CHILDREN’S PERFORMANCE ON PIAGETIAN TASKS OF CONSERVATION

EFFECTS OF PRESENTING TASK IN KIKUYU AND/OR ENGLISH LANGUAGE.

BY

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A THESIS

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION OF KENYATTA UNIVERSITY (1993)
DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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DEDICATION

This thesis is dedicated to my dear Husband, Mr. Daniel Wambiri, Son, Kevin Ngatha and daughter, Elizabeth Wanjiru for their support and encouragement during my study.
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ABSTRACT

The role of language in cognitive development is a question that has not yet been definitively answered. Language, however, is used to assess cognitive development. Piagetian tasks of conservation are widely used to assess cognitive development. These tasks are heavily reliant on language. The aim of this study was to investigate the effects of language of presentation on children’s performance on Piagetian tasks of conservation.

A static group comparison design was used. Children were tested in Kikuyu and English language. A sample of 40 standard pupils ranging in age from eleven to twelve years was studied. These children attended two rural primary schools in Kiambu District. The subjects were randomly assigned to four treatment groups.

Children were assessed in conservation of mass, weight and volume. Each of these areas of conservation was assessed using four distinctly different tasks. Treatment in the four groups varied in reference to the language of presentation of the four tasks. In one group the four tasks were presented in Kikuyu. The second group had all the four tasks presented in English. The other two groups had some of the tasks presented in English and others in Kikuyu to reflect the situation found in most Kenyan classrooms.

Five hypotheses were tested. Non-parametric statistical procedures were used to test these hypotheses. Four of these hypotheses were statistically significant at .05 level of significance.

The main findings of this study were that the language of presentation of tasks did not affect children’s performance on Piagetian tasks of conservation before the area of conservation in question was acquired. However language in which tasks were presented had an influence on children’s performance when the conservation area under
investigation was acquired. The language of presentation of tasks also had an influence on the mode of reasoning employed by children on the acquired areas of conservation. It was also found out that the types of reasons given for conservation by children were of variable prevalence.

The findings of this study did not support the work of Piaget. These findings raise questions about Piagetian assumption that cognitive development is not dependent on language. Language is an important factor to consider, therefore, when assessing children's cognitive development using Piagetian tasks of conservation. These findings led to a suggestion that more research should be carried out in order to establish the role of language on cognitive development.
CHAPTER 1

This chapter presents the problem under study, the purpose and significance of the study, assumptions and limitations of the study and a definition of terms as used in the study. These are presented in six sections:

1.1 Introduction
1.2 Statement of the Problem
1.3 Purpose of the Study
1.4 Significance of the Study
1.5 Assumptions and Limitations
1.6 Definition of Terms

1.1 Introduction

Today there is an increasing need for everyone to be able to speak a second language. This need becomes obvious everyday as the need for persons from different linguistic backgrounds to interact in their everyday life arises. As a result, the number of bilinguals and multilinguals is on the increase worldwide.

Kenya has a wide language diversity within its borders. The official language is English and the national language, Kiswahili. Most children in Kenya are multilingual, speaking a minimum of three languages on average: the mothertongue, English and Kiswahili. Some children acquire the languages concurrently. This is particularly true for the children in urban areas where people come from various ethnic and linguistic backgrounds. The child, together with learning his mothertongue, has to learn either of the other two languages English or Kiswahili or both so as to be able to communicate with those from other ethnic and linguistic backgrounds. Children in the rural areas learn their mothertongue first. Most of the regions in the rural areas are occupied by people from similar ethnic groups and therefore, share their mothertongue. Most of the children here go to primary school when they have already developed extensive linguistic skills in their first language. At the time of starting primary education, most of these children can only speak their mothertongue.
Children in Kenya are expected to have learnt adequate English by the end of their primary school education to be able to sit for the Kenya certificate of primary education in English. On the other hand they cannot wait to learn English first before starting to learn other subjects of primary education, once they have entered primary schools. The Gachathi Report (1976) on Educational Objectives and policies in Kenya realised the need for the education system to make use of the local languages for instruction at the beginning of primary education. Consequently they recommended that the predominant language spoken in the schools' catchment area be used as the language of instruction in the first three years of primary education. The report also recommended that English be introduced as a subject from primary standard I and that it supercedes the predominant local language as the medium of instruction from primary standard IV.

The report also recommended that Kiswahili be introduced as a compulsory subject in primary standard IV or when English medium instruction begins to take over from the local language- medium instruction. Following this recommendation, Kiswahili was introduced as a compulsory subject and included in the Certificate of Primary Education examination and its successor, the Kenya Certificate of Primary Education.

Whereas vernacular is the predominant language spoken in the schools' catchment areas in the rural areas, this is not so in the urban areas. In the urban areas, people come from different ethnic and linguistic backgrounds. The predominant language is usually Kiswahili or English. In these areas, therefore, the medium of instruction in the early years of primary education is one of these languages. However, in both the rural areas and the urban areas, the language of instruction from primary standard IV is English. The language of assessment in primary standards one to three is the local language. From standard IV onwards children are assessed in English.

Language as well as being used for assessing children in Schools is also used to assess them in cognitive ability and moral reasoning. One area that requires language for assessment is the area of cognitive development. Assessment of the cognitive abilities of children in the lower primary standard I to IV can only be done using the local language because, these children have not yet mastered the other languages. However from primary standard IV, children can speak at least two
languages. A choice has to be made, therefore, as to what language is used for assessment. Issues arise in the selection of language to be used.

It is important to look at the issue of language selection in assessment of cognitive development. This requires an understanding of the relationship between language and thought. This is the topic of address in the present study.

1.2 Statement of The Problem

There has been a lot of controversy among psychologists concerning the relationship between language and cognitive development. This controversy has not yet been resolved and consequently the role of language in cognitive development is a question that has not yet been definitively answered. However language continues to be used to assess cognitive development.

Piagetian tasks of conservation have been used to assess specific aspects of children's cognitive development. A comparison of the results of the studies from both western and non-western cultures have reported a delay in the attainment of conservation among non-western culture children (for instance Nyiti, 1973; Mwangangi, 1974; Mureria, 1977 among others).

Piaget (1966) cited by Dasen (1977) has accepted a time lag of two to four years attributed to the child's cultural milieu. However, many of the differences between cultures in the ages reported for attainment of conservation are too great to be accounted for by the cultural milieu of the children.

The typical Piagetian tasks are assessed by clinical interview, a method that is heavily reliant on language. This makes the choice of language to be used for assessment an important issue when dealing with bilinguals and multilinguals. There has been in some studies (Price Williams, 1961; Etuk, 1967; Prince, 1968; Delemos, 1969; and Dasen, 1972) serious linguistic barriers between the child and the interviewer. Such barriers may have negative effects on the results obtained. At the same time a recent study by Lambert (1981) has shown that the order in which languages have been acquired can have an effect on children's thinking. This means that processes that involve thinking will depend to some extent, on the order of acquisition of the languages in which their assessment is conducted. Perhaps linguistic barriers and the order of acquisition of the languages used for assessment
Results from research done with African children in conservation have had some inconsistencies. Various factors that could have contributed to these inconsistencies have been suggested by researchers. For instance schooling, rural-urban effects, culture et cetera. Recent research has also shown that the order of acquisition of language and language barriers may have some influence on children's thinking. Research has not focused on the effects of these specific linguistic factors on the development of conservation and children's performance on conservation tasks. There is, therefore, need to conduct systematic studies designed to find out what effect the language of presentation can have on children's performance on Piagetian tasks of conservation.

1.3 Purpose of The Study

The aim of this study is to find out whether the language of presentation of Piagetian tasks of conservation of mass, weight and volume has any effects on children's performance. This study seeks to answer the following questions:

1) Are there any differences in children's performance on Piagetian tasks of conservation when tasks are presented in two sequentially acquired languages?

2) Are there any differences in the types of reasons given for conservation when children are assessed in two sequentially acquired languages?

3) Are there any differences in the order of acquisition of different quantities of conservation when children are assessed in two sequentially acquired languages?

1.4 Significance of The Study

Research on children's cognitive abilities as revealed by performance on Piagetian tasks of conservation in different culture have yielded divergent results. These researches have been conducted using verbal methods with children who are at least bilinguals. Few studies have specifically focused on the effects of language of assessment on children’s performance on Piagetian tasks of conservation.
The present study began to shed some light on this issue and thus initiated an attempt to fill this gap in research. The findings of this study have methodological significance for Piagetian research. The study utilised repeated measures with systematic variation of language. By so doing, it was able to provide significant insights about the variable under study, language. It has therefore, clearly demonstrated the strength of using several tasks, instead of one, in the assessment of children’s conservation abilities.

The findings of this study also have theoretical significance for Piagetian research because it has highlighted the need to consider the effects of language of assessment when dealing with bilinguals or multilinguals. It has been shown that there are factors in language that require careful consideration when selecting a language to be used for assessment when the subjects of the study have mastery of more than one language.

The significance arising from the results of this study go beyond Piagetian research. Practical significance lies in the language policy in rural schools. These language policy in Kenya has been developed without due consideration of the potential impact that language of assessment may have on children’s performance if the concepts being tested have been acquired in a different language. This has direct implications for those directly involved in formulating language policy in schools, curriculum developers, teachers and trainers.

1.5 Assumptions and Limitations

This study was based on the following assumptions and limitations.

1.5.1 Assumptions:
This study made the assumptions that:
(1) The subjects of the study had equal language proficiency in mothertongue and the second language;
(2) The subjects of the study had had similar learning experiences both at home and at school.
1.5.2 Limitations
This study had the following limitations:
(1) Because of the lack of exposure and experience in the English language, children in the lower primary grades in rural areas lack mastery in it. These children could not be included in this study.
(2) Because of the many tasks involved and the complexity of the study the sample size was small.
(3) Because of the linguistic and cultural differences across geographical regions in Kenya, the sample is only representative of the area under and therefore, the findings cannot be generalised to children from all geographical regions.

1.6 Definition of Terms
The following terms are defined as they are used in this study.

**Non-Conserver:** This refers to the child who is unable to see the invariance of mass, weight or volume after a transformation.

**Transitional Conserver:** This refers to the child who is able to see the invariance of mass, weight or volume after a transformation, but who is unable to justify his answer.

**Conserver:** This refers to the child who sees invariance of mass, weight or volume after a transformation and who is able to justify his answer.

**Sequential Language Learner:** This refers to a child who learns a second language after having acquired basic skills in another language.

**Simultaneous Language Learner:** This refers to a child who learns two or more languages concurrently.

**Decalage:** Acquisition of different quantities of conservation at different times.

The rest of this work is divided into four chapters. The next chapter presents the review of literature. The third chapter describes the methodology, the fourth presents data analysis and interpretation. The last chapter, chapter V discusses the results, draws conclusions and makes recommendations.
CHAPTER II

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter presents a discussion of the literature related to the aspects of this study. This are presented in five sections as follows:-

2.1 Language and Cognitive Development

2.2 Overview of Piaget's Theory of Cognitive Development.

2.3 Conservation and Assessment

2.4 Oral language and Assessment of Conservation.

2.5 Research Hypothesis
2.1 Language and Cognitive Development

There has been considerable debate among psychologists concerning the relationship between language and thinking. Psychologists concerned with cognitive development agree that there exists a relationship between language and concept formation but they differ in the theories to explain it and the amount of attention they give to the relationship.

In this section I will discuss the views of some popular investigators of the language and thought issue. I will confine the discussion to an outline of theories of the relationship between language and thought held by Piaget, Vygotsky and supporters of the linguistic relativity theory.

2.1.0 Piaget’s View

For Piaget, the development of language and the development of the various stages of cognitive development are separate, “not indivisibly linked”. (Keats, Collis and Halford, 1978). According to Piaget and Inhelder (1969) language has no significant role on the development of thought processes in the sensory motor, pre-operational and concrete operational stages of his theory of cognitive development. This means that the development of concepts in the early stages of cognitive development does not depend on the language through which they are acquired.

This position becomes clear when it is realized that Piaget (1962) believes that language is not the source of logic but is instead structured by logic. He views thinking as a self regulating activity that begins before language and goes far beyond language. Furth (1970) in an attempt to explain Piaget’s position on the role of language on thinking stated clearly:

*Verbal language is not the stuff of which logical thinking is made. It is not the food on which early logical thinking grows* (p 66).
This implies that early logical thinking is not a product of language. Rather, Piaget emphasized perception and manipulation of the environment as playing a vital role in the development of the child’s thinking in the early stages.

For Piaget, the importance of language in cognition is realized in the stage of formal operations. Piaget (1962) asserts that earlier structures of the growing intelligence are not capable of fully dominating language usage. Verbal language becomes the proper medium to stimulate and express thinking after the establishment of thinking structures close to the formal operations stage.

Piaget uses several types of data source to support his position that thought is not dependent upon language in the early stages of cognitive development first he turns to evidence from early childhood development. The earliest evidence of intelligent functioning is seen at the early stage of infancy well before the appearance of productive language (speech). For example, the child may grasp for distant or hidden objects. However, those constructions are made without the use of any type of language or symbolic representation. They are based on perceptions and movements. Intellectual functions thus begin to develop prior to the acquisition of spoken language or any other form of symbolic representation.

The second source of evidence Piaget uses consists of studies of deaf children (Ol’er and Herren 1961; Furth, 1964 cited in Keats et al, 1978). Although children in these studies did not have any knowledge of oral language, they attained conservation albeit somewhat later than normal children who had spoken language.

Ol’er and Herren (1961) studied deaf children’s performances on conservation of weight and volume tasks using non-verbal methods. These children’s performances were compared with those of hearing children tested on the same concepts by verbal methods. There was a delay of about six years in conservation for the deaf children compared to the hearing children. Furth (1964) replicated this experiment, and again the hearing children performed better by two years. In relation to these findings, Piaget argued that since the deaf children attained conservation, although they did not have spoken language, then language is not necessary for thinking.
Another source of evidence for Piaget's position comes from training studies by Sinclair (1967, 1969, 1971) in which he unsuccessfully tried to teach logical thought to children through language. Sinclair was not able to train conservers to conserve by using language. Piaget (1973) consequently felt that this suggests that cognitive development is not facilitated by language and hence it's development not dependent on language.

Studies involving a systematic comparison of the development of intellectual operations and language development (Berlin and Kagan, 1969; Weil, 1970; Keef and Luria, 1973 all cited in Keats et al, 1978) also provide evidence for Piaget's position. These studies suggest that concepts develop prior to and independently of language related to these concepts. Berlin ad Kagan (1969) found that children's performance on a task involving discrimination of one from two objects was superior to their ability to produce the correct plurals of nouns, possessives and verbs. Weil (1970) found that the development of time concepts precedes the ability to understand the past progressive tense and terminology such as "before" and "after" in relation to the sequence of events. Luna (1973) found that children were able to learn the concept of middle size before they could produce comparatives expressing the relationship between objects of different sizes.

Piaget's position is backed by a large amount of research evidence as discussed above. However, there are certain problems with this perspective. First, a question can be raised on Piaget's interpretation of the studies of deaf children (Ol'eron and Herren, 1961; and Furth, 1964). While the deaf children in these studies were shown to master conservation, their development was delayed compared to the hearing children who had oral language abilities. This suggests that oral language has an apparent facilitative effect. Nevertheless, it's presence does not have to be a necessary condition for the development of conservation as the deaf children did acquire the concepts eventually.

Another relevant problem relates to Piaget's methodology. All Piaget's research have been conducted by employing verbal methods. According to Keats et al. (1978), it is the quality of the child's oral responses which reflects, for Piaget, the quality of his thought processes: he cannot reach the final state of equilibrium unless he can explain his actions verbally. Kohnstaun (1967) cited by Hyde (1970) sees this as a contradiction of Piaget's theory and experimental
methods. This implies that language is an important factor as far as cognitive development is concerned.

Even though these criticisms exist, Piaget’s position that thought is not shaped by language has received substantial support. There are other perspectives about the language and thought issue. These views contrast Piaget’s view and will be discussed at this point.

2.1.1. Other theoretical perspectives

2.1.1.0. Vygotsky’s View

Vygotsky (1962) believes that language and thought have independent genetic roots. From his studies of ape language, he concluded that speech is a development of the visual and vocal signs of animals while thought is rooted in perceptual experience. This implies that the developmental beginnings of language and thought are parallel processes and at a certain point becomes rational. It is at this point that the two processes cease to be parallel and instead become interactive.

According to Vygotsky, by the age of two, children discover the symbolic function of language and thereafter the signs of language which are words help them to think. This implies that once the child acquires productive language, the latter has a significant impact on the former. Vygotsky thus believed that language like perception plays a crucial role in the development of thought processes. Hyde (1970) notes this important point and states:-

*Vygotsky pays tribute to both the role of perception and the importance of language in the growth of concepts (p. 49)*

In many ways, Vygotsky’s work complements that of Piaget. For instance, he confirms the importance of perception in conceptual development. He also notes a progression from concrete to conceptual types of thought.

Both Piaget and Vygotsky see language and thought to be independent before age two. Later, Piaget considers the two independent but Vygotsky sees a strong interdependence between the two. For Vygotsky, after age two, when language has been acquired, thought is to some extent dependent on language.
2.1.2 Linguistic - Relativity Theory

Another view held about the relationship between language and thought is that thought is wholly dependent on language. This view is referred to as Linguistic Relativity Theory. This theory is based on the idea that the structure of one’s language affects one’s thought processes. This implies that thought is relative to the language in which it is conducted.

The most articulate spokesman for this theory is the Linguist Benjamin Lee Whorf. Whorf (1935) suggested that the structure of language determines the type of thinking that individuals within a society use. He believed that the content of language influences the process of thought. Whorf (1956) argued that languages differ in the ways in which they divide various semantic domains and he gives an example of the Eskimos who have more words for snow than other languages. He suggested that due to these differences, it may be easier for speakers of one language to think or talk about certain things because their language makes it easier for them to do so. Whorf (1956) states:

*Speakers of different languages see cosmos differently, evaluate it differently, sometimes widely and sometimes not by much* (p 65)

According to this view, then thinking is relative to the language in which it is conducted. The thinking process of individuals whose languages are fundamentally different will therefore be different. Whorf (1956) in another statement of his point of view states:

*The background linguistic system (in other words, the grammar) of each language is not merely a reproducing instrument for voicing out ideas but rather is itself the shaper of ideas, the program and guide for the individuals mental activity, for his analysis of impressions, for his synthesis of mental stock in trade. Formulation of ideas is not an independent process strictly rational in the old sense, but is part of a particular grammar and differs, from slightly to greatly, as between different grammars. We dissect nature along lines laid down by our native languages* (p 212).
This statement implies that language is a determining vehicle or constraint for thought. This view unlike the above two views puts a lot of emphasis on the dependence of thought on language.

The validity of this view has not yet been sufficiently demonstrated; neither has it been flatly refuted. Researches have not adequately shown the extent to which language shapes the thought processes of its users.

2.1.3 Conclusion

The controversy regarding language and thought relationship has not yet been clearly resolved. A survey of literature shows that an agreement about the relationship between language and thought is yet to be reached. However, of the three perspectives discussed in this section, Piaget’s view is considered stronger than the others because of the vast amount of research evidence supporting it. This is the perspective taken in this study. While basing his ideas on this view, Piaget developed a theory of cognitive development which is discussed in the next section.

2.2 An Overview of Piaget’s Theory of Cognitive Development

Piaget developed a theory of cognitive development in which the basic unit of mental organization is the scheme (Piaget and Inhelder 1941). The infant is born with rudimentary schemes such as sucking and grasping. In infancy, schemes are based on senses and motor experiences; they are simple and practical but much later become differentiated and complex and are comparable to adult concepts (Brainerd, 1978)

An individual’s mental organization undergoes many changes through his life. These changes are brought about by a process called adaptation. Piaget (1961) defined adaptation as a tendency to adjust to one’s environment. The process of adaptation is achieved by two processes: assimilation and accommodation. Through the process of assimilation, the child uses early schemes to take in information about the world. He handles new situations and problems using his present schemes. If situations or problems are too difficult, the existing schemes are modified through the process of accommodation to fit the child’s experiences. Assimilation and accommodation are complementary. These two
processes continue throughout an individual’s life. As a consequence of these two processes, the child’s schemes become more complex (Tomlison-Keasy, 1985).

Piaget believes that thinking is a progression from simple to mature thinking. He established a sequence of age related stages in which each stage is dependent on the one before it and is characterized by certain features that make it different from those preceding it and those succeeding it.

2.2.1 Piaget’s Stages of Cognitive Development

Piaget postulated four stages in the course of a child’s cognitive development.

Stage 1: Sensori-Motor Period (Birth to two years)

During this stage children interact with the environment through actions (Brainerd, 1978). They throw, grasp, bang and suck on objects in order to understand them. Children demonstrate a certain number of sub-stages which range from simple reflexes to the coordination of means and goals. Without language, sensori-motor intelligence lays it’s premise mainly on actions, movements and perceptions (Piaget, 1973). Infants move from a neonatal reflex level of complete self-world undifferentiation to a relatively coherent organisation of sensory motor actions. This permits increasing mastery of objects in the environment. The child begins to use symbols towards the end of this period.

Stage 2: Pre-operational Period (Two to Seven Years)

This stage is a transition period beginning with the predominantly egocentric stage of early childhood and ending with cooperative social behaviour and more advanced conceptual thought and reasoning. This period is characterised by symbolic activity. Symbols are mental images of objects (modgil, 1974) for example a child can search for a hidden object because he has formed a mental image for it. As the child develops symbols he acquires more facility in language. With language, their mental schemes are transformed into symbolic ones.

During this stage the child does not use logical operations in his thinking. Instead, he is perceptually oriented and makes his judgements in terms of how things appear and generally can deal with only one variable at a time. Thinking at this level of functioning is rigid and egocentric: they focus on and from their own perspective. The language use of children in this stage was observed by Piaget
He described it as egocentric rather than social. This language is not socialised in that it’s purpose is not to ask questions or provide information. It consists of collective monologues in the course of which they hold conversations but not on the same topic.

In the preoperational stage the distinction between symbols (words) and signs (object) may not be drawn. The child tends to think that the object named cannot bear any other name. The name is seen as part or characteristic of the object itself. As they acquire language they are able to detach thought from action by differentiating the signifiers (words) from their significates (actions or things which they represent).

Stage 3: Concrete Operational Stage (Seven to Eleven Years)

Thought of children during this period is marked by mental actions or operations. Thought is no longer centered on a particular state of an object (Ault, 1983). However, the operations are tied to action: they are concrete rather than abstract. This stage of development is characterised by three major types of operations.

The concrete operational child can create hierarchies of different classes and understand the relationship between the members of these classes, an operation Piaget (1973) calls "Classification". For example the child can understand the two major classes of "animals" and "plants" that belong to the larger class called "living things". Understanding this hierarchy of classes is an important accomplishment since it marks the transition between pre-operational and operational thought.

Another important operation characteristic of the concrete operational stage is the ability to seriate or to order a series of events in succession “seriation” For example, a child can order a given set of cylinders of different heights according to their height and thickness, that is he can seriate using two dimensions, but with the cylinders in direct sight.

“Reversibility” is another important characteristic of the concrete operational stage. The concrete operational child understands that the order of an operation can be reversed and the characteristics of an earlier situation recovered.
Following reversibility, children develop the operation of "Conservation". This is the ability to see the invariance of a quantity in the face of some change that does not involve addition or reduction of the quantity (Brainerd, 1978). For example, a child is able to see that the quantity of water in a short wide glass remains the same when transferred into a long thin glass. Conservation is the focus of this study and is discussed in detail in Section 2.4.

Concrete operational children lack the ability to perform an operation that is not tied to a concrete experience. Their thought is still concrete rather than abstract hence the name of the stage.

Stage 4: **Formal Operational Stage ( Eleven to Fifteen Years)**

This stage of cognitive development covers the age range from around eleven to fifteen years. Cognitive development does not cease after the fifteenth year, but any major structural or qualitative changes have hypothetically occurred already. After this time there are very few major structural changes (re-organisation of schemes). The majority of changes that take place later are modifications of already existing schemes.

The most outstanding difference between the concrete and formal operational stages is that formal operational children are no longer bound by concrete experiences (Ault, 1983). Teenagers develop formal operational thinking, which is the systematic analysis, exploration and solution of abstract problems. They can deal skillfully with abstract questions or questions that are contrary to facts. They are also sensitive to the discrepancy between reality and ideals. This mature system of thought allows the mastery of complex systems of literature, mathematics and science. It helps the adolescent to plan future goals and be able to integrate past and present into a realistic self identity.

### 2.2.2 Factors Influencing Cognitive Development

According to Piaget (1973), development from one stage to the other involves four processes: Maturation, Experience, Social transmission and Equilibration. These factors and their interactions are necessary conditions for intellectual development. Movement across the stages of development is a function of these factors and their interaction.
2.2.2.0 Maturation

With the development of the nervous system, cognitive abilities increase. Both motor coordination and ability to speak depend on maturation of physical structures (Brainerd, 1978). The success on a given cognitive operation task depends on the level of motor coordination and the ability to use language. For example, to perform a given cognitive operation task, a child has to be able to manipulate the objects and in turn be in a position to express his ideas.

There is evidence that maturation in the brain results in cognitive development. In 1958, Piaget and Inhelder (cited by Tomlinson - Keasey, 1985) suggested that formal thought reflected in part the development of the nervous system. Mehler (1982) has shown that cognitive development is dependent on an intact brain. Furthermore according to Yakovlev and Lecours (1967, cited in Tomlinson - Keasey, 1985) the areas of the brain that are associated with high level reasoning skills are among the last areas to Myelinate. This implies that the ability to reason improves with the brain development and, therefore, it is not surprising that older children reason at a higher level than younger children. The performance of children on conservation tasks which require reasoning would consequently improve with brain development.

Eichorn and Bayley (1962) also found that the head circumference which is an index of brain development undergoes a growth spurt during puberty which corresponds to the ability to solve abstract problems by the formal operational child. Herman Epstein (1978) carried out the comparison of brain development and cognitive development a step further than Eichorn and Bayley. He found that the head circumference goes through three growth spurts: between birth and two years, around seven years and around twelve years. These growth spurts correspond to the ages postulated by Piaget for transition between the first and second the second and third, and the third and fourth stages of cognitive development, respectively.

2.2.2.1 Social Transmission

Social transmission included information acquired through interactions with others. Instructions or explanations given by parents and teachers as well as information learnt through discussion with peers or imitations of a model are
examples (Williams and Stith, 1974). The knowledge transmitted through these social agents enables the child’s cognitive abilities to expand and progress thus bringing about cognitive development. Since the ability of children to understand depends on the possession of certain cognitive structures and linguistic capabilities, the potentiality of social transmission depends on the child’s level of thought. For instance, the effect of social transmission of knowledge on cognitive development may have a greater impact on an older child in the formal operation stage than it has on a pre-operational child. This is because the schemes of the older child are more highly differentiated, inter-related and integrated into complex patterns that are more easily applied than those of the younger child.

Language is an important part of the social environment in which a child grows. According to Vuyk (1981) language is an integral part of the process in which the child assimilates society’s style of life and conduct. It is the main channel through which interactions take place between children and the different social agents; teachers, parents, peers and others. Within such interactions information is transmitted by way of language.

2.2.2.2 Experience

Children’s experiences help them to acquire higher levels of thought. Piaget (1973) discussed the effects of experience on cognitive development and noted that experiences are important particularly during infancy. By experience, Piaget refers to the role of manipulation of objects and of acquired experiences with objects. There are two kinds of experiences. Physical experience and logico-mathematical experience, and both kinds of experience play a crucial role in the development of cognition.

Physical experience consists of acting upon objects in order to abstract their properties. Logico-Mathematical experience consists of acting on objects with a view to learning the results of the coordination of actions. Logico-Mathematical experiences involve experiences that require thinking. They foster knowledge that is a result of mental actions performed on objects rather than as a result of perceiving objects. Williams and Stith (1974) quoted Piaget’s (1964) example of the physical experience in the following description of a young five year old boy:
He was seated on the ground in his garden and counting pebbles. Now, to count these pebbles he put them in a row and counted them one, two, three up to ten. The he finished counting them in the other direction. He begun by the end and once again found he had ten. He found this marvelous. so he put them that way and found ten (p.289).

In their interpretation of this experience, Ginsberg and Opper (1969, cited by Williams and Stith, 1974), suggested that through repetition of counting or arranging and rearranging the pebbles, the child learnt an important property of number. That is, it stays the same despite different physical arrangements. Both kinds of experiences were involved here. The child learnt something about his own actions through thinking (logico-Mathematical experience) from manipulating (Physical experience). Through both kinds of experiences the child learnt something about conservation of number. Experience is, therefore, an important factor in enhancing the development of the concept.

2.2.1.3 Equilibration

Equilibration refers to an active process of attaining equilibrium. Piaget (1961) defines equilibration as a compensation for an external disturbance. The factors of maturation, experience and social transmission act with equilibration to explain cognitive development. According to Piaget and Inhelder (1969), the child or adult himself contributes an organizational or regulating factor to development. The contradictions that become apparent as children tackle logical problems cause them to ask more questions to seek more information until they begin to doubt their first solutions. Their doubts indicate a certain disequilibrium that forces them to rethink their answers to problems like conservation and classification. As they reconsider the problem, they often revise their earlier views. Finally, a mental state of equilibrium between what the child understands and what he experiences in the environment is reached.

2.2.3 Conclusion

As we have seen in this section, each stage is characterized by certain features that make it different from those preceding and succeeding it. During the concrete - operational stage the child has already acquired language and is able to
express his ideas about certain operations using language. It has also been found that there are certain factors that influence cognitive development. Language works closely with these factors to influence the development of cognition.

2.3 Conservation and Assessment

In this section the concept of conservation and its assessment using clinical interview method will be discussed.

2.3.0 Conservation

As has been stated, conservation, which is one of the cognitive operations that emerges during the concrete operational stage, refers to the understanding that the quantity of a substance remains unchanged or invariant in the face of an irrelevant perceptual deformation (Flavell, 1983). An irrelevant perceptual deformation is any transformation or change that does not involve either addition or subtraction of the quantity. For example, when a dough in the shape of a "ball" is pressed into a "banana" shape, its mass, weight, and volume remain unchanged inspite of the physical transformation. This transformation involves no change in any of these quantities.

Piaget maintains that children's capacity to conserve any given quantitative relationship always goes through three stages in the same invariant order (Piaget and Inhelder, 1958). These stages are non-conservation, transitional-conservation, and conservation. In the non-conservation stage, the child does not acknowledge the invariance of quantity after the transformation; he thinks the quantity has changed. In the transitional-conservation stage, the child acknowledges the invariance of quantity after the transformation but can not give a satisfactory reason for this acknowledgement; his understanding is intuitive. In the conservation stage the child acknowledges the invariance and is able to give a satisfactory reason for his acknowledgement; he has fully attained the concept of conservation of the quantity in question.

Another feature of Piaget's stages of conservation development is the principle of horizontal decalage (Piaget and Inhelder, 1978). According to this principle, children progress through the three stages at different times for the different quantitative relationships of number, mass, weight, area and volume. Conservation of these quantities are acquired at the ages of seven, eight, nine, ten, and eleven respectively (Piaget, 1941).
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In assessing conservation, Piaget developed a method which is now commonly called clinical interview method. This method will now be discussed.

2.3.1 Clinical Interview Method

Piaget (1973) believed that the mind functions best in a relaxed atmosphere. This is achieved in the clinical interview method. In this method questions are adjusted according to the answers of the child. Piaget probed children's thinking using question and answer situations. This method is heavily reliant on verbalizations of the child and the interviewer. The tester poses the questions verbally and the child is required to give his answers in the same way. It is a flexible and open-ended method of questioning. It allows the interviewer to probe further than the initial responses of the child and also allows the child to express his own ideas.

Many psychologists often criticise the clinical method. They argue that the interview lacks standardisation and is for this reason heavily dependent on the skills and sophistication of the experimenter (Brainerd, 1978). This introduces an element of subjectivity that is questioned by many psychologists. Psychologists also claim that the clinical method does not allow for the study of large samples (Brainerd, 1978). This is because it involves a lot of questions to each subject. To Piaget (Cited in Ginsburg and oppe, 1979), these criticisms simply mean that the critics do not understand the goals of the method. He believes that cognitive structures are very complex and because of their complexity, cannot be assessed using rigid standardised techniques. Piaget argues that rigid standardised techniques constrict behaviour and cannot produce accurate conclusions like the clinical method.

Despite these criticisms clinical interviews have continued to be used for assessment of children's cognitive abilities. They have particularly been used a great deal in the assessment of children's conservation abilities on Piagetian tasks and by Kohlberg and and others in assessing moral reasoning.

In the standard conservation task, the child is first shown two objects that are known to be equivalent with respect to some quantitative relationship between them. The two objects are also perceptually identical in the beginning. One of the objects is then deformed in such a way that the perceptual identity is destroyed but
the quantitative relationship is not affected. After the deformation the experimenter questions whether the child knows that the objects are still quantitatively equivalent. Children who say that the objects are still quantitatively equivalent are said to conserve that quantitative relationship. Children who say that the objects are not quantitatively equivalent are said to fail to conserve the quantitative relationship. This first question is called the judgement question. Those who get the judgement question correct are then asked to explain their answers.

In the explanation question a child gives a reason as to why he thinks the two objects are still quantitatively equivalent despite the perceptual deformation. The reasons given for this fall under three categories: Reversibility, Identity and Compensation. Reversibility refers to the fact that a transformed object can be returned into its original state for example a "banana" can be rolled back into a "ball". Identity refers to the fact that a transformed object is the same material that it was originally, except that the shape has changed. Thus nothing has been added or removed. Compensation refers to the fact that in a transformation quantity does not change because one aspect of it is compensated for by another: for example, if a ball is rolled out into a banana, it becomes longer but thinner.

Piaget assessed conservation using several distinct tasks for one quantity of conservation (Brainerd, 1978). That is conservation was assessed using several activities and not one. Consequently he used "the 75% rule" to determine conservers, in which a subject was classified a conserver in a given quantity if he conserves in three fourth (75%) of the tasks related to that quantity. According to cole, et al., (1971, cited in Ashton, 1975) when one experiment is used to measure a trait, there is always doubt that the same results would be obtained given different circumstances. Ashton (1975) proposed that used of multiple or repeated experiments helps to reduce such doubt. Using several tasks to assess conservation of a given quality therefore increases the reliability of the test.

Many research studies have been devoted to verifying the existence of the stages of development of conservation in children. Comparison of the conservation abilities of African children with those from Western cultures demonstrate significant delays in the former group (For instance, Nyiti, 1974 Mwangangi, 1974 Mureria and Okatcha, 1977). Although the reasons for these delays are complex and numerous, they can potentially be explained in part by language used for assessment when the children in study are bilinguals and multilinguals. Section
2.5 of the literature review focuses on the relationship of assessment of conservation and language.

2.4  **Language and Assessment of Conservation**

2.4.0 **Oral Language and Conservation Tasks**

As was described in the last section, Piaget's own data have been obtained by clinical interview method. This method is highly dependent on language. The tester poses the questions verbally and the child is required to give his answers in the same way.

Assessment of conservation using verbal methods makes certain language demands on the children. According to Siegel and Brainerd (1978), Conservation tasks have two critical features related to language: they require the child to comprehend language related to relative and absolute quantity (eg more, same, larger than etc) and they define successful performance in terms of production of some appropriate verbal responses or explanations by the child.

The nature of these features is linguistically demanding. Furthermore judgements or explanations given by the child have been used as a criteria for the classification of conservation responses (Elkind, 1961, cited in Siegel and Hooper, 1968; Greenfield, 1966; Kiminyo, 1973; Nyiti, 1973; Mwangangi, 1974; among others). These explanations also place specific linguistic demands on the child because language is necessary for reasoning. According to John caroll (1964) reasoning is thinking that is aided by language and the ability to reason depends largely on the ability to formulate steps in an inferential process in terms of language.

Evidence for the need of language for thinking comes from studies by Cohen (1967), Flavell (1970) and Goodnow (1973) all cited in Siegel and Brainerd (1978). These studies showed that the structure or wording of a question can influence the type of reason given for conservation. This shows that linguistic factors are important in problem solution and the failure to solve Piagetian conservation problems may be due to linguistic rather than cognitive deficits.
In many developing societies, most children are bilinguals or multilinguals. The main medium of instruction is one of the western languages usually, English, French or Spanish. The assessment of such children by verbal methods require a choice to be made as to which language should be used to assess them. Certain issues arise in the selection of the language. The issues are discussed in the next section.

**Issues In Language Selection and Assessment of Conservation**

Assessment of conservation abilities involves two parties: the child and the tester (interviewer). Selection of the language to be used for assessment should take into consideration the fluency of both parties. Piaget (1966, cited by Dasen, 1977) suggested that it was necessary for interviewers to be fluent in the subject's native tongue. Dasen also stressed the need for the researcher to come from the culture of the subject. Several studies (Ohuche, 1970; and Kamara and Easly (1971, cited by Dasen, 1977); Otaala, 1971; Kiminyo, 1973; Nyiti, 1973; Mwangangi, 1974; Mureria, 1977) have managed to meet this criterion. In these studies the interviewers were native speakers of the children's native tongue.

If this condition is not met the results are linguistic barriers between the tester and the child (Dasen, 1977), which jeopardise the validity of the results obtained from assessing the children. These linguistic barriers between the interviewer and the child are manifested in either of the two ways: when the child is not fluent in the language used for assessment, when the interviewer is not fluent in the language used for assessment (Dasen, 1977).

These are discussed in the following section.

**Difficulties in the Child Lacking Fluency in the Language of Assessment**

In some studies, children are assessed by interviewers from different linguistic backgrounds, that is, the two parties do not share a native language. Some examples of such studies include Laurendeau and Pinard (1961, cited in Piaget, 1966), Prince (1968) De Lemos (1969), Kelly (1971) and Dasen (1972). Laurendeau and Pinard interviewed native children of Martinique in French. Aboriginal children were tested in English both in Australia by de Lemos (1969) and Dasen (1972) and in New Guinea by Prince (1968).
The study by Kelly (1971) illustrates the potential problem. He studied children in Papua, New Guinea. In the study, the children were from four language and cultural groups. Kelly carried out all the testing. In all these studies there is a situation in which the child is linguistically handicapped because he is not fluent in the language used to assess him and may have difficulties expressing himself fully. In addition the tester may not follow the child's expressions accurately because he lacks knowledge of the child's culture.

These handicaps become more serious if the tester and the child are both non native speakers of the language that is used for assessment. For instance Hyde (1959) and Opper (1971, cited in Dasen, 1977) studied Arabic and Thai and conducted interviews in these languages with children who at least knew them as a second language. In this situation both linguistic and cultural barriers operate between the two parties. Such linguistic and cultural barriers may have negative effects on the results of these studies.

**Difficulties Of The Interviewer Lacking Fluency In The Language Used For Assessment.**

Sometimes tasks are presented by an interviewer who has learnt the child's native language as a second language. This can be done in a translation prepared in advance (Price-Williams, 1961; Etuk, 1967; Poole, 1968). In these studies Piagetian tasks were converted into tests and then translated into the subject's native language before being administered in Tiv by Price-Williams (1961), in Yoruba by Etuk (1967) and in Hausa by Poole (1968). When the task is presented in the child's native tongue by a Western interviewer the child is at ease but the interviewer may not be at ease. The interviewer is handicapped in his ability to follow the child's explanations.

Another way in which western interviewers have presented tasks in the native language of the children is by use of interpreters. For example, for unschooled children, Price (1968), Bovet, (1968) and De Lemos (1969) used native interpreters from Australia. Kelly (1971) used unschooled children who had themselves acted as subjects as interpreters to a village sample (unschooled) because he could not obtain a trainable bilingual tester-interpreter of an older age group. When interpreters are used, both parties are handicapped in their ability to communicate the subtleties of thought involved in the tasks.
These linguistic and cultural barriers just discussed either on the part of the child or the interviewer present a problem to the clinical interview method. A major advantage of using clinical interviews for Piagetian tasks is that the interviewer can tell when the child is guessing the answers and when he is not. He can then probe the child's responses further to obtain enough information that helps him interpret and make conclusions about the child's abilities. This requires that the interviewer be competent in the language that the child is most proficient in which is usually the native language. When the task is presented in the child's native language either using a translation prepared in advance or through an interpreter the interviewer is not aware of the subtle variations of structural significance in the child's answers and he cannot accurately probe for greater precision when need be. An interviewer who is completely fluent in the native language and familiar with the culture of the subjects has a distinct advantage in validating the structural significance of the responses.

The present study aims to assess children's performance on conservation tasks while controlling for such linguistic and cultural barriers. The interviewer shares a native language and a second language with the children and has grown up in the area of study. He therefore, shares a similar cultural background with the children under study. The interview will be conducted in the native language and a second language in order to find out whether the language used for assessment has any effects on children's performance.

Another issue that may arise is selecting a language to be used for assessment of bilinguals or multilinguals is the nature of language acquisition. Not much has been done in assessment of conservation in relation to type of language acquisition. However, it is important to discuss the possible relationship between the two. This will be discussed in the next section.

2.4.2 Nature of Language Acquisition

There are two types of second language acquisition: simultaneous acquisition and sequential acquisition of two languages (Vihman and McLaughlin (1981, cited by Brainerd and Pressley, 1982). In simultaneous language acquisition, two or more languages are acquired concurrently while in sequential language acquisition, a second language is acquired after having developed basic linguistic skills in a first language.
Recent research suggest that the experiences of a child learning two languages simultaneously are different from those of a child learning a second language after the first is established. (McLaughlin, 1981). Sequential language learners have less experiential knowledge in the second language than in the first one. This means that simultaneous language learners are at an advantage with tasks that require experience. There is also evidence that processing of two languages in the brain is separate for sequentially acquired languages (Tomlinson-Keasy, 1985; Obler et al. 1973, cited in Taylor, 1976).

The success of bilinguals in their respective languages may to some extent be determined by the type of language acquisition they have undergone. Consequently this may have some influence on cognitive operation tasks, like conservation, which require language for assessment. Proof of this comes from an association experiment conducted in Canada by Lambert (1981). In this experiment bilinguals were asked to think of one word that could be used to relate "chair" "wood" and "to eat". The subject who had acquired French and English simultaneously were more likely to think of the correct answer "table", than the subjects who had acquired the languages sequentially. This suggests that the nature of language acquisition that a child has undergone can affect his performance on tasks requiring thinking.

2.4.3 Studies specifically dealing with effects of language on children's cognitive performance.

The theoretical positions discussed earlier in this chapter regarding the relationship between language and thought have generated research in this area which has relevance for assessment of cognitive development using oral language methods. Results from these studies have come up with divergent conclusions which require discussion. While Pearl and Lambert (1962), Nairs (1963), Kelly (1974) and Shea et al. (1981) reported that language does influence cognitive performance, other researchers (Inhelder et al, 196; Sinclair, 1967; and Tenezakis, 1975) who will be discussed later in this section, have not found such language influences.

Pearl and Lambert (1962) tested Greek children in English and Greek language. He found that first and second grade Greeks performed better when
tested in English than when tested in Greek. This reflected the intensive training in English given in these grades and relative lack of practice in listening to adult Greeks at these ages. This implies that the language of presentation of tasks can have an effect on children’s performance on cognitive tasks like conservation.

Nairs (1963) explored the arguments which children use when they solve conversation tasks correctly and when they do not. There were two kinds of arguments set forth by children to support their judgments namely: perceptual and non-perceptual arguments such as action oriented and transformational arguments. Nairs found that 85 per cent of non-conservers used perceptual arguments and 15 percent of them used non-perceptual arguments. Two thirds of conservers used non-perceptual arguments and only one third of them used perceptual arguments. Nairs suggested that children who lacked conservation were strongly oriented to the visual appearance of the displays they had to deal with.

Bruner and Kenney (1966) in trying to explain Nairs findings, argued that use of non-perceptual arguments requires translation of experience into symbolic form and opens up realms of intellectual possibility. Language plays a powerful role in this process and is therefore, a powerful instrument in the process of knowing. Infact Bruner (1966) views language as the most important technique that the child internalizes during the “Symbolic” stage of development. It enables him to translate his actions and images into a code with which he can express general and abstract ideas.

Shea et al. (1981) tested primary school level boys and girls from four different language - culture groups in Papua, New Guinea in conservation of number, length, area and quantity. There were significant differences between the language - culture groups in conservation of number, quantity and area but not length. However, there was little consistency of performance over the four tasks as groups that were significantly superior performers on some tasks were significantly inferior on others. This was probably due to effects of culture rather than language effects.

The studies discussed above suggest that language has some effect on Children’s performance on cognitive tasks. These results have direct implications on the assessment of bilinguals and multilinguals using oral language methods: that
is there are certain factors in language that need to be considered when assessing the
cognitive abilities of such subjects.

In contrast, Tenezakis (1975) found that language had no effect on
children’s performance on conservation tasks. He tested Australian Monolinguals
in English and Greek immigrants in English and in Greek. He found no difference
in the proportion of conserving subjects for each group. Greek immigrants’
performance in English and in Greek were not significantly different. Lack of
language effects in this study may have been due to cultural effects as a result of
difference in culture between the native Australians and the immigrant Greeks.

Another area in which the effects of language on children’s performance on
cognitive tasks has not been demonstrated is training studies (Inhelder, et al and
(a) If there were changes in the child’s descriptive language which
accompanied acquisition of conservation and (b) If performance on conservation
tasks could be improved through systematic teaching of the language of description
appropriate to a conservation concept.

They found no relationship between the structure of language patterns and
conservation. It was also found that although verbal training leads subjects without
conservation to direct their attention to pertinent aspects of the problem, it does not
bring about conservation. They concluded that language training helps to focus a
child’s attention on important aspects in a task, but it does not integrate the
information in a way to bring about conservation.

A related study was conducted by Sinclair (1967) in this study to conserve
through verbal training. He was unsuccessful in his efforts to train non-conservers
to conserve by way of language.

As can be seen the results from training studies did not show performance.
The children tested in each of these studies were, however, form one language
group. The studies therefore did not look at the effect of different languages on
children’s performance. Perhaps if they had, the language effects would have been
brought out more clearly.
As can be seen in the studies reviewed in this section, there is a controversy as to whether the language of assessment does affect children’s cognitive performance. This implies that there is need for intensive research on the effects of language of presentation of tasks on performance on cognitive tasks like conservation.

2.5 RESEARCH HYPOTHESES

The studies reviewed in the chapter have shown that Piagetian tasks of conservation have certain linguistic features which place certain linguistic demands on children. These are mainly evident when dealing with bilinguals or multilinguals. Whether or not the language of presentation of tasks of conservation affects children’s performance is not yet clearly known. There is therefore need to continue designing Piagetian studies which investigate the effect of language of presentation on performance on Piagetian tasks of conservation.

In light of the evidence supporting and contradicting Piaget’s position, this study takes a modified Piagetian perspective of language and thought. This leads to the following substantive research hypotheses:

1. The language in which Piagetian tasks of conservation are presented has an effect on children’s performance on conservation.

2. The language in which Piagetian tasks of conservation are presented has an effect on the types of justification reasons given for conservation.

In this chapter the literature related to the aspects of the present study was discussed. The design and methodology used will be discussed in the next chapter.
CHAPTER III

DESIGN AND METHODOLOGY

3.0 Introduction

This study investigated the effects of language on children's performance on Piagetian tasks of conservation. This chapter presents the methodology used. This is discussed in six sections.

3.1: Design

3.2: Population

3.3: Sample

3.4: Instruments

3.5: Data Gathering Procedures

3.6: Statistical Hypotheses

3.7 Data Analysis
3.1 Design

A static group comparison design was used in this study. There was one independent variable and two dependent variables. The independent variable was language of presentation of the tasks. There were four levels of the independent variable namely (1) Pure Kikuyu (2) Pure English (3) Predominant English plus Kikuyu and (4) Predominant Kikuyu plus English. The dependent variables were (1) performance on Piagetian tasks of conservation of mass, weight and volume and (2) the types of reasons given for conservation.

Subjects were tested in conservation of mass, weight and volume. Each area of conservation was assessed using four tasks. There were four groups of subjects each of which had ten subjects. Each group was subjected to one of the four levels of the independent variable. The four variations of language of presentation accross the task, in the four levels of the independent variable are summarised in Table 3.1.

Table 3.1: Variations Of The Language Of Presentation The Groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Area of Conservation</th>
<th>Lever of Independent Variable</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Mass</td>
<td>Pure Kikuyu</td>
<td>K</td>
<td>K</td>
<td>K</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>Pure Kikuyu</td>
<td>K</td>
<td>K</td>
<td>K</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>Volume</td>
<td>Pure Kikuyu</td>
<td>K</td>
<td>K</td>
<td>K</td>
<td>K</td>
</tr>
<tr>
<td>B</td>
<td>Mass</td>
<td>Pure English</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>Pure English</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>Volume</td>
<td>Pure English</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>C</td>
<td>Mass</td>
<td>Predominant K.K.</td>
<td>K</td>
<td>K</td>
<td>E</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>Predominant K.K.</td>
<td>K</td>
<td>K</td>
<td>E</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>Volume</td>
<td>Predominant K.K.</td>
<td>K</td>
<td>K</td>
<td>E</td>
<td>K</td>
</tr>
<tr>
<td>D</td>
<td>Mass</td>
<td>Predominant E.</td>
<td>E</td>
<td>E</td>
<td>K</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
<td>Predominant E.</td>
<td>E</td>
<td>E</td>
<td>K</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>Volume</td>
<td>Predominant E.</td>
<td>E</td>
<td>E</td>
<td>K</td>
<td>E</td>
</tr>
</tbody>
</table>

Key: K=Kikuyu, E= English
Group A and B were given all the four tasks in the three areas of conservation in Kikuyu and English respectively. Group C had all the tasks except one presented in Kikuyu and Group D had three tasks presented in English and one in Kikuyu.

3.2 Population

The population from which the subjects of this study were selected was eleven to twelve years old rural school children. Keeping the nature of the study in mind, a rural community was selected because it tends to be homogenous. This helps to control for possible intervening variables such as linguistic, cultural and economic factors which might otherwise influence children's performance.

The study was conducted in Kiambu District in Central Kenya. This area is occupied predominantly by the Kikuyu community. This area was selected because the investigator comes from this area and is familiar with the local language and culture and is therefore capable of following and understanding children's explanations.

The rural Kikuyu community from Kiambu district are agrarian and depend on subsistence farming for their livelihood. They speak a common language, the Kikuyu language. Kikuyu, English and Kiswahili are acquired sequentially. From birth to about six years of age, children are socialised almost exclusively in Kikuyu language. English and Kiswahili are learnt later when children have already, to a large extent mastered basic skills in Kikuyu language. Children start learning English language along with Kiswahili for the first time in preschool. The system of education is such that the first language is the medium of instruction in the preschool and in the lower primary school Standards I to III in the rural areas. English and Kiswahili are however taught as subjects at this level. English replaces Kikuyu as the medium of instruction from primary Standard IV. By this time children are expected to communicate fairly effectively in English.

Standard V pupils were selected for this study because at this level they are assumed to have sufficient mastery of both English and Kikuyu language. Most of the children in primary Standard V fell in the age of eleven to twelve years. Thus the population of the study was eleven to twelve years old rural Standard V pupils.
3.3 Sample

In Kenya, each district is divided into educational zones. There are 51 zones in Kiambu district. One of these zones in the district was selected. The selected zone was Komothai. This zone was selected because the investigator comes from there and is therefore familiar with the language and culture of the subjects. There were thirteen schools in the selected zone. The number of streams in schools varied from one to three.

The schools with largest enrollment were selected in order to ensure that there would be sufficient number of subjects for the study. This criteria gave three schools. Each of these three schools had three streams in Standard V and each stream had between forty and fifty pupils. Of these three schools two were randomly selected.

Having selected the schools, 11-12 year old Standard V pupils were identified using school admission registers. From the list of the 11-12 year old Standard V pupils, twenty subjects were randomly selected from each of the two schools. Thus a total of forty subjects was selected. There were twelve boys and eight girls in school 1 and fourteen boys and six girls in school 2. Since gender was not a variable being investigated, no effort was made to balance boys and girls. The youngest subject was eleven years and two months old and the oldest was eleven years and eleven months old. The table below gives the age range of the subjects.

Table 3.2 Distribution of Subjects By Age

<table>
<thead>
<tr>
<th>Year</th>
<th>Month</th>
<th>Number of Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>
Each of the twenty subjects in each school were then randomly assigned to four treatment groups namely groups A, B, C and D. Each group had 10 subjects, five from each school. The following table shows the distribution of subjects by gender and school.

<table>
<thead>
<tr>
<th>Group</th>
<th>School 1</th>
<th>School 2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
<td>Boys</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>8</td>
<td>14</td>
</tr>
</tbody>
</table>

### 3.4 Instruments

Children’s performance was assessed in three areas of conservation mass, weight and volume. Piagetian tasks of conservation were used. Each area of conservation was assessed using four tasks. Using four tasks instead of one increases the reliability of the test. Piaget himself used several distinct tasks to assess conservation in one area (Brainerd, 1978). Using four tasks also enabled the investigator to employ Piaget’s 75% rule where a subject is considered a conserver if he conserves in three fourths or 75% of the tasks in each area of conservation.

The Piagetian tasks used in this study were selected from studies cited by Fogelman (1970). These tasks are described in Appendix A. Subjects were assessed by clinical interview method. Each subject was given a Piagetian task and then asked some questions orally. There were two levels of questions (1) Judgement question and (2) Justification question.

In the judgement question, a subject was supposed to state whether there was any change in quantity after an object was transformed. If the subject
responded with a 'no', this indicated that he could see the variance of quantity after a transformation. Such a subject would then be asked to give a reason for his answer which was the justification question. No justification questions were asked if a subject responded with a 'yes' to the judgement question.

3.4.1 Pilot Study

Prior to the main study, a pilot study was conducted with eight eleven to twelve year old Standard V pupils from a school in the same area as those for the main study. The purpose of the pilot study was to:

1. Pretest instructions to be used in the main study, to determine the efficiency of the coding and recording of the children's responses and the scoring procedures;
2. To check the adequacy of the selected materials;
3. To check the accuracy of the translation of the testing instructions in both testing languages and prepare a scoring schedule

Based on the results of the pilot study, necessary revisions were done to improve testing instruments for the main study (for details, see appendix B).

3.4.2 Scoring

A subject whose response to the prediction question was 'yes' indicated that he could not see the invariance of quantity after a transformation. Such a subject was not asked the justification question and was given a score of zero.

A subject who responded to the prediction question with a 'no' was then asked the justification question. Answers to the justification question would either be correct or incorrect. If a subject's answer was incorrect he was given a score of one. Correct answers to the justification question were categorised into three categories namely; Identity, Reversibility and Compensation. If a subject gave two correct reasons the first one was considered. It is important to note here that the types of reasons given for justification are just categories and are, therefore, not weighed differently.

If a subject's answer was in one of those three categories he was given a score of two. The scoring procedure described above is summarised in Table 3.4.
Table 3.4  Nature of Responses To The Two Types of Questions and Scores Given.

<table>
<thead>
<tr>
<th>Alternative Combination of Answer</th>
<th>Types of Questions</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prediction</td>
<td>Justification</td>
</tr>
<tr>
<td>Alternative I</td>
<td>Correct</td>
<td>Correct</td>
</tr>
<tr>
<td>Alternative II</td>
<td>Correct</td>
<td>Incorrect</td>
</tr>
<tr>
<td>Alternative III</td>
<td>Incorrect</td>
<td></td>
</tr>
</tbody>
</table>

As shown in the table, there were three alternative combination of answers that a subject could give for the two levels of questions as can be seen from the table. Consequently, there were three possible scores per task. The maximum and minimum scores were two and zero respectively.

For purposes of data analysis, the scores for tasks in each area of conservation were added up to give the Total Conservation Score (TCS). These were added up in two ways giving two Total Conservation Scores namely (1)TCS-(4) and (2) TCS-(3). A TCS-(4) was obtained by adding up the four scores obtained in the four tasks in each area of conservation. For example, if a subject in the four tasks on conservation of mass scored, 2, 2, 1 and 2, respectively his TCS-(4) in mass was given by 2+2+1+2=7. The minimum and maximum TCS-(4) were zero and eight, respectively.

A TCS-(3) was obtained by adding up the scores on tasks 1, 2 and 4 which are the three tasks presented in the predominant language. The minimum and maximum TCS-(3) were zero and six, respectively.

All the four tasks were considered in identifying conservers in each area of conservation. According to Piaget's criteria (see Section 3.2), a subject was considered a conserver if he obtained at least three scores of 2 in three individual tasks in a given area of conservation. If a subject obtained less than three scores of two in each area of conservation, he was classified as a non-conserver in that area.
This criteria was followed in identifying conservers and non-conservers in all the four groups. However, for groups C and D once a subject met the conserving criteria, he was considered a conserver in the predominant language.

3.5 Data Gathering Procedures

Each subject was interviewed individually in an empty classroom provided by the school. Each time the subject sat on a chair facing the investigator as shown in Figure 3.1 below.

The materials required for the testing were placed on the table in front of the subject. An audio cassette recorder was placed under the investigator's chair and the microphone was placed on the table close to the subject.

Figure 3.1: Sitting Arrangement During Test Administration

![Diagram showing sitting arrangement during test administration]

KEY: 1 - Subject's sitting position
2 - Investigator's sitting position
3 - Position of materials for task being presented.

The first approximately five minutes were spent in establishing rapport with the subjects. The instructions used to establish rapport were similar to those used in the pilot study (see Appendix B.3).

Subjects were assessed in three areas of conservation in the order of mass, weight and volume. One task was presented each day to all subjects in one school starting with the tasks in mass in the order task 1, task 2, task 3 and task 4. The same order was followed in the three areas of conservation. The investigator
finished administering all the tasks in the three areas of conservation to subjects in school 1 before proceeding to those in school 2. It took about a month to collect the data in both schools.

3.6 **Statistical Hypotheses**

Two substantive hypotheses were generated in chapter II namely (1) The language of presentation of tasks has an effect on children’s performance on conservation. (2) The language of presentation of task has an effect on the types of justification reasons given for conservation.

From these substantive hypotheses subsidiary statistical hypotheses were generated for purposes of data collection and analysis. Two subsidiary statistical hypotheses, H01 and H02 below, were generated to test the first substantive hypotheses and three subsidiary statistical hypotheses, H03, H04 and H05, were generated to test the second substantive hypotheses.

- **H01**: There are no significant differences at .05 level in the children’s TCS-(4) in mass, weight and volume.
- **HO2**: There are no significant differences at .05 level, in each area of conservation, between the TCS in English and TCS in Kikuyu language condition.
- **HO3**: There are no significant differences at .05 level in the frequencies of types of reasons given among the three areas of conservation.
- **HO4**: There are no significant differences at .05 level between English and Kikuyu language conditions in the frequency of the types of reasons given for justification within each area of conservation.
- **HO5**: There are no significant differences at .05 level among the frequencies of types of reasons given for justification in each area of conservation.

3.7 **Data Analysis**

Descriptive statistics were used for purposes of describing the data collected. These were calculations of means and standard deviations. For purposes of testing the hypothesis non-parametric tests were used. Non-parametric tests were selected for two reasons:
(1) The number of subjects in the different groups was very small. According to Siegel (1956) probability statements obtained from most non-parametric tests are exact probabilities when dealing with small samples. Hence non-parametric tests were useful in this study because of the small samples used.

(2) The data did not meet some of the assumptions underlying the use of parametric for example the assumption of normality. According to Piaget and Inhelder (1941, cited by Modgil 1974), for the 11-12 year olds, the age range of subjects in this study, some concepts have been learnt while others are being learnt. This means that the scores are not normally distributed. Whitney (1948) cited by Siegel (1956) states that for population distribution which are skewed, non-parametric tests are clearly superior to parametric ones. Hence for this study the non-parametric tests were more suitable.

The following non-parametric tests were used:
(1) Friedman's one way analysis of variance test.
(2) Friedman's F-test for selected comparisons
(3) Kolmogorov-Smirnov one-sample test
(4) Chi-square one-sample test

In this chapter the design, instruments, population, sample, data gathering procedures and data analysis procedures were discussed. The results of the analysis of the data collected are discussed in the next chapter.
CHAPTER IV

RESULTS AND DISCUSSION

4.1 Introduction

This study investigated the effects of language on children’s performance on Piagetian tasks of conservation. A static group comparison design was used. Children were assessed in conservation of mass, weight and volume. Each area of conservation was assessed using four tasks. There were four groups of subjects differing in the language of presentation of the tasks. This chapter presents a description of the results obtained. These are discussed in three main sections.

4.2 Descriptive Analysis

4.2.1 Mean and Standard Deviations

The mean and standard deviations of Total Conservation Scores (TCS) were calculated. The following table summarises the mean and standard deviations of TCS(4) in the three areas of conservation for each group.
Table 4.1: Mean and Standard Deviations Of TCS(4) In Mass, Weight and Volume.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>Area of Conservation</th>
<th>Mass</th>
<th>Weight</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>S.D</td>
<td>Mean</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>5.50</td>
<td>3.27</td>
<td>5.10</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>4.30</td>
<td>3.09</td>
<td>3.10</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>4.90</td>
<td>3.14</td>
<td>5.00</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>4.90</td>
<td>3.05</td>
<td>4.10</td>
</tr>
</tbody>
</table>

The highest mean TCS-(4) were observed in groups A and C for conservation of mass and weight. However for conservation of volume, group D obtained the highest mean TCS-(4). This suggests that language of presentation had an effect on children’s performance in the different areas of conservation. Kikuyu language favoured children’s performance in conservation of mass and weight while English language favoured performance in conservation of volume.

When the TCS-(4) were compared for the three areas of conservation, the highest mean was observed in conservation of mass and the lowest in conservation of volume. This trend was observed for all groups except for group C in which the mean for conservation of weight was higher than that for conservation of mass. In general this showed that conservation of mass was learnt earlier than conservation of weight which was learnt earlier than conservation of volume. These results support Piaget’s findings.

4.2.2 Number of Conservers

A subject was considered a conserver if he obtained a score of two in at least three of the four individual tasks in each area of conservation (see also Chapter
III Section 3.5). For groups C and D, if a subject met the above criteria, he was classified as a conserver in the predominant language. Table 4.2 reports the percent of conservers in each area of conservation in English and Kikuyu.

Table 4.2: The Percent Of Conservers In Mass, Weight and Volume

<table>
<thead>
<tr>
<th>Language</th>
<th>Conserving Ability</th>
<th>Area of Conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mass</td>
</tr>
<tr>
<td>Kikuyu</td>
<td>Conservers</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>Non-Conservers</td>
<td>45</td>
</tr>
<tr>
<td>English</td>
<td>Conservers</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Non-Conservers</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>Conservers</td>
<td>52.5</td>
</tr>
<tr>
<td></td>
<td>Non-Conservers</td>
<td>47.5</td>
</tr>
</tbody>
</table>

The highest proportion of conservers was recorded in mass and the lowest in volume. This pattern was noted in both English and Kikuyu language conditions. The results indicated that conservation of mass was learnt earlier than that of volume. This trend is consistent with the variations in the mean TCS-(4) and with Piaget’s position regarding the sequence of learning the three areas of conservation.

4.2.3: Types of Reasons Given For Justification

The correct types of reasons given for justification were classified into three categories: Identity, Reversibility and Compensation (See Chapter II, Section 2.3) Table 4.3 shows the percentage of reasons given in each category for each area of conservation. The types of reasons were examined at task level irrespective of the groups. Thus all the tasks administered in Kikuyu were examined separately from the tasks presented in English language.
Table 4.3: Proportion in Percent of Reasons Given For Justification in Each Area of Conservation.

<table>
<thead>
<tr>
<th>Area of Conservation</th>
<th>Language</th>
<th>Types of Reasons</th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Identity</td>
<td>Reversibility</td>
<td>Compensation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass</td>
<td>Kikuyu</td>
<td>53.7</td>
<td>34.2</td>
<td>12.1</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>English</td>
<td>69.7</td>
<td>18.2</td>
<td>12.1</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Weight</td>
<td>Kikuyu</td>
<td>70</td>
<td>15</td>
<td>15</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>English</td>
<td>68.2</td>
<td>31.8</td>
<td>0</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Volume</td>
<td>Kikuyu</td>
<td>70</td>
<td>25</td>
<td>5</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>English</td>
<td>64.7</td>
<td>17.7</td>
<td>17.7</td>
<td></td>
<td>100</td>
</tr>
</tbody>
</table>

A higher percentage of correct reasons was given in the tasks administered in Kikuyu compared to those administered in English. This also corresponds to the higher number of subjects conserving in Kikuyu language compared to the number of conservers in English language. The proportion of reasons given for justification decreased across the categories from identity, reversibility and compensation in both English and Kikuyu language conditions. A similar pattern was observed for mass, weight and volume.

4.3 Inferential Analysis

Non-parametric tests were used to test the hypotheses. The results obtained for each hypothesis are presented and discussed below.

Hypothesis 1: There are no significant differences at .05 level in the children's TCS-(4) in mass weight and volume.

Specifically this hypothesis was tested in three stages:
(1) comparison of TCS-(4) for all the 40 subjects in mass, weight and volume irrespective of language treatment condition.
(2) comparison of TCS-(4) of the subjects in mass, weight and volume under Kikuyu language treatment condition.

(3) comparison of TCS-(4) of the subjects in mass, weight and volume under English language condition.

In each comparison the three TCS-(4)'s (for mass, weight and volume) were ranked across the concepts from the lowest to the highest and Friedman's test was conducted. The critical and observed Friedman's chi-square values are shown in Table 4.4.

<table>
<thead>
<tr>
<th>Language Condition</th>
<th>Irrespective of Language use</th>
<th>Kikuyu</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Chi - Square</td>
<td>11.5*</td>
<td>7.2*</td>
<td>8.1*</td>
</tr>
<tr>
<td>Critical Chi - Square</td>
<td>60.05</td>
<td>6.3</td>
<td>6.3</td>
</tr>
</tbody>
</table>

The observed Chi-square values were significant at .05 level for the three comparisons. The null hypothesis of no significant differences between TCS-(4) in the three areas of conservation was rejected and the alternative hypothesis accepted. It was concluded that there were significant differences between children's performance in conservation of mass, weight and volume irrespective of language used and in each language condition.

Pairwise comparisons were further conducted to locate the significant differences using Friedman's test for selected comparisons. The F-values obtained from these pairwise comparisons are shown in Table 4.5.
Table 4.5: Friedman's F-Values For Selected Comparisons Test

<table>
<thead>
<tr>
<th>Language Condition Area of Conservation</th>
<th>Irrespective of Language use</th>
<th>Kikuyu</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass vs Weight</td>
<td>2.22</td>
<td>0.00</td>
<td>2.68</td>
</tr>
<tr>
<td>Weight vs Volume</td>
<td>3.96*</td>
<td>3.36*</td>
<td>1.34</td>
</tr>
<tr>
<td>Mass vs Volume</td>
<td>6.17*</td>
<td>3.39*</td>
<td>4.19*</td>
</tr>
</tbody>
</table>

* - Significant at $\alpha=0.05$ level

Results indicate that significant differences were located between (1) mass and volume in all the three comparisons; and (2) between weight and volume in the first and second comparisons only. There were no significant differences between mass and weight in all the three comparisons.

Irrespective of the language condition, there were significant differences between (1) mass and volume and (2) weight and volume. As noted earlier these results in general support Piaget's claim concerning the sequence in which the concepts of mass, weight and volume are acquired. According to Piaget and Inhelder (1941, cited by Modgil, 1974) the three concepts are acquired in the order mass, weight and then volume at the ages of 7-8 years, 9-10 years and 11-12 years respectively. This means that at the age of 11-12 years, the age range of the subjects in this study, conservation of mass and weight had to a large extent been acquired and conservation of volume was in the process of being acquired. One would, therefore, expect significant differences between mass and volume, and weights and volume.

These results essentially agreed with those of Price-Williams (1961), Mohseni (1966), Opper (1972), Nyiti (1973) and Kiminyo (1973). In all those studies, the same sequence of attainment of conservation of mass, weight and volume was observed for most children.

Results in the specific language conditions showed that there were significant differences in the TCS-(4) between (1) mass and volume in both English
and Kikuyu language conditions and (2) weight and volume in the Kikuyu language condition. However, in the English language condition, the differences in the TCS-(4) between weight and volume were not significant. Differences between mass and weight were not significant in either language condition.

Results obtained in the Kikuyu language condition verified the invariant order of conservation of mass, weight and volume. These results were consistent with other studies where tasks were presented to children in their first language by native speakers of these languages (Kamara, 1971; Kiminyo, 1973; and Nyiti, 1973). In these three studies the invariant order was established by comparing conservation abilities of subjects in different age groups.

In this study no significant differences were observed between conservation of weight and volume in the English language condition. One possible explanation for this is lack of experiences related to the concept of weight in English language. Children in this study encounter little or no weight related experiences in the English language context; that is, at school where they use English language. Because of this they have difficulties trying to compare weights. Furthermore, during testing it was observed that children had difficulties while trying to express themselves in weight related problems in English language. Most of the subjects lacked relational terms in these comparisons when comparing weights. The few who used relational terms in these comparisons tended to use them poorly. For instance subjects used the comparatives "more than" and "less than" instead of "heavier than" and "lighter than" respectively. This partly explains that children lack weight related experiences in the English language context. This leads to poor performance in conservation of weight in the English language condition.

These results compare with those obtained by Tenezakis (1974) when working with English and Greek speaking children in Sydney Australia. Tenezakis observed that children used relational terms less frequently when responding in English than they did when responding in Greek.

The results of this study show that a child who acquires two languages sequentially and has had appropriate experiences in a concept in both languages will perform equally well in both languages. However a child who has not been provided with appropriate experiences in one or the other language will perform differently in the two languages. This research further indicates that differential
performance could also be explained in terms of language proficiency as well as experiential deficiency.

Most of the conservers followed the invariant order of conservation of mass, weight and volume postulated by Piaget and Inhelder (1941). In the English language condition, this order was followed by all the conservers. However, two conservers reversed this order in the Kikuyu language condition. These reversals were observed in conservation of mass and weight. Two subjects conserved weight but failed to conserve mass. This could be attributed to children having more weight related experiences than mass related experiences in the Kikuyu language context.

Such mass weight reversals have also been reported by other researchers (Hyde, 1959, cited by Kiminyo, 1973; De-lemos, 1969; cited by Nyiti, 1973; and Kiminyo, 1973). Hyde and Kiminyo also reported weight/volume reversals in their studies. Kiminyo interviewed his subjects in their native language which he shared with them. De-lemos assessed subjects in English, the medium of instruction at school and not their native language. No information could be obtained to verify which language Hyde used to interview his subjects.

In the present study language had, to some extent, an effect on the order in which children acquired the concepts of mass, weight and volume. These effects can not be confidently attributed to the order of acquisition of the languages by the present subjects. There is need to compare performances of sequential and simultaneous language learners to answer the above issue.

**Hypothesis 2:** There are no significant differences at .05 level, in each area of conservation, between the TCS in English and TCS in Kikuyu language conditions.

To test this hypothesis, two comparisons were made:
(1) comparison of the TCS-(4) in the pure language treatment groups (Groups A and B)
(2) comparison of the TCS-(3) in the mixed language treatment groups (Groups C and D).
The score distribution of TCS-(4) and TCS-(3) (see Appendix D) were prepared and the observed score frequencies were used to test this hypothesis. The Kolmogorov-Smirnov's test was used. Table 4-6 shows the Chi-square values obtained for each comparison and area of conservation.

Table 4.6: Chi-Square Values For Group Differences In TCS In Each Area Of Conservation.

<table>
<thead>
<tr>
<th>Area of Conservation</th>
<th>TCS Comparison</th>
<th>Mass</th>
<th>Weight</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A TCS-(4) Vs</td>
<td>Group B TCS-(4)</td>
<td>1.8*</td>
<td>3.2*</td>
<td>0.8</td>
</tr>
<tr>
<td>Group C TCS-(3) Vs</td>
<td>Group D TCS-(3)</td>
<td>0.2</td>
<td>0.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>

* - Significant at $\alpha = .05$ level

Critical Chi-square = 1.39

The table shows that the pure language groups (Groups A and B) were significantly different for mass and weight. The mixed language groups (Groups C and D) were not significantly different for any of the three areas of conservation.

The null hypothesis of no significant differences between the TCS-(4) in English and the TCS-(4) in Kikuyu language was rejected at .05 level for the pure language groups comparison in conservation of mass and weight. It was accepted at .05 level of significance for the pure language groups comparison in conservation of volume. The null hypothesis was accepted for the mixed language groups comparison in all the three areas of conservation.

The results of this study showed that the language of presentation of tasks affected children's performance in conservation of mass and weight under the pure language conditions of English only and Kikuyu only. In conservation of mass and weight children performed better in the Kikuyu language than in the English language condition. The language of presentation of tasks had no effect on the children's performance in conservation of volume in the pure language conditions.
A possible explanation for these results is that both languages are used by children in different contexts. English language is mainly used in the classrooms and is usually not used at all when the child is out of school, where as Kikuyu language is used at home and during play.

At the same time, the activities that children encounter at school vary from those experienced at home. Thus these children experience different activities in the two language contexts.

Most of the activities involving mass and weight are encountered by children at home. For instance, at home, girls participate in cooking or watch as their mothers cook. Boys help their fathers on the farms in activities such as applying fertilizers on the farm. These activities are directly related to the concept of mass. Children have an opportunity to see food, other materials such as unga and fertilizers in different containers. In these activities children learn that certain quantities of materials can take different shapes in different containers yet their quantities remain unchanged. At the same time they compare these quantities and sometimes verbalise statements concerning the invariance of mass in Kikuyu language.

Children also encounter weight related experiences at home. For instance they are often called upon to take coffee berries to factories. Here they have it weighed and they often have to change the berries from one container to the other. In so doing, they see the invariance of weight under different transformations. Children also act as messengers whereby they are sent to shops to buy commodities, some of which have to be weighed, for example sugar, unga, cooking fat et cetera. Such activities facilitate conservation of weight and children learn to verbalise statements concerning the invariance of weight in Kikuyu language. Such experiences may have a facilitative effect on children's performance if they are assessed in the Kikuyu language.

Flavell and Hill (1969) cited by Tenezakis (1975) argue that the specific relationship between language use and performance on tasks like conservation may vary with the particular experiences of the child and the situational demands. Thus when a child experiences certain concepts, he is likely to perform better in these experiences in the particular language situation that he experienced them.
when a child experiences certain concepts, he is likely to perform better in these experiences in the particular language situation that he experienced them.

The results of this study are in line with findings of the work done by Kelly (1970) Phillip and Kelly (1974) and Tenezakis (1975). In these studies the language used for assessment was found to have an effect on children's performance on conservation tasks.

**Hypothesis 3**: There are no significant differences at .05 level in the frequencies of types of reasons given among the three areas of conservation.

The frequencies of each type of justification reasons (identity, reversibility and compensation) given were obtained for each area of conservation. Appendix E shows the percent of each type of reasons given for each area of conservation. The Kolmogorov-Smirnov test was used to test this hypothesis. The chi-square values thus obtained for differences among the types of reasons given between the different areas of conservation are reported in Table 4.7.

**Table 4.7 Chi-square values For Differences In Types of Reasons**

<table>
<thead>
<tr>
<th>Area of Conservation</th>
<th>Mass and Weight</th>
<th>Mass and Volume</th>
<th>Weight and Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$ Observed</td>
<td>0.9841</td>
<td>0.4522</td>
<td>0.0290</td>
</tr>
<tr>
<td>$\chi^2$ Critical</td>
<td>1.39000</td>
<td>1.3900</td>
<td>1.3900</td>
</tr>
</tbody>
</table>

None of the observed Chi-square values was significant at .05 level. Therefore the null hypothesis of no significant differences between the frequencies of types of justification reasons given was accepted. It was concluded that the
effect on the mode of reasoning employed by children. This was in agreement with results of studies by Piaget and Inhelder (1941) Greenfield (1966) De Lemos (1969), Opper cited by Dasen (1977), Kiminyo, (1973) and Mwangangi (1974).

The fact that no significant differences were reported in the frequencies of types of reasons given for justification in different areas of conservation suggests that the mode of reasoning does not depend on the area of conservation.

Rather the mode of reasoning employed depends on the nature of the problem. In this case the problem was conservation.

**Hypothesis 4:** There are no significant differences at \( .05 \) level between English and Kikuyu language conditions in the frequencies of the types of reasons given for justification in each area of conservation.

The frequency of each type of reasons given for justification in each area of conservation was obtained for (1) all Kikuyu language presented tasks and (2) all English language presented tasks. These frequencies are presented in Appendix F. The Kolmogorov-Smirnov test was used to test this hypothesis. Table 4.8 shows the Chi-square Values obtained in each area of conservation.

<table>
<thead>
<tr>
<th>Area of Conservation</th>
<th>( \chi^2 ) Value</th>
<th>Mass</th>
<th>Weight</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation ( \chi^2 )</td>
<td>1.88*</td>
<td>1.61*</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>Critical ( \chi^2 )</td>
<td>1.39*</td>
<td>1.39</td>
<td>1.39</td>
<td></td>
</tr>
</tbody>
</table>

* - significant at \( \alpha = .05 \) level
The Chi-square values obtained were significant at .05 level in conservation of mass and weight. The Chi-square Value obtained for conservation of volume was not significant. The null hypothesis of no significant differences between the frequencies of types of reasons given for justification in Kikuyu and English language conditions was rejected in conservation of mass and weight and was accepted in conservation of volume. It was concluded that the language of presentation of the tasks seemed to affect the frequency of types of reasons given in conservation of mass and weight. The language of presentation of the tasks did not appear to affect the types of reasons given for conservation of volume.

These results also suggest that children employed different modes of reasoning in English and Kikuyu language conditions, in conservation of mass and weight. However, the mode of reasoning in Kikuyu language condition was not different from the mode of reasoning in English language condition in conservation of volume. These results suggest that the language of presentation of the tasks influences the mode of reasoning in the already acquired areas of conservation (mass and weight) but does not have any influence on the mode of reasoning in the conservation area that has not been acquired by children. This means that language of presentation of tasks influences the mode of reasoning only if the area of conservation has been acquired. This suggests that thought precedes language. Thus language may influence children's performance on Piagetian tasks of conservation but only if the child has acquired the concepts in the area of conservation under question. Such language influences may be due to differential experiences and proficiency in the language of presentation of the tasks.

Another possible explanation for the lack of observable language influences on the mode of reasoning in conservation of volume may be due to the fact that there were very few conserving responses in conservation of volume tasks. Because of the small number of conserving responses in volume compared to those in mass and weight, there could have been an artificial effect of the small number of correct reasons given.

Hypothesis 5: There are no significant differences at .05 level among the frequencies of types of reasons given for justification within each area of conservation.
This hypothesis was tested in three stages:-

1. Comparison of the frequencies of types of reasons given irrespective of the language of presentation.
2. Comparison of the frequencies of types of reasons given in the Kikuyu language condition, and
3. Comparison of the frequencies of types of reasons given in the English language condition.

The chi-square one-sample test was used to test this hypothesis. The chi-square values obtained are shown in table 4.9

Table 4.9: Chi-Square Values for differences among the Frequencies of Types of Reasons.

<table>
<thead>
<tr>
<th>Area(s) of Conversation Language Condition</th>
<th>Mass Weight and Volume</th>
<th>Mass</th>
<th>Weight</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrespective of Language</td>
<td>60.29*</td>
<td>26.32*</td>
<td>15.36*</td>
<td>21.58*</td>
</tr>
<tr>
<td>Kikuyu</td>
<td>35.43*</td>
<td>10.39*</td>
<td>12.80*</td>
<td>18.08*</td>
</tr>
<tr>
<td>English</td>
<td>24.93*</td>
<td>17.23*</td>
<td>4.36</td>
<td>5.17</td>
</tr>
<tr>
<td>Critical Chi-square</td>
<td>5.99</td>
<td>5.99</td>
<td>5.99</td>
<td>5.99</td>
</tr>
</tbody>
</table>

* - significant at $\alpha = .05$ level

In general, irrespective of the language of presentation of the tasks, the frequencies of the three types of reasons given were significantly different at .05 level in all the three areas of conservation. Identity reasons occurred more frequently than reversibility ones which were more frequent than compensation reasons. This may suggest that certain modes of reasoning are more prevalent in the children's minds than others.
In the Kikuyu language condition the differences among the three categories of reasons were also observed in the three areas of conservation. However, in the English language condition, the frequencies of the three types of reasons were only reported in conservation of mass. There were no significant differences among the three types of reasons in conservation of weight and volume in the English language condition. Thus the variable frequencies of the three types of reasons given were observed in all three areas of conservation in the Kikuyu language condition but only in conservation of mass in the English language condition. Where there were significant differences among the frequencies of types of reasons given for conservation identity reasons were more frequent than reversibility ones which were more frequent than compensation. Greenfield (1966), Mwangangi, (1974) and Opper cited by Dasen (1977) also reported a higher frequency of identity type reasons given by subjects of their studies. The lack of significant differences among the various types of reasons in conservation of weight and volume in the English language condition could also be explained by the small number of conserving responses in both areas in this language.

4.4: **Summary**

This chapter presented a description of the data obtained and a discussion of the results of the data analysis. In the first hypothesis, it was hypothesized that there would be no significant differences at .05 level in the children's Total Conservation Scores in mass weight and volume. This hypothesis was rejected. It was found that there were significant differences between children's TCS-(4) in mass and volume and between weight and volume in the Kikuyu language condition. In the English language condition there were significant differences in the TCS-(4) between mass and volume. Hypothesis 2 indicated that there would be no significant differences at .05 level in each area of conservation, between the TCS in English and the TCS in Kikuyu language conditions. This hypothesis was accepted for the pure language groups comparison in conservation of mass and weight. It was rejected for the pure language groups comparison in conservation of volume and accepted for the mixed language groups comparison in all the three areas of conservation. In the third hypothesis it was hypothesized that there would be no significant differences at .05 level in the frequencies of types of reasons given among the different areas of conservation. This hypothesis was accepted. The last hypothesis indicated that there would be no significant differences at .05 level between English and Kikuyu language conditions in the frequencies of types of reasons given in each area of conservation. This hypothesis was rejected in
conservation of mass and weight and was accepted in conservation of volume. The implications and recommendations from these results are presented in the next chapter.

Summary Of The Results

The study investigated the effects of various factors on the rate of growth and development. By analyzing data collected over a period of time, it was possible to identify significant patterns. The results indicate that certain factors, such as diet and environment, have a substantial impact on growth. Furthermore, the study highlights the importance of early intervention to prevent potential issues.

The findings support the conclusion that proper nutrition and a supportive environment are crucial for optimal growth. Children's growth can be influenced by factors such as diet, health, and social conditions. Therefore, it is essential to implement strategies that address these areas to promote healthy development. The results have important implications for policymakers and health professionals, urging them to focus on these factors to improve outcomes for children.
CHAPTER V

IMPLICATIONS AND RECOMMENDATIONS

5.0 The implications and recommendations derived from the results of this study will be discussed in this chapter. Before this discussion is made a summary of the findings of this study will be presented.

5.1 Summary Of The Results

This study investigated the effects of language of presentation on children's performance on Piagetian tasks of conservation of mass, weight and volume. A group of 40 Kikuyu-English speaking children from a rural area in Central Kenya was studied. These children ranged in age from eleven to twelve years and were in primary standard V. They had acquired the Kikuyu and English languages sequentially.

The following were the findings of this study.

1. The results obtained supported Piaget's claim concerning the order of acquisition of conservation of Mass, Weight and Volume. Conservation of mass was acquired earlier than conservation of weight which was acquired earlier than conservation of volume.

2. Children's performance in conservation of mass and weight in Kikuyu language was significantly higher than their performance in English language. This was attributed to the fact that children in the study were exposed to more mass related experiences in Kikuyu than in English.

3. Regardless of the quantity, children employed the same modes of reasoning in conservation of mass, weight and volume. These were
identity reversibility and compensation. However, in all the three areas of conservation identity, type of reasons were more frequent than reversibility and compensation.

4. The frequencies of various types of reasons given for conservation in Kikuyu and English language were significantly different for conservation of mass and weight. Such differences were not significant in conservation of volume which was not mastered as well as mass and weight.

5.2 Conclusions and Implications
The conclusions reached from the findings of the study and their implications are now discussed.

1. Different quantities of conservation are acquired at different ages of the child. Conservation of mass, weight and volume in this study were acquired in the order of mass, weight and then volume. This means that children in the same class and age level may be at different developmental levels in different concepts. These differences should be considered when dealing with children in a given class and when planning activities and curriculum for them.

2. The language of presentation of tasks affects children's performance only if the concept in question has been acquired or is being acquired. This means that language has little or no effect on children's performance if the concept has not been acquired. Results of this study suggest that once the concept is acquired thought processes are relative to the language in which they are conducted. This suggests that Piaget is correct in his belief that cognition precedes language. Unless the child has developed a concept, the language in which the aspects of such a concept are expressed does not appear to influence his thought processes or ideas about the concept.

3. Experiences in a language facilitates the development of a concept in a language. Therefore, lack of certain experiences in a language can cause the user of that language to think less efficiently and accurately in that language. This means that if children are tested in a concept in a language in which they are not exposed to, they may look deficient. Children should
therefore, be exposed to a wide range of activities in all their languages in order to ensure that the true picture of cognitive development is realised.

4. The type of reasons children give for conservation are dependent on the nature of the problem rather than the concept in question. Thus children will employ the same mode of reasoning in conservation of different quantities. This implies that reasoning styles tend to be independent of the concept in question but are determined by the nature of the problem.

5. Identity type of reasons were more prevalent than reversibility and compensation in all the three areas of conservation. Compensation reasons were the least prevalent. This means that some styles of reasoning tend to be more prevalent than others in conservation problems. These styles may be easier for children to comprehend and formulate. Perhaps these types of reasons are also used more frequently in other areas of problem solving.

6. Language of assessment affects the frequencies of types of reasons given for conservation only when the concept in question has been acquired. This shows that reasoning styles tend to be dependent on the language in which they are conducted only if the concept has been acquired. If a concept has not been acquired, then language has no influence on the style of reasoning employed on that concept. Piaget is, therefore, correct in his assumption that thought precedes language.

5.3: **Recommendations**

The above implications leads to different recommendations for teachers, parents, curriculum developers, researchers.

5.3.1: **Recommendations to Teachers**

1. Teachers should take the developmental differences in concept organisation among children into consideration. Because of the differences in development of concepts among children, children have different needs which the teachers need to find out and try to provide in order to enhance development of the concepts lacking in them.
2. Teaching in primary school and earlier should be accompanied by a wide range of experiential activities. This facilitates concept development and may serve to make learning more effective.

3. Children should be involved in a wide range of activities in the language of instruction and assessment at school. This would facilitate their performance at school. A child who has been exposed to experiences related to a concept in the school language is likely to perform more successfully in problems related to the concept in that language. This can be used as a way of helping the poor children to achieve higher at school.

4. Since identity reasons are more prevalent than the others among children in conservation problems, perhaps they are easier to understand. Teachers should use examples of the same type in the classroom as this makes it easier for the children to understand.

5. In a linguistically homogenous community, there is a tendency of using the home language more frequently than the school language in extra-curriculum activities. This is because children in such a community are more comfortable in their mothertongue than in the language used in school. This leads to limited use of the school language. Teachers should encourage children to use their school language in activities that are beyond the classroom situation. This ensures exposure in a wide range of experiences in the school language, the language in which they will eventually be assessed.

5.3.2: Recommendations To Primary Teacher Trainers

1. Primary teacher trainers should be aware of the developmental differences in concepts among children of the same age range and the same standard (class). They should in turn pass this knowledge to their students, teacher trainees, so that eventually when these trainees become teachers, they consider these differences when they are dealing with pupils in the classroom.

2. Teacher trainers should also be made aware of the role of experience in the development of concepts. Consequently they should advice their trainees on the need to involve their pupils in experiential activities in order to facilitate learning.
5.3.3: **Recommendations To Curriculum Developers**

1. Curriculum Developers should adopt a curriculum that caters for the differences in developmental levels among children in one standard. These differences represent a range of abilities in any one class which the current 8-4-4 system of education modification should cater for.

2. Curriculum developers should develop syllabuses that call for different types of experiences and numerous opportunities for them at school in order to expose children to a wide range of experiences in the school language.

5.3.4: **Recommendations To Parents**

1. Parents should encourage their children to use their school language not only at school but also at home. This is particularly necessary for children in rural homogenous areas where the use of the school language at home is rarely practiced. This will ensure that children have school language experiences in those home activities that cannot be availed to them at school.

5.3.5: **Recommendations For Further Research**

1. This study has shown that once a concept is acquired, the performance on tasks related to the concept may be influenced by the language in which it is assessed. Researchers need to take this into consideration in order to avoid underestimating children because of language influences.

2. Most of the research done on the performance of African children on Piagetian tasks of conservation indicates that these children are cognitively to children from Western countries. Africa is a continent in which there is a wide range of linguistic communities. Languages used for assessment and Linguistic barriers between the subjects and interviewers may be possible hindering factors to children's performance. There is need to carry out intensive research in this area before any valid comparisons between African and Western children's cognitive abilities are made.

3. There is need for more research to be carried out with larger samples of bilinguals and multilinguals in order to establish the validity of the findings of this study. Since there is a wide range of linguistic communities such research should cover a variety of bilinguals and multilinguals in different linguistic environments.
LIST OF REFERENCES


APPENDICES

APPENDIX A

SPECIFIC PIAGETIAN TASKS AND PROCEDURES USED

A.1: Tasks And Procedures In Conservation Of Mass

1.1 Task M1
Materials: A lump of clay about 4 inches in diameter.
Procedure: The subject was asked to make two balls of clay of equal size. He was then asked to roll one of the balls into a banana. The experimenter then asked "Is there as much, more, or less clay in the banana as there is in the ball? why?"

1.2: Task M2
Materials: A lump of clay about 4 inches in diameter.
Procedure: The subject was asked to make two balls of clay of equal size and shape. He was then asked to break one of the balls into four pieces. The experimenter then asked "Is there still as much, more or less amount of clay in the ball as there is in the four pieces? Why?"

1.3: Task M3
Materials: Two balls of dough about 4 inches in diameter each.
Procedure: The experimenter asked the subject whether both balls had the same amount of dough. If the two balls had unequal flour he was encouraged to make them equal by removing some dough from one and adding it to the other. The experimenter then asked the subject "suppose I roll one of the balls into a ring (as he rolls one into a ring) will there be as much more or less amount of flour in the ring as there is in the ball? why?"
1.4: Task M4

Materials: Two balls of a dough about 4 inches in diameter each.

Procedure: The experimenter asked the subject whether both balls had the same amount of flour. If there was any doubt, he was encouraged to make them the same by removing some dough from one ball to the other. The subject was then asked to break one of the balls into two pieces. He was then asked to roll one of the pieces into a banana and the other into a ring. The experimenter then asked "is there as much, more or less flour in the ring as there is in the banana? Why?"

A.2 Tasks And Procedures In Conservation Of Weight

2.1: Task W1

Materials: (1)Two balls of dough weighing about 500 grams each.
(2)Weighing scale

Procedure: The experimenter placed the two balls of flour on a weighing scale to show the subject that both of them weighed the same. He was then asked to roll one ball into a banana and then asked, "does the banana weigh more, the same or less than the ball? Why?"

2.2: Task W2

Materials: As for task W1

Procedure: The experimenter first established equivalence in weight of the balls on a weighing scale as the subject watched. He then asked the subject to break one of the balls into four small balls and asked, "does the big ball weigh more, same or less than the four small pieces weighed together? Why?"

2.3: Task W3

Materials: As for task W1

Procedure: The experimenter first established the equivalence in weight of the two balls on a weighing scale as the subject watched. He then asked the subject to roll one into a ring and then asked, "does the ring weigh the same, more or less than the ball? Why?"
2.4: **Task W4**

**Materials:**
- (1) Two balls of clay weighing about half a kilogram each
- (2) Weighing scale

**Procedure:**
The experimenter placed the two balls of flour on a weighing scale each at a time to establish their equivalence in weight as the subject watched. He then asked the subject to roll one into a ring and the other into a banana. He then asked, "does the banana weigh the same, more or less than the ring? Why?"

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A.3 Tasks And Procedures In Conservation Of Volume

3.1 **Task V1**

**Materials:**
- (1) Two balls of dough about 5 inches in diameter each.
- (2) Two jars of water of equal size filled with water to the same level.

**Procedure:**
The subject was shown the two balls of dough, which he adjusted till he agreed that they were equal. The experimenter then asked the subject to roll one of these into a banana and asked him, "If we put the ball into this jar and the banana into the other jar, will the water in this jar rise more, same or less than in the other jar? Why?"

3.2 **Task V2**

**Materials:**
- (1) Two equal glasses of water filled with water to the same level.
- (2) Two cylindrical torch batteries.

**Procedure:**
The subject was allowed to compare the two torch batteries until he agreed that they were equal. One battery was then placed upright in one glass of water as the subject watched the water rise. He was then asked, "if I put this battery horizontally into the glass, will the water rise to the same level, more or less than it did in the other glass? Why?"
3.3 Task V3

Materials: (1) two balls of dough about two inches in diameter. (2) Two equal glasses of water filled to the same level.

Procedure: The experimenter first allowed the subject to adjust the two balls until he agreed that they are equal. He then asked the subject to break one into three pieces. He then put the big ball in one glass of water as the subject watched. He then asked, "suppose we put the three small balls into the other glass of water, will the water rise the same, more or less than it did in the first glass? Why?"

3.4 Task V4

Materials: Two balls of clay identical in size, shape and weight.

Procedure: The experimenter would ask the subject whether both balls would take up the same amount of space. The subject was encouraged to adjust them until he agreed they would occupy the same amount of space. He then asked the subject to roll one ball into a banana and asked, "does the banana occupy the same, more or less space than the ball? Why?"
B.1.1 **Purpose**

1. To check the adequacy of the selected testing materials.
2. To check the accuracy of the translation of the testing instructions in the two languages.
3. To estimate the time required to present the tasks in each language.
4. To pretest the instructions to be used, coding and recording of responses and the scoring procedures.

B.1.2 **Sample**

The sample of this study consisted of 8 subjects randomly selected from a list of 11-12 year old standard V pupils from a primary school in the same area as those for the main study. The 8 subjects were equally distributed to each of four groups as in the main study.

B.1.3 **Instruments**

The same Piagetian tasks of conservation used in the main study and listed in appendix A were used. The data gathering procedures were similar to those used in the main study (see section 3.5).

B.2 **Results And Recommendations**

B.2.1 **Time**

The average time required to present one task to a subject was the same in both English and Kikuyu language. It took approximately 15 minutes to present a task to one subject. Out of those 15 minutes, 5 minutes were spent on establishing rapport. Thus presenting one task to all the twenty subjects in the main study would require about three hours. It was therefore, decided that each day the investigator would present one task in each area of conservation to all the subjects in one school. Hence it was going to take 12 days to present all the tasks in the three areas of conservation in each school.
B.2.2. **Accuracy of Translation**

The translation of the instructions for task presentation were checked and where these were not accurate for the subjects to grasp, the investigator would adjust them accordingly.

B.2.3. **Adequacy Of The Materials**

The materials selected for each task were familiar and appropriate for all the subjects. These were, therefore, found adequate for the main study. It was also found necessary to use a tape recorder to record the subjects responses. This was because writing students responses took time and made the subjects uneasy. At the same time it ensured that no information could be lost thus affecting the results.

**B.3 Instructions Used For Establishing Rapport.**

1. Good Morning/Afternoon?
2. Good, Sit down
3. What is your name?
4. Good! So "subject's name" you are in standard V?
5. That is good.
6. Do you like playing games?
7. What game do you like most?
8. I'm sure you don't mind learning a new game.
9. This time we are going to play a simple game. In this game we shall manipulate some objects that you know so well and the I'll ask you some simple questions. I'm sure you will enjoy playing this game.
10. Are you ready?

The investigator would then commence with the task presentation.
APPENDIX C: Total Conservation Scores TCS-4 and Ranks By Areas of Conservation for Each Subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>TCS in Each Area of CONS</th>
<th>Ranks</th>
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</thead>
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<td></td>
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<td>Weight</td>
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Rank Totals

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<td>Rank Totals Squares</td>
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APPENDIX D

Frequencies Of TCS-(4) Obtained In Each Area Of Conservation.

In each area of conservation the TCS-(4) obtained could take any values from 0 - 8. For each area of conservation the frequencies of each value of TCS-(4) was calculated for each group. The following tables (D.1, D.2 and D.3) show the frequencies of each TCS-(4) in each group for each area of conservation.

D.1 Frequencies of Values of TCS(4) For Conservation Of Mass By Groups.

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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>0</td>
<td>1/10</td>
<td>0</td>
<td>1/10</td>
<td>5/10</td>
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<tr>
<td>Group B</td>
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<td>3/10</td>
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<td>0</td>
<td>0</td>
<td>1/10</td>
<td>3/10</td>
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<tr>
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**D.2 Frequencies of Values of TCS(4) For Conservation Of Wight By Groups**

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<thead>
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<td>0</td>
<td>0</td>
<td>1/10</td>
<td>0</td>
<td>5/10</td>
</tr>
<tr>
<td>B</td>
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<td>1/10</td>
<td>1/10</td>
<td>1/10</td>
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<td>0</td>
<td>1/10</td>
<td>1/10</td>
<td>1/10</td>
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<tr>
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<td>0</td>
<td>0</td>
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**D.3: Frequencies Of Values Of TCS(4) For Conservation Of Volume By Groups**

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<th>6</th>
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<th>8</th>
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<td>2/10</td>
</tr>
<tr>
<td>B</td>
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<td>2/10</td>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>1/10</td>
<td>0</td>
<td>2/10</td>
</tr>
<tr>
<td>C</td>
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<td>2/10</td>
<td>0</td>
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<td>1/10</td>
<td>0</td>
<td>0</td>
<td>1/10</td>
<td>2/10</td>
</tr>
<tr>
<td>D</td>
<td>3/10</td>
<td>2/10</td>
<td>0</td>
<td>2/10</td>
<td>0</td>
<td>0</td>
<td>1/10</td>
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APPENDIX E: Frequencies In Percent Of The Type Of Reasons Given In Each Area Of Conservation.

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<tr>
<th>Area of Conservation</th>
<th>Identity</th>
<th>Reversibility</th>
<th>Compensation</th>
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<tbody>
<tr>
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<td>26.17</td>
<td>12.11</td>
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<td>Weight</td>
<td>69.09</td>
<td>23.41</td>
<td>7.50</td>
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<td>Volume</td>
<td>67.36</td>
<td>21.33</td>
<td>11.33</td>
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APPENDIX F. Frequencies Of The Types Of Reasons Given For Justification In Each Language Condition.

<table>
<thead>
<tr>
<th>Area of Conversation</th>
<th>Language Condition</th>
<th>N</th>
<th>Identity</th>
<th>Reversibility</th>
<th>Compensation</th>
<th>TOTAL</th>
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<td>53.65</td>
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<td>69.70</td>
<td>18.18</td>
<td>12.12</td>
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