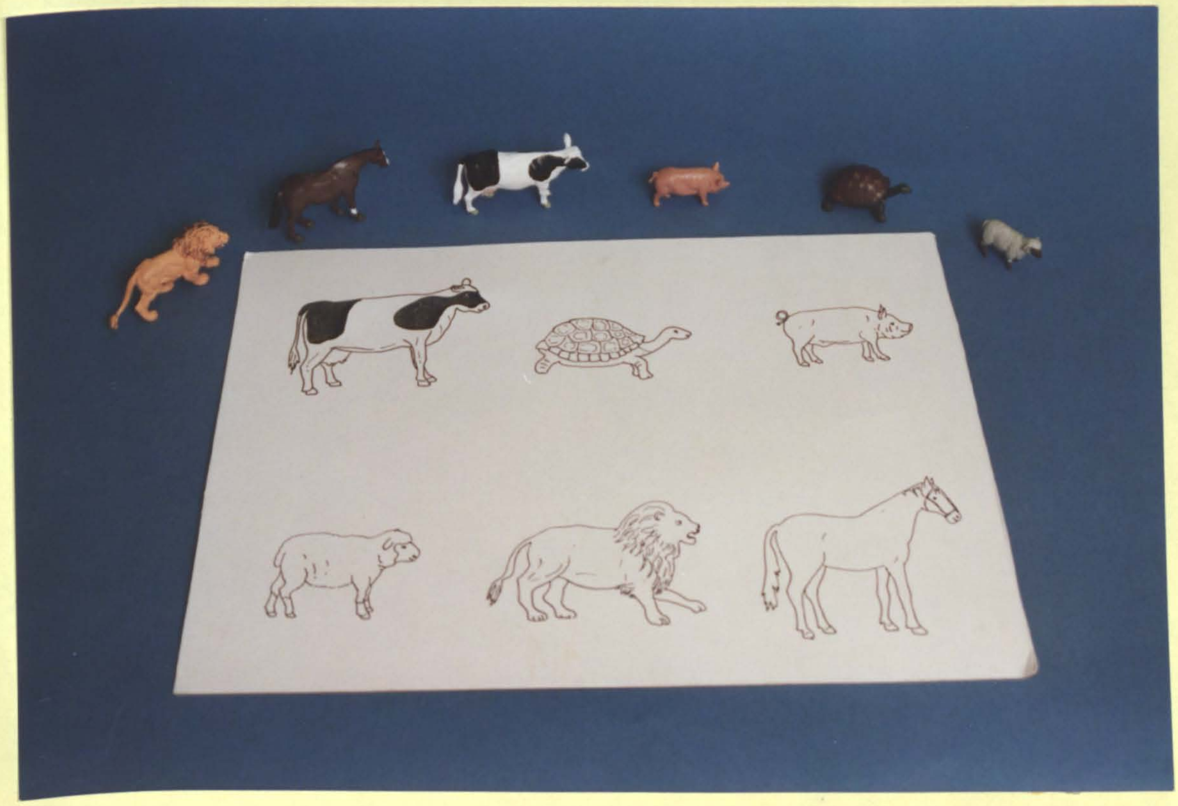


Figure 12.18. Test 7 Matching Miniature Objects to Outline Drawings

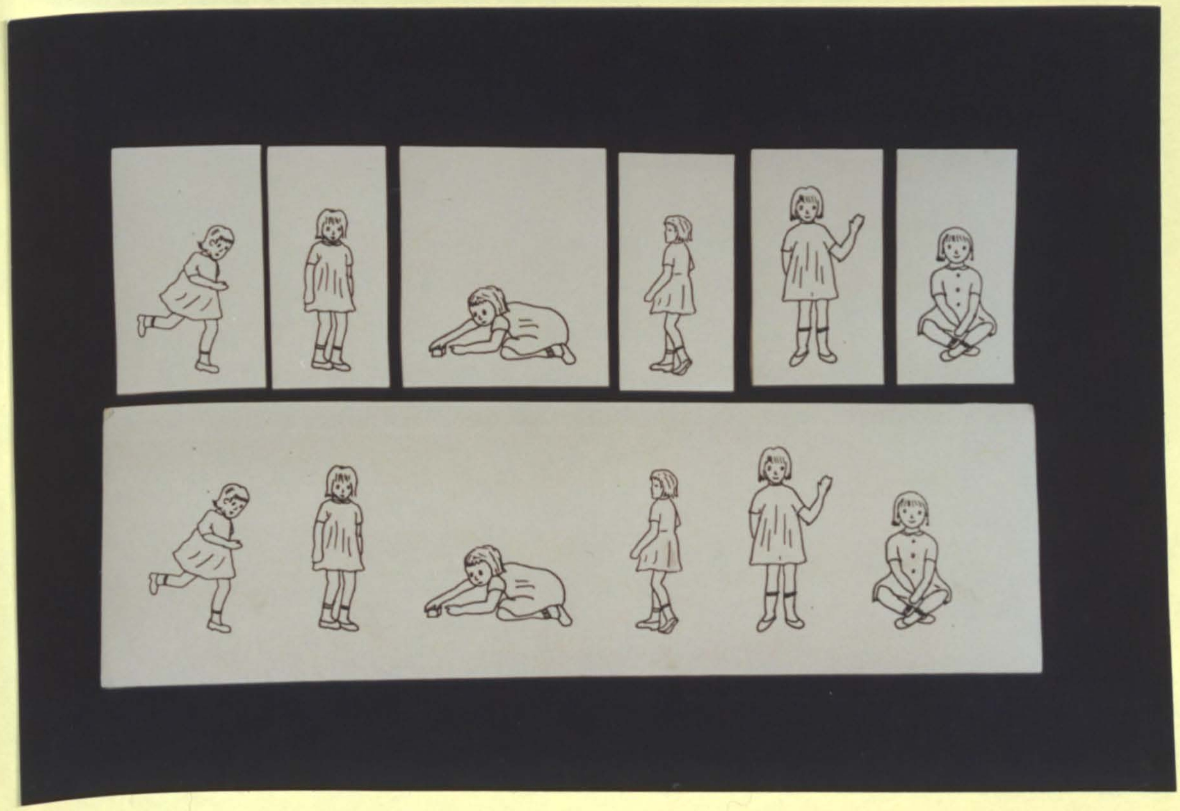


Figure 12.19. Test 8 Matching Girls

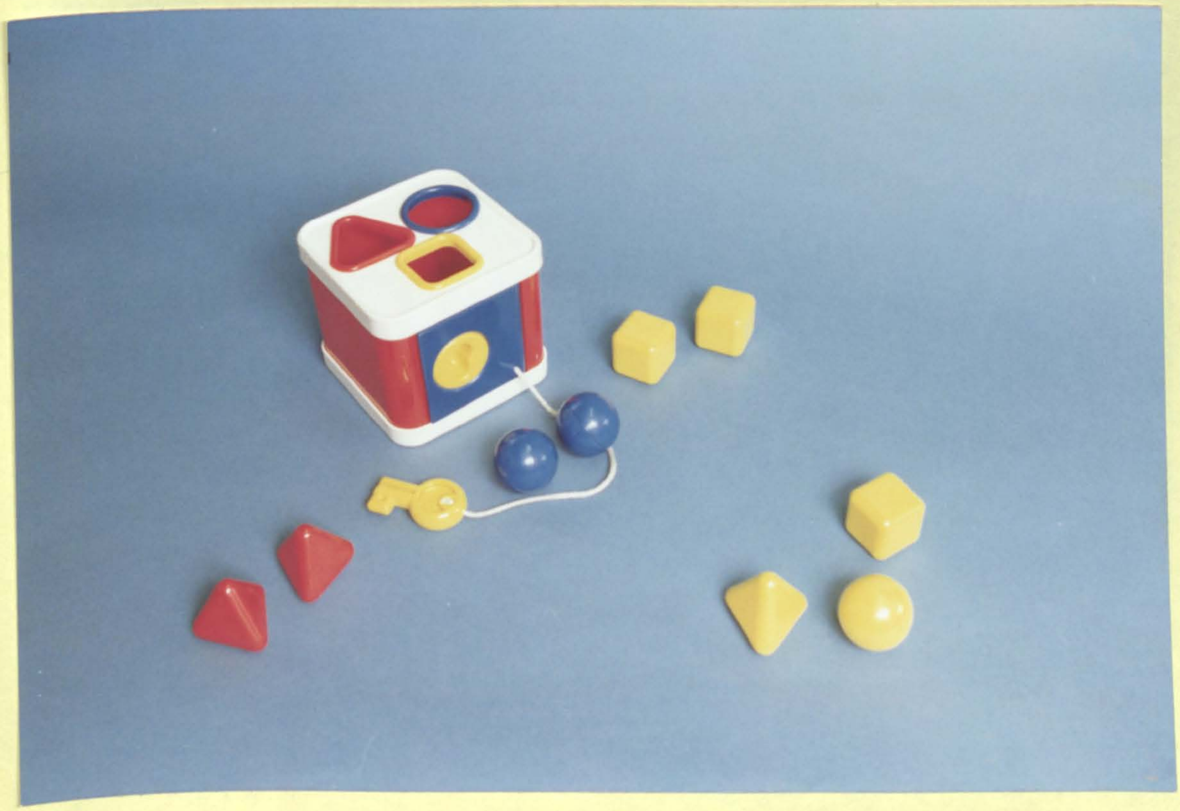


Figure 12.20. Test 9 Three-Hole Posting Box

Figure 12.21. Test 10 Stacking Cups

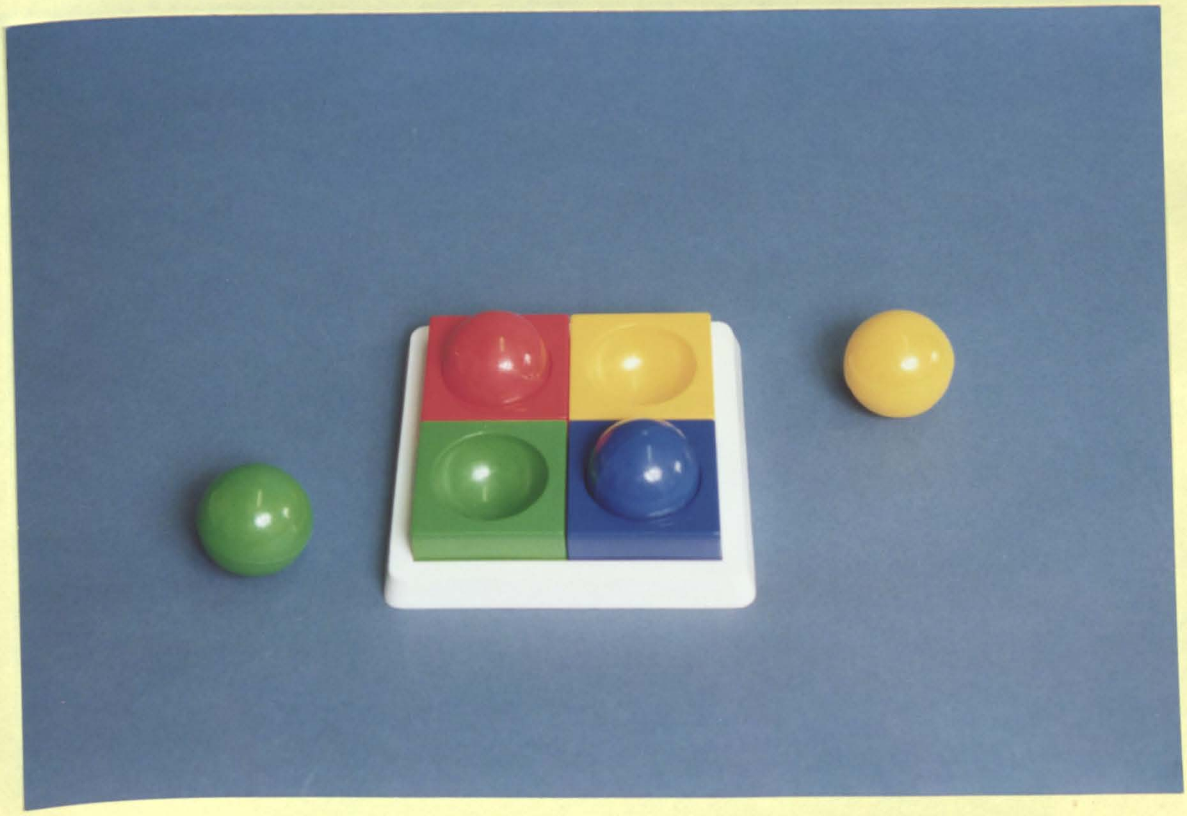


Figure 12.22. Test 11 Colour Matching Balls and Cups

Figure 12.23. Test 12 Peg Towers

Figure 12.24. Test 13 Face Puzzle

Face with features arranged for placement

Figure 12.25. Test 13 Face Puzzle complete

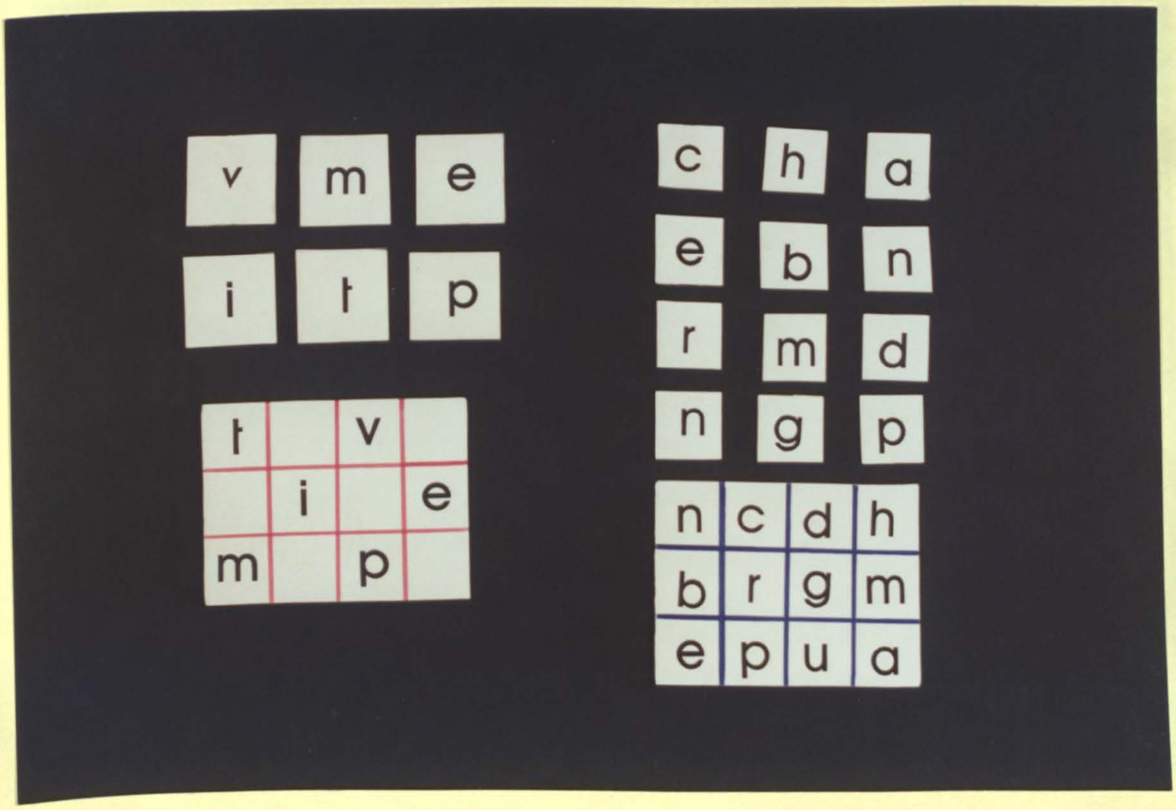


Figure 12.26. Test 14 Letter Matching

Figure 12.27. Test 15 Six-Hole Posting Box

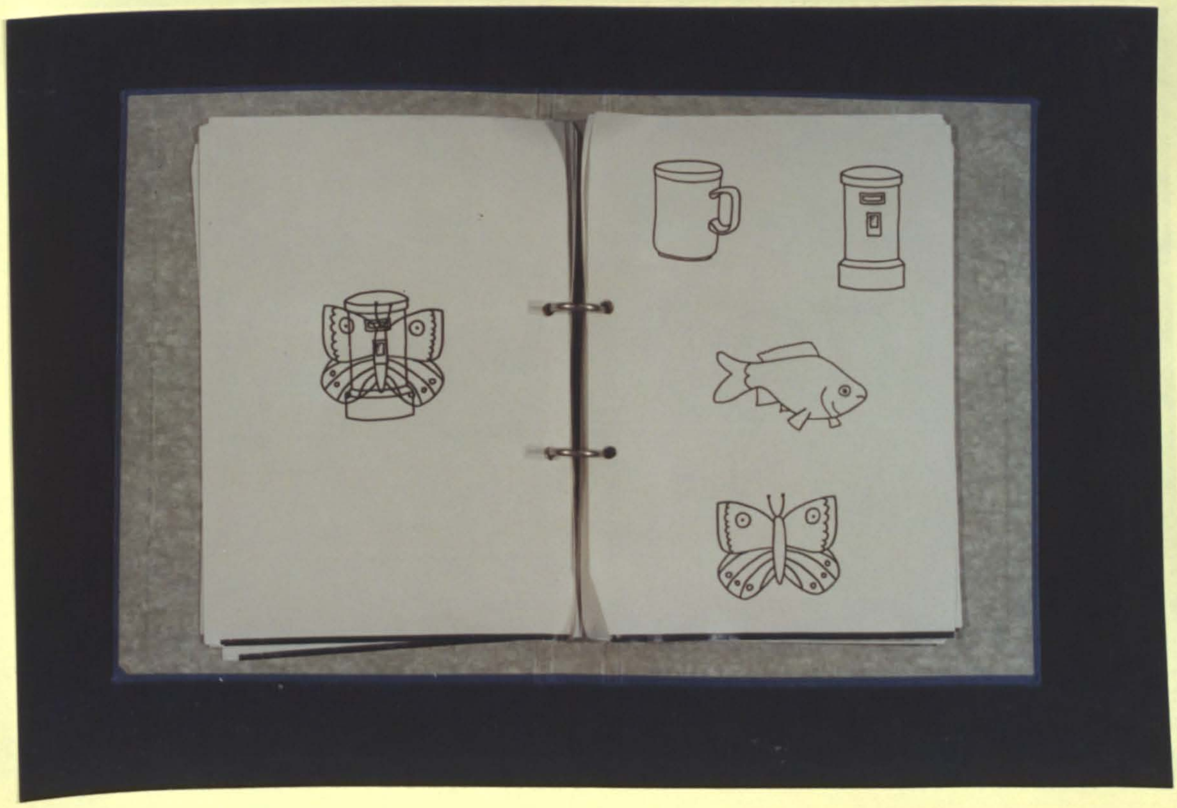


Figure 12.28. Test 16 Superimposed Pictures

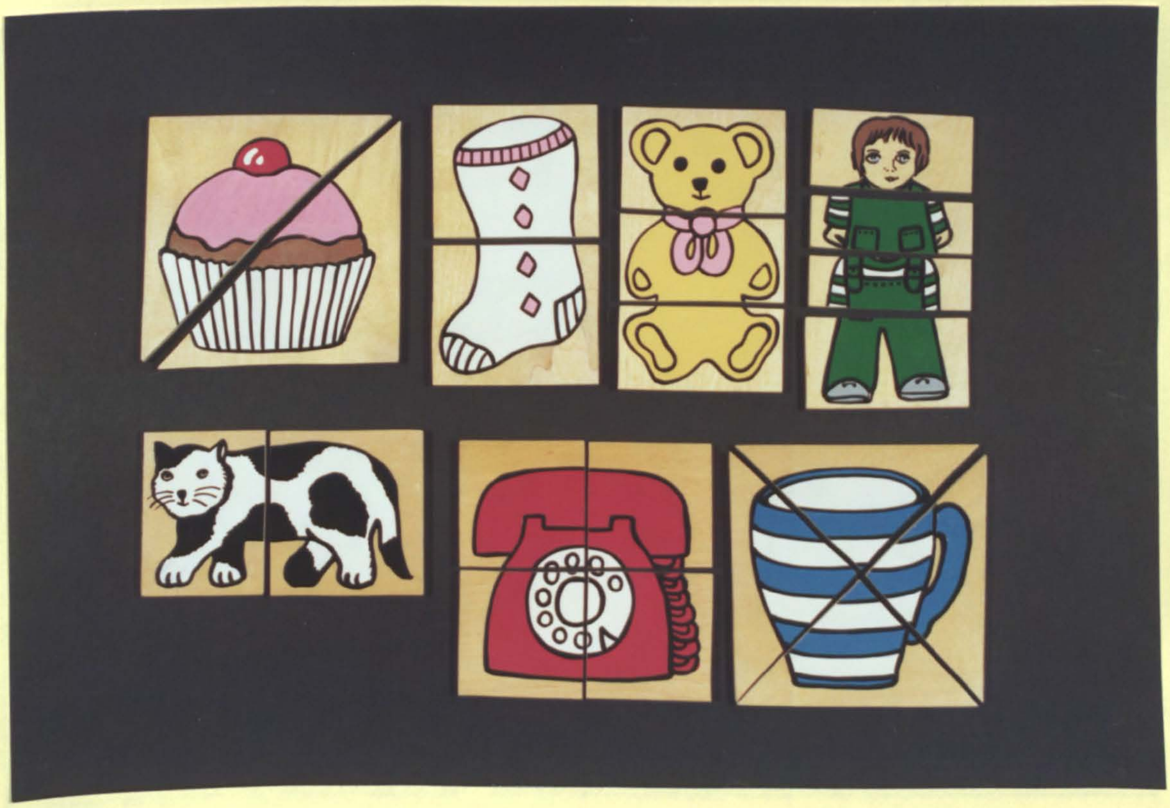


Figure 12.29. Test 17 Puzzles - Wooden Series

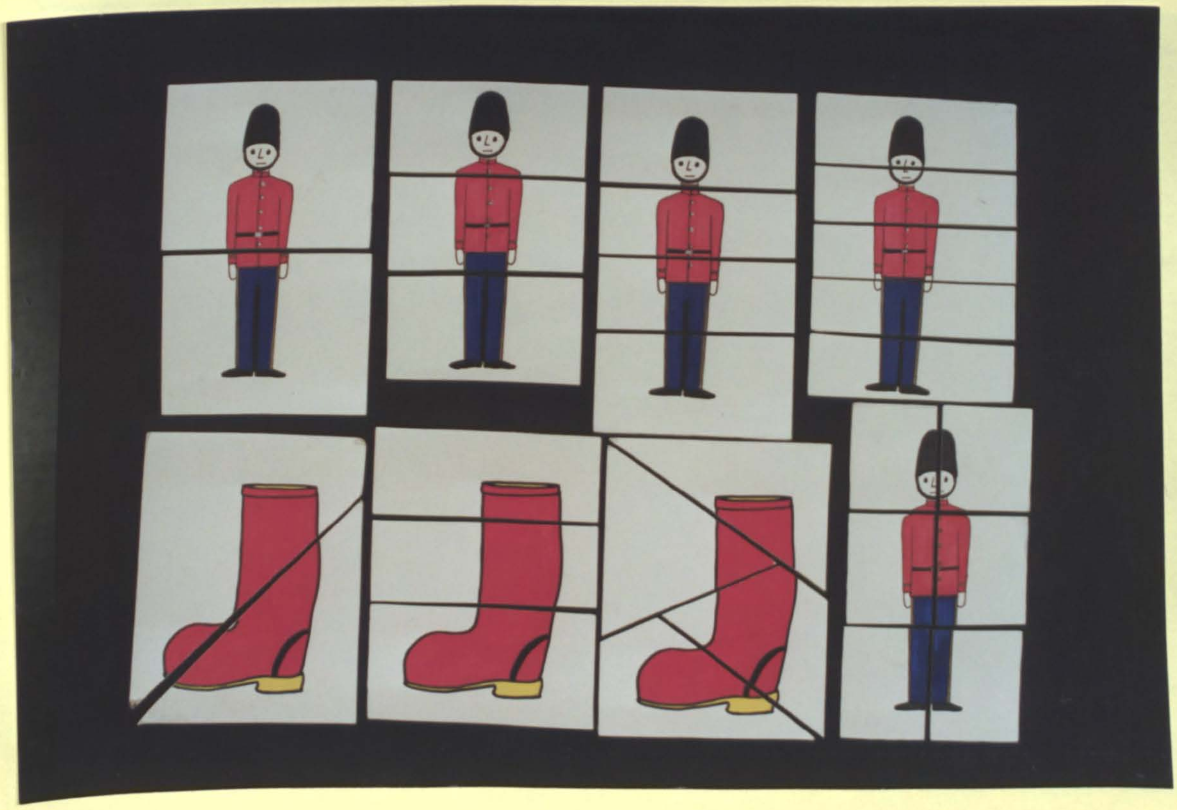


Figure 12.30. Test 17 Puzzles - Card Series

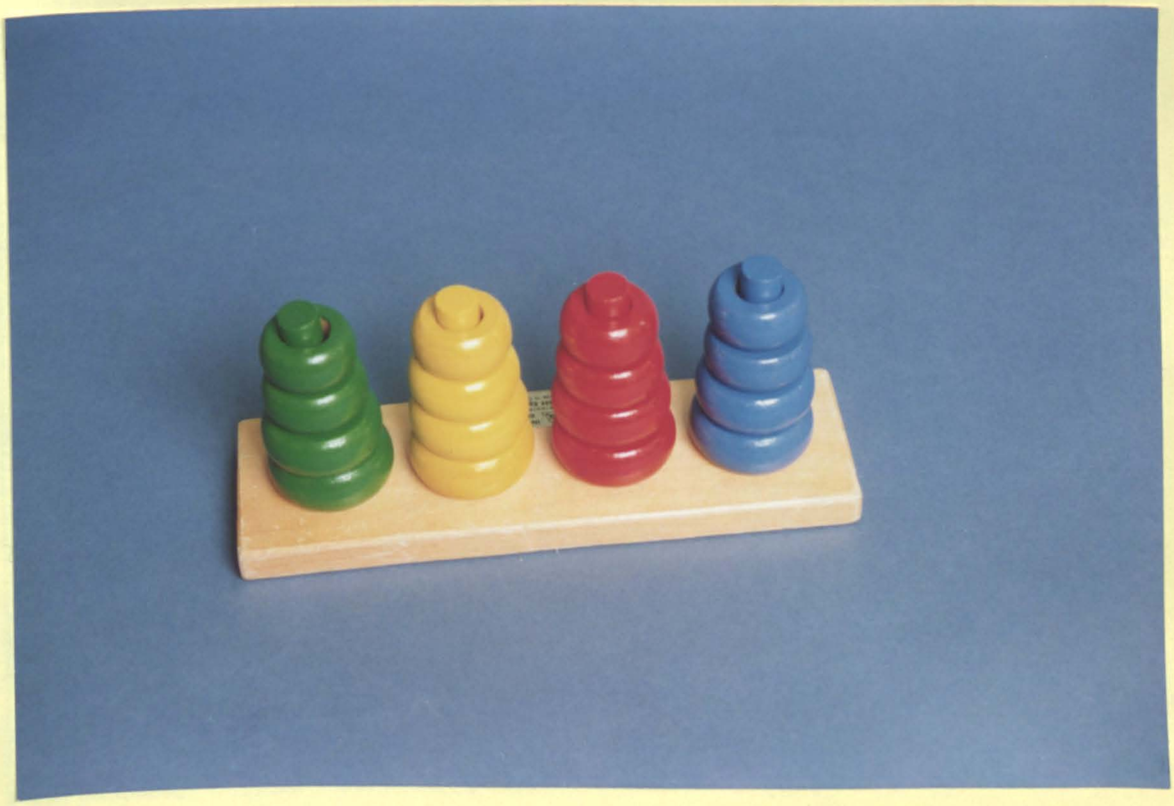


Figure 12.31. Test 18 Graded Rings

Figure 12.32. Test 19 Figure-Ground Puzzle - Training Puzzle

Figure 12.33. Test 19 Figure-Ground Puzzle

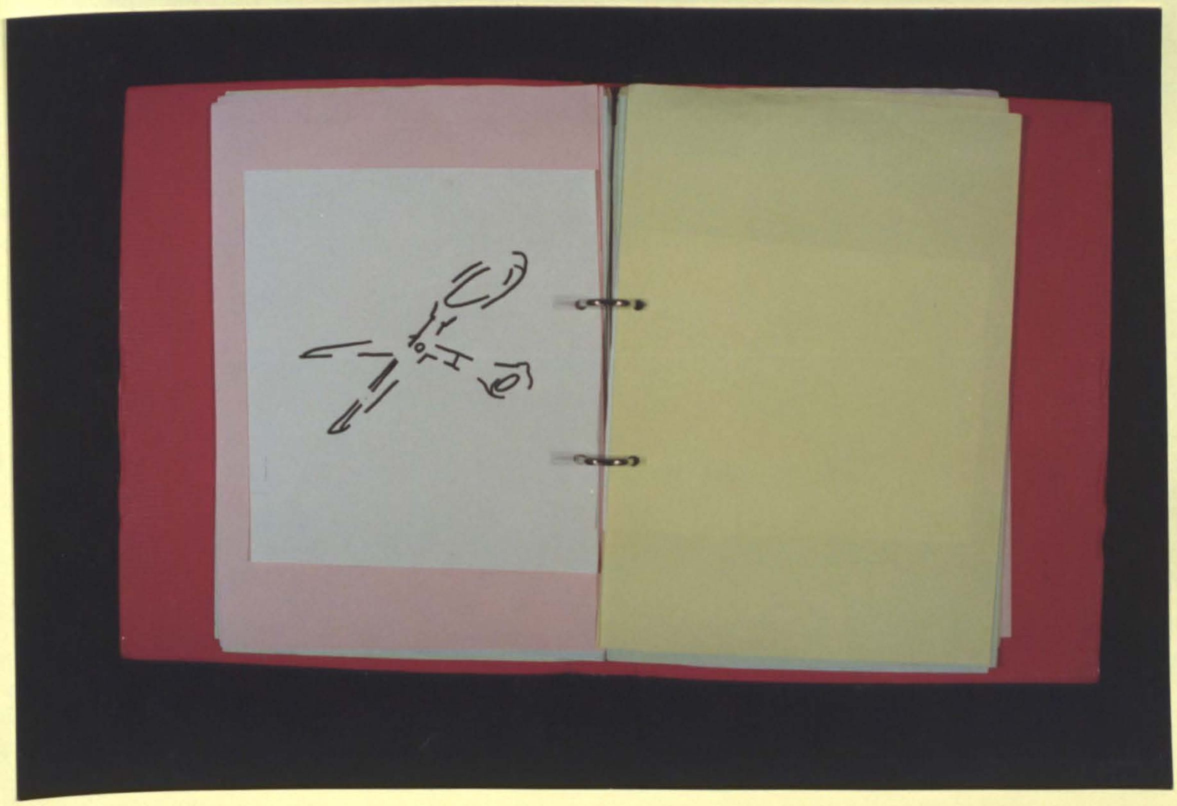


Figure 12.34. Test 20 Incomplete Pictures

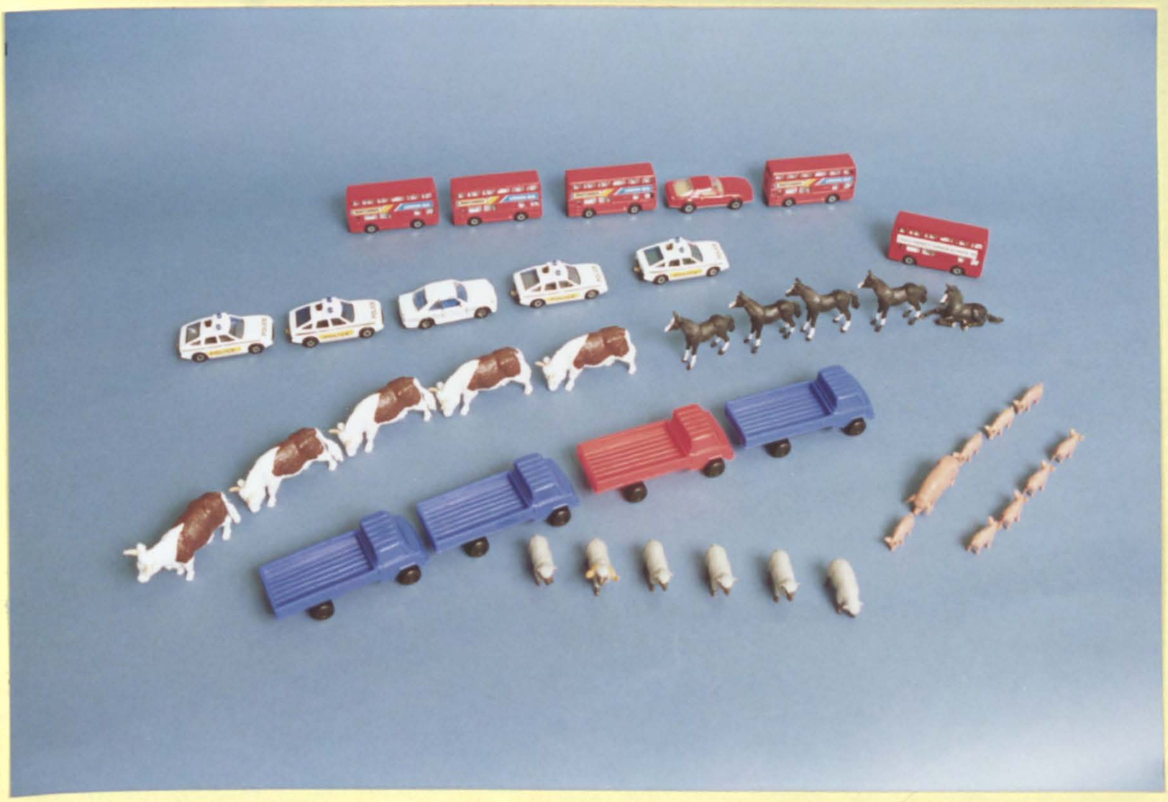


Figure 12.35. Test 21 Which is Different?

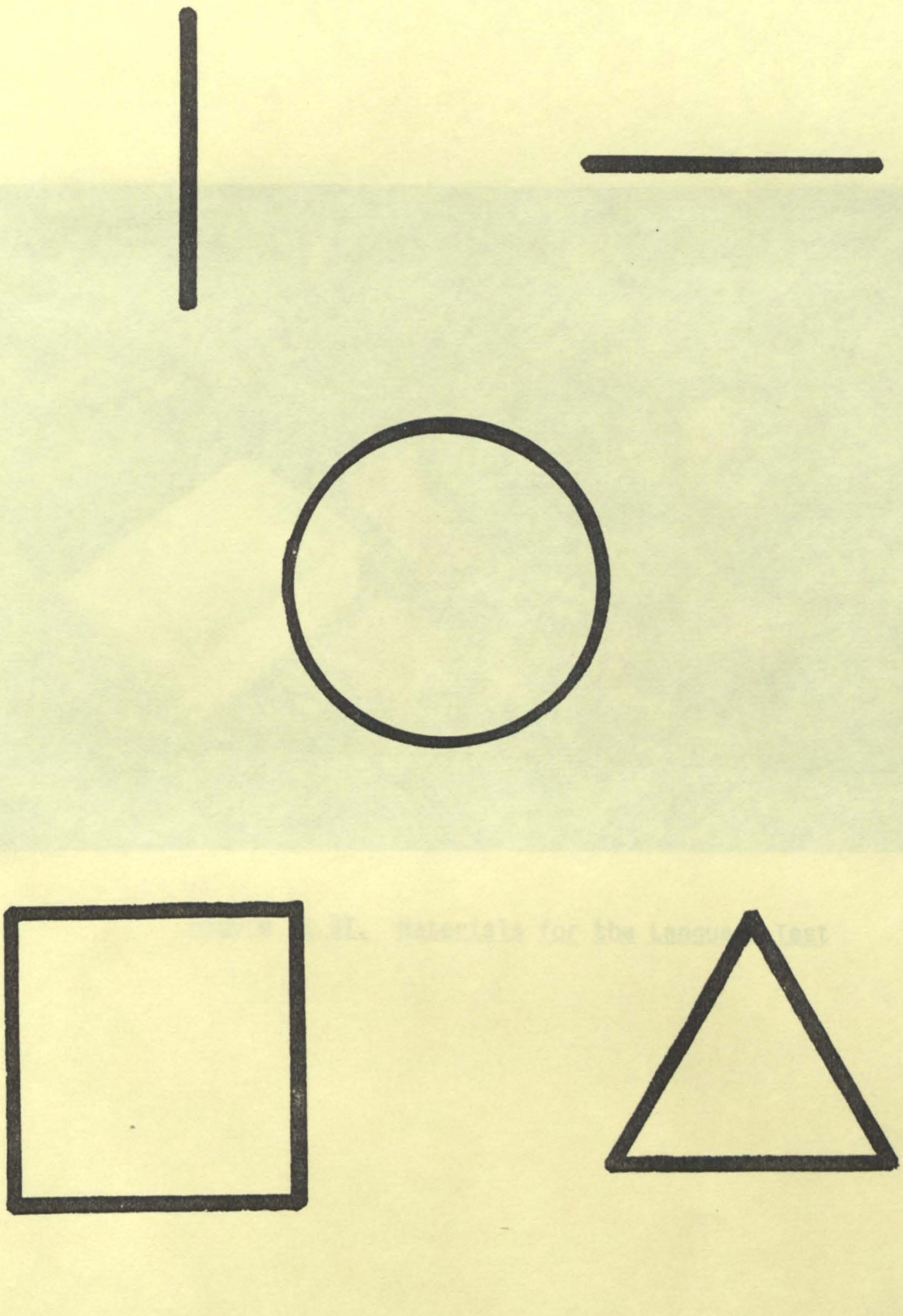


Figure 12.36. Drawing Test - Shapes

Figure 12.37. Materials for the Language Test

THE PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT

SCORE SHEET

NAME OF CHILD ....

AGE ....

DATE OF BIRTH ....

DATE OF TEST ....

SCHOOL ATTENDED ....

TEST 1. OBJECT MATCHING - DIFFERENT COLOURS

Object no.	1	shoe	....	dem req. YES / NO
	2	cup	....	
	3	spoon	....	
	4	brick	....	
		TOTAL	......../4	

TEST 2 OBJECT MATCHING - SAME COLOUR (YELLOW)

Object no.	1	Brick (large)	....
	2	Toothbrush	....
	3	Lemon	....
	4	Funnel	....
	5	Comb	....
	6	Pencil	....
	7	Car	....
	8	Spoon	....
	9	Brick (small)	....
	10	Lorry	....
		TOTAL	......./10

TEST 3. MATCHING COLOURED PICTURES

1	Teddy	....
2	Cat	....
3	Shoe	....
4	Cup	....
	TOTAL	......./4

TEST 4 MATCHING BLACK AND WHITE OUTLINE DRAWINGS

1	Dog	....
2	Car	....
3	Cat	....
4	Shoe	....
5	Television	....
6	Bus	....
	TOTAL	......./6

TEST 5 MATCHING BLACK AND WHITE OUTLINES FAMILY

1	Baby	....
2	Mummy	....
3	Boy	....
4	Daddy	....
5	Girl	....
	TOTAL	......./5

TEST 6 MATCHING OBJECTS TO PHOTOGRAPHS

1	Spoon	....
2	Cup	....
3	Orange	....
4	Toothbrush	....
5	Pig	....
6	Soap	....
	TOTAL	......./6

TEST 7 MATCHING MINIATURE OBJECTS TO OUTLINE DRAWINGS (ANIMALS)

1	Cow	....
2	Lion	....
3	Pig	....
4	Tortoise	....
5	Horse	....
6	Sheep	....
	TOTAL	......./6

TEST 8 MATCHING GIRLS

1	Girl building	....
2	Waving	....
3	Running	....
4	Walking	....
5	Sitting	....
6	Standing	....
	TOTAL	......./6

TEST 9 THREE-HOLE POSTING BOX

Score 2 for each piece replaced without trial and error

" 1 " " " tried in an incorrect hole before correct placement

" 0 " " " tried in 2 holes before correct placement

	1st piece	2nd piece
Round	....	....
Square	....	....
Triangle	....	....

Yellow pieces - 2 for correct placement
1 for trial in incorrect yellow hole
0 for trial in incorrect different coloured hole before correct placement

Round ....

Square ....

Triangle ....

TOTAL ..../18

TEST 10. STACKING CUPS

DIRECTIONS
Build a red tower of 3 cups for the child, talking about building the tower, but not about the size grading aspect.

Dismantle the tower and present the cups, placing them

small large medium

in front of the child. Say "Now you do it".

Score 3 if successful at the first attempt
2 if trial and error, self corrected, is used
1 if he requires a further demonstration, but is then successful.

....

Leave the red cups in place.
Present the blue cups, placing them

large small medium

Say "Let's build another tower". Don't name the colours.

Score 3 if successful at the first attempt
2 for success after trial and error

....

Present the green cups on their sides so that the child has to work out the orientation.

Score 3 for success
2 if trial and error is used
1 if the child orientates the cups but does not build a tower.

....

Present the yellow cups upside down.

Score 3 for success
2 for correct building using trial and error strategies
1 orientates cups but does not build tower successfully
1 nests cups

....

TOTAL ....../12

Colour recognition check: red.... yellow.... green.... blue....

TEST 11. COLOUR MATCHING BALLS AND CUPS

Balls to be arranged as directed.

Child replaces successfully score 4 ....

Successful after demonstration score 2 ....

Note other behaviours.........................

TEST 12. COLOUR MATCHING PEG TOWERS

Present pegs from child's left to right:
red, yellow, black, green, white, blue.

1. Child colour matches, no trial and error. Score 6 ....

Observe whether he:
a) selects all the same colour to build one tower at a time ....
b) takes pegs at random from the box and allocates them to the appropriate tower. ....

2. Child places one or two pegs incorrectly and seems satisfied with their placement. If he places a peg wrongly and goes to get another from the box, say "Do you think this is right?"(pointing). Allow him to correct it and proceed with the task.

DEDUCT ONE POINT FOR EACH PEG YOU HAVE TO CORRECT ....

4 If a child places more than six pegs incorrectly, teach the task if he still seems interested, otherwise discontinue.

SCORE 0 ....

5. If the child starts off well but does not have the perseverance to complete the task, which requires quite a lot of concentration, make a note and deduct the number of unplaced pegs from 6.

TOTAL ....../6

TEST 13. FACE PUZZLE

Assemble face, naming features. Allow child to assemble face.
Score 0, 1 or 2 according to administration directions.
If child's construction is
interesting make a simple
sketch here for later
reference. SCORE:....../2

TEST 14. LETTER MATCHING

1 SIMPLE LETTER MATCHING

1. v	2. m	3. e ....
4. i	5. t	6. p ....

TOTAL ....../6

2 COMPLEX LETTER MATCHING - note errors in second column

1. c	....	....
2. h	....	....
3. a	....	....
4. e	....	....
5. b	....	....
6. u	....	....
7. r	....	....
8. m	....	....
9. d	....	....
10. n	....	....
11. g	....	....
12. p	....	.... TOTAL ..../12

TOTAL CORRECT FOR BOTH SIMPLE AND COMPLEX LETTER MATCHING ...../18

Scoring for error pattern analysis (not included in total test score):
Score 2 for correct match. Score 1 for reversal or orientation error
(b d p / n u) and similarity confusion (a d /n h).

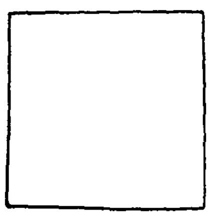
Total for complex letter matching only: ....../24

TEST 15. SIX-HOLE POSTING BOX

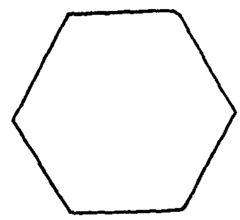
Score 2 if child places piece straight in.

Score 1 if child has an orientation problem with the correct hole only.

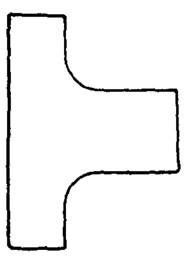
Score 0 if a piece is tried in an incorrect hole, even if subsequently placed correctly.



SCORE ....



SCORE ....



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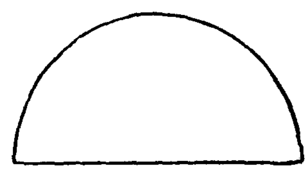

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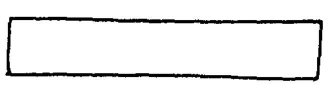

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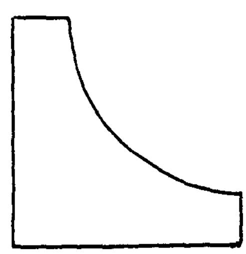


....

TOTAL ..../12

TEST 17. PUZZLES

WOODEN SERIES		CARDBOARD SERIES	
1. Bun (2 pieces)	......	SOLDIER 2 pieces	......
2. Cat (2 pieces)	......	3 pieces	......
3. Sock (2 pieces)	......	4 pieces	......
4. Teddy (3 pieces)	......	5 pieces	......
5. Boy (4 pieces)	......	6 pieces	......

TOTAL NUMBER OF PUZZLES COMPLETE ..../10

TEST 18. GRADED RINGS

Score 1 for each piece placed in the correct position (irrespective of the position of other pieces).

TOTAL ..../12

TEST 19. SHAPE MATCHING FIGURE GROUND PUZZLE

TRAINER PUZZLE - all five pieces correct ....

		correct	if wrong, confused with which shape?
1.	Orange door	....	....
2.	Square black window	....	....
3.	Pram base	....	....
4.	Sun	....	....
5.	Car wheel	....	....
6.	Pram hood	....	....
7.	Oval black window	....	....
8.	Pram wheel	....	....
9.	White gable end (triangle)	....	....
10.	Red traffic light	....	....

TOTAL ..../10

TEST 20. INCOMPLETE PICTURES

1.	Teddy bear	....	6.	Bird	....
2.	Dog	....	7.	Scissors	....
3.	Cat	....	8.	Egg	....
4.	Shoe	....	9.	Toothbrush	....
5.	Cup	....	10.	Fish	....

TOTAL ....../10

TEST 21. WHICH IS DIFFERENT?

Sequence of items is from the examiner's (E's) left to right. Refer to Fig. 12.35, (p. 268) for illustration of presentation (though items are not, of course, presented all together!)

1. 4 buses, 1 red car (all facing E's right)
   bus, bus, bus, car, bus. .... Dem req. yes / no
2. 4 police cars, 1 white car (facing E's right)
   police, police, white, police, police ....
3. horses - 4 standing, 1 sitting (facing E's left)
   standing, standing, standing, standing, sitting ....
4. sheep - 4 with heads up + 1 ram (facing child)
   sheep, ram, sheep, sheep, sheep. ....
5. cows - 4 eating, 1 with head up (facing E's right).
   head up, eating, eating, eating, eating. ....
6. 3 blue lorries, 1 red (facing E's right)
   blue, blue, red, blue ....
7. 4 sheep with heads up, 1 sheep eating, (facing E's left)
   head up, head up, head up, head up, eating. ....
8. 4 small pigs eating, 1 large pig eating, (facing E's left)
   small, large, small, small, small. ....
9. 4 small pigs head up, 1 small pig eating, (facing E's right)
   eating, head up, head up, head up, head up. ....
10. red buses, one with different advertisement on the side (facing E's left)
    same, same, same, different, same. ....

TOTAL ..../10

DRAWING TEST

Score 3 for a good copy, 2 for "poor" copy, 1 for a reasonable imitation.

Vertical stroke	....
Horizontal stroke	....
Circle	....
Cross	....
Square	....
Triangle	....
TOTAL	......../18

HAND USED left / right

PREFERRED EYE left / right

Compare tracing with copied designs - does the child seem to find it much easier to trace shapes than copy or imitate them?

DRAW MUMMY OR DADDY

Score 2 if part is well drawn, 1 if poorly indicated. (Refer to administration directions for detailed scoring instructions.)

Head	....	Legs	....
Body	....	Arms	....
Hair	....	Feet	....
Eyes	....	Hands or fingers	....
Nose	....	Ears	....
Mouth	....	Other features (name)	....

TOTAL ....../24

PRE-SCHOOL VISUAL PERCEPTION ASSESSMENT TOTAL SCORES

CHILD'S NAME:.................................

		RAW SCORE	SCALED SCORE	10% CRITERION SCORE	BELOW CRITERION?
Test 1	OBJECT MATCH				
2	YELLOW OBJECTS				
3	PICTURE MATCH				
4	OUTLINE MATCH				
5	FAMILY				
6	PHOTOS				
7	ANIMALS				
8	GIRLS				
9	3-HOLE POSTING				
10	STACKING CUPS				
11	BALLS & CUPS				
12	PEG TOWERS				
13	FACE				
14	LETTERS				
15	6-HOLE POSTING				
16	SUPERIMPOSED PICTURES				
17	PUZZLES				
18	GRADED RINGS				
19	SHAPE PUZZLE				
20	INCOMPLETE PICTURES				
21	WHICH IS DIFFERENT?				
	TOTAL				

SCORING THE TEST

1. Total the raw score for each sub-test and enter in the space provided at the end of the individual sub-tests.

2. Enter the raw scores in the columns on the last page of the score sheet.

3. If you only need to know how many items a child has passed, (i.e. scored above the 10% criterion level), enter the criterion scores for the appropriate age group, to the nearest half year, from Table 12.4. (p. 304) in the column headed 'Criterion Score' and compare the two scores. Mark X in the column headed 'Below Criterion' if the child's score falls below this.

4. If you wish to calculate a total score for the test, convert the raw scores to standard (scaled) scores using Table 12.1. (p.285) and total.

5. A visual comparison can be made by entering the standard scores for each sub-test onto the bar charts in Figures 12.38 to 12.42, pages 314-319.

LANGUAGE TEST

Name .... Age .... D.O.B. ....
School .... D.O.T. ....

Materials	cup, plate, spoon, knife, box, Mummy, Daddy, baby table, chair, bed (dolls' house size), brick	
1 Word level	Check vocabulary if necessary - mainly to gain child's co-operation and confidence.	
2 Word level	Use cup, plate, spoon.	
object: place	1. Put the spoon in the cup	_____
	2. Put the cup on the plate	_____
	add Mummy, Daddy, bed	
possessive	3. Show me Mummy's hair	_____
	4. Show me Daddy's feet	_____
moving object	5. Put Daddy on the bed	_____
	6. Give the cup to Mummy	_____
	add chair & table	
3 Word level	7. Put Mummy on the table	_____
preposition & moving object	8. Put the spoon under the bed	_____
	9. Make Daddy stand on the chair	_____
	add baby, knife, brick & box	
4 Word level	10. Make baby lie down under the table	_____
	11. Make Mummy sit on the bed	_____
	12. Put the spoon & the knife on the plate	_____
	13. Put the cup & the table in the box	_____
	14. Put the chair in the box & the knife in the cup	_____
5 Word+ level	15. Put the brick under the cup & give the plate to Mummy	_____
	16. Put Mummy and the baby in the box & put the cup under the bed	_____
	TOTAL CORRECT	_____

TABLE 12.1.

STANDARD SCORES

TEST 1. MATCHING OBJECTS

Raw Score	Standard Score
1	5
2	10
3	15
4	20

TEST 2. MATCHING YELLOW OBJECTS

Raw Score	Standard Score
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20

TEST 3. MATCHING COLOURED PICTURES

Raw Score	Standard Score
1	5
2	10
3	15
4	20

TABLE 12.2. (Cont.)

TEST 4. MATCHING OUTLINES

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TEST 5. MATCHING FAMILY

Raw Score	Standard Score
1	4
2	8
3	12
4	16
5	20

TEST 6. MATCHING OBJECTS TO COLOURED PICTURES

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TEST 7. MATCHING MINIATURE OBJECTS TO OUTLINE DRAWINGS

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TABLE 12.2. (Cont.)

TEST 4. MATCHING OUTLINES

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TEST 5. MATCHING FAMILY

Raw Score	Standard Score
1	4
2	8
3	12
4	16
5	20

TEST 6. MATCHING OBJECTS TO COLOURED PICTURES

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TEST 7. MATCHING MINIATURE OBJECTS TO OUTLINE DRAWINGS

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TABLE 12.1 (Cont.)

TEST 8. MATCHING GIRLS

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TEST 9. THREE-HOLE POSTING BOX

Raw Score	Standard Score
1	1
2	2
3	3
4	4
5	6
6	7
7	8
8	9
9	10
10	11
11	12
12	13
13	14
14	15
15	17
16	18
17	19
18	20

TABLE 12.1. (Cont.)

TEST 10. STACKING CUPS

Raw Score	Standard Score
1	2
2	3
3	5
4	7
5	8
6	10
7	12
8	13
9	15
10	17
11	18
12	20

TEST 11. BALLS AND CUPS

Raw Score	Standard Score
1	5
2	10
3	15
4	20

TEST 12. PEG TOWERS

Raw Score	Standard Score
1	3
2	7
3	10
4	13
5	17
6	20

TABLE 12.1. (Cont.)

TEST 13. FACE PUZZLE

Raw Score	Standard Score
1	10
2	20

TEST 14. LETTER-MATCHING

Raw Score	Standard Score
1	1
2	2
3	3
4	4
5	6
6	7
7	8
8	9
9	10
10	11
11	12
12	13
13	14
14	15
15	17
16	18
17	19
18	20

TABLE 12.1. (Cont.)

TEST 14a. LETTER-MATCHING (REVISED SCORING)

Raw Score	Standard Score
1	1
2	2
3	2
4	3
5	4
6	5
7	6
8	7
9	7
10	8
11	9
12	10
13	11
14	12
15	12
16	13
17	14
18	15
19	16
20	17
21	17
22	18
23	19
24	20

TEST 15. SIX-HOLE POSTING BOX

Raw Score	Standard Score
1	2
2	3
3	5
4	7
5	8
6	10
7	12
8	13
9	15
10	17
11	18
12	20

TABLE 12.1. (Cont.)

TEST 16. SUPERIMPOSED PICTURES

Raw Score	Standard Score
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	10
12	11
13	12
14	13
15	14
16	15
17	16
18	17
19	18
20	19
21	19
22	20

TEST 17. PUZZLES

Raw Score	Standard Score
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20

TABLE 12.1. (Cont.)

TEST 18. GRADED RINGS

Raw Score	Standard Score
1	2
2	3
3	5
4	7
5	8
6	10
7	12
8	13
9	15
10	17
11	18
12	20

TEST 19. FIGURE-GROUND PUZZLE

Raw Score	Standard Score
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20

TABLE 12.1. (Cont.)

TEST 20. INCOMPLETE PICTURES

Raw Score	Standard Score
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20

TEST 21. WHICH IS DIFFERENT?

Raw Score	Standard Score
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20

TABLE 12.1. (Cont.)

DRAWING SHAPES TEST

Raw Score	Standard Score
1	1
2	2
3	3
4	4
5	6
6	7
7	8
8	9
9	10
10	11
11	12
12	13
13	14
14	15
15	17
16	18
17	19
18	20

DRAW A PERSON

Raw Score	Standard Score
1	1
2	2
3	2
4	3
5	4
6	5
7	6
8	7
9	8
10	8
11	9
12	10
13	11
14	12
15	12
16	13
17	14
18	15
19	16
20	17
21	18
22	18
23	19
24	20

TABLE 12.2. MEAN TOTAL STANDARD SCORES ACCORDING TO AGE

AGE GROUP	MEAN	STANDARD DEVIATION
2 years 6 months	254	44
3 years	283	41
3 years 6 months	331	25
4 years	354	29
4 years 6 months	377	14

TABLE 12.3. CRITERION SCORES FOR THE LOWEST 10% OF CHILDREN AT EACH AGE LEVEL

TEST 1. MATCHING OBJECTS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	4	20
3 yrs	4	20
3 yrs 6 mths	4	20
4 yrs	4	20
4 yrs 6 mths	4	20

TEST 2. MATCHING YELLOW OBJECTS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6mths	9	18
3 yrs	9	18
3 yrs 6 mths	10	20
4 yrs	10	20
4 yrs 6 mths	10	20

TEST 3. MATCHING COLOURED PICTURES

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6mths	4	20
3 yrs	4	20
3 yrs 6 mths	4	20
4 yrs	4	20
4 yrs 6 mths	4	20

TABLE 12.3. (Cont.)

TEST 4. MATCHING OUTLINE DRAWINGS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6mths	6	20
3 yrs	6	20
3 yrs 6 mths	6	20
4 yrs	6	20
4 yrs 6 mths	6	20

TEST 5. MATCHING FAMILY

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	4	16
3 yrs	4	16
3 yrs 6 mths	4	16
4 yrs	5	20
4 yrs 6 mths	5	20

TEST 6. MATCHING OBJECTS TO COLOURED PICTURES

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6mths	6	20
3 yrs	6	20
3 yrs 6 mths	6	20
4 yrs	6	20
4 yrs 6 mths	6	20

TABLE 12.3. (Cont.)

TEST 7. MATCHING MINIATURE OBJECTS TO OUTLINE DRAWINGS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	3	10
3 yrs	4	13
3 yrs 6 mths	5	17
4 yrs	6	20
4 yrs 6 mths	6	20

TEST 8. MATCHING GIRLS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6mths	1	3
3 yrs	1	3
3 yrs 6 mths	2	7
4 yrs	2	7
4 yrs 6 mths	3	10

TABLE 12.3. (Cont.)

TEST 9. THREE-HOLE POSTING BOX

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	12	13
3 yrs	15	17
3 yrs 6 mths	16	18
4 yrs	17	19
4 yrs 6 mths	17	19

TEST 10. STACKING CUPS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	2	3
3 yrs	6	10
3 yrs 6 mths	6	10
4 yrs	9	15
4 yrs 6 mths	11	18

TEST 11. BALLS AND CUPS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	2	10
3 yrs	4	20
3 yrs 6 mths	4	20
4 yrs	4	20
4 yrs 6 mths	4	20

TABLE 12.3. (CONT.)

TEST 12. PEG TOWERS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	2	7
3 yrs	3	10
3 yrs 6 mths	6	20
4 yrs	6	20
4 yrs 6 mths	6	20

TEST 13. FACE PUZZLE

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	0	0
3 yrs	0	0
3 yrs 6 mths	1	10
4 yrs	1	10
4 yrs 6 mths	1	10

TEST 14. LETTER-MATCHING

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	2	2
3 yrs	4	4
3 yrs 6 mths	10	11
4 yrs	11	12
4 yrs 6 mths	13	14

TABLE 12.3. (CONT.)

TEST 15. SIX-HOLE POSTING BOX

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	2	3
3 yrs	3	5
3 yrs 6 mths	4	7
4 yrs	6	10
4 yrs 6 mths	8	13

TEST 16. SUPERIMPOSED PICTURES

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	4	4
3 yrs	8	7
3 yrs 6 mths	16	12
4 yrs	18	15
4 yrs 6 mths	19	17

TEST 17. PUZZLES (TOTAL COMPLETED)

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	0	0
3 yrs	1	2
3 yrs 6 mths	3	6
4 yrs	5	10
4 yrs 6 mths	8	16

TABLE 12.3. (CONT.)

TEST 18. GRADED RINGS

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	0	0
3 yrs	0	0
3 yrs 6 mths	2	3
4 yrs	6	10
4 yrs 6 mths	10	17

TEST 19. FIGURE-GROUND PUZZLE

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	1	2
3 yrs	2	4
3 yrs 6 mths	4	8
4 yrs	6	12
4 yrs 6 mths	7	14

TEST 20. INCOMPLETE PICTURES

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	2	4
3 yrs	4	8
3 yrs 6 mths	6	12
4 yrs	7	14
4 yrs 6 mths	8	16

TABLE 12.3. (CONT.)

TEST 21. WHICH IS DIFFERENT?

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	0	0
3 yrs	0	0
3 yrs 6 mths	0	0
4 yrs	3	6
4 yrs 6 mths	6	12

DRAWING SHAPES

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	1	1
3 yrs	2	2
3 yrs 6 mths	6	7
4 yrs	9	10
4 yrs 6 mths	11	12

DRAWING A PERSON

AGE	10% CRITERION RAW SCORE	10% CRITERION STANDARD SCORE
2 yrs 6 mths	0	0
3 yrs	0	0
3 yrs 6 mths	0	0
4 yrs	6	4
4 yrs 6 mths	7	5

TABLE 12.4. RAW SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION LEVELS

AGE 2 YEARS 6 MONTHS

TEST NO.	RAW SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	3.90	0.30	4
2	9.45	1.40	9
3	3.90	0.30	4
4	5.85	0.48	6
5	4.70	0.46	4
6	5.75	0.77	6
7	5.25	1.22	3
8	3.10	1.80	1
9	15.60	2.60	12
10	7.65	3.32	2
11	3.60	1.02	2
12	4.90	1.84	2
13	0.90	0.62	0
14	7.15	4.41	2
15	4.60	1.99	2
16	11.15	4.85	4
17	1.55	1.91	0
18	3.25	3.25	0
19	4.35	2.37	1
20	5.00	2.53	2
21	1.95	2.96	0
DRAWING	3.30	2.45	1
PERSON	1.00	2.30	0

TABLE 12.4. (Cont.) RAW SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION LEVELS

AGE 3 YEARS

TEST NO.	RAW SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	4.00	0.00	4
2	9.90	0.30	9
3	4.00	0.00	4
4	5.75	0.54	6
5	4.40	0.92	4
6	6.00	0.00	6
7	5.45	0.62	4
8	3.30	1.56	1
9	16.85	2.08	15
10	9.00	2.86	6
11	3.80	0.60	4
12	4.90	1.51	3
13	0.95	0.50	0
14	9.75	3.82	4
15	6.70	2.72	3
16	14.30	4.56	8
17	4.10	2.83	1
18	3.60	2.89	0
19	5.10	2.64	2
20	6.60	2.31	4
21	2.70	2.30	0
DRAWING	6.00	3.70	2
PERSON	1.4	2.15	0

TABLE 12.4. (Cont.) RAW SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION LEVELS

AGE 3 YEARS 6 MONTHS

TEST NO.	RAW SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	4.00	0.00	4
2	9.95	0.22	10
3	4.00	0.00	4
4	5.90	0.22	6
5	4.80	0.51	4
6	6.00	0.00	6
7	5.75	1.02	5
8	4.45	1.53	2
9	16.86	1.62	16
10	10.00	2.93	6
11	3.80	0.60	4
12	5.65	1.31	6
13	1.40	0.58	1
14	12.35	3.58	10
15	6.75	2.48	4
16	18.05	2.24	16
17	6.90	2.19	3
18	6.55	3.43	2
19	6.90	2.12	4
20	7.95	1.94	6
21	5.30	2.93	0
DRAWING	9.95	3.20	6
PERSON	5.10	5.10	0

TABLE 12.4. (Cont.) RAW SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION LEVELS

AGE 4 YEARS

TEST NO.	RAW SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	4.00	0.00	4
2	10.00	0.00	10
3	4.00	0.00	4
4	5.90	0.30	6
5	4.95	0.22	5
6	6.00	0.00	6
7	5.90	0.30	6
8	4.65	1.75	2
9	17.35	0.85	17
10	11.30	1.88	9
11	3.90	0.44	4
12	5.80	0.60	6
13	1.70	0.56	1
14	13.30	1.62	11
15	9.15	2.73	6
16	19.80	1.94	18
17	7.60	2.45	5
18	8.70	2.92	6
19	8.20	1.83	6
20	8.65	1.56	7
21	6.95	2.91	3
DRAWING	12.65	2.69	9
PERSON	7.70	3.18	6

TABLE 12.4. (Cont.) RAW SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION LEVELS

AGE 4 YEARS 6 MONTHS

TEST NO.	RAW SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	4.00	0.00	4
2	9.90	0.44	10
3	4.00	0.00	4
4	5.95	0.22	6
5	5.00	0.00	5
6	6.00	0.00	6
7	6.00	0.00	6
8	5.25	1.22	3
9	17.80	0.51	17
10	11.50	1.32	11
11	4.00	0.00	4
12	6.00	0.00	6
13	1.85	0.36	1
14	15.25	1.79	13
15	9.95	1.56	8
16	20.95	1.43	19
17	9.15	0.91	8
18	10.90	1.95	10
19	9.00	1.14	7
20	9.35	1.01	8
21	8.55	1.72	6
DRAWING	14.90	2.72	11
PERSON	12.20	5.50	7

TABLE 12.5. STANDARD SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION SCORES.

AGE 2 YEARS 6 MONTHS

TEST NO.	STANDARD SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	19.50	1.50	20
2	18.90	2.80	18
3	19.50	1.50	20
4	19.50	1.60	20
5	18.80	1.84	16
6	19.70	2.57	20
7	17.50	4.06	10
8	10.33	6.00	3
9	17.33	2.89	13
10	12.75	5.53	3
11	18.00	5.10	10
12	16.33	6.13	7
13	9.00	6.20	0
14	7.94	4.90	2
15	7.67	3.32	3
16	10.14	4.41	4
17	3.10	3.82	0
18	5.42	5.42	0
19	8.70	4.74	2
20	10.00	5.06	4
21	3.90	5.92	0
DRAWING	3.67	2.72	1
PERSON	0.74	1.70	0

TABLE 12.5. (Cont.) STANDARD SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION SCORES.

AGE 3 YEARS

TEST NO.	STANDARD SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	20.00	0.00	20
2	19.80	0.60	18
3	20.00	0.00	20
4	19.17	1.80	20
5	17.60	3.68	16
6	20.00	0.00	20
7	18.20	2.07	13
8	11.00	5.20	3
9	18.72	2.31	17
10	15.00	4.77	10
11	19.00	3.00	20
12	16.33	5.03	10
13	9.50	5.00	0
14	10.83	4.24	4
15	11.17	4.53	5
16	13.00	4.15	7
17	8.20	5.66	2
18	6.00	4.82	0
19	10.20	5.28	4
20	13.20	4.62	8
21	5.40	4.60	0
DRAWING	6.67	4.11	2
PERSON	1.04	1.59	0

TABLE 12.5. (Cont.) STANDARD SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION SCORES.

AGE 3 YEARS 6 MONTHS

TEST NO.	STANDARD SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	20.00	0.00	20
2	19.90	0.40	20
3	20.00	0.00	20
4	19.67	0.73	20
5	19.20	2.04	16
6	20.00	0.00	20
7	19.17	3.40	17
8	14.83	5.10	7
9	18.73	1.80	18
10	16.67	4.88	10
11	19.00	3.00	20
12	18.83	4.37	20
13	14.00	5.80	10
14	13.72	3.98	11
15	11.25	4.13	7
16	18.41	2.04	12
17	13.80	4.38	6
18	10.92	5.72	3
19	13.80	4.24	8
20	15.90	2.80	12
21	10.60	5.86	0
DRAWING	11.06	3.56	7
PERSON	3.78	3.78	0

TABLE 12.5. (Cont.) STANDARD SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION SCORES.

AGE 4 YEARS

TEST NO.	MEAN	STANDARD DEVIATION	10% CRITERION
1	20.00	0.00	20
2	20.00	0.00	20
3	20.00	0.00	20
4	19.67	1.00	20
5	19.80	0.88	20
6	20.00	0.00	20
7	19.67	1.00	20
8	15.50	5.83	7
9	19.28	0.94	19
10	18.83	3.13	15
11	19.50	2.20	20
12	19.30	2.00	20
13	17.00	5.60	10
14	14.78	1.80	12
15	15.24	4.55	10
16	18.00	1.94	15
17	15.20	4.90	10
18	14.50	4.87	10
19	13.67	3.05	12
20	17.30	3.12	14
21	13.90	5.82	6
DRAWING	14.06	2.99	10
PERSON	5.70	2.36	4

TABLE 12.5. (Cont.) STANDARD SCORE MEANS, STANDARD DEVIATIONS AND 10% CRITERION SCORES.

AGE 4 YEARS 6 MONTHS

TEST NO.	STANDARD SCORE MEAN	STANDARD DEVIATION	10% CRITERION
1	20.00	0.00	20
2	19.80	0.88	20
3	20.00	0.00	20
4	19.83	0.73	20
5	20.00	0.00	20
6	20.00	0.00	20
7	20.00	0.00	20
8	17.50	4.07	10
9	19.78	0.57	19
10	19.17	2.20	18
11	20.00	0.00	20
12	20.00	0.00	20
13	18.50	3.60	10
14	16.94	1.99	14
15	16.58	2.60	13
16	19.05	1.30	17
17	18.30	1.82	16
18	18.17	3.25	17
19	18.00	2.28	14
20	18.70	2.02	16
21	17.10	3.44	12
DRAWING	16.56	3.02	12
PERSON	9.04	4.07	5

Figure 12.38. Chart of Mean Standard Scores, Standard Deviations and 10% Criterion Scores

Age Two Years Six Months

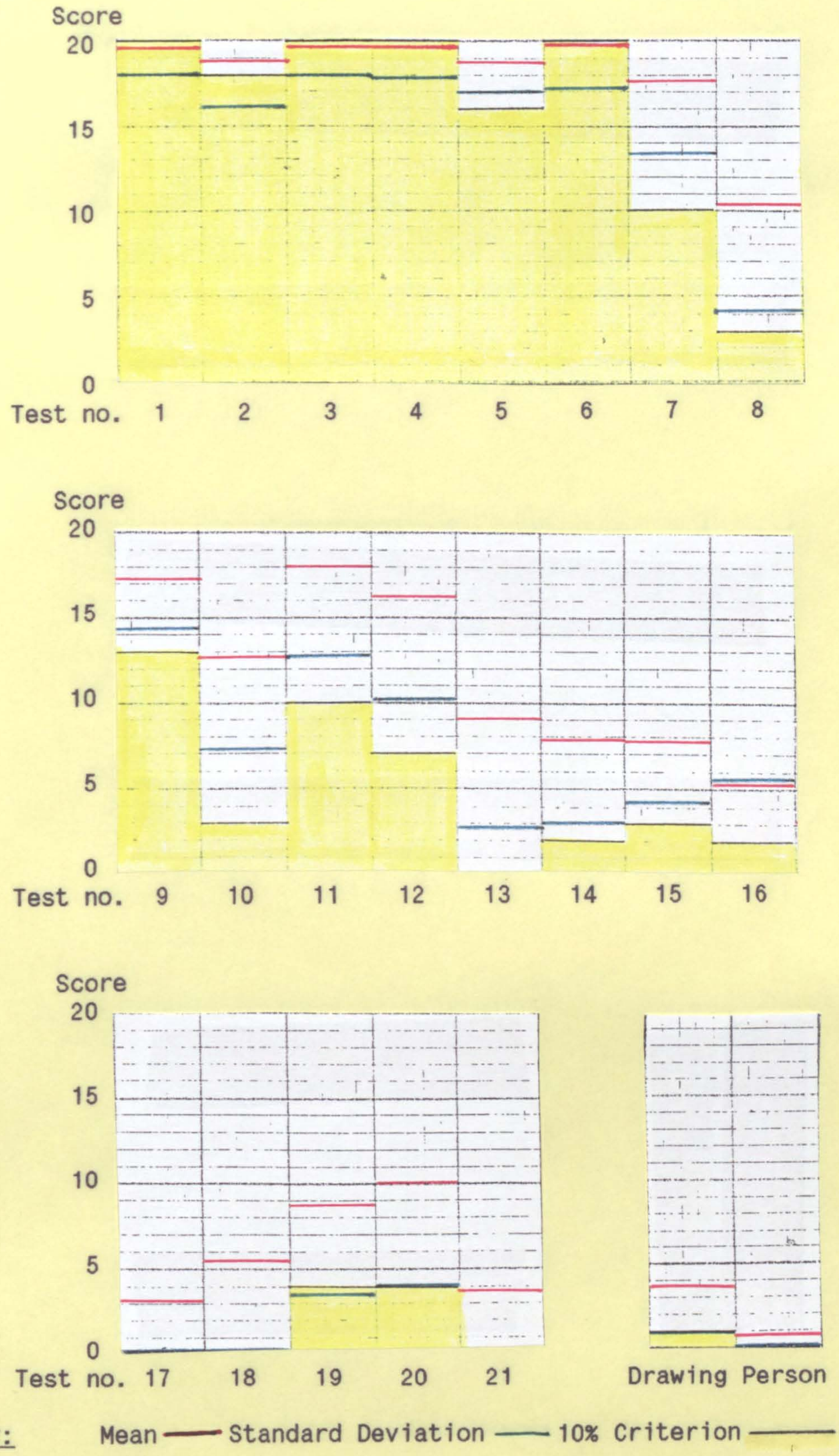
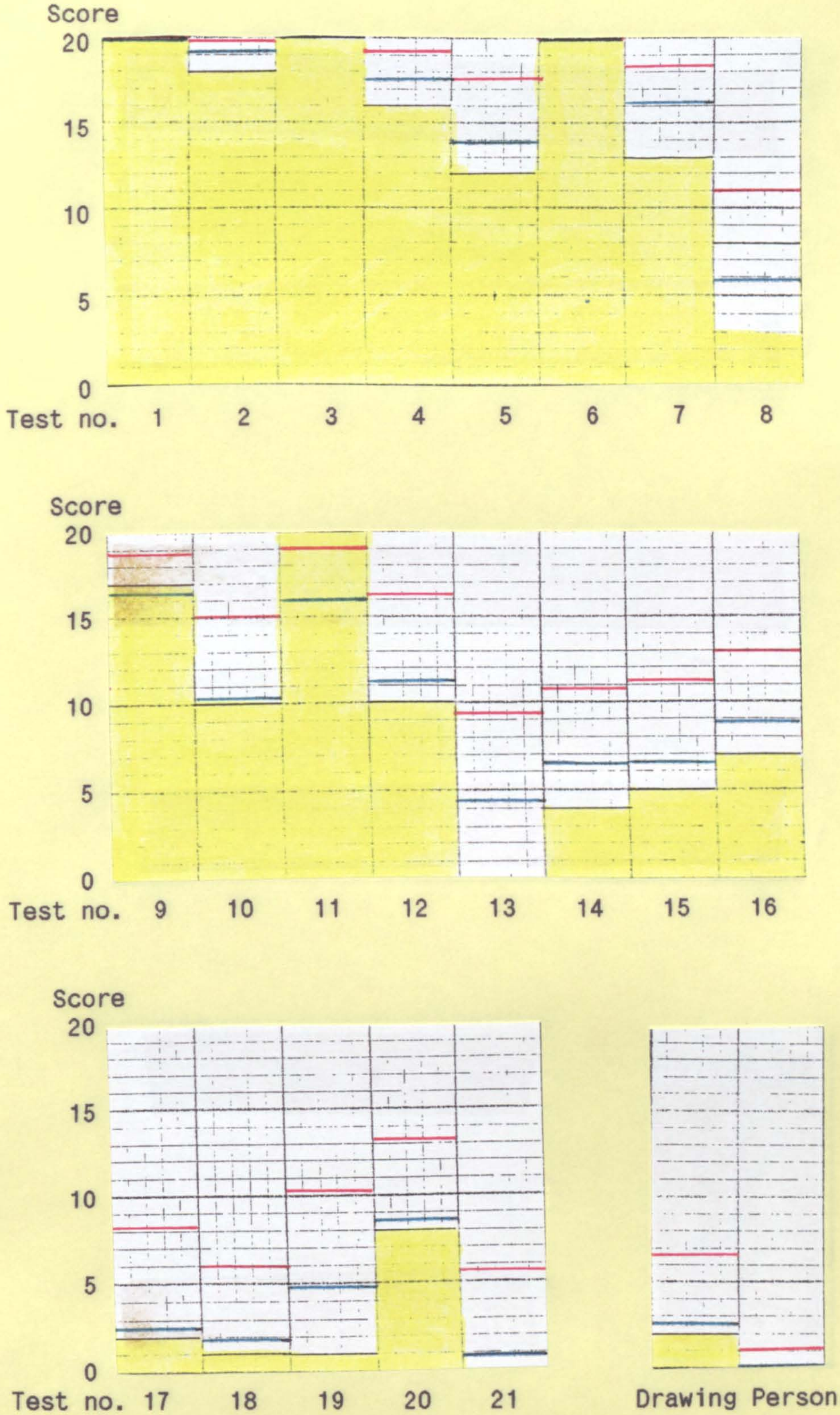


Figure 12.39. Chart of Mean Standard Scores, Standard Deviations and 10% Criterion Scores

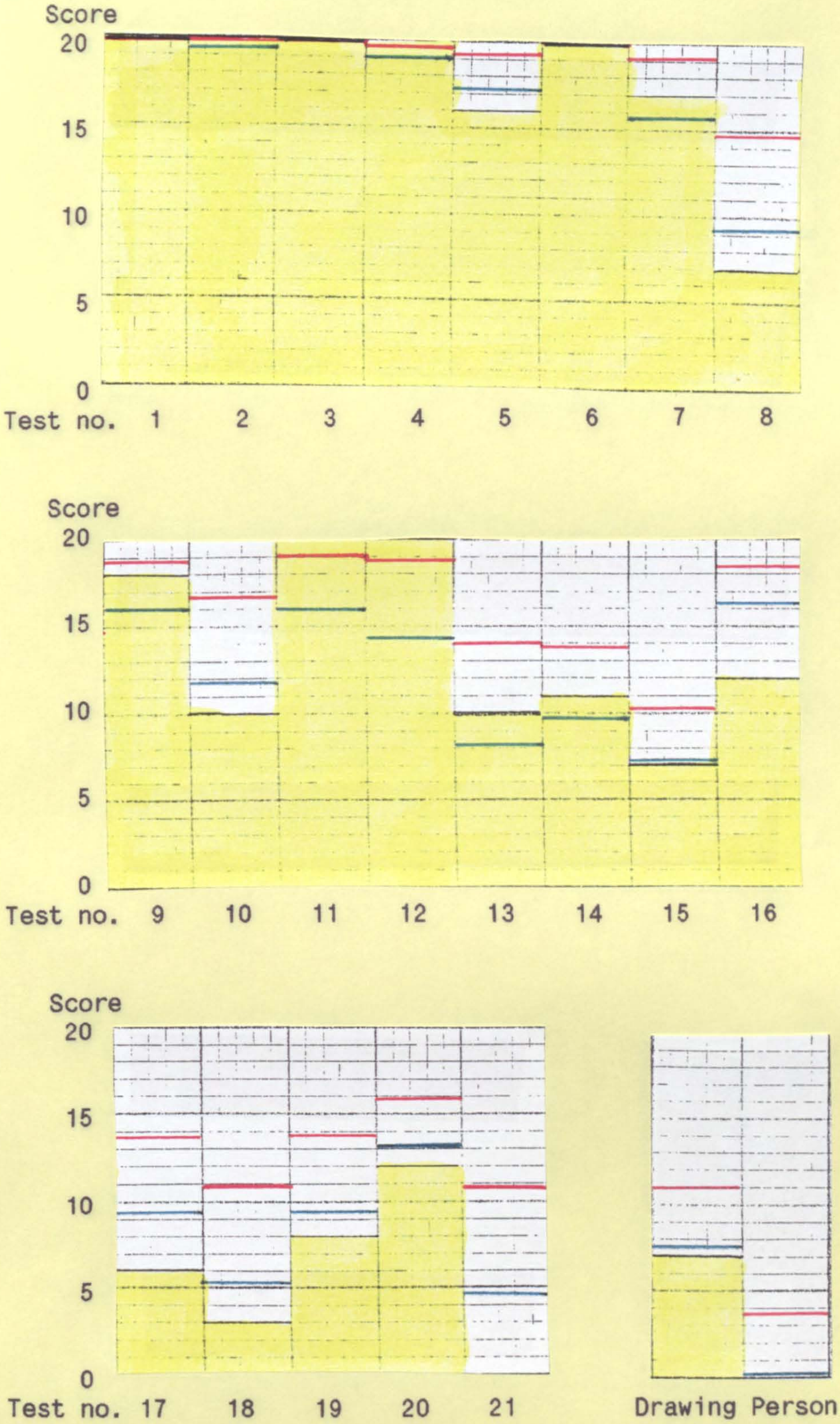
Age Three Years



Key: Mean —— Standard Deviation —— 10% Criterion ——

Figure 12.40. Chart of Mean Standard Scores, Standard Deviations and 10% Criterion Scores

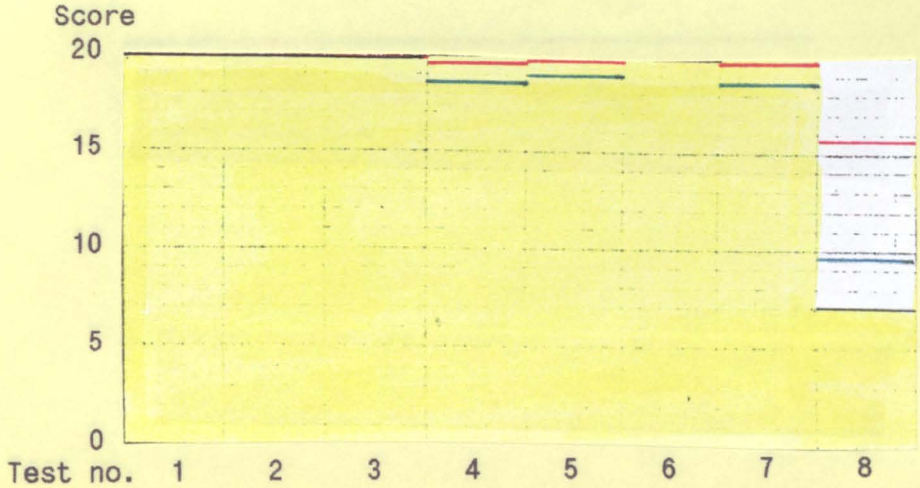
Age Three Years Six Months

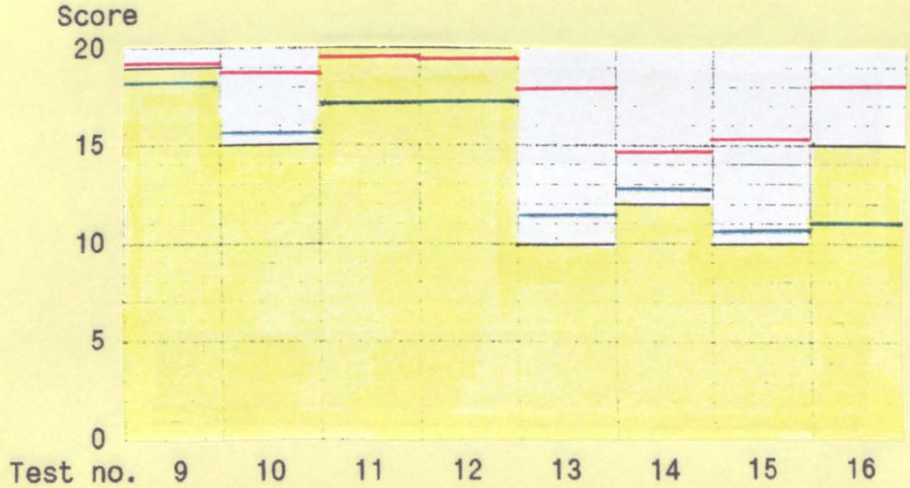


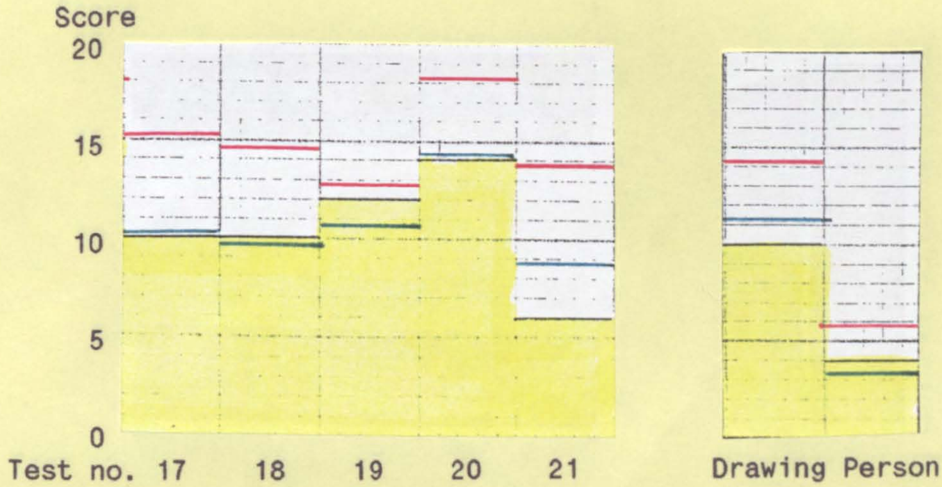
Key: Mean —— Standard Deviation —— 10% Criterion ——

Figure 12.41. Chart of Mean Standard Scores, Standard Deviations and 10% Criterion Scores

Age Four Years



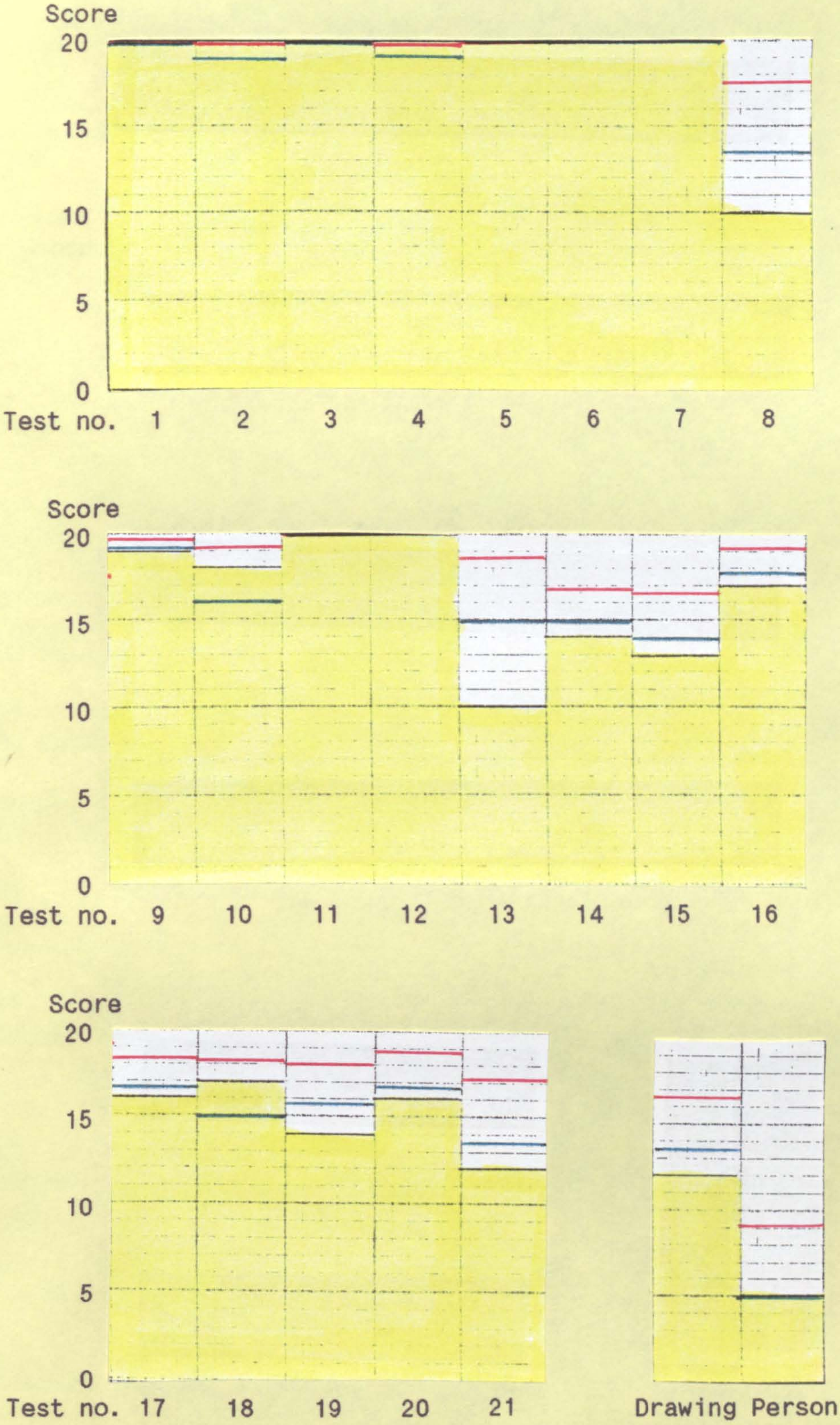




Key: Mean —— Standard Deviation —— 10% Criterion ——

Figure 12.42. Chart of Mean Standard Scores, Standard Deviations and 10% Criterion Scores

Age Four Years Six Months



Key: Mean —— Standard Deviation —— 10% Criterion ——

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