

RELATIONSHIP BETWEEN METHODS OF TRAINING AND  
LEVELS OF INTELLIGENCE

by

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ABSTRACT

The purpose of the study was to explore the feasibility of training conservation skills to a group of Black 7 - 8 year old children enrolled in a primary school in the Gugulethu township, a Black residential area in the Cape.

From a group of 100 children, 60 subjects were selected on the basis of failure to conserve as measured by Piagetian conservation tasks. One of the conservation tasks was employed for training the subject to be able to conserve.

A pre test/post test experimental design was used in a six phase experiment; assessment of possession of conservation concepts through the aid of Piagetian tasks of conservation of substance, weight, number and length; assessment of intelligence with the aid of the New South African Individual Scale; assessment of mental ability using the Draw-a-person test; group training with different methods of teaching on length conservation; immediate post test to determine effectiveness of training and transfer to other tasks and a delayed post test to four weeks after training to assess retention of training effects.

The 60 non-conservers were assigned to three experimental groups of 20 subjects. Each of these groups was trained on conservation of length using a different method of training, namely, a demonstration-recitation method, limited manipulation and full manipulation methods. Furthermore, the three groups were divided into high and low levels of intelligence according to their IQ scores. An attempt was made to match the subjects on age and IQ score. The children were interviewed individually for all assessments of the pre tests and post tests.

Training was instituted with the aid of familiar materials to enhance development of conservation concepts. The three training sessions ran consecutively over three days. The teaching aids, together with an explanation of the rules of invariance were used to facilitate understanding of the concept of conservation. The group that was trained with the use of the demonstration-recitation method, could only observe the demonstrator, listening to an explanation provided, and repeating these as required.

The limited manipulation method of training allowed each group member a chance of being a demonstrator, and of manipulating the training material. The full manipulation method permitted a higher level of activity, each subject handling his or her own material. All subjects had an intensive training on variance of matter, with emphasis on identity, reversibility and compensation. The three training methods allowed varying degrees of activity - from passivity in the demonstration-recitation method, to high activity of the full manipulation method of instruction.

Analysis of variance was utilized to explore effects of the methods of training on acquisition of conservation, effects of intelligence levels and the interaction of the two variables.

Kendall's test was employed to examine the degree of conservation in relation to the degree of activity as defined by the methods of instruction for each subtest on conservation.

Kendall's test was also used to assess the frequency of conservation in relation to methods of training. Analysis of variance was used to explore improvement or regression in conservation over a four week period after training, in relation to the three methods of training and the high and low levels of intelligence.

Emergence of patterns of conservation were observed in subtests. No significant differences were identified on performance of the high and low levels of intelligence. There was a significant training and transfer effect from non-conservation to full conservation. The specific training effects on length conservation transferred to conservation of substance, weight, number and liquid quantity. The results of the immediate post test reflect the status of conservation of the demonstration-recitation, limited manipulation and full manipulation groups as follows: 60%, 65% and 55% conservers respectively.

In the delayed post test, the status of conservation was maintained by 70% conservers in the demonstration group, 65% of the limited manipulation group and 65% of the full manipulation group.

The study demonstrated feasibility of training non-conserving Black children to conserve. This finding is in consensus with previous research on non-technological societies.

The study highlighted the importance of the role of the mediator and intensive training in understanding the principles of identity, reversibility and compensation for variance of matter.

From the findings, the flexibility of the children of different levels of intelligence in relation to different methods of instruction was discussed with reference to culture and the measures of intelligence. The status of conservation achieved by these children from their training was also discussed.

PREFACE

Whilst Piaget has documented the constraints imposed upon facilitation of cognitive skills in a developing child, one would contend that different schools of thought appear to be related to certain periods and places in history. The initial publications on feasibility of training Piaget's concepts of conservation (1959 - 1971) were in consensus with Piaget, claiming no learning of these concepts (Brainerd 1983). In support of these researchers, Flavell (1963) commented that even when a behaviour change does occur, it is superficial (Ausubel, Novak and Hanesian 1978).

Subsequently, several researchers, mostly in America, challenged the idea and showed evidence of learning in number conservation (Brainerd 1983; Wallach and Sprott 1964).

Certain studies, reported to be successful, employed rule instruction through perceptual demonstration (Smith 1968).

Subsequently, researchers accentuated the training methods of Piagetian concepts where self-discovery was recommended as opposed to the tutorial procedure (Wohlwill and Lowe 1962; Flavell 1963).

Research that was conducted by Inhelder and Sinclair (1969), and Inhelder (1956) using the self-discovery method has been reported to have been successful (Brainerd 1983).

With regard to training methods, one would conclude that contradictions were evident in some reports. Observational learning, rule instruction and corrective feedback were regarded

as being effective, whilst tutorial procedures were unsuccessful (Brainerd 1983).

However, after the year 1971, certain questions were answered. Experimental findings by Brainerd (1971, 1977, 1982) on conservation training proved to be a success both in transitional and pre-operational children. The success seemed to be attributed to training techniques such as attentional training, verbal rule instruction, observation of skilled models and corrective feedback, and one question only experiments (Brainerd 1983; Johnson and Howe 1978; Botvin and Murray 1975; Fischer and Pipp 1984; Weiss, Barstis and Ford 1977; Hooper, Wanska, Paterson and De Fran 1979; John, Dambe, Polhemus and John 1983; Schiff 1983; Golomb and McLean 1984; Shea, Ogaiea and Bagara 1983; Goodnow and Bethon 1966; Samuel and Bryant 1984).

In an earlier study that investigated the effects of instruction on length and area, both the experimental and control groups showed improvement (Flavell 1963). The researchers proposed that the pre test may constitute a training experience - hence the post test improvement in the control group.

Numerous studies on mentally retarded children lend support to feasibility of training conservation skills (Bilsky, Gilbert and Pawelski 1978; Brooks and McCauley 1984; Keasey and Charles 1967; Feuerstein 1979; Borkowski and Varnhagen 1984; Fabre, McManis and Stanton 1978; Kahn 1976).

Cross-cultural studies by Dasen and Heron (1980) have substantiated certain issues and trends with regard to cognitive development, as demonstrated in their research. They have highlighted the competence/performance issue whereby a skill

remains hidden if unused, and they have also indicated the universality of stages of cognitive development at different developmental rates. Reynolds (1984) explored the cognitive development of children in a squatter camp of Crossroads in the Cape, analysing the link between society and the child, and concluded that people proceed at different speeds through the stages of cognitive development.

In support of the above, Ausubel, Novak and Hanesian (1978) maintain that because the rate of development is partially a function of environmental stimulation, the age range in which a developmental stage occurs is inclined to vary from culture to culture. Various writers are in agreement with this notion (Tomlinson-Keasey, Eisert, Kahle, Hardy-Brown and Keasey 1979; Feuerstein 1979; Mays 1983).

However, intensive educational intervention for the disadvantaged in the United States is reported to have failed, thus bringing into question the value of environmental stimulation in certain societies (A. K. Jensen 1969).

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## CHAPTER ONE

### THE CONCRETE OPERATIONAL STAGE AND CONSERVATION

In his attempt to investigate acquisition of knowledge in children, Piaget has identified certain stages of development, one of which being the concrete operational stage. This stage of cognitive development is usually reached by the age of 7-8 years (Piaget and Inhelder 1969; Bogden 1979; Flavell 1977).

#### 1.1 Definition of Conservation

An index that a child has reached the stage of concrete operations is the ability to understand conservation of matter. The achievement of conservation is conceptualised as the subject's realisation that certain properties of a system remain the same, in spite of transformation performed within the system. In terms of sequence of conservation tasks, the child is expected to discover the conservation of substance at the age of 7 or 8 years, conservation of weight is attained at 9 and 10 years of age, and conservation of volume reached at the age of 11 or 12 years (Piaget and Inhelder 1969; Kahn 1976).

Around the age of 4 or 5 years, the child's judgement of amount is perceptual, it is only at the age of 5 or 6 years that he begins to vacillate in his response to the conservation problem.

The learning of the conservation skill, is a gradual process, taking place through substages within the concrete operational stage (Dasen and Heron 1980). The child, in his arguments for his judgement, may demonstrate either negation, identity response or an argument that indicates

compensation or reciprocity. During the development of cognition, the child progresses from failure to conserve through a transitional stage where he vacillates in his responses, to a final stage of being able to conserve. The failure to conserve may be attributed to the tendency of the child to focus on one dimension. The ability to maintain invariance of one quantitative property or dimension of an object after a spatio temporal transformation, results from the child's ability to impose an appropriate operative structure on perceptually misleading information (Piaget 1969).

## 1.2 Concrete Operational Stage

### 1.2.1 Piaget's Model

According to Piaget, this is a period that begins when physical actions start being internalized as mental operations or actions (Beard 1969). A child at this stage, is expected to think logically about tangible situations or events as evident in arranging objects in sequential order or when objects have to be compared in a logical relationship with each other.

The cumulative experience of the preoperational stage, provided the child with mental operations which enable him to appreciate relationships. In the absence of mental operations, the child depends on perceptual judgement centering on one aspect of the problem. The transition from 4 to 6 years of age is conceived as a major one, when the first "functional logic emerges from which the full concrete operational structures will ultimately be

assembled" (Case 1984:26). A child in the concrete operational stage, is capable of working well with the concrete and real and has the potential to apply the rules to new things.

#### 1.2.1.1 Cognitive processes

In the course of the child's cognitive development in his environment he is constantly thrown into disequilibrium. However, due to autoregulation, he is able to assimilate new material and thus maintain equilibrium. Piaget has emphasised this dynamic equilibrium whereby an organism is endowed with the "principle to avoid the pathology of durable disequilibrium" (Rothman 1977:34). Dynamic equilibrium is a purposive behaviour which is regarded as intelligence, and it is self regulatory in the child's environment demonstrating a feedback mechanism.

Self regulation is considered as being universal with all kinds of mental activity from perception, memory and anticipation to scientific thought. The interaction of the neurological structures and experience results in the emergence of cognitive structures.

#### 1.2.1.2 Processes in Piaget's theory

Piaget perceives symbolic logic as arising out of elimination of inconsistency through equilibration. Other researchers refer to this inconsistency as cognitive conflict, which has also been conceptualised as cognitive dissonance (Flavell 1963). Processes that are reported as being responsible for progressive

changes in cognitive development are assimilation, accommodation and equilibration. Piaget regards cognitive development as a stage wise sequential acquisition of fundamental, broadly generalised structures of cognitive actions (Flavell 1984).

The child at this stage demonstrates certain features of reasoning, egocentricity is lost, intuitive thinking yields to an integrated model of using representation. This is a stage considered appropriate for formal education and also accorded a certain status in some cultures (Reynolds 1984).

It has been well documented that knowledge of the timetable of intellectual development should facilitate scientific grade placement of subject matter, for example, knowledge of development of number and spatial concepts would make easier grade placement of subjects such as mathematics and science. The concrete operational period is crucial for the understanding of mathematics. Piaget's invariants such as dynamic structurations, assimilation and accommodation have been reported as resulting in new adaptation, achievement of equilibrium. The acquisition of equilibrium further leads to more refined cognitive structures building upon earlier structures (Ausubel, Novak and Hanesian 1978; Feldman 1977).

### 1.2.2 The Neo-Piagetian Theory

In terms of this orientation, the children's intellectual functioning at different stages of development is seen as

a sequence of increasingly sophisticated mental structures (Case 1984). The focus in this discussion, is in transition from one stage to another, from 4 to 6 years of age. In this theory, the child's mental structures are modelled by the concepts employed in information processing and computer simulation, whilst Piaget uses symbolic logic in his theory.

#### 1.2.2.1 Processes in the Neo-Piagetian Model

At the age of 4 to 6 years, it is believed that certain changes take place as a result of the child's ability to assemble executive control structures. These control structures are considered a mental blueprint or a plan for solving a class of problems. These structures have the following properties a representation of the problem situation, conditions for which the plan is appropriate; a representation of the problem objectives towards which the plan is directed and also a problem strategy from the problem situation to the objective.

The intellectual functioning of the preschool child is dependent on these representations of the tasks of this period. The child has to take into consideration the problem at issue, the goal and how to accomplish the objective. If the child is provided with the appropriate experience, he should be able to apply the relevant control structure (Case 1984). Certain processes that have to be employed to a particular physical and social environment in order to reach a specific goal are problem solving, exploration,

imitation and mental regulation.

As the child progresses towards the age of 6 years, one finds complexity in structures applied to tasks. It has been established that the period between 4 to 6 years of age is marked by a shift from dimensional thought to relational thought. Minor qualitative changes take place with new control structures integrated resulting in a new unit of thought. The progressive changes that take place have been ascribed to a number of structural changes within the general systemic constraint, imposed by the size of the subjects' short term storage space (Case 1984; Sharratt 1986 and Brainerd 1983).

It has been suggested, that the increase in age of the child is related to increase in the short term storage space and decrease in the amount of operating space. Operational efficiency accounts for the decrease in operating space (Case, Kurland and Goldberg 1982; Flavell 1984). The child's processing limitations are aligned with the child's age and neurological development (Flavell 1984).

### 1.3 Conservation Concepts

One of the characteristic features of the stage of concrete operations is the grasp of the idea of 'conservation'. The child attains this status through appreciation of reversibility of matter in his logical operations.

With the awareness of compensation in dimension, that a loss in one dimension is compensated by a gain in another, the concept of conservation is acquired.

The achievement of these abilities results in complexity of the child's cognitive structures, though he is still confined to concrete experience of reality as opposed to hypothetical reasoning of the formal operational stage. Conservation does not emerge in a unitary fashion in all kinds of problem solving tasks and materials. The order of emergence has been identified as the conservation of mass, weight, number and volume (Ausubel, Novak and Hanesian 1978; Bogden 1979; Piaget and Inhelder 1969).

The ability to achieve higher cognitive structures is attributed to the generating power of equilibration which is dependent on activity and experience. Equilibration implies "a change in the duration of increasing stability, consistency and completeness of behavioural structures" (Ausubel, Novak and Hanesian 1978:239). Universality of the sequence and order of development is ascribed to maturation.

#### **1.3.1 Research on conservation**

The studies conducted in the area of conservation in other cultures, have shown certain disparities that may be pertinent to the developmental psychologist and educationalist. In a study of 6 and 7 year old Wolof children in Senegal on conservation of liquid quantity, certain qualitative factors were noted. The children, in their justification answers, said that there was more water because the experimenter had poured it himself. When the action was carried out by the children themselves, they were able to show conservation answers.

The initial failure to conserve was ascribed to the

magical powers of the experimenter (a stranger) (Dasen and Heron 1980). Another factor related to the failure to conserve was the phrasing of the questions. The unschooled children were more subject to failure to conserve in comparison to schooled children (Rogoff 1980). This failure to conserve has also been quoted as being due to the communication problems within the experimental situation (Gold 1983; Golomb and Mclean 1984).

A pseudo-conservation in 7 to 9 year old unschooled Algerian children, has been reported on conservation of liquid quantity. Although these children's responses demonstrated conservation, they failed in the justification of their answers which was characteristic of pre-operational children.

Apparently these children initially ignored the perceptual dimensions; after they were given a task to pour water into another container they became aware of the perceptual differences in the containers. However, these children only considered one dimension. It has been suggested that this pseudo-conservation might be a universal substage occurring at a very young age in Western children (Dasen and Heron 1980).

#### 1.4 Horizontal Decalage

This implies that various conservations are not attained at the same time (Bogden 1979). There is a progressive sequence whereby a child extends the conservation strategy to various domains (Onyehalu 1985). A sequence of emergence of stages often seen in Western populations has been conser-

vation of quantity, weight and volume. However, a study of Australian aborigines demonstrated that conservation of weight was easier than conservation of quantity. On replication of these studies in the same location, there were conflicting results. Further, the individual results showed discrepancies in findings compared to group averages (Dasen and Heron 1980).

### 1.5 The Competence/performance Factor

Competence is regarded as the degree to which a given operation has developed in a child, whilst performance would refer to the likelihood for the given task to be called into action in a given cultural setting (Dasen and Heron 1980).

The competence - performance issue suggests that the child's response to a Piagetian task may not be a true reflection of a cognitive structure. It has been established that little effort is necessary to elicit latent competence in conservation as shown by West Berlin non-conservers who were able to conserve weight and volume after a pretest.

A group of Algerian illiterates also progressed from non-conservation to operational performance during a testing session. It is thought that culturally deprived groups possess the same underlying competence, the difference lies in the performance which is a function of the situation and cultural context in which the competence is expressed (Dasen and Heron 1980).

The task performance of children in the concrete operational stages seems to be related to the function and contextual aspects in which the child is operating. It has been

pointed out that when Piaget mentioned conservation as a necessary condition for concrete operational activity, he did not imply performance on these tasks which may not be important for the survival of other groups (Heron and Kroeger 1980: Reynolds 1984).

## CHAPTER TWO

### COGNITIVE DEVELOPMENT AND MEMORY

#### 2.1 Definition

In view of the psychological processes involved in acquisition of knowledge, one needs to examine cognitive development. Cognition is regarded as the interpretation of sensory events, their registration and efficient retrieval from memory; the ability to manipulate schemata, images, symbols and concepts in thinking, reasoning and solving problems; and the acquisition of knowledge and beliefs about the environment (Mussen, Conger and Kagan 1974).

Piaget conceptualised cognition as involving a period of formation (genesis) and a period of development, from early relatively simple thinking to more mature and complex abilities. One is able to observe a progression of organisation of cognitive abilities.

#### 2.2 Memory

This refers to the storage of experiences for a period after they have ended (Mussen, Conger and Kagan 1974). Two kinds of memory have been distinguished - short term memory and long term memory. Short term memory refers to a memory trace that is available for a maximum of 30 seconds, and typically for a shorter period of time (Ibid 1974).

For retention of information over a long time, the child is expected to be able to actively transfer information from short term memory to long term memory.

It has been suggested, that without special control processes to encode information in short term memory, it cannot be retrieved at a later stage (Mussen, Conger and Kagan 1969).

Factors related to memory, are the capacity to sustain attention, availability of vocabulary, images and concepts that are associated with the events, and the aid to keep them in memory. Certain factors that control memory have been identified as selective attention and focussing attention. Anxiety, distracting stimuli and interfering thoughts, have been quoted as having a negative effect on memory by deflecting attention from relevant incoming information (Mussen, Conger and Kagan 1969).

Other pertinent factors are, that memory and vocabulary size improve with age in relation to the number of words remembered. Consequently, children from linguistically impoverished environments, are reported to perform poorly on memory tasks involving language (Mussen, Conger and Kagan 1974; Flavell 1984).

### 2.3 The Cognitive Developmental Theory

The main proponent of this theory, Piaget, maintains that the child actively selects the experiences he wishes to understand and exploit. From these experimental encounters the child develops beliefs, thoughts and ways of problem solving. Piaget asserts that the goals of development include the ability to reason abstractly, to think about hypothetical situations in a logical manner, and to organise rules into complex higher order structures (Mussen, Conger

and Kagan 1969, 1974).

#### 2.4 The Neo-Piagetian Theorists

These theorists who belong to the information processing movement, state that there are age linked constraints or limitations on the child's cognitive and learning capabilities. These theorists seem to be in consensus with Piaget in the notion that, as the child grows older, the constraints become less, and the child's cognitive and learning capabilities increase (Flavell 1984). The constraints are ascribed to limitation in the size of the child's short term storage space. Case (1984) models the child's mental structures in terms of concepts that have been developed in the field of information processing and computer simulation, as opposed to those developed in the field of symbolic logic of Piaget (Case 1984).

In an effort to illustrate his position, Case cites one of the major changes in cognitive development, as the ability to assemble executive control structures for solving different classes of problems. The term 'control structure' refers to a mental blue-print or plan for solving problems.

The key words in the information - processing movement are the terms - short term space for immediate recall of information; storage space which refers to the hypothetical amount of space possessed by a subject for storing information, operating space referring to a hypothetical amount of space available for executing intellectual operations, and a total processing space that refers to the

subject's total central processing resources that is the sum of the subject's storage space and operating space (Case, Kurland and Goldberg 1982; Case 1984).

## 2.5 Discussion on Information Processing in Relation to Short-term Memory

Cognitive development, as observed above, encompasses concepts such as short term storage, encoding and retrieval of information from long term memory. Research has proved that memory variables exert a powerful influence on a child's performance on cognitive tasks. This is illustrated by the short-term memory, which prescribes the number of items that can be retrieved on an immediate recall test, after one study trial (Brainerd 1983). Mentally retarded children have been reported to have very short memory spans. Correlation has been found between individual measures of memory span and individual Piagetian tasks (Brainerd 1983; Case 1984). Other findings suggest that short-term memory failures are responsible for errors in Piagetian measures (Case 1984).

Thus it appears that the development of short-term memory accounts for age variation on performance of tasks. Case suggests that there is a two year lag between the emergence of control structures at the age of 4 years, and the integration into hierarchical superstructures at the age of 6 years. The delay in integration is attributed to the size of the child's short-term space, which sets limits to the effectiveness of invariant structures. In addition, as the operating space becomes more efficient with development, the amount of operating space is decreased since the function of

the space devoted to executing basic operations is reduced. As a result of this activity there is more space for short-term storage (Case, Kurland and Goldberg 1982; Case 1984; Flavell 1984).

This approach highlights the age related constraints or limitations on the child's cognitive and learning abilities. Whilst Case considers the constraints as a function of the size of the child's short-term space, Fischer regards the age limitation as being due to the upper limit on the complexity of the skills that the child can construct and control (Flavell 1984; Fischer and Pipp 1984).

However, the Neo-Piagetian theorists seem to be in agreement with Piaget that the degree of myelinisation of nerves sets the developmental ceiling on operational efficiency at any age (Piaget 1972; Case, Kurland and Goldberg 1982; Ausubel, Novak and Hanesian 1978).

### CHAPTER THREE

#### HIGH AND LOW INTELLIGENCE SCORES

The problem of high and low intelligence scores needs to be addressed, since the study involves the training of children of different I.Q. levels on conservation skills. It is assumed that children of high and low I.Q. levels may respond differently to different methods of training.

On the other hand, this division may be theoretical in the sense that the children in the current study attend a normal school; hence one would not expect a vast difference in the performance on the intelligence test. The creation of the different categories of intellectual functioning is essential so as to observe their response to different methods of training.

This exercise is pertinent to the study in the sense that it affords the researcher an opportunity to explore a method that would be appropriate for the facilitation of cognitive development of low intellectual functioning individuals.

The aim of devising intelligence tests was to measure individual differences to predict academic performance. This exercise ensured that the children were able to be categorised as either fully educable, educable with special help in school or retarded to the extent of being unable to benefit from public schooling (Anastasi 1976, Hetherington and Parke 1979). It is necessary that factors that may influence intellectual performance be examined.

### 3.1 Factors Influencing the Intelligence Scores

#### 3.1.3 Undernutrition

One of the variables that has been claimed to affect performance on I.Q. tests is malnutrition; undernourished children in Mexico showed that they had reduced sensory motorskills and capacity to associate across modalities compared to children of rich parents in the same country. They demonstrated deficits which manifest themselves in I.Q. tests (Rose 1972, Warren 1973).

From these findings it has been suggested that low I.Q. scores are associated with a low socio-economic background of the parents. Children from impoverished environments are likely to suffer nutritional disadvantages.

It has been discovered that the brain structure and chemistry determine intellectual performance. In addition both factors are affected by immediate environmental influences including those extending beyond the present generation into the past. These influences have been conceived as trans-generational effects that may affect performance on intelligence tests. The problem of protein starvation affecting brain growth, which is rife in developing countries, is compounded by the issue of rearing children in overcrowded homes and schools. The culture of poverty through unemployment perpetuates a vicious circle of undernutrition (Evans, Bowie, Hansen, Moodie and Van der Spuy 1980). This results in a physiological insult on the developing brain of the young child with disastrous consequences on intellectual

functioning (Stoch and Smythe 1967).

### 3.1.2 Cognitive Style

Another factor that is pertinent to this discussion is the cognitive style of the child, in the sense that the approach in problem solving may be a decisive factor on his/her performance on the intelligence test. It is well documented that differences in the cognitive style of children from various societies result in differences in development of intellectual abilities (Dasen and Heron 1980). Children show a preferred cognitive style that may be related to differences in motivation (Hetherington and Parker 1979). Cognitive style does not refer to the level of intellectual ability as much as to the manner in which cognitive functions are executed. These cognitive styles reflect individual differences among children, and systematic changes with age have been associated with a variety of social and cognitive aspects (Weiss Barstis and Ford 1977; Shinn-Strieker 1986). Impulsivity, as one of the cognitive styles, manifests as a rapid response to answering questions resulting in many errors. On the other hand, individuals who are reflective in their cognitive style evaluate their answers slowly with accuracy. The children who are reflective have been reported to be superior compared to the impulsive on certain standard tests of discrimination learning, reasoning, memory and Piagetian measures of conservation.

### 3.1.3 The Cultural Factor and Intelligence Score

Performance on all tests appears to be influenced, to a certain degree, by cultural factors. The intelligence

quotient is conceived as a measure representing the interaction of many factors including those of innate capacity and experience. Some intellectual abilities are reported to be more influenced by experiences than others, and that there may be individual differences in vulnerability to environmental influences (Hetherington and Parke 1979).

Certain non-intellectual behaviour associated with temperamental or personality factors may shape the expression of inherited intellectual capacities. There are variations in the quality, amount and pattern of stimulation of children in different environments. Children from isolated communities and low socio-economic class and from the minority group have been found to show deviations in their intellectual performance. In these communities there is a tendency for educational and economical deprivations. Children from the above communities and those from rural areas have been found to have intellectual deficits (Dasen and Heron 1980; Biesheuvel 1943; Stoch and Smythe 1967 and Girardeau 1971). Studies conducted on children of the Blue Ridges mountains in Virginia have revealed that they had lower I.Q. scores compared to those of nearby villages (Hetherington and Parke 1979).

It has been suggested that different environments stimulate and facilitate development of different cognitive abilities. There are certain cases where the influence of culture results in superior performance in

certain abilities of primitive societies. A typical example is the case of the Pulawat islanders with a primitive culture and little technology, who possess an exceptional navigational system (Hetherington and Parke 1979). Although those islanders would be unable to perform in any intelligence test, their navigational skills place them at the level of formal logic operations in terms of their deductive reasoning.

Although Jensen (1973) has identified deficits in both verbal and non-verbal I.Q. in Blacks from poor environmental circumstances, he denied the role of the environment with the belief that evolution is responsible for the biological difference in abstract reasoning. Amongst other explanations that have been forwarded to account for the disparities in I.Q. performance is the social mobility, in the sense that parents of the lower class individuals might have lacked essential skills to stimulate the necessary cognitive skills from an early age.

A study conducted by Mercer (1972) demonstrated that when an I.Q. score of 84 or 75 was employed as a criterion to define mental retardation, many individuals labelled as retarded were functioning adequately in their roles according to the adaptive behaviour scale. However, the subjects who scored below I.Q. 70 were likely to be functioning inadequately in their environment. The studies conducted on Blacks of different classes in the United States revealed that the socio-economic status has an influence on I.Q. scores.

What transpires from the above factors is that the influence on I.Q. may result in a low global I.Q. score. The latter may not be a true reflection of the actual mental ability of the child relative to his/her culture.

### 3.2 The Developmental Approach

The developmental approach in terms of low I.Q. score, takes cognizance of individual differences in cognitive functioning as being due to differences in the developmental stage and not due to individual differences within a stage (Heal 1970; Scott 1978). The developmental retardation concept implies the potential for a mental growth spurt where appropriate treatment is provided. The reasoning abilities of children of low intellect are regarded as being characterised by fixations in operational activities at different stages of development (Kamhi 1981; Stephens and McLaughlin 1974).

Studies conducted by Stephen and McLaughlin (1974) using a battery of Piagetian tasks have shown a significant difference between individuals of average and low I.Q. The distinguishing factor identified between the two groups involves categorising and reversibility in tasks of conservation and classification (Kamhi 1981). However, both groups traverse the same stages of cognitive development in the same order, differing in the rate at which they progress and in the ultimate ability they attain (Weisz and Zigler 1979).

Certain aspects which appear to be related to low I.Q. scores as measured by intelligence tests, are places of

residence e.g. slum areas and the behavioural interaction in the child's environment. From the above discussion it is evident that many variables determine the global I.Q. score of the child. Amongst variables involved in the development of intelligent behaviour are the amount of income, number of children in the family, number of books and magazines and the father's occupation.

The performance on the test may be influenced by situational emotional and experiential factors (Girardeau 1971; Hetherington and Parke 1979; Jensen 1969).

The differences in performance on intelligence tests can be looked upon as being due to a variety of causes (Brooks and McCauley 1984; Mays 1983; Reschley and Jipson 1976; Haywood 1970). Although I.Q. scores vary they can be modified by experience and by intervention programmes.

## CHAPTER FOUR

### CULTURE AND MENTAL RETARDATION

It has been established that cultural factors influence what shall be learnt at different ages of development. As a result, a different cultural environment gives rise to different patterns of ability (Grant 1972). Cultural differences, language and education are expected to either accelerate or delay the chronological age at which stages of cognitive development are attained (Dasen and Heron 1980). Certain factors related to mental retardation have been discussed by several writers.

#### 4.1 Environmental Influences

The term 'environment' has been employed with reference to many factors and events which include pre-natal condition, nutritional factors, housing conditions, social interaction and income. The emphasis is on the manner by which the learning experience of the child is affected. Social and cultural factors have been quoted as being important in the cognitive development of the child (Piaget 1966).

Piaget has recognised the role of social transmission in the development of cognitive abilities besides the spontaneous and endogenous factors (Piaget 1966; Reynolds 1984 and Onyehalu 1985).

The developing child is exposed to social exchanges operating between other children and adults during the socialisation process. These interactions may be related to the cognitive functions of the child. Intellectual development results from activities such as exercising,

experiencing or acting upon the environment (Piaget 1966; Jensen 1969). Piaget considers the equilibration factor as being a function of the co-ordination of these actions. Thus the equilibration process or autoregulation is regarded as depending on both the epigenetic potentialities and environmental circumstances.

#### 4.2 Eco-cultural Relevance

Dasen and Heron have mentioned eco-cultural relevance, whereby people develop those skills that are useful for their survival in a particular ecology and its associated subsistence economy. The problem of specifying the mechanism by which eco-cultural influence affects cognitive development has been reported. For example, there are so many variables in urban life as opposed to rural life, that it would be impossible to identify one that influences cognitive development. However, children from these rural societies are not able to develop to their full cognitive potential as a result of their cognitive style as discussed in the previous chapter.

Numerous factors in the environment tend to retard the child's cognitive development or cause marked variations.

#### 4.3 Environmental Deprivation

In the United States compensatory programmes have been initiated as means of bridging the gap caused by environmental deprivation. Certain sources that affect intelligence other than the genetic influences may be social and cultural influences on the individual.

The U.S. Commission on Civil Rights on its evaluation of compensatory education has reported that the average child is considered as being similar to other children in mental development and capabilities. The differences that these children manifest, may be attributed to their upbringing at home, their pre-school and out of school experiences, motivations, interests and educational influences of their family background (Jensen 1969).

The term environmental deprivation refers to extreme sensory and motor restrictions, where the children have little sensory stimulation and less contact with adults. Children are reported to manifest intellectual deficits if environmental deprivation occurs early in life (Jensen 1969). When the environment is enriched, children have been reported to gain some points in their intelligence scores.

#### 4.4 Culture

The concept 'culture' refers to those aspects of the life of a society which are shared by all members of that society and normally handed down from generation to generation (Broom and Selznick 1968).

This term incorporates all laws, manners, customs, values, methods of education, arts and beliefs. During the socialisation process, the values and norms of the society are perpetuated by the children. Buck-Morss (1975) has stated that the structure of the society determines the cognitive structure of the members of the society. It is maintained that there is a structural identity between mind and society which is historical in origin. In an attempt to

clarify this socio-cultural basis of the argument, it has been documented that, during the first eighteen months of life when the child's experience of the world is most immediate and most concrete, the Western child is not superior in psycho-motor development to the African child. The 'lag' developmentally is apparent in subsequent skills in formal abstraction (Buck-Morss 1975).

Piaget has been quoted to have said, "the most important thing is not what the child can do in the concrete world, as how quickly he can do without it (Buck-Morss 1975:41). This implies that the ability to progress to the stage of formal logical thought is the ultimate goal in cognitive development.

#### 4.4.1 Cultural deprivation

This term is constantly used in the discussion of retardation in cognitive development. Numerous researchers have approached the topic from different facets. Certain investigators have provided an operational definition, that "cultural deprivation refers to a reduced capacity of the part of the individuals to modify their intellectual structures, in response to direct exposure to external sources of stimulation" (Feuerstein, Rand, Hoffman, Hoffman and Miller 1979: 539).

The reduced capacity to learn, is related to a lack of mediated learning experience by parents, teachers or siblings. Relevant here is the issue, addressed by Bruner, of developing countries that, for a child born in a culture where there is a general feeling of hopelessness

and ineffectiveness,, there may be less stimulation to achieve mastery over the environment that is central to Piaget's theory (Cole and Bruner 1971). Unfavourable conditions,, malnutrition and lack of stimulation,, which prevail in some underdeveloped countries,, tend to retard the children's cognitive development.

#### 4.5 Cognitive Ambiance

This concept is defined as the total pattern of implicit cognitively - relevant cultural values communicated through linguistic and other behaviour by adults and older children (Dasen and Heron 1980). Cognitive ambiance appears to set the cognitive style of the children of different societies,, and results in differences in the development of intellectual abilities. For example,, peasants are reported to have difficulty in adapting to the urban industrial world,, where functional and abstract attributes are in the forefront of thought (Dasen and Heron 1980).

#### 4.6 Social Deprivation

This is a term which is related to the idea that children of ethnic minorities and the economically poor,, who achieve below average in school,, perform poorly as a result of beginning school lacking certain crucial experiences,, which are prerequisites for school learning (Jensen 1969).

The necessary experiences that the socially deprived children lack are perceptual,, attentional and verbal skills,, self-confidence,, direction and teacher-oriented attitudes conducive to achievement in the classroom. This situation

is further compounded by the lack of parental help and encouragement necessary to promote academic achievement.

The psychologists in their evaluation of intervention programmes have pointed out that severe undernutrition, a function of poverty, results in lowered intelligence (Jensen 1969). These variations, created by both social factors and cultural pressures, have an influence on the child's intellectual operations. Because a child has social contacts early in his life, certain common socialisation processes occur, which interact with the equilibration processes.

It has been indicated that pre-school and compensatory programmes are conducted with the aim of making up for the environmental lack by providing appropriate experiences, enrichment and training in basic skills possessed by the majority of children of the same age. The academic lag in certain societies has been attributed to social, economic and educational deprivation. Some of the skills affected in cognitive development are exploration, problem solving and mutual regulation (Case 1984; John, Dambe, Polhemus and John 1983).

#### 4.7 Research Evidence

Research that has been conducted, has demonstrated developmental lag in rural samples which was reduced by contact with a Western technological culture (Reschly and Jipson 1976). Other studies have shown that cognitive processes which are present in children may not be utilised or may fail to emerge, because of lack of experience (Dasen

and Heron 1980).

In a study of lower and middle class kindergarten children, it was found that there was a gap in performance on conservation scores (Peisach and Hardeman 1976). These findings created uncertainty as to whether verbal ability was not the cause of the difference in intellectual functioning of these social groups. These differences in class performance result in inconsistencies in the developmental rate of cognitive tasks. In certain communities, adults have been reported to be unable to perform certain tasks within the concrete operational level (Piaget 1966; Buck-Morss 1975 and Reynolds 1984).

However, Buck-Morss (1975) has remarked that if the structure of cognition is determined by the structure of the society, the potential for a cognitive structure typical of an industrialised society is latent in all human beings.

## CHAPTER FIVE

### COGNITIVE MODIFIABILITY

#### 5.1 Historical Background

Early intervention programmes date back from Froebel's kindergarten which was started in 1837, which utilised play as a learning medium (Short 1986). In an effort to facilitate cognitive development in pre-school children, Montessori, in 1906, introduced a prepared environment for children from a community of refugees and unfortunate people in San Lorenzo in Rome (Montessori 1978). These children were afforded an opportunity to manipulate educational material, with the teacher in this situation being a facilitator in their spontaneous work. The children in Montessori's project progressed from being timid, clumsy and stupid to a level where they showed patience, ability to write and draw, and demonstrate some confidence that would propel them for a life-long education.

With the concept of compensatory education, the Head Start programme was put into operation in 1965 to improve scholastic achievement of disadvantaged children (Jensen 1969).

The failure of these projects raised certain controversial issues about trainability of these children and the nature-nurture problem on the intelligence of the Black American children. Some of the factors thought to be related to the failure, were the attitudes of both the children and the researchers involved. It was suggested that the failure of compensatory education might have been due to the attitudes

of the developers of the programme, in terms of cultural deficiency and inferiority, and the internalisation of these beliefs by those being helped by the project (Sanday 1972). Flavell (1977) seemed to be in agreement with the above statement, when he remarked that psychologists who engage in cross-cultural studies of cognitive growth, tend to have a different problem in avoiding false negative errors of diagnosis. This stems from the fact that the psychologist's inclination to underestimate the child's capacity increases, if the child's experiences, concerning the cognitive tasks, are very different from the examiner with regard to culture.

Although enhancement of Piaget's tasks of conservation in pre-school children (5 and 6 year olds) was regarded as a remote occurrence by previous researchers mainly in Geneva, later, researchers (in America) were adamant that the normal course of development could be altered by appropriate learning experience (Brainerd 1983).

The learning experiments conducted from the late 1960's to the mid 1970's in Geneva, supported Piaget's theory that it was not possible to induce learning of his concepts of conservation. The studies that were published after the year 1979 demonstrated the trainability of conservation skills.

All the above attempts were aimed at accelerating or improving the children's scholastic achievement in certain communities. These programmes were relevant to societies which were disadvantaged socially and culturally where

children showed a developmental lag.

## 5.2 Cognitive Modifiability

Feuerstein has described cognitive modifiability as a means of adapting to the environment which is a prerequisite for survival (Feuerstein 1972). It has been recommended that to enhance self-regulation in the students, one requires understanding of the strategies employed in solving problems in learning and thinking and guiding their intelligence towards further development (Groenewald 1986).

Cognitive modifiability rests on the premise that the child in the transition from the pre-operational period to operational thinking, is capable of performing mental operations. As a result of the ability to reverse mental operations, the child can understand the concept of conservation (Smith 1968).

Early childhood has been considered a critical period for the growth of intelligence; it is during this time that experience plays an important role in the development which makes people different from other living things.

Thus intelligence has been regarded as a teachable and learnable faculty (Short 1986).

"Since guided practise is demonstrably more efficient than incidental learning, it should be quite possible for suitable training to accelerate the rate at which the various stages of intellectual development succeed each other" (Ausubel, Novak and Hanesian 1978: 248).

### 5.3 Problem Issues Related to Enhancement of Piaget's Tasks of Conservation

According to Piaget's theory, it has been emphasised that the cognitive structures of a stage, which comprise mental entities called "operations", define the basic characteristics of intelligence during that stage, and they are supposed to set certain constraints on learning (Brainerd 1983).

Within this premise, one realises the constraints imposed by this theory of modifiability of children's cognitive skills and the stage of development (Ausubel, Novak and Hanesian 1978).

Several studies have been done on conservation, which is achieved during the concrete operational stage. Conservation implies that the child's understanding that quantitative relationships among objects remain invariant across changes in irrelevant perceptual aspects of the objects (Brainerd 1983). Despite the conflicting, controversial results, reports interpreted that the group likely to benefit from training would be children who have some conservation ability. The argument forwarded was that, even if the children do learn to conserve, it is easy to extinguish that skill compared to those who acquire it spontaneously as demonstrated by Smedslund's experiments. However, both pre-operational and transitional children, from various experiments, produced evidence of trainability (Brainerd 1983).

Another point of contention has been the method of training of Piagetian concepts. Self-discovery was proposed as

a method of choice for training the conservation skills, though no substantial results were reported. The tutorial method was hypothesised as being ineffective as opposed to observational learning, rule instruction and corrective feedback.

It cannot be omitted that the Piagetian concepts were related to studies of a middle-class group of children, whose cognitive development was also generated by self-discovery in toys provided, and an appropriate mother-child interaction.

As a result of cultural differences, it has been suggested that "two concepts that develop congruently in an average Geneva child may develop at very different rates in another culture" if one of them is highly valued (Heron and Kroeger 1980: 327). As a result of diversity in producing both qualitative and quantitative differences in the concrete operational stage, the researchers in cross-cultural studies have instituted training procedures in an attempt to accelerate the transition to the next stage as a means of triggering latent competence (Heron and Kroeger 1980).

#### 5.4 Research on the Training of Conservation Tasks

Cross-cultural studies exploring feasibility of training conservation have been conducted in several countries. Dasen and Heron have reported three groups of unschooled children in Rwanda, and schooled children in Montreal. All of these groups demonstrated a significant training effect and a similar rate of learning.

A study conducted by Heron and Kroeger (1980) comprising 109 children (9 to 13 years old) of Yugoslav migrant workers in West Berlin, demonstrated no training effects on conservation after nine weeks of training. The findings showed that there was no significant difference between the experimental and control groups (Dasen and Heron 1980).

However, a highly significant training effect was noted in multiple classification which transferred to certain items from the Progressive Matrices (Dasen and Heron 1980). Experiments in a group of Eskimo West African and East African children were trained in conservation of liquid quantity, class inclusion and horizontality, showed a significant training effect which remained stable after a month. These children were able to transfer to the concrete operational concepts. Evidence has proved that the developmental lag can be reduced by training. This reflects that the mental retardation observed in some children is not a sign of incapacity, since with the appropriate learning experience, performance does improve.

#### 5.5 Studies on Number and Quantity Conservation Concepts

Certain experiments conducted in the direction of Piagetian relevant research, as reported by Flavell (1963), might reveal some crucial formative processes underlying the various cognitive achievements. A study done by Churchill (1958) on training number tasks to 5 year old children indicated improvement in performance after a four week post test period.

However, it has been reported that Harker (1960), who

administered a similar experiment, discovered little improvement (Flavell 1963).

A study undertaken by Wohlwill and Lowe (1962) to facilitate number conservation in 72 kindergarten children, demonstrated a significant post test improvement. This success is consistent with the experiment by Churchill, indicating feasibility of training non-conserving children. Smedslund, with his hypothesis on genesis of conservation, proposed that cognitive conflict and external reinforcement in the form of corrective feedback were necessary conditions for development of conservation (Flavell 1963). The cognitive conflict induces a reorganisation of the subject's intellectual actions, resulting in the conservation strategy. This process seems to be on similar lines with the Piagetian equilibrium model.

In another Smedslund study, five-and-half and six-and-half year old children were trained on quantity conservation, employing the subtraction-addition scheme and plasticine for demonstration. The findings showed that five of the thirteen children ignored the transformation of the plasticine; four of the five children exhibited logical conservation response and eight showed no improvement focussing on transformation in their responses. In an attempt to facilitate number conservation in 20 mentally retarded adults, with a mental age ranging from 5 to 10 years and I.Q. ranging from 47 to 71, a demonstration of the subtraction addition was employed. Feedback was provided as a rule (Fabre, McManis and Stanton 1978).

The results showed that the training group improved significantly in performance, compared with the control group in both the immediate and delayed post tests. This study showed generalisation to other tasks. In the number conservation, eight out of ten trained subjects made correct judgements. Acceptable explanations were given by five subjects in the immediate post test, in comparison to seven subjects in the delayed post test. These results were an indication of the progress in the subjects development of number conservation.

#### 5.6 Length Conservation Studies

A study reported by Flavell, which explored the training effects on length and area, both the experimental and the control groups showed improvement on testing (Flavell 1977). The gain in the control group might have been a function of the test experience. A study that promoted conservation skill of length by group training was undertaken in Botswana (Polhemus, Dambe and Moorad 1985). A group of 40 children ranging between 11 and 12 years of age showed improvement and transferred their conservation skills to number, substance, and weight conservation.

#### 5.7 Conservation of Solid Quantity and Liquid Quantity

A study that examined acquisition of conservation skills of pre-school children of middle and low income families was conducted in Boston (Golomb and McLean 1984). A modified version of questions was employed in the assessment of conservation to avoid the confounding effect of the conventional questions. These non-conserving pre-school

children were trained in the above-mentioned conservation skills.

The training effects proved to be significant in eliciting conservation in non-conserving children. Logical problem solving strategies, associated with the concrete operational stage of development, could be tapped at an earlier period in 4 and 5 year old children. The low income group, as well as the middle class group of children performed with no significant difference. Perhaps this study also highlighted that the variable that might affect the emergence of the concrete operations is the experiential background more than socio-economic status (Mwamwenda 1985).

Despite the fact that conservation has been rated as the most difficult compared to other concrete operational skills, most non-conserving pre-school children could be trained to conserve (Golomb and McLean 1984, Brainerd 1983). Smedslund's studies on conservation of quantity, led him to hypothesise that the essential condition for development of conservation where there has been none, is a state of cognitive conflict in the subject.

He emphasised that it is reorganisation that produces the conservation strategy. Smedslund had discovered that it was easy to extinguish the conservation concept whereas the children who had acquired it naturally would not be misled by the experimenter (Smedslund 1963).

## 5.8 Certain Issues Related to Conservation

### 5.8.1 Identity Response as a Precursor of Conservation

The type of explanation is a function of the particular

quantity involved, and the identity responses may be determined by the particular task and form in which the questions are stated. It has been suggested that the standard format of conservation training and testing, appears to predispose the child towards an identity explanation. Research has shown that prevalent responses of pre-schoolers are identity ones (Golomb and McLean 1984). The sudden change in appearance of quantity, and the phrasing of the question in the conventional tests, may mask the availability of logical reasoning (Golomb and McLean 1984) encouraging a non-conserving group.

Gold (1983, 1986) has also raised this question of whether the young child's failure to conserve is due to a conceptual deficit or to an inability to cope with the task's communication demands. In the training of number conservation, Golomb and McLean requested the children to demonstrate reversibility in support of their responses; through this approach the researchers were able to elicit equality responses. In terms of verbal articulation of the conservation rule, the lower socio-economic class was noted to perform poorly in the conservation responses (Golomb and McLean 1984). Parisi and Sias (1985) maintain that the child's semantic confusion could be misinterpreted as an indication of failure.

#### 5.8.2 Educational Implications

If concrete operations begin from 6 to 12 years of age, it could be feasible for the curriculum to be designed accordingly (Oakes 1984). Despite the different rates of

cognitive development, the sequence has proved to be universal. Thus the same curriculum planning could be followed for all children regardless of their culture.

If Piaget's task of conservation can be used to assess the level of cognitive functioning, it is possible to place children of similar levels together (Oakes 1984). Further, feasibility of training conservation skills could promote learning of the logical operations at an earlier age as demonstrated by previous studies (Brainerd 1982). This could in turn influence the age of admission at school depending on Piaget's test of cognitive functioning.

### 5.8.3 Training to Enhance the Ability to Conserve

In the facilitation of learning to conserve one is faced with the consideration of the age of readiness. One would regard the children from five-and-a-half onwards, who are pre-operational, to be the ones who would benefit from the programme. The child has to be made aware of pre-operational concepts such as identity. Patience is emphasised as children learn step by step. The sequence used by previous researchers is number, length and quantity.

#### 5.8.3.1 Self-discovery

The type of learning that has been recommended by previous researchers is self-discovery of the concept that is being trained (Brainerd 1983). The child is encouraged to use his own co-ordination whereby he can anticipate the result of some transformation and at the same time observe it. This method of training derives from the fact that "the subject, himself, is the

mainspring of his development in that it is his own activity in the environment or his own active reactions that make progress" (Brainerd 1983: 36).

The active manipulation of objects in the environment, building things, tearing them down and then transforming them all contributes to learning. "Since guided practise is demonstrably more efficient than incidental learning, it should be quite possible for suitable training to accelerate the rate at which the various stages of intellectual development succeed each other" (Ausubel, Novak and Hanesian 1978: 248).

#### 5.8.3.2 Tutorial Training

This is conceptualised as a passive reception procedure of information transmission. Examples of this method of training are observational learning, that is a demonstration of the concept by an adult or child who possesses the concept. This method has been illustrated in certain reaching methods such as rule instruction, that is teaching of rule which is critical for the correct performance. Corrective feedback is also regarded as a form of tutorial training, in particular, instruction the children who are deficient in the specific concept are provided with a direct training in the correct answers to items on the tests for that particular concept (Brainerd 1983).

It is maintained that short-term verbal training is capable of producing a limited degree of stable sustained transitional change, from pre-operational

stage to the stage of logical operations; thus long-term training would be more effective.

Certain investigators have discovered that "the children's readiness to learn proceeds from specific training operations and specifically relevant ideas in cognitive structure rather than from more general experience in the mode of cognitive functioning during the course of development" (Ausubel, Novak and Hanesian 1978: 249).

Piagetians have emphasised self-discovery as being more successful compared to the tutorial practise. However, this issue has been addressed by various researchers in cross-cultural studies who found no differences in the training methods (Polhemus, Dambe and Moorad 1985).

Other researchers have found that the feedback technique is more valuable in training subjects to conserve (Onyehalu 1983; Brainerd 1977). Peer modelling has proved to produce social conflict which results in acquisition of conservation (Botvin and Murray 1975; Johnson and Howe 1978; Polhemus, Dambe and Moorad 1985).

Non-verbal conservation tasks with simplified verbal conservation instructions have elicited conservation in non-conserving children (Schiff 1983; Golomb 1984; Wheldall and West 1985; Cowan and Al-zubaidi 1985; Benner and Wheldall 1981).

## 5.9 Issues Related to Stimulation of Cognitive Development

### 5.9.1 The Critical Periods Hypothesis

Explanations emanating from the failure of compensatory education have been discussed by several investigators who questioned the value of providing programmes to improve scholastic performance. Perhaps certain facts may account for failure of the enhancement. The critical period hypothesis implies that irreversibility of behavioural development is a function of extreme susceptibility of particular types of stimulation during those brief periods in individual development when certain types of behaviour are shaped and moulded for life (Ausubel, Novak and Hanesian 1978).

According to this hypothesis, if the individual is deprived of the relevant stimulation during the sensitive period when he or she is optimally susceptible for a particular capacity, some degree of permanent retardation may occur. This notion has been applied to an intervention programme by Montessori and followers, hence the emphasis in pre-school educational programmes. However, there are conflicting arguments about this proposition since a human being is different from the animal species in which the experiments were carried out. It has been proved that the same degree of cognitive capacity that decides readiness at an earlier age would still be available at a later age, the only difference being that it fails to grow at a normal rate due to lack of exercise.

In support to the above statement, Rutter (1985: 693) suggested that "there is no marked critical period for cognitive development." Further, it has been pointed out that "the benefit of good experiences in the early years is lost if subsequent experiences are bad" (Rutter 1985: 639). Relevant here is the idea that there may be good experiences in middle childhood.

#### 5.9.2 The Cumulative Nature of Development Deficits

A prolonged cultural disadvantage is regarded as another cause of possible irreversibility in cognitive development. It has been emphasised that the child who has an existing deficit in growth incurred from past deprivation, is less able to profit developmentally from new and more advanced levels of environmental stimulation (Ausubel, Novak and Hanesian 1978). According to this proposition the defect that the child possessed tends to increase cumulatively resulting in permanent retardation. For example, initial failure to acquire adequate language, information processing and problem solving abilities, obstructs development of intellectual capacities and functioning (Ausubel, Novak and Hanesian 1978).

#### 5.9.3 Differentiation of Cognitive Functioning

A factor that is considered to pose a limiting factor to stimulation of cognitive development is the child's degree of freedom to respond developmentally towards the appropriate environmental stimulation. It has been established that plasticity is inclined to decrease with age; this factor seems to be consistent with the sensitive period.

Verbal intelligence has been reported to be affected if the child has been deprived of initial adequate stimulation. Apparently the chances of complete recovery from environmentally induced retardation are less as the child gets older.

Despite all these assumptions, it does not mean that "later enrichment is entirely to no avail" (Ausubel, Novak and Hanesian 1978: 222).

## CHAPTER SIX

### RATIONALE

Little has been published in the accessible journals on cognitive development of Black children in South Africa. It has been reported that children from non-technological cultures are often delayed in acquisition of some conservation skills compared to Euro-American children (Polhemus, Dambe and Moorad 1985).

A few studies that have been conducted on these societies, have demonstrated cognitive modifiability (Polhemus, Dambe and Moorad 1985; Feuerstein et al 1979; Dasen and Heron 1980; Dasen and Kroeger 1980; Onyhalu 1983; John, Dambe, Polhemus and John 1983; Rogoff 1980; Saxe 1983; Shea, Ogaia and Bagara 1983).

#### 6.1 Problem

This intervention study was aimed at facilitating learning by exposing low intellectual functioning Black children to cognitive tasks designed to modify their functioning.

The reported under achievement of these children might be a function of many variables.

Amongst the variables known, one would mention cultural deprivation, and social deprivation, which could result in a host of social and psychiatric problems. These could create a vicious circle that could affect the child's performance and motivation at school, which in turn might subsequently result in delinquency.

This prevailing climate prompted the researcher to seek an

attempt or some means of introducing an intervention programme which would examine the feasibility of training these deprived children to promote their cognitive development.

## 6.2 Cultural Background

The sample under study lived in an area where there was a mixture of modern ways of living, with a strong traditional background. This study seemed pertinent to promote thinking skills and development of the potential of Black children whose natural curiosity to seek and obtain information was thwarted in the traditional upbringing.

The issue of training the child's mind in the understanding of the physical world, as well as the acquisition of appropriate skills and competence to contribute to developing society have been emphasised (Onyehalu 1983; Buck-Mors 1975; Feuerstein 1972).

## 6.3 Cognitive Development and Training on Conservation Skills

In the present study it was considered that active manipulation of educational material in the environment would lead to cognitive changes which a culturally deprived child might have been denied. As described by previous researchers, children from such communities could not employ strategic behaviour spontaneously as a standard approach to learning.

#### 6.4 Conservation and Levels of Intellectual Functioning

The decision to restrict the study to the conservation of substance, weight, length, number and quantity was influenced by the fact that acquisition of this knowledge is beneficial for arithmetic skills and equations.

Though several investigators have tried to enhance development of the concept of conservation, they have emerged with diverse opinions, and Smedslund's studies demonstrated that laboratory experience could not lead to stable concepts, however, other researchers proved that training could help children to conserve even prior to age levels designated by Piaget (Keasey and Charles 1967).

The present study was an attempt to provide experience by training school children who were non-conservers in the ability to conserve.

Another aim was to explore the performance of these children at two different levels of intellectual functioning, in response to different methods of training conservation skills. The I.Q. scores of these children offered a baseline for categorising children into high and low levels of intellectual functioning. However, the researcher had to be cautious about labelling these children according to the known divisions of I.Q. scores as the intelligence test was not standardised for Black children.

A method of teaching that could be proved to be more effective in the training of the children, could be employed at a later stage in an extension of services concerned with the development of cognitive potential in disadvantaged

children.

If children of a higher intellectual functioning could reach a cognitive stage earlier than those of lower intelligence, one would postulate that the performance on conservation would be related to the efficacy of the method of training that allows self-discovery.

This study evaluated the efficacy of three training procedures designed to promote logical thinking as measured by acquisition of the concept of conservation.

#### 6.5 Aim

The aim of the study, was to explore the interaction between the training procedure and the level of intelligence during the training of non-conservers to conserve. For the purpose of this experiment, three producers (demonstration-recitation, limited manipulation and full manipulation) were used to train children at two levels of intellectual functioning (high and low).

#### 6.6 Hypotheses

##### 6.6.1 Hypothesis 1

All methods of training non-conservers to conserve would be more effective with high I.Q. children than low I.Q. children. The wider the range of intellectual stimulation and the wider the range to which the children are exposed, the greater are the chances that all diverse potentialities within a group and within a single child will be brought forth. Thus, this exercise is aimed at detecting a method of training which meets the needs of

the children functioning at different levels of intelligence. This would help toward engineering an approach appropriate for the specific groups.

#### 6.6.2 Hypothesis 2

For high I.Q. children the three methods of training non-conservers to conserve would be equally effective. The efficacy of the demonstration recitation method can be attributed to an attempt to recall presented material, which tests the extent of internalisation; the feedback would indicate the degree to which learning has occurred. On the other hand the full manipulation method permits self discovery, which enhances learning, providing additional motivation for future learning. The limited manipulation method offers the child a role of being an instructor, and exposes him to corrective feedback by the peer group. The latter effect results in cognitive conflict which promotes learning. Thus any method found to be effective for the high I.Q. children would be recommended for consideration in the education system for facilitation of cognitive development of this particular group of children.

#### 6.6.3 Hypothesis 3

For the low I.Q. children the method of full manipulation would be more effective in training non-conservers to conserve than methods of limited manipulation and demonstration-recitation.

The claim by Piaget that active self discovery facilitates the ability to conserve during the pre-operational stage

has been discussed. This notion would be relevant here, as it is the concern of the researcher to find means of promoting the cognitive skills of these children. If the full manipulation method proves to be the ideal technique to facilitate learning of conservation skills, this could promote a wider use of this method. The intervention programme could be extended to include other low intellectual functioning children.

#### 6.7 Level of Significance

The probability of efficacy in the methods of training and superiority in performance on conservation by the children was set at 0,10 level of significance. 0,10 as a significant level is appropriate for this exploratory research, in the sense that it is the first amongst Blacks in South Africa.

#### 6.8 Research Design

There were two levels of I.Q. (high and low), and three methods of training subjects to conserve (demonstration-recitation, limited manipulation and full manipulation.

This reduces to a 2 X 3 design.

No pretest scores were available as subjects of the sample were non-conservers.

The scores employed were those of immediate post test, i.e. 2 - 4 days after training the subjects to be able to conserve. Delayed post scores were also examined for analysis (4 weeks after training).

The number of children who were able to conserve, transitional and non-conserving, was explored in relation to the training method and for each subtest.

Retention or improvement scores were the difference between the immediate and the delayed post test score totals.

For Hypothesis 1 : a 2 - Anova on retention scores was done. The interaction and the main effects of I.Q. levels and methods of training were assessed.

FOR HYPOTHESIS 1:

		METHODS OF TRAINING		
		DEMONSTRATION	LIMITED	FULL MANIPULATION
IQ LEVEL	HIGH			
	LOW			

For Hypothesis 2 and Hypothesis 3: a 1 way - Anova on retention scores as a dependent variable was used to examine main effects.

FOR HYPOTHESIS 2:

	DEMONSTRATION	LIMITED	FULL MANIPULATION
HIGH IQ			

FOR HYPOTHESIS 3:

	DEMONSTRATION	LIMITED	FULL MANIPULATION
LOW IQ			

For each subtest (e.g. mass), Kendall's test was used, to test the relationship between methods and degree of conservation.

		DEGREE OF CONSERVATION		
		0	1	2
METHODS OF TRAINING	1			
	2			
	3			

## CHAPTER SEVEN

### METHOD

#### 7.1 Subjects

This study was confined to the area of Gugulethu Township, Cape, with all the children belonging to the same socio-economic group. The subjects were composed of 60 Black children, aged 7 to 8 years old, who were currently enrolled in a lower primary school. They were selected from a sample of 100 subjects on the basis of failure to conserve in the pre test.

The criteria for selection were as follows:

##### 7.1.1 Inclusion

Non-conservers - all the children who demonstrated incorrect responses in their judgement of Piaget's tasks were admitted for the study.

##### 7.1.2 Exclusion

Conservers - the rest of the children who responded correctly in their judgement regardless of their explanations were eliminated from the study.

All children who were beyond 8 years of age were excluded from participating in the study.

The selected subjects were assigned to three groups, each consisting of 20 children matched for age, I.Q. and race. The mean age was 7 with an I.Q. of 80. The majority of the children were doing Sub B and a few in Sub A. Both females and males were included in the study.

## 7.2 Instruments for Assessment

### 7.2.1 Piagetian Test

This test was employed to assess the children for conservation ability.

This measurement encompassed four subtests - mass, weight, number, length (and liquid quantity later), the order of which was modified in the different phases of the procedure.

### 7.2.2 The New S.A. Individual Scale (Intelligence test)

The purpose of administering this test was primarily to categorise the subjects into two levels of intelligence. Although the test was not standardised for Black children, it was necessary that some form of assessment be instituted using a recognised, standardised test. For the study to be valid, the researcher had to ensure that she was dealing with a normal sample.

The subjects were categorised into two levels of intelligence - high and low, for the purpose of evaluating the training effects of the different methods of training on each level of intelligence as measured by the intelligence test.

The test that has been recommended and widely used is the new South African Individual Scale (Butler Adam 1982; Stoch, Smythe, Moodie and Bradshaw 1982; Heyns van Niekerk, Hermanus and Le Roux 1981). Although no literature or evidence from other sources was available to provide evaluation of its use for Black children, the

researcher had found it useful from experiences.

This test provided a range of scores from which the sample could be selected. Subjects who had an I.Q. score lower than 70 were excluded. The test is composed of verbal and non-verbal sections. A non-verbal test on its own would not be a genuine measure of these children's intellectual capacity.

This test has been used on Coloureds, Indians and Whites and found to be reliable and valid by the Human Sciences Research Council. (For further information see Manual of the New South African Individual Scale). However, instructions were given in Xhosa.

### 7.2.3 The Draw-A-Person Test

This test was used as a measure to validate the new South African individual scale in the assessment of intellectual functioning of the subjects. Since the New South African Individual scale is not a standardised test for the Black children, the researcher deemed it necessary to combine it with another intelligence test. The Goodenough's Draw-a-Person Test is regarded as a satisfactory predictor of the child's mental age from which an I.Q. score can be calculated. The Draw-a-Person test is non-verbal as there is no language or reading. Its use was an attempt to eliminate some of the parameters that might influence the children's performance on the New South African individual scale. The test demands simple instructions for the testees - one is asked to make a picture of a man, (the best picture one can make). Richter, Windell and Griessel

(1985) have reported this test to be reliable, valid, easy to administer and attractive to young children.

The emphasis in this test is placed on the child's accuracy of observation and on the development of conceptual thinking. The child is given credit for inclusion of individual body parts, clothing details, proportion, perspective and similar features (Anastasi 1976). The reliability of the Goodenough Drawing test yields a score of 0.90. It has been established that this test correlates with tests of reasoning, spatial aptitude and perceptual accuracy.

The Draw-a-Person test has been used as a supplement to intelligence tests such as the Stanford-Binet and other verbal scales (Anastasi 1976). The test has been used on different cultural and ethnic groups (Mayekiso 1982). However, research has demonstrated that performance on the Draw-a-Person test is influenced by cultural background. Comparative data obtained from different cultural groups showed that the mean group scores were related to the amount of experience in representational art within each culture. A comparative study of American and Mexican children on the Draw-a-Person test has revealed cultural differences in experiential background.

Instructions were given in Xhosa.

(For further information see Appendix E)

#### 7.2.4 Training Material

Apparatus for the training of length conservation were:

Ribbon lengths

Pipe cleaners

Rope lengths

Lengths of sticks

### 7.3 Independent Variables

#### 7.3.1 Levels of Intelligence

Each group of 20 subjects was categorised into higher and lower levels of intelligence according to I.Q. scores of the specific category. This decision provided means of examining effects of different training methods on these categories.

The higher I.Q. level range was rated from I.Q. 101-85, whilst the lower I.Q. level range was rated from I.Q. 84 and below.

#### 7.3.2 Methods of Training Conservation of Length

Another independent variable was the method of training employed to facilitate learning of conservation skills. These methods of training permitted different degrees of activity on experimental material. The following methods were used to enhance conservation in non-conservers:

##### 7.3.2.1 The Demonstration-recitation Method

Despite the fact that the subjects were taught the principles involved in conservation, they were observers and listeners devoid of the experience of handling the materials during the demonstration. The

subjects merely repeated what the experimenter had said and demonstrated.

#### 7.3.2.2 The Limited Manipulation Method of Training

This method afforded each child a chance of being a demonstrator and of handling the material and verbalising the principles in operation. Simultaneously, each child was faced with social conflict by being exposed to his peer group, who would occasionally provide a corrective feedback, together with the experimenter. This notion in turn fostered some cognitive conflict which is essential for equilibration (Hooper, Wanska, Peterson and De Fran 1979; Polhemus, Dambe and Moorad 1985; Onyehalu 1983).

#### 7.3.2.3 The full Manipulation Method

This method of training encouraged a higher degree of activity. All the children were actively involved individually in the manipulation of the apparatus used for the training. This was experiential in the sense that the children could practise reversibility, and compensation of dimensions could be observed. Reinforcement by corrective feedback and praise could be provided by the experimenter when necessary.

#### 7.4 The Dependent Variable: Conservation Score

The scales with which this variable of interest was assessed were the Piagetian sub tests administered initially as a pretest and at a later stage as a post test.

The scores obtained were rated on a 2 point scale for each subtest - mass, weight, number, length and quantity (which

was introduced in the delayed post test). Specifically, the categories determined by the scores were:

Non-conservers	=	0
Transitional	=	1
Conservers	=	2

The design included three phases: a pre-test to establish the non-conserving status of all participants; a limited conservation training intervention; and conservation post-tests (immediate and delayed).

#### 7.4.1 Scoring Criteria

Certain categories had to be identified in relation to the degree of conservation.

##### 1. Non-Conservers

A non-conserving judgement received a score of 0. A total score of 0 was an indication of being a non-conserver.

##### 2. Transitional Conserver

A conserving judgement, without a correct qualifying statement, was awarded a score of 1. A total score of less than 6 was considered a state of being a transitional conserver.

##### 3. Conservers

A correct judgement and a corresponding explanation of identity, transformation of reversibility or compensation was offered a score of 2. A total score of 6 was regarded as evidence of being conserver.

#### 7.4.2 Selection

On the first day of the research period, a group of 100 available children aged 7 - 8 years old were screened with the aid of the Piagetian test for conservation skills. After elimination of conservers, 60 subjects who were non-conservers were selected for the study. The process of selecting subjects lasted for a week, each child being tested through an average period of 20 minutes in Xhosa (the familiar language).

The children were selected on the basis of being non-conservers and being 7 - 8 years old.

#### 7.4.3 Apparatus

Items of apparatus used for the testing of the subjects were as follows:

A balance scale with height, length and two circular pans to contain solid quantity or substance to determine weight conservation.

Two plasticine balls to assess mass conservation.

Twelve buttons for assessment of number conservation.

Three lengths of stick to examine length conservation.

In addition, the various materials for the training of length conservation were collected.

Two identical glasses and a tall thin glass for assessment of liquid quantity conservation.

#### 7.4.4 The Pre Testing

The sessions were held in a big office for the purpose of interviewing the children individually in a quiet setting. The subjects were familiar with the researcher as she had been introduced beforehand to the teachers and students of

the different classrooms by the school principle.

In turn, each child was seated in a chair comfortably across the table from the experimenter, with all the test materials assembled on the table. To establish the necessary rapport, the researcher introduced herself on the first meeting with each subject, and to reduce anxiety of the experimental situation. Each child was informed by the researcher that the programme to be followed was aimed at enhancing performance in school work, particularly arithmetic.

After ensuring that the child was comfortable physically and psychologically, the test was administered using Piagetian tasks to assess conservation. Each child was allowed to handle the apparatus before being questioned on it. Instructions that were followed can be found in Appendix D. All instructions had to be translated into Xhosa - a language that the children understood better.

#### 7.4.5 Assessment of Intelligence

On the following week, the subjects who were unable to conserve were selected. The non-conservers were assessed for their level of intelligence with the aid of The New South African Individual Scale in a familiar language - Xhosa. During each session, the child was assessed alone in a quiet room with the tester.

Before the intelligence test was administered, the subject was requested to draw a person. The drawing session was enjoyed by some of the children, and at the same time, it

served as some form of alleviating the anxiety of a test situation. The instructions for the draw-a-person test are available in Appendix E.

The average period taken by each child for the intelligence test was about 45 minutes. The intelligence testing of the children was completed within a period of 3 weeks. Sixty subjects were drawn out of this group of non-conservers as suitable candidates who could be matched accordingly. The children were then assigned to three different groups matched for their I.Q. scores and age. Each group was allocated both higher and lower I.Q. subjects. If there was a difference in I.Q. scores in the matching of subjects it was not more than five points.

Group number 1 was the demonstration-recitation group, where children were assigned a passive role by the method of instruction, in the sense that they had to echo what the experimenter had said.

Group number 2 was the limited manipulation group, whereby each child stood a chance of being a demonstrator to others.

Group number 3 was the full manipulation group, all of which were expected to work on their own, with the demonstrator as a facilitator.

A group that received no training was not included in the study, the argument being that the pre tests of conservation tasks have been found sometimes to activate learning of the concept. This factor tends to confound

the results, creating no difference between the control and the experimental groups. (Brainerd 1983, Dasen and Heron 1980).

#### 7.4.6 Training

The training of the 60 accessible children was commenced soon after matching and assigning them to three groups of 20 subjects. The following week, after I.Q. testing, training sessions were conducted. The children were trained in length conservation. The following apparatus were used:

Equal lengths of ribbon, rope, pipe cleaners, a standard 12 inch stick and 2 halves of a 12 inch stick.

Group training was implemented for each group separately in different sessions, that is, if one group was in a training session in the morning, another group would follow at another time.

The children assembled in a big room, seated in a semi-circle, with the demonstrator standing in front of the children. Group training with different methods was considered to be a strategy pertinent in exploring a more effective method, in facilitating conservation skills at all levels of intellectual functioning. The variety of materials employed in training of length conservation were capable of reinforcing invariance of matter, in this instance, length. Principles of reversibility and compensation were emphasised.

For the demonstration-recitation group, the demonstrator would show the children pieces of equal lengths in

different positions and shapes to ascertain that they had grasped the notion of invariance of length. Whenever she demonstrated a certain item and a relevant concept, she would ask the children to repeat what she had just said, and also ensure that they understood the statement. Positive reinforcement was provided by praising the children for correct answers and corrective feedback for wrong answers.

The method of training employed for the second group of subjects was limited manipulation of materials, where every member of the group got a chance of being a demonstrator to other children during each session. At the beginning of the session, the experimenter demonstrated and explained to the children the principles of invariance of matter identity, reversibility and compensation. Over these sessions of training, all the children managed to be demonstrators and to experience correction and praise from the researcher; the peer group members were also allowed to comment when a child demonstrator was modelling incorrectly. This practice afforded the child the opportunity to be exposed to peer group conflict which has been proved to be beneficial for equilibration. The child would suddenly be thrown into a disequilibrium and begin to realise his deficit in terms of the specific concept.

The third group of children, was trained in length conservation using the full manipulation method. This particular method provided an opportunity for the children

to invent self discovery through working independently with the experimenter as a facilitator and demonstrator. As before, the demonstrator described the principles operating in conversation - invariance, identity, reversibility and compensation.

The children were either praised or corrected on their responses where appropriate. All children in this group had their own items of apparatus for practice.

The training of the subjects was conducted over three sessions of 30 minutes for each experimental group. The period of training lasted for three days.

#### **7.4.7 Post Tests**

The immediate post test was commenced on the following week, 3 - 4 days after the training sessions. The measures employed for this post test were identical with those of the pre test - Piagetian subtests of mass, weight and number with length excluded. This practise provided a means of exploring transfer of conservation skills from length to other tasks of conservation. A female research assistant who was a blind tester, assessed the children, in Xhosa, after a training session to satisfy the researcher of her competence in the required skills of interviewing and testing children. The immediate post testing extended over one week.

#### **7.4.8 The delayed Post Test**

A period of four weeks elapsed before the delayed post-test was conducted. This exercise was done for the purpose of examining retention of conservation skills.

For learning to have occurred, children would be able to retain whatever they have been taught after two weeks. The measures employed during the delayed post test were identical with those of the immediate post test, except that a liquid quantity conservation test had to be included. The addition of liquid quantity conservation was a means of observing transfer of extension of conservation skills to more complex conservation skills usually attained at the age of 12 years. A period of one week was spent in testing the children which was done by the same research assistant.

CHAPTER EIGHTRESULTS AND INTERPRETATIONS

As a point of departure, the pre test scores which were zero (reflecting failure to conserve) provided a baseline. Thus it is unequivocal that all subjects improved in scores from facilitation of conservation skills as reflected in both the immediate and delayed post tests in the table below.

8.1 Cell MeansTable 1

	Training Method		
	Demonstration	Limited Manipulation	Full Manipulation
Pre test	0	0	0
Immediate post test	4,8	4,5	4,4
Delayed post test	4,7	4,8	4,7

A Graph of Cell Means of Both Immediate and Delayed Post Tests  
in Relation to Methods of Training

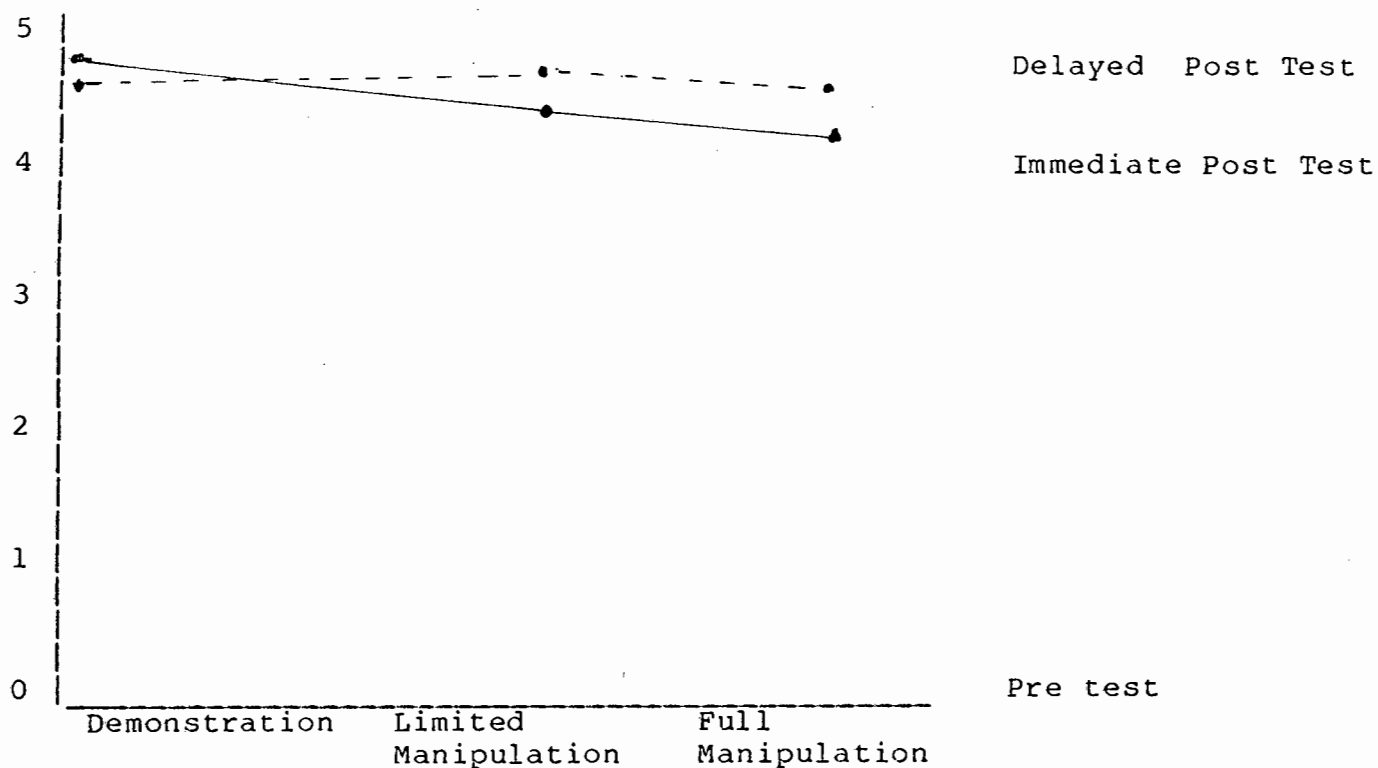


Figure 1

The graph of cell means demonstrates the pre test scores as being on the X-axis. A dramatic improvement of scores during the immediate post test is apparent; this tendency is maintained almost at a constant level during the delayed post test four weeks after training.

The maximum score for conservation ability was 6.

The mean score for the immediate post test was 4,584, whilst the standard deviation was 2,036. For the delayed post test the mean was 4,733 with a standard deviation of 2,074.

The issue of conservation brings us to a question of what the operational definition of conservation is. Is it acquisition or retention? One would maintain that to have learnt, the child

should be able to retain the material over a period of four weeks. Within this premise the index of improvement would be the retention score which would be the difference in scores between the immediate post test and the delayed post test scores. Regression refers to a negative score.

As evidence of having learnt to conserve, regardless of the method of training, there is no significant difference in retention scores between the two levels of intelligence (high and low I.Q.), because for high and low I.Q.  $F_{1,54} = 0,12$ ;  $p > 0,01$  in table 2.

## 8.2 Table of Cell Means for Improvement on Retention Scores

Table 2

LEVELS OF I.Q.	TRAINING METHOD		
	DEMONSTRATION	LIMITED MANIPULATION	FULL MANIPULATION
HIGH	-0,625	0,444	0,875
LOW	0,25	-0,091	0,083

The first hypothesis that all methods of training non-conservers to conserve would be more effective with normal rather than retarded children was not confirmed, since the difference was not significant.

Most children appear to have gained from the facilitation of the ability to conserve as reflected by the total scores. All the methods demonstrate a substantial number of conservers in both the immediate and delayed post tests. See table of total score column 6 in tables 3 and 4:

8.3 Frequency of Total Immediate Post Test Scores 0 - 6Table 3

GROUP	0	1	2	3	4	5	6	TOTAL
DEMONSTRATION	1	1	1	0	4	1	12	20
LIMITED	3	0	1	1	2	0	13	20
FULL MANIPULATION	1	1	3	1	3	0	11	20
TOTALS:	5	2	5	2	9	1	36	60

Where 0 denotes non-conservers and 6 represents conservation

8.4 Frequency of Total Delayed Post Test Scores 0 - 6Table 4

GROUP	0	1	2	3	4	5	6	TOTAL
DEMONSTRATION	3	0	1	0	2	0	14	20
LIMITED	2	0	2	0	1	2	13	20
FULL MANIPULATION	1	0	4	0	2	0	13	20
	5	2	5	2	9	1	36	60

Where 0 denotes non-conservers and 6 represents conservation

8.5 Summary of 2 X 3 Analysis of Variance for 2 I.Q. Levels and 3 Methods of TrainingTable 5

SOURCE OF VARIANCE	df	ms	F	PROBABILITY
GROUP METHOD	2	1,8	0,71	0,49
HIGH AND LOW I.Q. LEVEL	1	0,3	0,12	0,72
GROUP X I.Q. LEVEL	2	4,2	1,65	0,2012
ERROR	54	2,5		

Hypothesis 2, that for normal children the three methods of training non-conservers to conserve would be equally effective, was supported because there was no interaction.

$$F_{2,54} = 1,65 ; p > 0,10$$

Therefore, all the methods were equally effective.

Hypothesis 3, that for the retarded children, the method of full manipulation would be more effective in training non-conservers than the methods of limited manipulation and demonstration, was not confirmed. There was no significant difference because there was no significant interaction.

$$F_{2,54} = 1,65 ; p > 0,10$$

A Graph of Retention Scores in Relation to Levels of Intelligence and Methods of Training

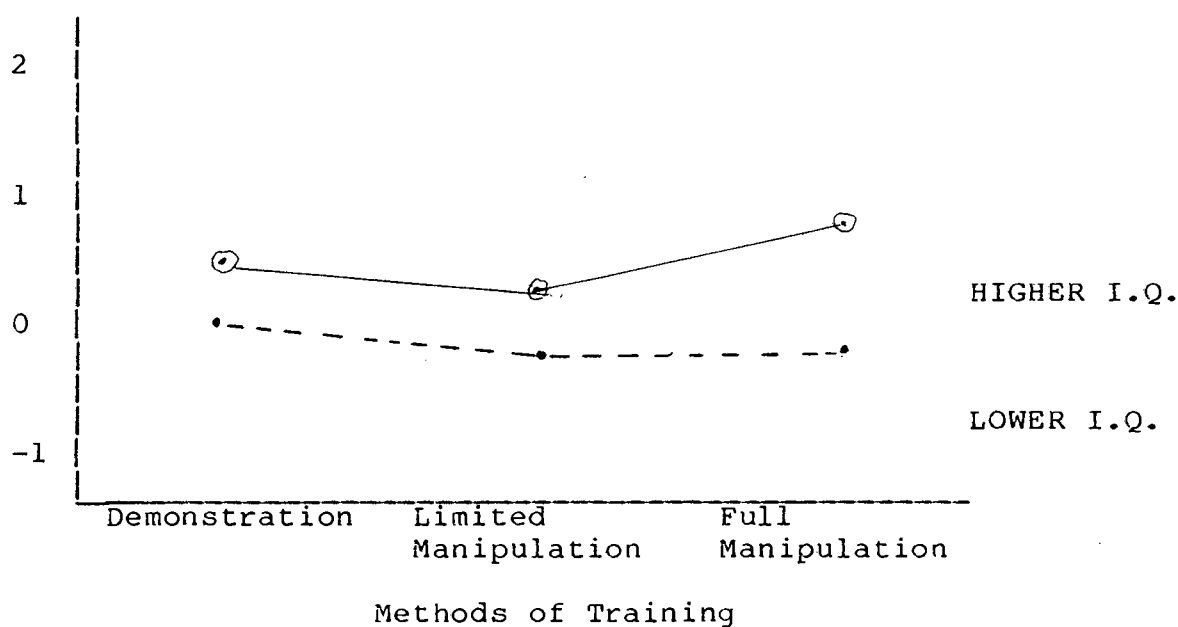


Figure 2

No significant difference was noted between the high and low I.Q. subjects in the learning of conservation skills.

$$\text{High - Low } (F_{1,54} = 0,12 ; p > 0,10)$$

Where the dependent variable is delayed post test score minus the immediate post test score, this variable is regarded as a retention score for each of the different I.Q. levels in relation to the method of training the subjects to conserve. A retention score is regarded as an indication of having acquired the skill (see figure 2).

Table 2 demonstrates the performance of children of different I.Q. levels in response to different methods of teaching.

Horizontal decalage, which has been described as the inability to transfer to another area of conservation, was revealed by findings in tables 3 and 4 of Frequency of Immediate and Delayed Total Post Test Scores.

These children exhibit different levels of achievement with regard to problems that require similar mental operations.

The columns with scores from 2 to 5 represent the number of children that failed to transfer the mechanism used in one conservation skill to another.

The various methods of training appear to differ in the numbers of children who demonstrate this horizontal decalage. The highest number that reflected this phenomenon was found in the Full Manipulation method group (6 children), followed by the Limited Manipulation group (5 children), the least number (3 children) being in the Demonstration method group. In both the immediate post test and the delayed post test, the frequency of scores demonstrated a small number of non-conservers, a large number of conservers and a wide distribution of subjects with incomplete conservation.

Certain trends emerged that were related to some subtests of conservation and methods of training.

The methods of training were arranged in a ranking fashion from passivity to activity, that is, from demonstration, limited manipulation to full manipulation methods (of material).

The scores of the quantity subtest demonstrated more or less equal numbers of conservers in all methods methods of training, with the full manipulation methods resulting in a slightly higher number of conservers.

#### 8.6 Frequency of Conservation in the Piagetian Subtest of Liquid Quantity

Table 6

A Table of a Subtest Showing the Pattern that Emerged

		QUANTITY		
		0	1	2
METHODS	1	7	0	13
OF	2	8	0	12
TRAINING	3	5	1	14

In both immediate post test and the delayed post test, the scores ranged from 0 to 6, where 0 indicated non-conservers; 6 was considered as the ability to conserve on the three subtests - mass, weight and number (see Tables 3 and 4).

No significant relationship was noted between methods of training and frequency in the degree of conservation on Kendall's T results being:

$t = -0,543$  ;  $p > 0,10$  for the immediate post test

$t = -0,192$  ;  $p > 0,10$  for the delayed post test

The levels of conservation were organised in an ordinal manner, from failure to conserve to mastery of conservation so as to represent non-conservers, transitionals and conservers. A test of this pattern using Kendall's T was not significant:

t = -0,192 ; p > 0,10

8.7 Frequency of Conservation in the Piagetian Subtest of Mass

Table 7

A Table of a Subtest Showing the Pattern that Emerged

		MASS (IMMEDIATE POST TEST)			MASS (DELAYED POST TEST)		
		0	1	2	0	1	2
METHODS	1	2	1	17	4	0	16
OF	2	5	0	15	7	0	16
TRAINING	3	6	0	14	7	0	13

This pattern was consistent but not significant throughout the immediate post and delayed post tests for all subjects except conservation of quantity and number. The quantity subtests subtest was introduced only in the delayed post test to assess validity of generalisation of conservation to other subtests.

Though none of the training methods indicated superiority in terms of performance of the subjects, certain trends developed.

The status of the response to the different training methods of conservation was evident in the number of subjects reflected by categories of achievement represented by the following scores:

- 0 = conservers
- 1 - 5 = transitionals
- 6 = conservers

The immediate post test total score frequency table shows the performance of the demonstration trained group as presenting 1 non-conservers, 7 transitionals and 12 conservers. The limited manipulation training method has produced 3 non-conservers, 4 transitionals and 13 conservers. The full manipulation training response shows 1 non-conservers, 8 transitionals and 11 conservers.

The demonstration-recitation and full manipulation groups have fewer non-conservers, whilst the limited manipulation group has 3. The number of transitional children is more or less the same in the demonstration and the full manipulation groups whilst the limited manipulation group reflects a drop in transitional subjects. However, the numbers of conservers illustrates a higher number in the limited manipulation group, followed by the demonstration-recitation group group, and lastly by the full manipulation group. No statistically significant difference was found between the training methods.

The table of frequency with delayed post test total scores exhibits a high number of non-conservers (3) in the demonstration trained group with a corresponding number (14) of conservers and, the least number of transitional children (3).

The limited manipulation group has the least number of non-conservers (2), with 5 transitionals and 13 conservers.

The full manipulation group has 1 subject that has failed to conserve: there is a high number of transitional subjects (6); and the number of conservers is the same as that shown by the limited manipulation group (13).

There is an improvement on the frequency of conservation from the immediate to the delayed post test as portrayed by the demonstration and the full manipulation groups. However, no marked difference exists between the groups' training methods as mentioned.

## CHAPTER NINE

### DISCUSSIONS AND CONCLUSIONS

In the present study, feasibility of evoking a conservation response was explored. Three methods of training, employed to elicit the ability to conserve in non-conserving Black children, proved to be equally effective.

The efficacy of the training on length conservation enabled these children to transfer to other conservation tasks of substance, weight, number and liquid quantity.

Both high and low intellectual functioning children were successfully stimulated with equal magnitude.

The children learnt to conserve within a relatively brief period and maintained this status over four weeks. The previous cross cultural studies have also shown this tendency (Dasen and Heron 1980; Polhemus, Dambe and Moorad 1985; Golomb and Mclean 1984; John, Dambe, Polhemus and John 1983; Harris 1973; and Smith 1976).

#### 9.1 Hypothesis No 1

The prediction that all methods of training non-conservers to be able to conserve would be more effective with normal than retarded children was not supported.

This outcome of equal performance of both normal and retarded children brings into question the relevance of the intelligence test to the Black child. One might ponder if it taps intelligence, a particular relative information or perhaps a measure of cultural experience (Cloete 1986).

On the other hand to account for equal performance of intelligence levels, one could argue that the training provided was relatively intensive (Feuerstein 1972) and incorporated both informative and therapeutic experiences for the disadvantaged children. All those factors were a contribution towards the achievements of children of different intellectual levels. The depressed intelligence scores might have been a function of an emotional component which could be situational or due to family influences. Emotions have been reported to repress the motivational aspect of intellectual activity (Ginsburg and Oppen 1969; Rutter 1985).

The emotional problems due to difficult family situations or relationships have been said to result in arrested or decelerated performance (Svensen 1983).

Both the attention and stimulation by the researcher provided to these children might have aroused interest and motivation necessary for learning. Lamprecht (1986) has emphasised the influence of motivation of the child in the learning situation.

The low intelligence scores might have been an influence of an environmental upheaval during the research period. Rutter (1985) has mentioned that a depression of intelligence scores by five points might result from war or political unrest. Thus the performance of those children with low intelligence scores demonstrates recovery from whatever transient insult they might have suffered before the training. For optimal cognitive development, it is

considered that both an active learning experience and a social context that promotes self confidence and interest in learning are essential. Though the criterion for classifying retardation is an intelligence score, it cannot be overlooked that the depression of intelligence scores may be due to cultural-familial retardation or to socio-political pressures (Anderson 1986)

As pointed out by Sharratt (1986) certain tasks in the intelligence tests are processed differently by some individuals by employing different modes of encoding, for example, the use of spatial encoding instead of verbal memory. Thus one would contend that the low intelligence score might not be a reflection of some structural impairment, but a function of inability to apply spontaneously efficient strategies for the specific tasks. Thus, there was a discrepancy between the performance on the tasks on the intelligence test and on the Piagetian task in which these children were trained.

## 9.2 Hypothesis No 2

The hypothesis that for normal children the three methods of training non-conservers to conserve would be equally effective was confirmed.

This finding is consistent with the result of a study of Botswana by Polhemus, Dambe and Moorad, where children were able to conserve regardless of the method of training (Polhemus, Dambe and Moorad 1985). The significant gain on scores from the pre test where children were unable to conserve to both immediate and delayed post tests signifies

that the children were amenable to remediation in the learning process.

The results demonstrated the potential inherent in these children on exposure to appropriate stimuli and methods of training. Through this exercise they were able to reach the expected stage of development comparable to their peers. Despite the fact that these training methods allowed different degrees of activity, there was no significant difference in their performance. Although all the methods were equally effective in accomplishing the objective of acquisition of conservation, one could have expected the full manipulation method to be superior. According to Piaget, self discovery was a guarantee for success in the acquisition of conservation (Brainerd 1983).

For the normal children who are supposed to be more creative and alert compared to the retarded children, one would expect best performance on the full manipulation method of training.

On the other side of the scale, the demonstration-recitation method would have been rather more effective for the retarded passive child with no incentive for exploration. The lack of superiority in the methods might be due to the fact that the children were a homogeneous sample with a common upbringing in the sense that they had a common socio-economic and racial background.

One could propose that the success of the demonstration-recitation method of training derives from the fact that this method resembles the traditional upbringing where an

adult authority gives instruction. The children were perhaps conditioned to this type of instruction and had respect in the absolute authority of the experimenter. In their study, Polhemus, Dambe and Moorad (1985) have documented that children in the non technological societies learn better on structuring where there is direction by adults.

Onyehalu (1983) has commented on discouragement of children against curiosity and exploration by the traditional discipline. Thus the children in the study were accustomed to being passive recipients of structured information. This passivity may derive partly from lack of energy and incentive that is characteristic of malnourished children, which is further exacerbated by the authoritarian discipline. The passivity and shyness were more pronounced during the initial sessions of the pre test and training. Montessori had identified these attributes of behaviour in a sample of children in her study of a disadvantaged group of refugees and other unfortunate people in San Lorenzo in Rome.

The involvement of the experimenter as a mediator might have played a significant role during the training sessions. In mediational strategies it has been emphasised that the mediator makes sure at all times that the child understands completely what is expected and that he or she knows that mistakes may be made and he or she will be repeatedly helped if necessary (Cloete 1986).

The efficacy of all the methods of training of varying degrees of activity, necessitates a focus on how Piaget generalised the cultural practice essential for acquisition of conservation. He only considered self discovery as a prerequisite for learning of conservation skills and disregarded the ways of learning the same skills adopted by other cultures.

Perhaps, the discipline in upbringing and the lack of material resources for stimulation combined with the relative passivity of children, led to the precocity to develop abstract skills relevant to the formal operational stage. The children under study had learnt to work out things from observation of adults at an earlier age due to cultural demands. This notion could be regarded as an advancement in their thinking ability that might have been underestimated. This lends support to what Polhemus, Dambe and Moorad (1985) considered to be cognitive restructuring in response to a verbal stimulus even before the children had reached the concrete operational stage in their skills. Observational learning has been considered to occur at a later stage of development (Piaget and Inhelder 1969). However, the training employed in this study used instruction with mediation rather than observation only.

### 9.3 Hypothesis No 3

It was hypothesised that for low I.Q. children the method of full manipulation would be more effective in training non-conservers to conserve than the methods of limited manipulation and demonstration. The above hypothesis failed to be confirmed as all the methods proved to be equally

effective in the training of low I.Q. children.

In the light of this finding, it might be suggested that the effect of stimulation regardless of the method of training was related to some factors other than intelligence of the children.

Low I.Q. scores as measured by Western intelligence test could be associated with varying degrees of cultural deprivation. Intelligence score differences within the same group could be due to either genetic, environmental differences or family influences. The children might have differed in points on intelligence scores as a result of varying degrees of deprivation within the same vicinity.

The failure of exposure to certain cultural elements might have affected or influenced expression of mental ability during the intelligence testing. Sanday (1972) has discussed the three types of acts that comprise the mental system in operation as cultural, genetic and emotional. Sanday (1972) has mentioned that group differences occur in measured intelligence because individuals in the same society do not necessarily have at their command the same set of cultural acts or the same culture based cognitive components.

On the other hand, the intelligence test has been noted to be a doubtful criterion of measuring the intellectual functioning of the individual. It could be measuring the level of performance of the individual more than his potential (Feuerstein 1972). Yet, an individual as an open system is considered to be amenable to structural changes irrespective of the known impediments to change (Feuerstein 1972). Of the few limitations one

could mention the etiology of certain conditions, the stage of development and the degree of severity of the condition.

In the present study, subjects of both high and low intelligence demonstrated equal performance following the intervention programme. The training was effective in producing the ability to conserve within a short time. Why was there no difference in performance between subjects of high and low intelligence? Since these children were attending a normal school, it could be assumed that they were functioning within normal limits of intelligence. This occurrence supports the argument that low I.Q. scores tend to create quasi-retarded individuals in the lower socio-economic group (Mercer 1972; Lamprecht 1986). This is consistent with Dobzhansky's (1973) assertion that genetic I.Q. differences show up in individuals who mature in favourable surroundings, whilst they remain latent in individuals from adverse or suppressive environments.

The performance of the children with a low I.Q. in the current study proved that they were functioning within average intelligence, in the sense that they achieved the same status on conservation tasks as the subjects of a high I.Q. level. The Piagetian tasks, after the training of the children under study, seemed to tap their actual mental ability. Piaget's tasks have been employed in diagnostic evaluation of intellectual defects (Flavell 1963).

Piaget's tasks of conservation of substance, weight and volume in Flavell's study were administered to differentiate levels of intellectual functioning. Within this context, if the subjects in the current study were retarded, they would have failed to

conserve, and to transfer to other tasks of conservation. From observation there was no relationship between the I.Q. scores and the subjects' mental age as measured by the Draw-a-Person Test. In this group of children, experience in art might have had an influence on their drawings. Some children had low I.Q. scores compared to their mental age. This discrepancy was evident in some boys who were artistic in their drawings compared to the girls. The Draw-a-Person Test was not a good predictor of these childrens' intelligence.

Piaget's assertion that acceleration of cognitive development is not possible has been disconfirmed by the findings of this study. Why was facilitation of conservation skills possible within a brief period? Piaget was not aware of the latent abilities of children from other cultures when he argued against acceleration of developmental stages. Children who were lagging behind in their cognitive development were regarded as developmentally immature. This was evident with the Martinique children who reached the concrete operational state 4 years later than the Swiss children (Brainerd 1983). Similarly, the subjects in the current study were behind in terms of conservation skills, the delay being more of a cultural/social nature in their upbringing. The culture did not provide a chance for these children to practice the skill, nor could the parents afford to send them to places where these skills could be facilitated.

This is consistent with the proposition by Dasen and Heron (1980) that the cognitive structure might remain hidden if the operation is not called into play. Thus it was possible to activate the latent skill of conservation through training. The success in the promotion of conservation supports Ausubel, Novak and

Hanesian's contention that after a certain degree of consolidation of the pre-operational stage, it is possible to facilitate the attainment of the concrete operational skills by training under learning conditions relevant to the stage.

The fact that non-conserving children were able to generalise conservation skills to other tasks and retained the information over a month, is evidence of true learning. Brainerd (1983) has pointed out that retention of information over two weeks reflects that the children have acquired the skill. The findings of the present study are consistent with those of previous research in non technological societies (Polhemus, Dambe and Moorad (1985); John, Dambe, Polhemus and John (1983); Shea, Ogaia and Bagara (1983)).

Piaget did not realise that children who had not attained the ability to conserve, could learn this concept through specific training, and even show abstract thinking typical of the formal operational stage through learning from observation. The success of the intervention programme highlights the contribution of informal everyday practices and cultural values towards creation of cognitive structures to which Piagetian conservation skills could be accommodated.

✓ In her study in Cross Roads in the Cape, Reynolds (1984) has noted the contribution of informal practices such as involving children in their parent's business entities (as hawkers). These practices might even be responsible for the precocity, in the expression of abstract thinking from watching their parents as models.

The brief acquisition of the conservation concept could be linked to the familiarity of the materials in the experiment to those employed in analysing the physical world of the culture. The emergence of the cognitive structure through practice has been noted in other studies on White Kindergarten children (Harris 1974; Smith 1977). Although the children in the present study were delayed in their cognitive development, the success in promoting their conservation skills supports the universality of sequence in the stages of cognitive development (Mwangangi 1974). When Piaget guaranteed active self discovery as the only means for acquisition of conservation skills, he underestimated the latent abilities in the non-technological cultures that could aid emergence of conservation skills.

Training was offered at an appropriate age when the children were at the period of concrete operations. In agreement with this position, other investigations have emphasised the importance of readiness before acceleration of conservation skills (Ausubel, Novak and Hanesian 1978; Brainerd 1983; Hetherington and Parke 1979). The initial failure to conserve in the present study is in accordance with the idea that their culture did not attach value on these tasks. Piaget has not considered the constraints imposed by culture on the rate of cognitive development. Perhaps if this problem was recognised, the importance of facilitating the rate of development would have been realised.

With regard to methods of training, the emphasis on the role of action and manipulation as being necessary for acquisition of knowledge (Piaget 1966) was disconfirmed in the present study. The subjects did not only learn to conserve, but they also demonstrated understanding and internalisation of activity

characteristic of formal operational stage through the demonstration-recitation method. From verbal presentation and action of the demonstrator, mastery of conservation was possible, this contradicts Piaget's stance of self discovery.

Polhemus, Dambe and Moorad have addressed the emphasis on exploration and self discovery for development of cognitive structures. Piaget disregarded the value of informal instruction provided by parents and peers.

When Piaget recommended self discovery as the ideal method of training conservation he did not specify the skills required to guide the child. He had focussed on the middle class children where upbringing encouraged competence in the skill for self discovery from an early age. In this study, the employment of the full manipulation method of training together with the role of the researcher as a mediator facilitated emergence of conservation.

Feuerstein (1972) has stressed the two modalities of learning which are direct exposure and mediated learning experience. Through full manipulation of material during the training, direct exposure was provided. During this process of self discovery the researcher was available as a mediator. The success of all the methods in the training of the retarded group could be attributed to the mediating experience provided by the experimenter. During training, the experimenter played a role of being a source of reference, support and as a facilitator/guide.

The success in promotion of conservation is consistent with a study in Iran, which showed that the country's children's

responses to operational tasks (Conservation) were superior compared to their intellectual performance (Piaget 1966).

The positive results indicate that promoting conservation contradicts Piaget's view that conservation cannot be acquired through training.

The acquisition of the concept of conservation by these children is a reflection of their cognitive potential, which supports Feuerstein's position that if mediated learning experience is provided, cognitive structures can be modified. Piaget's claim that the stage of development and the method of training are constraints against the feasibility of training conservation has been disconfirmed. These children's level of development made it likely for the learning of the concept to occur (Rogers 1977). Both Case (1984) and Fischer and Pipp (1984) have acknowledged that the content and the rate of cognitive development are dependent on specific experiences and opportunities to learn.

The findings of the study do not support Piaget's contention that the tutorial method is ineffective in producing learning. The demonstration-recitation method of instruction was as efficient as other methods of instruction. The methods of training were no constraint to the training of conservation.

The role played by a mediator to reinforce a learning experience might have contributed to the success of all the methods of instruction in stimulating the ability to conserve. The results of the present study confirm Fischer and Pipp's assertion that, a new optimal level in skill acquisition is reached under environmental conditions that produce optimal performance. The success of the demonstration recitation method of training, with implicit

observational learning, could be ascribed to social experience of observation which seems to activate cognitive restructuring of the children's mental operations (Charbonneau, Robert, Bourassa and Gladu-Bissonnette 1976; Snyder and Feldman 1977). The positive findings in the training of the conservation concept is congruent with other experiments conducted after the year 1971 as reported by Brainerd (1983).

The efficacy of the demonstration-recitation procedure supports the notion by Botvin and Murray (1975) that non-conservers could acquire conservation by observing adult models through a process of passive social interaction.

All the training methods proved to be effective in promoting conservation skills as observed in the significant gains of the post test performance (both immediate and delayed). These gains included the criteria of transferring to other tasks, and retention over a period of four weeks.

As was expected, the full manipulation method generated learning through the process of self discovery. The limited manipulation procedure resulted in social conflict introduced by the social interaction with the peers and the trainer.

This supports Piaget's claim that repeated communication conflicts between children were a necessary condition for cognitive development because they provoked a breakdown of egocentrism. Further, the social interaction was effective in the sense that the non-conserver's acquiescence might have induced a classic cognitive conflict, that generated cognitive growth fostering an operative solution to the conservation problem.

Piaget insisted that dealing with verbal problems and inability to see general rules or to accept assumptions were limitations of children in the concrete operational stage (Beard 1969). The ability to transcend the concrete operational stage towards the skills of the formal logical operations by interiorising actions of the demonstrator, might be ascribed to cultural emphasis on learning from behaviour and instructions of authority figures. This is consistent with Polhemus, Dambe and Moorad's position that children of non-technological societies benefit from structure and guidance in their learning.

The success in this intervention programme can also be attributed to the fact that the training of the conservation skills was introduced at a sensitive period, at the beginning of the stage of concrete operations (7-8 years). This age related achievement confirms the position of the Neo-Piagetians, that the efficiency in executing operations results in decreased attentional load with a corresponding increase in storage space (Case, Kurland and Goldberg 1982). With efficiency in the handling of conservation tasks, the concept of invariance of matter remained in memory over a month. This disconfirms Smedlund's assertion that despite the acquisition of the concept through training, it is easy to extinguish.

The feasibility of training the concept could be ascribed to the relevance of the methods and the role of the experimenter in the learning situation (Hurley 1982).

The strength of the demonstration method stems from the fact that it was a familiar method of instruction in their culture. This issue has been addressed by Polhemus, Dambe and Moorad (1985) in

their study of Botswana children.

The failure of superiority in the full manipulation method might be due to lack of initiative and suppressed exploration in traditional societies (Shea 1983, Onyehalu 1983, Polhemus, Dambe and Moorad 1985).

The limited manipulation method incorporated skills employed in both the demonstration and full manipulation method. Both the social conflict from the peer group and corrective feedback of the experimenter enhanced the performance of the children.

Why did these children acquire conservation within a short period? The question of conservation within a brief period is not a novelty or new occurrence in cross-cultural studies. This phenomenon is consistent with Dasen and Kroeger's (1980) findings of the latent skills that are activated by practice in children of non-Western societies.

The investigators attributed the failure of emergence of conservation to lack of opportunity to exercise the skills. They reported that training of one conservation skill induced ability to conserve, that transferred to other conservation skills. In the present study the evidence of this competence/performance factor was demonstrated further by continued improvement in the delayed post test.

This finding contradicts Phillip's (1975) suggestion that only the transitional children can be accelerated to the next stage of development.

Brief periods of intervention have occurred in studies on

Eskimos, West and East African children (Dasen and Heron 1980). Conservation of liquid and class inclusion were demonstrated and retained over a months period. A study of 11 and 12 year old children in Botswana children were able to conserve within 2 - 4 days and generalised to other conservation tasks. These skills remained stable after seven weeks.

In a study done by Smith (1977), 18 white middle and upper-middle class 4 and 5 year olds in South Carolina confirmed the efficacy of a brief period of intervention. The experimental group instructed on a cumulative set of learning sequences for conservation of length showed improvement both in the post test and three weeks retention test compared to the control non-cumulative group. However, unlike the present study, the post test and retention test measures of generalisation to other tasks were not significant.

Harris' (1974) study showed consistence with the findings of the present study. In his attempt to train White kindergarten children on the conservation of area, there was evidence of this concept on post-testing. These results were durable two months after cessation of training. In support of the present study and other researchers, there was generalisation to the concept of area in which no specific training was offered. In agreement with previous researchers he ascribed the feasibility of conservation training to reversibility as a basic element in training.

The results of the present study showed that the concrete operational structures that were latent could be triggered by the mechanisms of cognitive conflict or disequilibrium together with social conflict offered by the peer group situation (Acredolo and

Accredolo 1979).

These factors together with verbal rules and corrective feedback provided by the experimenter facilitated restructuring of cognition. Previous practices and play activities might have laid the foundation of the potential for acquisition of conservation skills. The feeling of competence experienced on success by these children generated a motivational support for further self development.

Though Piaget was sceptical about acceleration of stages of development, he did acknowledge that there is an optimal time for facilitating cognitive development (Phillips 1975; Piaget 1972).

According to the children's ages, the training was at an appropriate period to enhance the emergence of the skills for conservation.

Because of the powerful impact of culture on the development of operational intelligence, intervention has been recommended for the affected individuals who are capable of competence but lack opportunity for performance.

Out of these results emerged another group of achievers - transitional children. These children exhibited horizontal decalage; they were unable to transfer their conservation skills to the task that required the same strategy. However, this partial conservation could be regarded as an attainment of a higher status resulting from the intervention programme. Serafine (1979) has indicated that conservers on a non-verbal task who, are unable to conserve verbally have the competence for conservation but not performance.

Another group of children demonstrated failure to conserve despite the efforts implemented. Investigators that have addressed this problem, have forwarded different views. Phillips (1975) regarded failure to conserve as time not wasted but as time used to re-invent the experience. Reynolds (1984) referring to the same issue proposed that this delay in conservation serves a psychological function whereby a child constantly attempts to gain predictive control over his environment. She maintained that if the child did not remain for a long period at a given stage but instead was continuously trying to acquire new information he would not be able to consolidate his procedures. However, one would not rule out the emotional component and individual differences that influenced the children's performance. Craig, Love and Olim (1973) ascribed non-conservation to interference between perceptual based judgement and conservation reasoning.

Another assumption for failure to conserve could be the fact that Piagetian tasks demand that the child makes a verbal response (Serafine 1979; Smedslund 1963; Donaldson 1982). The acquisition of conservation in this view is seen not as a change in the cognitive structure but a growth in appropriate use of words. Flavell in his criticism of Piaget, has stated that conservation is nothing but a vocabulary accomplishment (Serafine 1979). Language is said to facilitate the development of conservation. Individual differences could influence the children in their responses in terms of difficulty and complexity of the tasks. For example, the structure for conservation demands that the child attends to two dimensions simultaneously. In conservation of liquid quantity perceptual centration on height has been

reported to be so strong as to result in non-conservation responses (Serafine 1979; Benner and Wheldall 1981). Due to language limitation, relational terms such as "more or less" appear to confuse children.

In addition, a group that is likely to fail to conserve may be that category of children identified as slow in acquiring new knowledge and information.

It is well documented that a marked environmental change results in a marked change in behaviour in terms of interest and motivation.

The frequency of trials and appropriate responses reinforced a concrete feedback. The reversible thought processes achieved by these children were a function of the structure of explanation provided by the researcher and attention devoted to all children. The results confirmed that deficiencies in cognitive growth could be remedied rapidly if appropriate strategies were used (Feuerstein 1972; Gallagher and Reid 1978).

Golomb and Mclean (1984) have also proved that cognitive strategies employed by middle class children also applied to the low income group of children.

The mastery of conservation by non-conservers and efficacy of all methods of training regardless of the degree of activity supported the findings of the Polhemus, Dambe and Moorad (1985) study.

As noted in Montessori's (1978) study, these children who were initially shy, passive and non-verbal showed alertness and confidence after training.

#### 9.4 Conclusions

The findings of the present study have demonstrated the feasibility of promoting cognitive growth.

The present study has highlighted, amongst other things, the importance of the role of the mediator. Mediation has been regarded as essential in the development of the potential of the child for education (Meerkotter 1986). The intervention programme has demonstrated that learning problems might not be within the child as much as being in the environment. The conservation skills were enhanced through perceptual supports and memory aids. The findings of the present study reflected the importance of understanding the role of transformation movement in perceptual change as a basis for acquisition of the conservation concept (Harris 1974).

In terms of effectiveness of all teaching methods of training the ability to conserve, it is relevant here to quote Gerber's address on the issue of children with special needs (Gerber 1986). He has stressed that there is a need for teachers who are trained to observe, who are flexible in their approach, but not susceptible to every new fad, teachers who are not puppets for every theorist who has never taught children.

The application of length conservation for training successfully evoked the ability to conserve and to transfer to other conservation tasks.

The mastery of conservation was observed to extend to tasks of more complexity - liquid quantity.

None of the training methods was found to be relatively superior in relation to levels of intelligence. No development trend was noted in the emergence of conservation skills. The subtest results showed a tendency of an inverse relationship between the demonstration and full manipulation methods with regard to conservation. This did not hold for number and quantity conservation.

To facilitate conservation, stimulus conditions that were responsible for arousal of the cognitive conflict might have been the use of rules in the explanation of invariance of matter. Emphasis was based on identity, reversibility and compensation communicated in a familiar language - Xhosa, in groups. The success of the intervention programme has been demonstrated where 66.7% were able to conserve, 23.3% attained the transitional status and 10% of the children remained non-conservers.

## 9.5 Implications

- 9.5.1 The findings of the current study show that experimentally induced conservation is possible and that this could be implemented to enhance cognitive development.
- 9.5.2 Group instruction proved to be beneficial in stimulating the development of logical thinking. Teachers could take cognisance of group instruction as being useful in promoting intellectual growth. Peer interaction together with the employment of concrete materials produced cognitive conflict on the part of the non-conservers.

9.5.3 Methods of teaching could be flexible enough to allow children, from different cultures and varying rearing practices, to develop their potential.

9.5.4 Intensive mediating skills during the intervention programmes have been found to be effective in introducing the concept of conservation.

9.5.5 The children in the current study have confirmed Brainerd's assertion that children who are susceptible to training are those who are developmentally prepared.

Thus, Piaget's contention that self-discovery is crucial for learning of conservation needs exploring with regard to this cultural group. It is significant that the training of conservation skills generated performance of a considerable magnitude in children who are non-conservers.

## 9.6 Recommendations

It would be suggested that a study looking at the effect of emotional problems on the intellectual development of the child may be necessary.

## 9.7 Limitations

9.7.1 The emotional climate in the immediate environment together with the presence of the army in the township, might have affected the children's performance. This factor was very pronounced during the initial assessment sessions. Some children would enter the interviewing room looking very sad and anxious. Before testing, the

researcher had to attend to the child's psychological needs when he/she would not verbalise.

9.7.2 The researcher sometimes seemed to be regarded as a person who could solve the children's emotional and intellectual problems. There were instances when the researcher was consulted by the staff members to discuss issues related to the children's emotional problems, emotional disturbances and conduct disorders. Some of the retarded children brought for attention gained little support from their families in dealing with some problems. These children were reported to appear emotionally disturbed resulting from abuse by gangsters. These sessions were time-consuming for the researcher, but they demanded attention.

9.7.3 The matching of children on age and I Q. was problematic.

9.7.4 The mental age showed no relationship to I. Q. ; it either over-estimated or under-estimated the mental abilities of the children. It was not a good predictor of the child's capabilities in relation to performance.

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## A P P E N D I X B

## RAW DATA

## DEMONSTRATION - RECITATION GROUP Scores

SEX	AGE	MENTAL AGE	I.Q.	MASS IMMEDIATE POST TEST	WEIGHT POST TEST	NUMBER POST TEST	MASS DELAYED POST TEST	WEIGHT POST TEST	NUMBER POST TEST	QUANTITY POST TEST
M	7	7.3	102	2	2	0	2	2	2	2
F	6	7.9	101	2	2	2	0	2	0	2
F	8	6.3	94	0	0	0	2	2	0	0
M	7	8.6	90	2	2	2	0	0	0	0
F	6	6.6	90	0	1	0	0	0	0	0
F	7	7.9	80	2	2	2	2	2	2	2
F	7	7.3	87	2	2	2	2	2	0	0
M	7	8.6	87	2	2	2	2	2	2	2
F	6	6.6	86	2	0	2	2	2	2	2
F	7	7.9	84	2	2	2	2	2	2	0
F	7	7.0	84	2	0	2	2	2	2	2
M	7	7.3	82	2	2	2	2	2	2	2
F	7	7.9	81	2	2	2	2	2	2	2
M	8	8.9	81	2	2	2	2	2	2	2
M	8	8.9	80	2	2	0	2	2	2	2
M	7	6.3	79	2	2	2	2	2	2	2
M	7	7.3	78	1	2	2	2	2	2	2
M	8	8.3	78	2	0	0	0	0	0	0
M	7	6.6	77	2	2	2	2	2	2	2
M	7	8.6	69	2	2	2	2	2	2	2

## APPENDIX C

## RAW DATA

## LIMITED MANIPULATION Scores

SEX	AGE	MENTAL AGE	I.Q.	MASS IMMEDIATE POST TEST	WEIGHT POST TEST	NUMBER POST TEST	MASS DELAYED POST TEST	WEIGHT DELAYED POST TEST	NUMBER POST TEST	QUANTITY POST TEST
F	7	5.9	100	2	2	2	2	2	2	2
F	6	7.6	101	2	2	2	2	2	2	2
M	8	8.3	95	2	2	2	2	2	2	2
F	7	7.9	92	2	2	2	2	2	2	2
M	7	8.6	89	2	2	2	2	2	2	2
M	7	7.6	88	2	2	2	2	2	2	2
M	7	7.9	87	2	2	2	2	2	2	2
F	6	7.3	86	2	0	2	2	2	2	2
F	6	6.6	88	0	0	0	0	2	0	0
M	7	6.6	84	0	0	0	0	0	0	0
M	7	8.0	84	2	2	2	2	2	1	2
F	7	6.6	83	0	0	2	0	0	0	0
M	7	7.3	81	2	2	2	2	2	2	2
M	8	6.9	81	2	2	2	2	2	2	2
M	8	8.6	81	2	2	2	2	2	2	2
M	7	7.9	78	2	2	2	2	2	2	0
F	7	7.6	76	2	2	0	2	1	1	0
M	7	7.9	74	2	2	2	2	2	2	0
F	8	7.3	73	0	1	2	2	1	2	0
M	7	5.0	72	0	0	0	0	2	0	0

A P P E N D I X DPIAGETIAN TASKS(a) Conservation of Substance (Keasey and Charles 1967)

The subject will be presented with two plasticine balls equal in size, weight and volume.

Instructions :

"Here are two balls of clay, they are exactly the same".

Allow the subject to examine the balls.

"Now I am going to change this one" (one of the balls is changed into a sausage).

"Now do both of these have the same amount of clay?

That is, is there much clay in this one as there is in this one?"

Throughout the session, the experimenter points to each of the balls when asking the subject this question.

After the subject has responded, the experimenter asks in a neutral manner-

"Why is that?"

"Now I am going to cut this sausage into two pieces.

Do these two pieces have the same amount of clay as this one, that is, is there as much clay in these two as there is in this one?"

"Why is that?"

The transformed sections are then removed, and then another ball of plasticine again equal in size and weight etc. is presented.

Exactly the same procedure is repeated except that the second and third transformations are shaped like a pancake and a doughnut (with a hole in the centre) respectively.

In each case the subject watches the transformation taking place.

The entire procedure is performed slowly so that the subject can watch change taking place.

All responses made by the subject to conservation questions are recorded for categorisation and scoring.

(b) Conservation of Weight (Goodnow and Bethon 1966); Brainerd 1973.

The subject starts with two balls of clay, weighing them on a balance to check that they weigh the same. He watches while one piece is changed into a pancake shape and is asked if the two pieces of clay still weigh the same. The child's answer is followed by a check similar to that given for conservation of substance.

- (c) Conservation of Length (Fabre, McManis and Stanton 1978)

Materials required:-

1 Stick of 12 inches long (12")

1 set of 2 six inch sticks (6")

The set is presented to the subject for comparison with the standard stick, placed end-to-end between the subject and the standard stick.

This permits the subject to see that the ends of the standard stick correspond to the ends of the shorter sticks when they are joined.

When the subject agrees to the equality in length of the standard and the joined sticks, he is asked if the shorter sticks will still be the same length all together if they are separated and placed side by side. After the subject has made his prediction, the experimenter separates the sticks and places them side by side between the subject and the standard (prediction question).

The subject is then asked if the separated sticks are still the same length all together as the standard stick (judgement question).

After the subject has made his judgement, he is asked to explain his question (explanation question).

Responses are required to meet two criteria on the test to be classified as showing conservation.

- (i) To judge the standard and the transformed stimuli to remain equal
- (ii) The subject must justify his judgement either on the basis of the reversibility of the transformation or on the basis of equation of the perceived differences produced by the transformation.

(d) Conservation of Number (Mussen, Conger and Kagan 1969)

Two rows of 5 buttons each are placed one above the other so that the rows are of equal length.

The subject acknowledges that the two rows have the same amount of buttons. But if one row is made shorter (by re-grouping the buttons) the pre-operational child says that the longer row has more buttons.

He behaves as if the word "more" refers to the apparent quantity the perceptual aspect and does not refer to the number of items.

- (e) Liquid Quantity Conservation Task (McCarthy-Gallagher & Reid 1978;  
Phillips 1975)

The subject is presented with two identical glasses and one narrower tall glass. Equal amount of water is poured in each of the two identical glasses. He is then asked this question: "Is there as much water here (experimenter points to glass A) as there is here (pointing to glass B) or does one have more?" After the child is convinced that the two glasses contain the same amount of water, the experimenter pours the water from one of the glasses into a narrower tall one (the subject observing).

"Now watch what I am doing. I am pouring this water here" (pointing to the tall, narrow glass).

After this act, the child is questioned, "Is there as much water in this glass as in that one?" (pointing first to the tall, narrow one and then to the shorter glass).

After a response the child is asked "Why?". This question is asked to elicit an explanatory response supporting the first answer.

A copy of Goodenough Test

INSTRUCTIONS:

"Draw the best man you can." Further encouragement can be given if necessary e.g. "I'm sure you can draw nicely. Show me how well you can draw a man."

(On no account must one suggest further e.g. "Draw your Daddy " etc.

SCORING SCHEDULE.

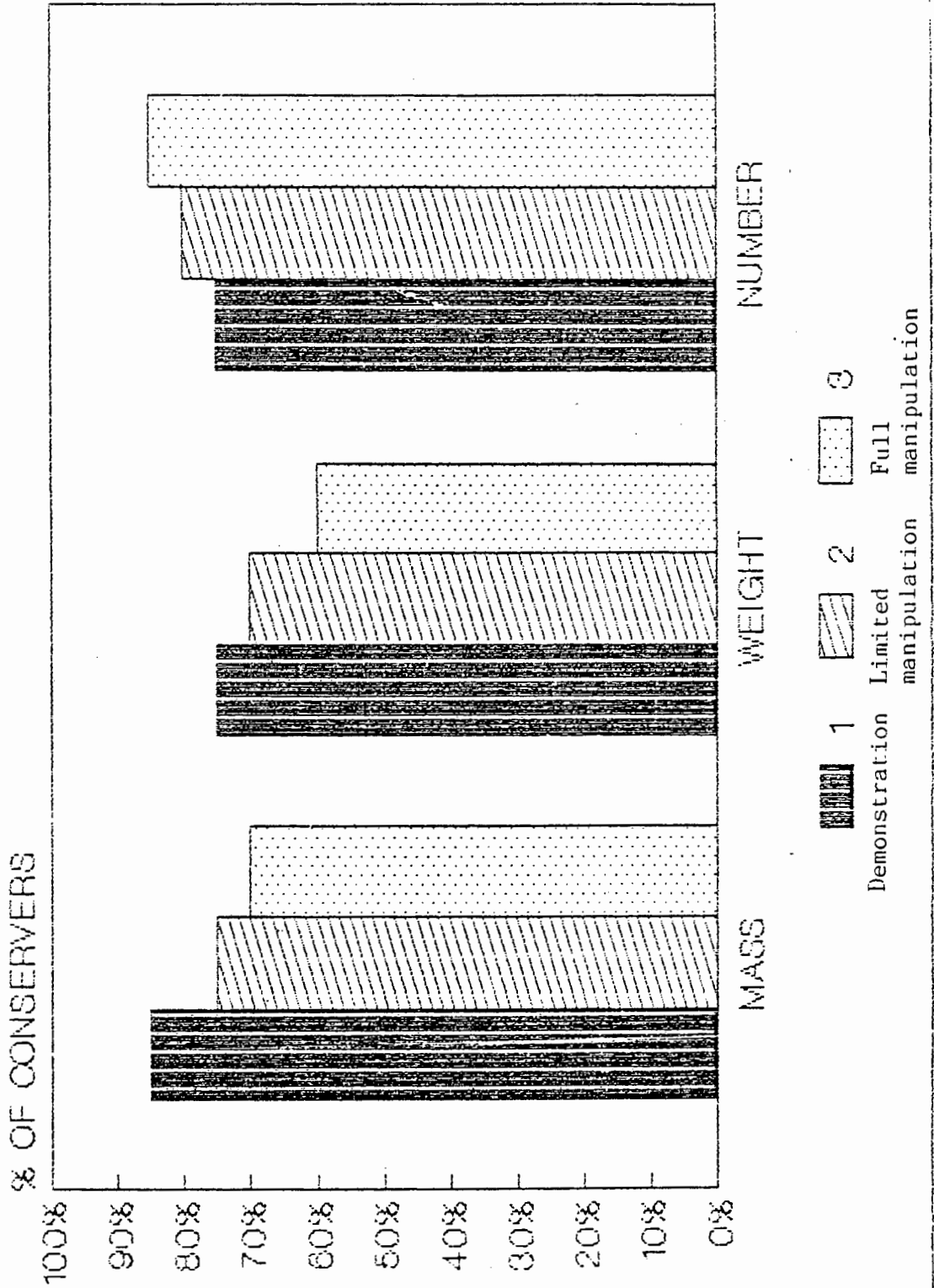
One point is given for each of following:

1. Head - enclosing head line must be present.
2. Legs - 2 from front view, 1 or 2 from side.
3. Arms - can be attached anywhere; if fingers only given, space must be left between fingers and body; 2 front view; 1 or 2 side view.
- 4a. Body - even a straight line scores.
- 4b. Length of body greater than breadth - cannot be scored if body is merely straight line.
- 4c. Shoulders - bend both at neck and shoulders.
- 5a. Arms and legs joined to body at any point or arms to neck or at junction of head and body if neck absent. No score if body absent.
- 5b. Legs attached to body, arms to shoulders or shoulder position. Mark strictly.
- 6a. Neck.
- 6b. Outline of neck continuous with that of head and body.
- 7a. Eyes - one or two.
- 7b. Nose - any method.
- 7c. Mouth - any method.
- 7d. Nose and mouth in two dimensions, two lips necessary.
- 7e. Nostrils - two little holes will do.
- 8a. Any hair.
- 8b. Hair without outline of head showing through.
- 9a. Clothes - any indication e.g. buttons, hat.
- 9b. 2 pieces clothing - not transparent; buttons do not score: hat must cover part of head to score.
- 9c. Both sleeves and trousers - not transparent.
- 9d. 4 pieces clothing of following: hat, shoes, coat, shirt, collar, tie, belt, trousers.
- 9e. Definite costume - suite of clothes, uniform, cowboy etc: if hat belongs it must be there. Mark strictly.
- 10a. Fingers - any method - if both hands shown, fingers on both.
- 10b. Right number of fingers - of both hands shown, right number on both.
- 10c. Finger detail correct.

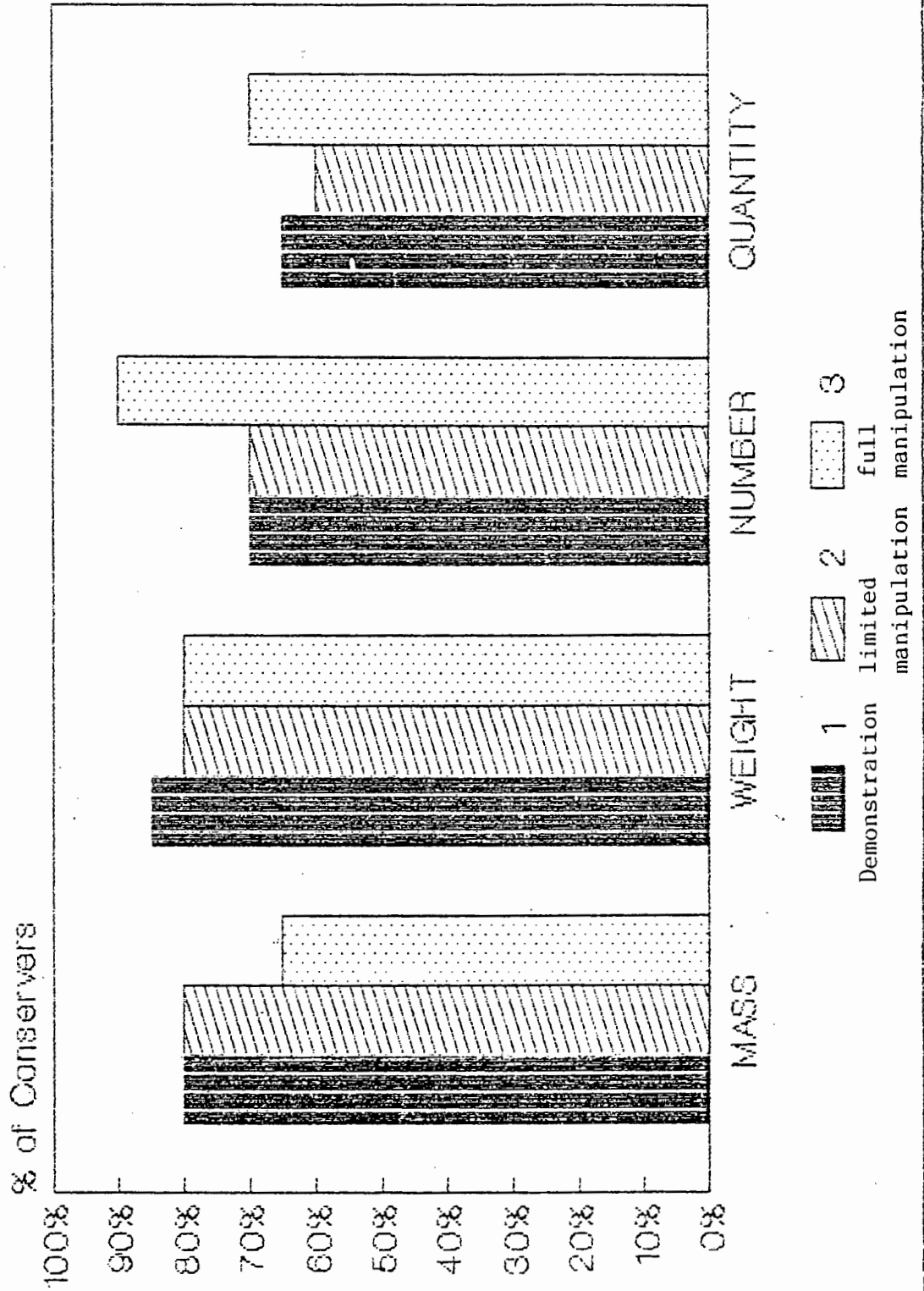
- d. Opposition of thumb - angle larger than between other fingers.
- 10e. Hand as distinguished from fingers and arms.
- Note: some children place hands in pockets; in such cases score 10a, 10b and 10c if small part of the hand shown: do not score 10d.
- 11a. Arm joint shown - elbow, shoulder or both, elbow must be definite bend, not curve and more or less in middle of arm, shoulder must be bent at attachment to body.
- 11b. Leg joint - knee, hip or both - Knee, sharp bend or narrowing hip can be scored if inside leg lines run towards one another.
- 12a. Proportion Head surface not more than  $\frac{1}{2}$  and not less than  $\frac{1}{10}$  of body.
- 12b. Proportion Arms - as long as or slightly longer than body, breadth less than body.
- 12c. Proportion Legs - not less than body in length, but not more than twice body length: breadth less than trunk.
- 12d. Proportion Feet - 2 dimensions for legs and feet necessary to score: length of feet greater than width, and not more than  $\frac{1}{3}$  or less than  $\frac{1}{10}$  leg.
- 12e. Two dimensions - Arms and legs in 2 dimensions, though hands and feet single line.
13. Heel - any method, and if suggested by position of feet front view.
- 14a. Motor Co-ordination - Line A - firm lines meeting without gaps.
- 14b. Motor Co-ordination - Line B - firm - accurate joins - mark strictly.
- 14c. Motor Co-ordination - Head outline without irregularities - primitive circle or ellipse not scored.
- 14d. Motor Co-ordination - Trunk outline - as head.
- 14e. Motor Co-ordination - Arms and legs - as above. 2 dimensions necessary to score.
- 14f. Motor Co-ordination - Features: In proportion, symmetrical and in right place.
- 15a. Ears - any method.
- 15b. Ears - right position and proportion ( placed in 2nd  $\frac{1}{3}$ rd of head).
- 16a. Eye details - Brows or lashes or both.
- 16b. Eye - pupils shown.
- 16c. Eye - Proportion - Length greater than breadth.
- 16d. Eye - Profile only - pupil to be shown correctly.
- 17a. Chin and forehead - eye and mouth must be present - and space left for chin and forehead.
- 17b. Chin marked off from underlip - in full face extra line under mouth.



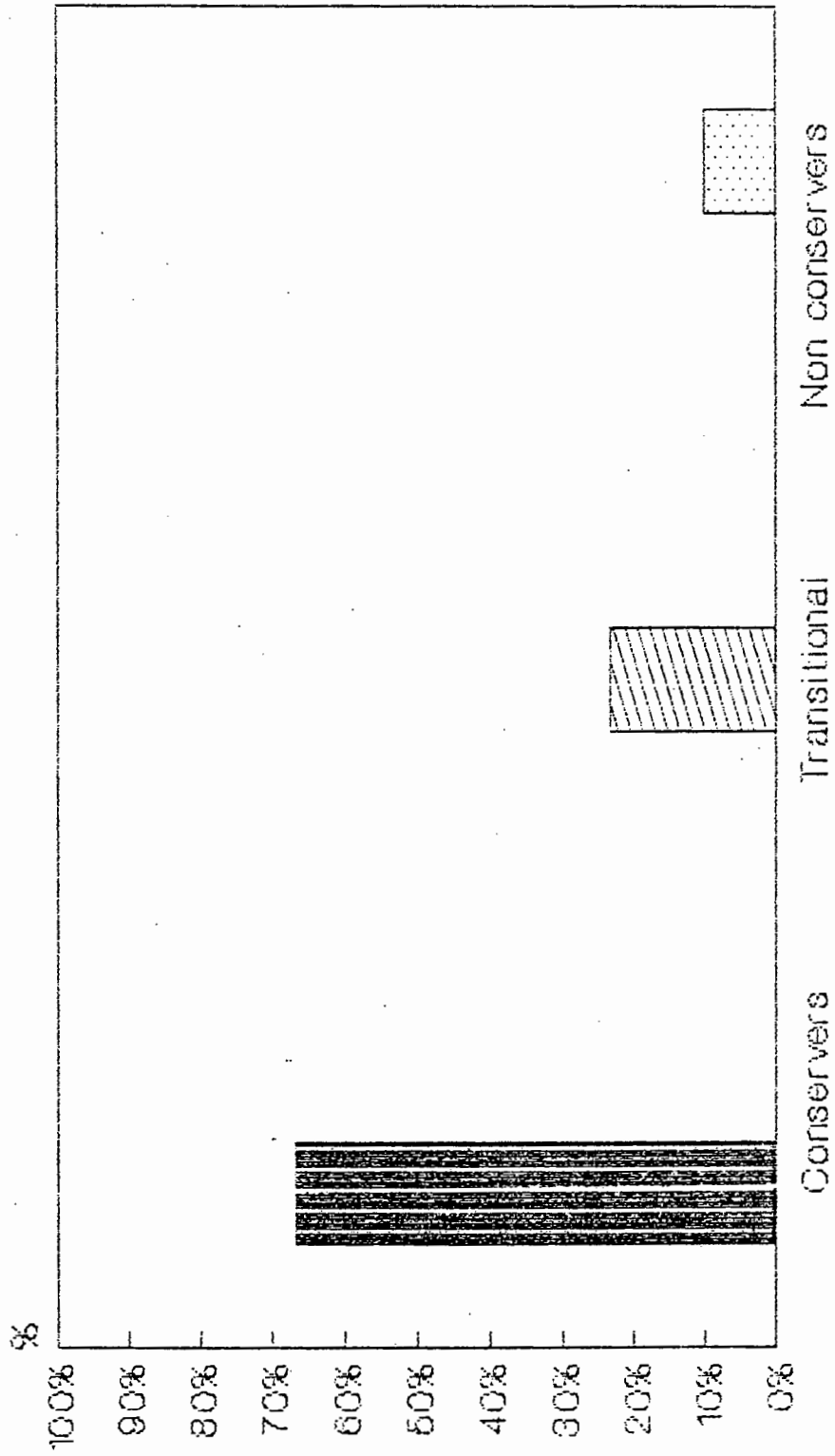
# Conservers on Piaget's Tasks Immediate Post Test



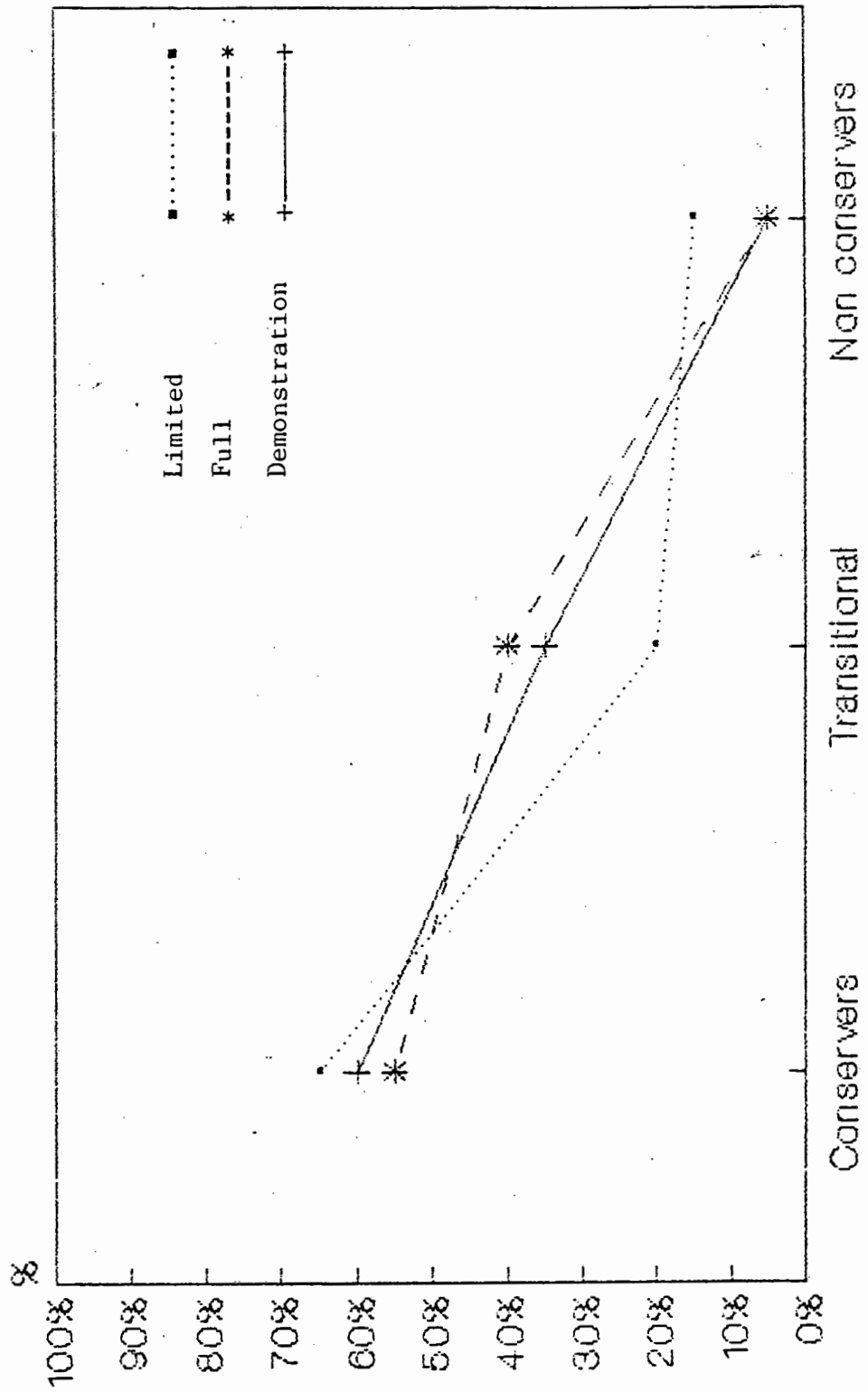
# Conservers on Piaget's Tasks. Delayed Post Test



# The Status of Conservation (of the whole sample)



# The Status of Conservation Immediate Post Test



RESULTS OF CONSERVATION SUBTESTS

KEY : Across

- 0 - non conservers
- 1 - transitional
- 2 - conservers

Immediate Post Test

WEIGHT

degree of conservation

Column

- 1 - demonstration
- 2 - limited
- 3 - full manipulation

Methods of training

	0	1	2
1	4	1	15
2	5	1	14
3	7	1	12

Kendall's T showed no significant difference in proportion

$$p, 8754 > ,10$$

WEIGHT

delayed post test

	0	1	2
1	3	0	17
2	2	2	16
3	4	0	16

Kendall's T showed no significant at p, 3186 > , 10

RESULTS OF CONSERVATION SUBTESTS

MASS

Immediate Post Test

	0	1	2
1	2	1	17
2	5	0	15
3	6	0	14

Proportion on Kendall's test was not significant  
 $p, 3664 > .10$

MASS

Delayed Post Test

	0	1	2
1	4	0	16
2	4	0	16
3	7	0	13

No significant difference at  $p, 4493 > .10$

THE RESULTS OF SUBTESTS (Continued)Immediate Post TestNUMBER

	0	1	2
1	5	0	15
2	4	0	16
3	2	1	17

Kendall's T showed no significant difference  
 $p. 4936 > .10$

Delayed Post TestNUMBER

	0	1	2
1	6	0	14
2	4	2	14
3	2	0	18

Kendall's T showed no significant difference  
 $p. 1529 > .10$

Delayed Post TestQUANTITY

	0	1	2
1	7	0	13
2	8	0	12
3	5	1	14

Kendall's T not significant  $p = .5826 > .10$

A P P E N D I X MExtracts of Children's Responses as Translated by the  
Research Assistant

Most children showed identity responses as follows:

Mass: "They (balls of plasticine) are equal. No clay has been added or broken off".

"They are still equal, the other one is flattened".

Weight: "The weight is still the same no matter the shape is not the same".

Number: "No buttons have been added or taken away".

Quantity: "None has been added to the other beaker".

"The water is equal, none has been drunk".

Some demonstrated compensation responses:

Quantity: The subject (pointing) "The tumblers are wider and this one is thin".

"The water is equal, the difference is that the other has been poured into a long container".

Number: "It is equal, this glass (pointing) is taller than this one".

"They (buttons) are equal, whereas the others are spaced, the others are shorter".

"They (buttons) are equal, the others (pointing) have been separated from each other".

Mass: "The other one has been sharpened, and the other one is round, but they are equal".

Quantity: "The water is equal, the difference is that this glass (pointing) is taller, and the other is wider".