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by

Barnabas Otaala

Dissertation Committee:

Professor Millie Almy, Sponsor
Professor Joel Davitz

Approved by the Committee on the Degree of Doctor of Education

Date FEB 8 1971

Submitted in partial fulfillment of the requirements for the Degree of Doctor of Education in Teachers College, Columbia University

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ABSTRACT

THE DEVELOPMENT OF OPERATIONAL THINKING IN PRIMARY SCHOOL CHILDREN: AN EXAMINATION OF SOME ASPECTS OF PIAGET'S THEORY AMONG THE ITESO CHILDREN OF UGANDA

Barnabas Otaala

An investigation patterned after Piaget's work was carried out among Iteso children of Uganda. The main aim was to examine the validity of certain aspects of Piaget's theory in a non-Western, rural population, and the relevance of the Piagetian approach to education in Uganda.

The present investigation employed a standardized interviewing procedure, using Piagetian tasks to investigate two questions. The first question related to the validity of the sequence of development of logical abilities as stated in Piaget's theory. The second question dealt with the Piagetian claim that conservation, seriation, and classification develop concurrently.

The subjects were 160 children from two rural primary schools in Teso District in the eastern region of Uganda. In each school 20 children were taken from each of the alternate classes P1, P3, P5, and P7. There were 20 boys and 20 girls in each of the two lower classes; there were 32 boys in P5, and only eight girls. In P7 there were 30 boys and ten girls. Altogether there were 102 boys compared to 58 girls, covering the age range of about six to 14 years.

An interview schedule consisting of a total of 13 conservation, seriation, and classification tasks was used to investigate the questions. Interviews were carried out in the schools. The data were

ACKNOWLEDGEMENTS

It is a pleasure to record my sincere thanks to my Sponsor, Professor Millie Almy, who guided me through both the precipices and thorn thickets of Piagetian theory. It is largely through her own deep interest in Piagetian work, her stimulating insights into cross-cultural research, and her judicious firmness and friendliness that the trip was brought to a successful end.

Professor Joel Davitz served as a Committee Member and Professor Brian Sutton-Smith as a Consultant to my project. Both men offered invaluable suggestions, and in general gave me much valued assistance. I am very grateful to both professors for their help and advice.

Teachers and Headmasters, in the schools where the investigation was carried out, gave me much support--for which I am most grateful. Special thanks to the children, who made the project possible.

Mr. Gerald Chiappa did an excellent job in typing the final copies. I am much obliged to him for this assistance.

Finally, it is a pleasant duty to record particular thanks to Constance, for her patience and understanding during all the stages of this project.

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1 - PROBLEM AND BACKGROUND

Throughout the world rapid increases both in scientific knowledge and in demand for scientists are causing teachers to reconsider the content of syllabuses and teaching methods. In developing countries where mass education even for primary school age children has not yet been introduced, the problems are more far-reaching.

In Africa, new nations face urgent and perplexing problems that require urgent solutions. There is recognition that in education may lie the instrument that will bring about rapid change. In all parts of Africa today, education is in the front line, so to speak, of national planning for the future of every independent country depends more than anything else on the rapid and effective development of its system of education. Hopes of achieving higher standards of living and even of establishing independence in a viable form seem to depend almost directly upon the ability of each country to train the nationals it requires for service at all levels in the administration, commerce and industry. Education has accordingly become a major concern of every independent country in Africa. For some, it may be viewed as a panacea that will pave the way for a technological society and simultaneously cure social and political tensions. "Not since Mexico in the 1920's has so much faith been placed in education. Never in the history of education has expansion taken place so rapidly, and never has there been so much concern to accelerate even faster the educational framework."[1]

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[1] David Scanlon, Education. In Robert A. Lystad (Ed.), The African world: A survey of social research. New York: Frederick A. Praeger, 1965. P. 199.

While the growth of education has been remarkable, it is but the beginning. Emphasis on education has been on expansion of the present system. Effort has been directed primarily towards meeting the demands of villagers for more schools, of youths for more education, and of businesses and governments for more trained personnel. The general approach throughout most of Africa, therefore, has been to expand the existing structure under the pressure of the need to produce more trained personnel for the country. In the case of Uganda, for instance, the expansion after independence, at various levels of education was stated to the National Assembly by the President of that country in these terms:

> The House, the people and indeed the Government, must feel highly satisfied with the results of those savings and investments in the development programmes. Take investment in education, for example; the school population at the Primary level in 1962 was 435,000 and 636,000 in 1969. In 1963 we had 9,500 students in the secondary schools and an enrollment for 1969 was 42,000 students. At the level of the University and post-secondary institutions we started with 1,300 students in 1962/63 and in 1969 the number was 3,400. At Makerere University College alone the number of Uganda students in 1962/63 was 290, whereas in 1969/70 the number had gone up to 1,640.[1]

There is an increasing demand in every independent country that the curriculum of the schools be Africanized. The basic problem is the paucity of research in the field. There has been no appreciable degree of blending of social science disciplines with education that is found in other countries; the emphasis has been upon methodology, and too often it has been a methodology imported from the former colonial power. In Uganda, for instance, the system of education inherited from colonial

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[1] Uganda. His Excellency The President's Communication From the Chair of the National Assembly on 20th April, 1970. Entebbe: Government Printer, 1970. P. 4.

days is, despite the fact of independence, still largely mechanical and unrelated to the background of the children. The Castle Commission Report suggests that primary education in Uganda has not emerged from the historical phase in all countries of the world where attempts to devise a primary education for the whole people resulted in a mechanical approach to teaching and learning. In those countries:

> Teaching was regarded as talking and writing on the blackboard, and committing material to memory. In these circumstances, the ideal class was equated with rows of silent, motionless children, and the whole classroom atmosphere was 'academic,' verbal rather than real; cut off from living interest of childhood, with emphasis on passivity rather than activity. The result was that certain aspects of education, just as important as the Three R's, were neglected; notably the physical growth of children, the aesthetic and emotional development which results from work in arts and crafts and training in the use of the spoken word.[1]

The basic studies relating the social sciences to education have for the most part not been carried out. And yet studies relating anthropology and sociology, economics and psychology to education should constitute the basis for the development of a successful African curriculum for which the cry is so loud and clear.

Studies of human growth and development, and in the psychology of learning have assumed great importance for the methodology of teaching in western countries. A teacher must be aware of the process by which people learn and must understand the different modes of learning.

Underlying all of the studies in the learning process is the assumption that--though the developmental level may vary from person to

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[1] Uganda. Education in Uganda: The report of the Uganda Education Commission, 1963. Entebbe: Government Printer, 1963. P. 11.

person--there are common grids that can be used as guidelines. In the case of African pupils, developmental studies have not yet been done, though a beginning has been made in a few scattered centres.[1]

There is need for new approaches in methodology. This need was recently emphasized by the Minister of Education in Uganda when he noted:

> ...One of the revolutions that should be taking place, not only in science teaching but in education as a whole, should be the move away from having children sitting in nice straight rows in classrooms passively absorbing facts from their teachers to having them getting up and out and doing things. This is what we want to see happening in all our schools. If Uganda is ever to get anywhere in this modern world, then our educational system must produce people who are not just passive absorbers of what other people tell them, people who stand and gape in awe at the wonders that others produce, but people who get up and do something, who produce wonders for the others to gape at.[2]

There is need for studies of contemporary African children who are passing through a difficult period of social and cultural change. What are the characteristics of children in primary schools? This is a crucial question, and, as one writer has suggested, "For the long run, the greatest challenge is at the primary level. Here is where the task of educating village Africans into the modern world begins, and here is where the new generation of African scientists must ultimately be formed."[3]

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[1] Examples of these include The Institute of Education at the University of Ghana; The Institut d'Etudes Pedagogiques of the University of Dakar, Senegal; and the Institute for Social Research, University of Zambia.

[2] Extract from a speech by Dr. Luyimbazi-Zake, Minister of Education, at the opening of the 1968 Uganda Science Fair.

[3] Charles Weiss, Jr., Science in Africa. Africa Report, 1968, 13, 13-20. P 17.

The present study was an attempt to provide some answers regarding some of the ways Uganda African children at the primary level of school view their world. The techniques of investigation derive from Piaget's work, and it seems in order to outline those aspects of his work which have relevance for the present study.

Piaget's Theoretical Formulations

Piaget has produced an account of the development of intelligence in children. He has endeavoured to trace the development of children from infancy to adulthood with regard to the manner in which they acquire knowledge of the world in which they live.

Intelligence is considered, by Piaget, as an instance of biological adaptation, and "behaviour becomes more intelligent as the pathways between the subject and the objects on which it acts cease to be simple and become progressively more complex."[1]

Piaget's over-all aim has been "to trace the development of intelligence as it comes to deal with increasingly complex problems or as it deals with simple problems in increasingly more efficient ways."[2] According to Piaget, children do not merely accumulate information. They seem to process it, to organize it into what is for them meaningful complexes of knowledge. This organization of knowledge reflects the evolution of the ability to think logically and systematically, and to

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[1] Jean Piaget, The psychology of intelligence. Paterson, New Jersey: Littlefield Adams & Co., 1966. P. 10.

[2] Anne Parsons, Translator's introduction: A guide for psychologists. In Barbel Inhelder and Jean Piaget, The growth of logical thinking from childhood to adolescence, Basic Books Inc., 1958. Pp. vii-xx. P. xi.

deal with abstract propositions as well as concrete realities. Piaget analyses this organization of knowledge in terms of relatively well-defined stages of development.

The earliest stage is that of the sensori-motor period (0-2 years). This is the stage during which the child learns to coordinate perceptual and motor functions and to deal with certain external objects and to organize spatial relationships. Elementary forms of symbolic behaviour, as well as expressive symbolism appear. A child at this stage can be seen to shut and open his mouth when "thinking" about extracting a watch chain from a half-open match-box; or to feign sleep. Much of what is acquired at this stage is foundational and is carried forward for further development in the succeeding stages. As Piaget put it: "What happens during the sensori-motor level concerning ideas of the permanence of an object, the construction of the ideas of space, time and causality, will constitute the substructure of the subsequent, fully achieved ideas of permanent objects, space, time and causality."[1]

Then there is the pre-operational or representational stage (2-7 years). In this stage, because of symbolic functions and the advent of language, it becomes possible for the child to invoke objects which are not present perceptually, to reconstruct the past, or to make projects, plans for the future, to think of objects not present but distant in space. The child for instance participates in symbolic play, representing something by means of something else. He is also capable of delayed

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[1] Jean Piaget, The stages of the intellectual development of the child. Bulletin of the Menninger Clinic, 1962, 26, 120-128. P. 122.

imitation, an imitation that takes place not in the presence of the original object but in its absence. The child at this stage is able, in short, "to span spatio-temporal distances much greater than before."[1]

In answering questions the pre-operational child shows a greater reliance on present perception than does the operational child. He judges that there is more liquid in the narrow container because it can be seen to rise to a greater height. The perception on which he relies tends to be partial in that it focuses on a single dimension of the problem. He attends to the height of the column of fluid or to its width but does not move back and forth between the two.

During the next stage, the stage of concrete operations (7-11 years), the ability to pass mentally from one point to another and be able to come back to the starting point, appears. It is limited when compared with the ability of the next stage only in the sense that the operations are concrete. That is, the child can manipulate the operations only when he is dealing with the properties of the immediately present object world.

The last stage in Piaget's system, the stage of formal operations (11+), differs from the period of concrete operations in that operations are no longer applied solely to manipulations of concrete objects, but now cover hypotheses and formal propositions. Children with formal operations see further into the sphere of the potential than do the concretely operational children. They frequently verbalize the necessity

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[1] Jean Piaget, The stages of the intellectual development of the child. Bulletin of the Menninger Clinic, 1962, 26, 120-128. P. 124.

of trying all possible combinations. This ability to represent in advance a full set of possibilities is a cardinal feature of intelligence on the most advanced level of development. This final stage comes during early adolescence, preparatory to adult thinking.

While Piaget sets down usual ages for each period he does not assert that these are absolutely fixed. He simply asserts that the periods are ordered, that they will in all cases succeed one another, as described. The claim is the same for the stages in each particular progression. Possibly for more intelligent children the age of attainment of each stage is earlier than for the less intelligent. All children will go through the stages in the same order but the rate of movement will vary from child to child, for a variety of reasons.

At this stage it seems in order to turn to a brief consideration of the concepts of operation, classification, seriation, conservation and number, all of which provide the theoretical background to the present study.

<u>Operations</u>

Piaget asserts that the central idea in the structure of knowledge is the operation:

> Knowledge is not a copy of reality. To know an object, to know an event, is not simply to look at it and make a mental copy, or image, of it. To know an object is to act on it. To know is to modify, to transform the object, and to understand the process of transformation, and as a consequence to understand the way the object is constructed. An operation is thus the essence of knowledge; it is an interiorized action which modifies the object of knowledge. For instance, an operation would consist of joining objects in a class,

> to construct a classification. Or an operation would consist of counting, or measuring. In other words, it is a set of actions modifying the object, and enabling the knower to get at the structure of the transformations.[1]

Roughly an operation is a means for mentally transforming data about the real world so that they can be organized and used selectively in the solution of problems. An operation differs from simple action or goal-directed behaviour in that it is internalized and reversible. According to Inhelder and Piaget[2] an operation is a reversible, internalizable action which is bound up with others in an integrated structure. A transformation is reversible when it gives rise to complete compensation or when it can be cancelled by an inverse transformation. Addition is cancelled by subtraction; multiplication by division, etc. As to structure, a logical class is part of a total structure of classification; or a given number is part of a sequence of numbers.

As stated earlier, Piaget's studies of intelligence aim at uncovering the order in which the child is able to deal with increasingly complex problems or as he deals with simple problems in increasingly more efficient ways.

Classification

Class inclusion operations relate to the child's ability to manipulate part-whole relationships within a set of categories. The simplest operation is concerned with classifying objects according to

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[1] Jean Piaget, Cognitive development in children: The Piaget papers. In R. E. Ripple, & V. N. Rockcastle (Eds.), Piaget rediscovered: A report of the conference on cognitive studies and curriculum development. Ithaca, New York: School of Education, Cornell University, March, 1964. Pp. 6-48. P. 8.

[2] Barbel Inhelder, & Jean Piaget, The growth of logical thinking from childhood to adolescence. New York: Basic Books, Inc., 1958.

their similarity and their difference. This is accomplished by including subclasses within larger and more inclusive general classes, a process which implies logical inclusion. According to Piaget such a classification is not acquired until around seven or eight years. Before that age, at the pre-operational level, logical inclusion is not evident. To illustrate, if a pre-operational child is shown a group of animals, some of which are dogs and the others of which are cows, and is asked whether there are more cows than animals, he is unable to respond correctly.

Piaget attributes this inability to the fact that the pre-operational child reasons either on the basis of the whole or of the parts. He cannot understand that the part is complementary to the rest and he says there are more cows than animals or as many cows as animals. He does not understand the inclusion of the subclass of cows in the class of animals. It is only around seven or eight, according to Piaget, that a child is capable of solving a problem of inclusion. Piaget himself gives a classical example of the study of the formation of classes:

> To study the formation of classes, we place about 20 beads in a box, the subject acknowledging that they are all made of wood, so that they constitute a whole, B. Most of these beads are brown and constitute part A, and some are white, forming the complementary part A'. In order to determine whether the child is capable of understanding the operation A + A' = B; that is, the uniting parts of a whole, we may put the following simple question: In this box (all the beads being still visible) which are there more of--wooden beads or brown beads--that is, is A < B?[1]

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[1] Jean Piaget, The psychology of intelligence. Paterson, New Jersey: Littlefield Adams & Co., 1966. P. 133.

Piaget states that the subject finds no difficulty in concentrating his attention on the whole B, or on the parts A and A', if they have been isolated in thought, but the difficulty for the pre-operational child is that by centering on A he destroys the whole, B, so that the part A can no longer be compared with the other part A'. So there is non-conservation of the whole for lack of mobility in the successive centrations of thought.

Seriation

Another system of operation which appears around seven or eight, according to Piaget, is the operation of serializing; that is, the arrangement of objects according to size, or their progressive weight. This also rests on the manipulation of concrete objects.

Pre-operational children, when presented with a series of sticks A, B, C, etc. of different lengths and asked to place them in order of magnitude are able only to construct uncoordinated pairs and are unable to interpolate new terms in a finished series without undoing the whole. A seven- or eight-year-old, a child at an operational level according to Piaget, when given a set of sticks to arrange in order of size, proceeds by taking the smallest first (or the largest), then the smallest of those which are left, and so on. Not only is a child who has acquired serial ordering operations able to register the changes in magnitude of a given variable, but given two independent series, the child learns to find correspondences between them. He begins, in other words, to relate two variables accurately by observing concurrent changes. To illustrate, given a set of stick-figures of women drawn on strips of cardboard of varying length which he successfully orders according to size, an operational child should, according to Piaget, be able to order a corresponding series of baskets according to size. To use Piaget's example:

> If a child knows how to serialize objects according to the relations A < B < C...the subject will find it no more difficult to seriate two or more sets, which correspond to each other, term for term; when a child aged seven has manikinis in order of size, he will be able to make a series of sticks or bags correspond to them, and he will be able to identify which element in one series corresponds to which in another even when they are all jumbled.[1]

Number Concepts

At the concrete operations stage, there is also the construction of number which Piaget suggests involves a synthesis of classification and seriation. Piaget suggests that earlier than the advent of number concept the child may be taught to count, but experiment reveals that the verbal use of the names of numbers has little connection with numerical operations as such. According to Piaget, a true concept of number evolves only after the child has begun to "conserve" quantity. The number concept involves both cardination and ordination, both of which are aspects of classification and seriation, respectively.

If one enumerates a set of objects and thereby arrives at its cardinal number value (there are ten objects here), one is in effect treating the objects as though they were all alike, just as one would do if one assigned them to a common class. In the process of discovering their cardinal value by enumeration, one has to order the objects--

[1] Jean Piaget, The psychology of Intelligence. Paterson, New Jersey: Littlefield Adams & Co., 1966. P. 143.

one, two, three, etc. This is ordination. For Piaget, number "is at the same time a class and an asymmetrical relation, the units of which it is composed being simultaneously added because they are equivalent, and seriated because they are different from one another."[1]

Conservation

Conservation refers to the ability to understand that certain properties of objects remain invariant (are conserved) in the face of external transformation. Piaget makes the distinction between conservation of continuous quantity and conservation of discontinuous quantity, and one-to-one correspondence.

To illustrate the first kind, conservation of continuous quantity, reference may be made to one of Piaget's classical experiments--that of conservation of an amount of liquid. In this experiment the child is shown two identical cylindrical containers containing the same quantity of liquid. The contents of one container are then transferred to a broader, shorter container or a taller, narrower container, and the child is asked whether the quantity of liquid in the new container is still equal to that remaining in the other container.

Piaget indicates that a child who is not operational would have difficulty with this problem, and he attributes this difficulty, in the case of a pre-operational child, to what he refers to as successive centrings. Suppose a child estimates that there is more liquid in the taller, narrower container because the level has been raised. He thus "centres" his thought, or his attention on the relation between the

[1] Jean Piaget, The child's conception of number. London: Routledge & Kegan Paul Ltd., 1952. P. 184.

heights of the containers and ignores their widths. But if the contents of the taller, narrower glass are emptied into a yet taller and narrower container, there must be a point at which the pre-operational child will reply that the contents in the new container is less because it is too narrow. There will thus be a correction of centring on height by a de-centring of attention to width.

To Piaget, "this transition from a single centring to two successive centrings heralds the beginnings of the operation; once he reasons with respect to both relations at the same time, the child will, in fact, deduce conservation."[1]

With respect to discontinuous quantity Piaget uses beads, instead of liquid, and finds that non-operational children respond in a manner that indicates that they are centring on width or on height.

In the one-to-one correspondence, for a pre-operational child, it is only necessary to spread the elements in one series further apart, or to draw them closer together for the subject to disbelieve in the equivalence. "As long as the optical correspondence lasts, the equivalence is obvious; once the first is changed, the second disappears, which brings us back to the non-conservation of the whole."[2]

Three-stage Development of Understanding

In the development of each of the various abilities considered, Piaget stipulates a three-stage development of understanding: pre-operational, transitional and operational.

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[1] Jean Piaget, The psychology of intelligence. Paterson, New Jersey, Littlefield Adams & Co., 1966. P. 131.

[2] Piaget, The psychology of intelligence. P. 132.

In the first stage there is no evidence of conservation. In the case of liquid, for instance, the child's responses indicate that the quantity of liquid increases or decreases according to the size of the containers. He pays attention either to the height or width of the container, and does not coordinate them in arriving at his judgment.

In the transitional stage conservation emerges gradually. In some instances the child maintains conservation, but not in others. This second stage, according to Piaget, is not necessarily found in all children.

In the third stage the child assumes conservation for each of the transformations the quantity undergoes. Whatever change he observes, the child knows that if the amounts were originally equivalent, they must remain equivalent. As Piaget puts it, "there always comes a time ($6\frac{1}{2}$-7 years, 8 months) when the child's attitude changes: he no longer needs to reflect, he decides; he even looks surprised that the question is asked, he is certain of the conservation. If we ask him his reasons, he replies that nothing has been removed or added."[1] Or else he replies that the height makes up for the width lost by the new glass; or he replies that a transfer from A to B can be corrected by a transfer from B to A and this reversibility is certainly essential.

In the case of a one-to-one correspondence, Piaget also finds a three-stage development. In the first the child finds it difficult, if not impossible, to make a one-to-one correspondence between two sets of objects. There is little differentiation between the space occupied and quantity. In the second stage, the child can set up the objects in a

[1] Jean Piaget, The psychology of intelligence. Paterson, New Jersey: Littlefield Adams & Co., 1966. P. 140.

one-to-one correspondence, but he cannot maintain it when the configuration of the sets is changed. In the third stage, the child discovers that "any spatial modification in the distribution of elements can be corrected by an inverse operation."[1]

In seriation, children in the pre-operation stage are unable to construct a series. When they are given a set of sticks to arrange in order of size, they begin at random and try to re-arrange in order of size only when very noticeable discrepancies occur. Children in the transitional stage are able to construct a series with few sticks, but may fail when the number increases, and when the differences from one stick to the next are not very great. It is only in the third stage that seriation is achieved straight away, by such a method as, for example, finding the smallest of all the terms, successively.

Piaget also postulates three stages in the evolution of logical classification functions. In the first stage the child's classification is termed "figural" collection. The child will sort a collection of objects on the basis of attribute similarity, but is soon distracted by the configurational aspects of the formation. If a collection is composed of toy cows and toy dogs, for example, he may begin to classify them into two categories, although he may soon forget the attribute defining each of the two classes and begin to mix dogs and cows.

In stage two the child is able to form classes on the basis of attribute similarity as opposed to part-whole configurations. He can reclassify a given collection in accordance with different attributes,

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[1] Jean Piaget, The child's conception of number. London: Routledge & Kegan Paul Ltd., 1952. P. 56.

such as colour, material or variety of animal. Piaget terms the sorting behaviour found in this second stage "nonfigural" because the child can form a class as opposed to part-whole pattern. However, the sorting is a collection and not a logical classification because the child cannot understand the inclusion relationship of a subclass to its superordinate class. Given a collection of red cows, A, and black cows, A', the child is asked the inclusion question, "Are there more red cows (A) or more cows?" The child will state that there are more red cows because there are fewer black ones. Piaget attributes this response to the fact that the child cannot simultaneously conceptualize the qualitative relationship of the two classes to one another as well as to the superordinate class.

In the third stage, the child explicitly recognizes the logical necessity of the inclusion relationship. When asked if there are more cows or more red cows, he will say that there are more cows because all the objects are cows and the red ones are just a part of them. He now realizes that the subclass is included within the superordinate class but does not exhaust it.

Validation Studies

Many validation studies have been carried out in Western countries, especially in Canada, Britain, and the United States; and increasingly are being carried out in non-western countries including those in Africa. These studies have addressed themselves to the question as to whether or not the stages of development in Swiss children, described by Piaget are identifiable in other populations. They have also sought to find out whether, within any given stage, the relationships among underlying abilities are similar to those set forth in the theory. Other studies have sought the relationships between attainments of levels of thought as described by Piaget and intellectual development as measured in other, more traditional ways. Finally, a number of studies have dealt with the role of experience in either facilitating or hindering progress from one level of thought to another. Brief comment will be made on some of the studies dealing with the validity of stages, the relationships among abilities within stages, and the role of environment and experience.

Validity of Stages

Replication studies have, in general, supported Piaget's findings regarding the sequence of development of the stages. A stage of pre-operational thought, is followed by the transitional stage, which in turn is followed by the operational stage.

Dodwell[1] used a large number of Piagetian number tasks, in studying a large number of Canadian children in kindergarten, first grade, and second grade. He was able to identify all the three stages in the development of number conservation. He also found that the operation of counting was often ineffective in guaranteeing conservation of number in young children. However, he noted that some of the number tasks showed less definite developmental trends than others, for the age range studied. Dodwell's overall evaluation of Piaget's number work was that

[1] P. C. Dodwell, Children's understanding of number concept: Characteristics of an individual and of a group test. Canadian Journal of Psychology, 1961, 15, 29-36.

"whilst Piaget is on the whole correct in his description of the child's understanding of number, the pattern of development is neither as neat nor as rigid as he would have us believe."[1]

Elkind[2] administered tests of conservation of number, of continuous quantity, and of discontinuous quantity to American children aged 4-7 years. He found that all three types of conservation were age-dependent. He also found that conservation of continuous quantity was more difficult than that of discontinuous quantity.

In another study Elkind[3] administered Piaget tests of conservation of global quantity, weight and volume to a large number of 5-11 year old American children. He again found that each type of conservation was clearly age-dependent. He also found that the mean ages of acquisition of the three supported Piaget's claim that the normal genetic order is global quantity first, then weight, and then volume. In a third replication study Elkind[4] tested about 500 children aged 12-15 years in a further effort to unearth the relationship between the development of the conservation of quantity, weight, and volume. His finding was that the age decalage between the first two and the third type of conservation may be considerably greater than Piaget had thought.

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[1] P. C. Dodwell, Children's understanding of number concept: Characteristics of an individual and of a group test. Canadian Journal of Psychology, 1961, 15, 29-36. P. 35.

[2] David Elkind, The development of quantitative thinking. Journal of Genetic Psychology, 1961, 98, 36-46.

[3] David Elkind, Children's discovery of the conservation of mass, weight and volume: Piaget replication study II. Journal of Genetic Psychology, 1961, 98, 219-227.

[4] David Elkind, Quantity conceptions in junior and senior high students. Child Development, 1961, 32, 551-560.

Lovell and Ogilvie[1] tested a large sample of English junior school children using tasks involving conservation of substance. The three stages in the development of the concept of conservation of substance were confirmed, but the investigators also noted that it was difficult at times to classify correctly a child at the transition stage.

Among the progressions described by Piaget, then, there are some which are universal. For example the occurrence of non-conservation answers before conservation answers and, among the conservations, a progression from quantity and space to weight and still later to volume. Wallach, summarizing a large number of European and North American replications of the Genevan researches on conservation, of which those cited above are only a sample, finds that while there are shifts of a year or two in the age norms, "... the same general developmental sequences have, on the whole, been obtained by such work."[2]

Relationships Among Abilities Within Stages

One basic Piagetian contention is that in any one developmental stage parallel invariant sequences exist for classification and seriation, and conservation.[3] In contrast to validation studies on quantity and number concepts, very few studies have examined the extent to which abilities of conservation, seriation and classification develop concurrently, as Piaget asserts. Moreover the results of those that have

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[1] K. Lovell, & E. Ogilvie, A study of the conservation of substance in the junior school child. British Journal of Educational Psychology, 1960, 30, 109-118.

[2] M. A. Wallach, Research in children's thinking. In H. Stevenson (Ed.), National Society for the Study of Education, 62nd Yearbook, Child Psychology. Chicago: University of Chicago Press, 1963. Pp. 236-276.

[3] Irving E. Sigel, & F. H. Cooper, Logical thinking in children: Research based on Piaget's theory. New York: Holt, Rinehart and Winston, 1968.

been done have not been very satisfactory. A brief mention will be made of studies by Dodwell (1960; 1962); Lovell and Ogilvie (1960); Lovell, Mitchell, and Everett (1962); and Kofsky (1966); Tuddenham (1970) and Almy (1970).

In his study involving kindergarten, first-, and second-grade children, Dodwell found that although they could not deal with either classes or series separately, some of the children could deal operationally with cardinal-ordinal properties. He also found that if they could deal with classes or series separately, it was not necessarily true that they could deal with numbers as constructs combining cardinal and ordinal relations.[1]

Dodwell[2] also investigated the relationships between developing concepts of number and the ability to handle classification problems. Most of the correlations between answers to the classification problems and the items on the number tests, though positive, were low and not significant. A possible explanation for this offered by Dodwell is that children typically received considerably more instruction in the development of number concepts than in the nature of hierarchical classification.

Lovell and Ogilvie[3] attempted to determine whether children who conserved had in their repertoire other related logical abilities as

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[1] P. C. Dodwell, Children's understanding of number and related concepts. Canadian Journal of Psychology, 1960, 14, 191-205.

[2] P. C. Dodwell, Relations between the understanding of the logic of classes and of cardinal number in children. Canadian Journal of Psychology, 1962, 16, 152-160.

[3] K. Lovell, & E. Ogilvie, A study of the conservation of substance in the junior school child. British Journal of Educational Psychology, 1962, 53, 175-188.

asserted in the Piagetian theory. Auxiliary experiments were done to test out the thinking of those who had been identified in the main experiment as conservers and non-conservers, as well as those who appreared to be in a transitional stage. They found six non-conservers who were capable of considering two dimensions in compensatory fashion when the exigencies of the experiment forced them to do so. They also found some children who showed evidence of reversibility but who did not conserve. The results led the investigators to question whether the reversibility, coordinated relations, and identity operations are essential to conservation as Piaget claims.

Lovell, Mitchell, and Everett[1] attempted to identify the relationships among a number of classification and seriation tasks. They replicated many of the experiments by Inhelder and Piaget (1964), using cross-sectional samples of primary school children and a group of educable retarded children.

They presented the entire task array to each subject in the sample; a procedure which permitted them to assess the degree of intra-individual consistency for the classification-seriation behaviours in question. The children consistently demonstrated a given stage-type behavior across the four task settings: Addition of classes, multiplication of classes, visual seriation, and multiplication of asymmetrical transitive relations. The authors conclude that operational mobility (Stage II) for the four logical tasks appears in primary school children at about the same time--a conclusion which supports the view that seriation and classification are parallel achievements.

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[1] K. Lovell, B. Mitchell, & I. R. Everett, An experimental study of the growth of some logical structures. British Journal of Psychology, 1962, 53, 175-188.

Kofsky[1] constructed eleven tests, based upon the report of Inhelder and Piaget, in an attempt to determine whether the order of difficulty in the development of classification corresponds to that described by Piaget; and whether mastery of a particular classification rule reflects mastery of previous rules.

The order of task difficulty she found was in accord with Piagetian theoretical expectations. A significant correlation between the age of the children and the number of successful completions was also found. But the scalogram analysis showed that the invariance of task mastery sequence was only partially upheld. Some of the more advanced tasks were passed while subjects failed earlier theoretically prerequisite tasks. The author interprets her results in the context of methodological issues which need to be considered before final determination of the validity of Piaget's claim is made.

Other more recent investigations agree with Dodwell, Lovell and Ogilvie, and others who have published data showing non-correspondence of cognitive stages across different content areas.

Tuddenham, for instance, has demonstrated that intercorrelations between Piagetian items he used, although positive, were generally very low. He concludes, "our data strongly suggest that the attainment of concrete operations on one problem is no guarantee that the child will achieve a comparable level when another problem is posed."[2]

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[1] Ellin Kofsky, A scalogram study of classificatory development. Child Development, 1966, 37 (1), 191-204.

[2] R. D. Tuddenham, Psychometricizing Piaget's methode clinique. In Irene J. Athey, & D. O. Rubadeau (Eds.), Educational implications of Piaget's theory. Waltham, Massachusetts: Ginn and Company, 1970. Pp. 317-324.

Almy[1] using a large sample of second-grade children, has found that her results provide better support for the invariance of the stages than they do for the hierarchical and integrative nature of cognitive growth that Piaget claims for his theory.

The few studies cited illustrate that, on the whole, the present available evidence does not unequivocally support or reject the Piagetian claim regarding the relationships among the abilities or structures at any given stage of development.

The Roles of Environment and Experience

Some studies have attempted an examination of how certain aspects of a child's environment and experience affect the development of thinking outlined by Piaget. Some cross-cultural studies have shown that despite varying cultural experiences, children's thinking tends to develop along the lines suggested by Piaget.

Hyde[2] carried out her study in Aden using a multiracial group of subjects aged six to eight (48 Arabs, 48 Europeans, 24 Indians and 24 Somali children). She presented several Piagetian tasks using local materials such as shells and beads, and obtained results similar to Piaget's. However, tasks involving seriation and class inclusion were difficult for all subjects in general, and for non-European subjects in particular.

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1 Millie Almy, Logical thinking in second grade. New York: Teachers College Press, 1970.

2 D. M. Hyde, An investigation of Piaget's theories of the development of the concept of number. Unpublished doctoral dissertation, University of London, 1959.

Jacquiline Goodnow[1] has taken the Piaget problems concerning the conservation of space, weight and volume to Hong Kong. She administered them to four groups of children, some of them European and some of them Chinese; some of them having had full schooling for their ages and some almost no schooling. The author summarizes the results by saying that "...the most striking result is the very real and close similarity in performance among boys of different nationality and education." and that "...replication of Geneva results was fair to good."

The differences in the rates of transition that may be associated with socio-economic status were strikingly underlined in cross-sectional and longitudinal studies by Almy and her associates.[2] The children's ability to conserve number and quantity were measured, amongst other things. The patterns into which the children's performances fell corresponded closely to what would be anticipated from Piaget's theory. The sequence of development he described, although holding for the children from both the lower and higher economic groups, showed that those from the school in the lower class neighbourhood made slower progress.

Price-Williams[3] tested 45 illiterate "bush" West African children of the Tiv tribe in Nigeria on the problem of conservation of continuous

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[1] Jacquiline J. Goodnow, A test of milieu effects with some of Piaget's tasks. Psychological Monographs, 1962, 76 (555), 1-22.

[2] Millie Almy, E. Chittenden, & P. Miller, Young children's thinking. New York: Teachers College Press, 1966.

[3] D. R. Price-Williams, A study concerning concepts of conservation of quantities among primitive children. Acta Psychologica, 1961, 18, 297-305.

and discontinuous quantities, using Piaget-type techniques of investigation. Earth and nuts were used as examples of continuous and discontinuous quantities respectively. Results indicated that the progression of the idea of conservation followed that found in European and other western children.

In another study Price-Williams[1] presented Piagetian tasks to "bush" and primary school children living in the same area who then were compared in their ability to sort and to classify. He found that, using local material, there was no difference between the two sets of children of an age range from about six to eleven. But he also found that a highly relevant feature involved in analysing the process of classification in non-western people is that of motivation or interest. Where there was little incentive in forming different kinds of categories, it was not surprising to find apparent dependency upon the concrete.

Another Nigerian study is that of Etuk.[2] Etuk administered a large number of Piagetian tasks on conservation, classification, and seriation to 110 Yoruba children aged 6-8 from the first three classes of elementary school. In the main, Piaget's theories were upheld in the Nigerian sample. Analyses showed, however, that the simultaneous development of conservation, seriation, and classification was only partially upheld.

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[1] D. R. Price-Williams, Abstract and concrete modes of classification in a primitive society. British Journal of Educational Psychology, 1962, 32, 50-61.

[2] Elizabeth S. Etuk, The development of number concepts among the Yoruba-speaking Nigerian children. Unpublished doctoral dissertation, Teachers College, Columbia University, 1967.

In Ghana, Beard[1] carried out an investigation into some children's understanding of concepts of number, quantity and space. Her finding was that the Piagetian pattern of development was evident in the Ghanaian children, although this development was noted to be slower than that of similar groups of children in England.

Greenfield's study[2] of the Wolof children of Senegal showed that school experience was very significant in the attainment of ability to conserve, although these children showed a time lag when their performance was compared with that of American children. She also found a difference between urban and rural children.

In Uganda Vernon[3] studied a group of fifty African boys in an urban school. The children were aged about 11. The tests in the "Piaget Battery" included conservation of liquid, plasticine, number, length, and area. The children were tested in English. Vernon found that although the Piagetian developmental trend was evident, scores on the Piagetian battery were among the lowest. The worst deficiencies were in all the conservation tasks. He suggested that "magical beliefs"

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[1] Ruth M. Beard, An investigation into mathematical concepts among Ghanaian children. Teacher Education in New Countries, 1968, 9, 132-145.

[2] Patricia M. Greenfield, On culture and conservation. In J. R. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966.

[3] P. E. Vernon, Intelligence and cultural environment. London: Methuen, 1969.

might especially affect the attainment of conservation, and the concrete operational stage, although he admitted that the use of English rather than the children's own vernacular may have affected the scores.

Some differences which have been found in cross-cultural studies may be attributable, among other things, to differences in cultural experiences. The exact nature of these experiences has been of interest to researchers. One way to look into the determinants of intellectual change is to attempt, by training, to advance a child from one stage into another. This has been tried by a number of investigators. Reference is made to a few of these in order to highlight the role of experience in the development of thinking as set out in Piagetian theory.

Wohlwill and Lowe[1] tried to teach kindergarten children that merely re-arranging a set of objects does not alter the numerical value of the set. They had a group count a set of objects before and after re-arrangement and this was done many times. Smedslund[2] has tried to teach children aged 5-7 years that the weight of a lump of plasticine is not altered by changing its shape. He gave his subjects 32 training trials involving two identical balls of plasticine. The shape of one would be altered and the child would predict whether the two would still have the same weight. He then tested his prediction by weighing the balls on a scale balance.

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[1] J. F. Wohlwill, & R. C. Lowe, Experimental analysis of the conservation of number. Child Development, 1962, 33, 153-169.

[2] J. Smedslund, The acquisition of conservation of substance and weight in children II: External reinforcement of conservation of weight and of the operations of addition and subtraction. Scandinavian Journal of Psychology, 1961, 2, 71-84.

In general the results of these earlier conservation-training studies have largely been negative. More recent studies reviewed by Wohlwill, however, report much more positive results regarding the effectiveness of a variety of procedures. Wohlwill observes that one principle which emerges from these recent studies is that "experience with concepts or rules other than conservation, but presumably linked to it, is far more effective than sheer practice on conservation per se. In other words, conservation comes about through a process of transfer."[1] Wohlwill also observes that in comparing the results of these more recent studies, the amount of transfer observed is related to the breadth and intensity of the training experience.

In seeking an answer to the question as to why conservation appears in the normal course of events without any intervention being required, Wohlwill has recently made a short-term longitudinal study of the correlates of the development of conservation and other Piagetian concepts. Using a set of conservation tests along with a set of tasks of measurement and similar activities, Wohlwill interviewed 74 children three times, over a period of 18 months. About half of the children were starting kindergarten, and the other half were starting first grade when the study began. In the testing situation, the procedure gave the child an opportunity to use his knowledge of measurement or ordering in a situation where this knowledge was relevant but was not specifically called for in the interviewing situation.

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[1] J. F. Wohlwill, The place of structured experience in early cognitive development. Interchange, 1970, 1 (2), 13-27.

The findings suggest that the correlation between the measurement and conservation data for any single testing is not strong, but the relationship between measurement in the first test and change in performance toward a more advanced level of conservation on a subsequent test is stronger.

Wohlwill's overall estimation of his investigation is that the results lend some support to the hypothesis regarding the manner in which conservation is acquired. The measuring activities, to him, "served the function of alerting the child to the attributes of the dimensions he was dealing with so as to lead him to respond to them in a more conceptual, or perhaps simply a more differentiated fashion."[1]

The studies cited illustrate, then, that despite much variation in methodology and in the cultural settings of the children, there is considerable consistency of findings supporting certain features of Piaget's theory. The sequence, more than the timing of the stages described by Piaget, have received almost unanimous confirmation.

The role of experience has not been adequately assessed. Piaget does acknowledge the significance of environment as a stimulant:

> Naturally, the ages at which different children reach the stages may vary. In some social environments the stages are accelerated, whereas in others they are more or less systematically retarded. This differential development shows that stages are not purely a question of the maturation of the nervous system but they are dependent upon interactions with the social environment and with experience in general. The order, however, remains constant.[2]

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[1] J. F. Wohlwill, The place of structured experience in early cognitive development. Interchange, 1970, 1 (2), 13-27. P. 17.

[2] J. Piaget, The theory of stages in cognitive development. Monterey: McGraw-Hill, 1969. P. 7.

The Present Study

During the First Five-Year Development Plan, 1961-1966, enrolments in primary and junior secondary schools in Uganda increased by 53 percent, those in the first four years of secondary school by 210 percent, and those in the last two years of secondary school by 378 percent. There were also substantial increases in the numbers enrolled in teacher-training colleges, technical schools, farm schools, and commercial schools. Enrolment at Makerere University College almost doubled, and the number of university students abroad more than doubled.

A substantial increase in primary education is provided in the Second Year Plan, 1966-1971, with the objective of achieving universal primary education in the 1970's.[1]

As the pace of educational development in Uganda quickens, it becomes increasingly apparent that its foundation is not very strong. Curriculum content and methodology, instructional materials, and examination instruments, and many other facets of the educational programme are still largely predicated on knowledge and research related to children reared in western culture. What are the factors that motivate African children from different geographical locations and from various ethnic and tribal groups? What are their feelings, attitudes, values, and aspirations? How do they learn? What strengths and weaknesses do they bring from their backgrounds to school? In short, what is really known about Ugandan African children and the way they live and view the world around them?

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[1] Uganda. Ministry of Planning and Economic Development. Work for progress: The second five-year plan, 1966-1971. Entebbe: Government Printer, 1967.

The present study was an attempt, on an exploratory basis, to answer some of the questions, using Piaget-type approach, on how a section of Ugandan African children--the Iteso--view their world.

Piaget has claimed that there is a stage-related development with regard to the manner in which children acquire knowledge of the world in which they live. He has maintained that prior to the age of six or seven, the child's thinking is pre-operational. He has also asserted that at about the age of six or seven a shift in the way a child views his world occurs, and that this shift is brought about by a number of factors including maturation, social experience in the world of adults and peers, and the child's manipulation of his environment. The development of conservation, for instance, as a maturational achievement is said by Piaget to be but one manifestation of more general and fundamental changes that occur in the course of cognitive development.

Scores of studies have largely supported Piaget's claim and assertions regarding the predictability and sequence with which logical concepts of conservation of quantity, number, weight and volume; classification, and seriation, emerge, although they have varied with respect to the equivalence of ages at which these abilities appear, or the close relationships between the emerging concepts. Studies have also suggested, and Piaget concurs, that cultural differences, individual differences, or differences in the rate of maturation, may affect the rate, and therefore, the ages at which children acquire certain concepts. Also, Piaget's own studies suggest that his claim concerning concurrent development of abilities of conservation, seriation, and classification, was not based on evidence obtained from a single administration of the same problems representing the various abilities to the same child, or group of children. Almy has put it this way:

> The children whose thinking is described as 'operational' in one experiment are, it appears, not necessarily the same children as those who are labeled 'operational' in experiments dealing with different but related concepts. Consequently the question of whether the levels of thought are actually as pervasive and as clearly demarcated for individual children as they are set forth in Piaget's theoretical formulation must remain open until the results obtained when each child completes an array of different experiments are known.[1]

The present study therefore investigated the validity of Piaget's claims with regard to the stage-related development of operational thinking among the Iteso primary children of Uganda. It also investigated the extent to which the various abilities develop concurrently.

Studies in Africa based on Piaget's work (Price-Williams, Greenfield, Beard, Etuk, Vernon, Almy and Bovet) have tended to be more supportive of the sequence of development of conservation (and other abilities) but have not confirmed the particular age periods specified by Piaget; they have instead found time lags. But the dangers of generalizing from those studies to other African groups are many.

The West African studies were done among the Ga (Beard); the Tiv (Price-Williams); the Wolof (Greenfield); and the Yoruba (Etuk), all of which tribes belong to the Nilotic group of tribes. The Bovet study was done among a Hamitic group in Algeria, and the Almy and Vernon studies were done among the Baganda, a Bantu tribe. The Iteso are a Nilo-Hamitic group. To what extent would results obtained among the Nilotics, Bantus, and Hamites be true of them? Moreover, even within the Nilotic group itself, the radical difference in the achievement of

[1] Millie Almy, E. Chittenden, & P. Miller, Young children's thinking. New York: Teachers College Press, 1966. P. 19

conservation and the mode of concept formation as between Tiv and Wolof, as reported by Price-Williams and Greenfield, reveals need for studies in a variety of African cultures and groups.

In discussing the question of time delays, Voyat[1] has pointed to the need to obtain an overall picture of cognitive development with a particular non-western population. He suggests that previous studies using non-western populations have been criticized for examining limited aspects of development of these populations and generalizing from these on the overall picture of cognitive development. The advantage in obtaining an overall picture of development in a population is that if a time delay is found in the acquisition of certain abilities in that population, it will be possible to check whether this reflects a general lag in development that would be found in any area examined, or whether a delay in one area, relative to western children, or to other groups of children within the non-western group, is balanced by the reverse situation in another area. Almy,[2] for instance, who used conservation, seriation and classification tasks in her study of Kampala children, suggests that they may be making more rapid progress in understanding seriation and perhaps also space relations than they are in grasping classification and conservation. In the present study therefore, it was proposed to use tasks that tested not only the conservation but also the seriation and classification abilities of the children.

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[1] G. Voyat, The forgotten people: Cross-cultural study of the cognitive development of the Pine-Ridge Indian Reservation. Unpublished report, 1969.

[2] Millie Almy, The usefulness of Piagetian methods for early primary education in Uganda: An exploratory study. Unpublished report, 1967. (See also Almy, M. et al, 1970.)

The specific aim of the present study was to investigate:

1. the level of thinking of the Iteso Primary School children in Uganda; and

2. whether abilities involved in conservation, classification, and seriation develop at the same rate.

II - METHODS AND PROCEDURES

In this chapter the methods and procedures used to investigate the problems outlined in the previous chapter will be described. Before this description is given, however, it may be in order to briefly describe the primary school and the teacher training systems in order to provide background information and a reference for later discussion concerning the implications of the present study for education at primary level, and for teacher training.

Primary Schools

In 1966 there were 2,676 government aided primary schools. In addition to these there were about 4,000 non-aided primary schools. Latest available figures[1] indicate that there were 641,637 children studying in aided primary schools in Uganda, of whom 242,129 (38 percent) were girls. This represents roughly 47 percent of the projected figures for the 6-12 year age group. It conceals, however, wide regional variations, as well as variations in enrolments as between boys and girls.

A typical primary school curriculum includes health education, arithmetic, nature study, language study, arts and crafts, geography, history, and some general science and civics. Since children are examined only in arithmetic and English at the end of their primary school

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[1] Uganda. Planning and Statistical Unit. Education Statistics, 1966. Entebbe: Government Printer, 1967.

career, by far the greatest emphasis is placed on these two subjects, by pupils and teachers alike, and to the neglect of other subjects. Libraries and other instructional materials to support this curriculum are generally lacking.

One of the greatest problems confronting educational administrators is the high dropout rate of pupils before the seven year primary course is completed. Dropouts are accounted for by a variety of reasons, including apathy on the part of parents or children or both; early marriage; and inability of parents to pay school fees.

After seven years of primary school, pupils who pass the Primary Leaving Examination very well are qualified to continue at secondary or technical schools and farm schools. The majority of pupils prefer academic secondary schools to technical, commercial or farm schools.

Teacher Training

There were 27 teachers training colleges in 1968, all except one, training teachers for the primary schools. There are plans to centralize the 26 teacher training colleges for primary teachers into four teacher training colleges.

There are various grades of teachers in the country; of these, only Grade II, III, and V are operative. Until 1954, Grade I teachers were trained to teach the first few years of primary school in African languages; subsequently a programme to replace them with teachers qualified to teach in English was introduced, but many unqualified in English are still teaching in rural schools. Grade II teachers, teaching the first years of Primary school, enter Teacher Training Colleges after seven years of primary school and undergo a four-year training course; Grade III teachers, entering Teacher Training after the East African Certificate of Education, take a two-year course and are qualified to teach the upper grades of primary school.

The selection of tasks, and their translation and administration; the selection of subjects and description of their background, and the methods of scoring and categorizing the data are presented in the remainder of this chapter.

Selection and Description of Tasks

An interview schedule based on Piaget's tasks was constructed to investigate the problems already outlined in the previous chapter.

Even in an exploratory study such as the present one, the problem becomes one of selecting from the many Piagetian tasks and experiments those most relevant and adequate, for the questions to which the investigator seeks answers. But there are a number of considerations which guided the selection of the tasks in the present study. Most of the tasks are replications, with modifications of those Piaget reports in his book, The Child's Conception of Number,[1] and a number are modified from The Early Growth of Logic in the Child.[2] These tasks have previously been used in cross-cultural studies and therefore the feasibility of their administration to non-western groups has been amply demonstrated.

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[1] Jean Piaget, The child's conception of number. New York: Humanities, 1952.

[2] Bärbel Inhelder, & J. Piaget, The early growth of logic in the child. New York: Harper & Row, 1964.

Another consideration in the selection of these tasks was the question of the translation of the experiments into Ateso. Tasks for which a precise translation into Ateso could be formulated were included; those for which the translation was too imprecise or vague, as demonstrated in the pilot study[1] were left out. In that study, for instance, in the task on the conservation of a number of buttons, after the initial orientation, the red buttons were then bunched, and the child was asked, "What about now?" in order to get his answer without giving him any clue. A preliminary trial questioning indicated that the Ateso version of this question proved so vague that it was necessary in each instance to follow it up with, "Are there more red buttons, or more yellow buttons, or are they the same?"

In the actual interviewing of the children, the standardized questioning procedure is preferred to Piaget's more flexible method of questioning because it provides a more comparable situation for all subjects. Some investigators, Voyat[2] among the more recent of them, have argued against this standardized procedure on the ground that it tends to be rather inflexible and represents a rigid approach to a dynamic problem. Voyat points out that a careful use of the clinical method might yield more useful information than the use of standardized testing

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[1] Barnabas Otaala, The performance of Ugandan African children on some Piagetian conservation tasks: An exploratory investigation. Unpublished paper submitted in partial fulfilment of departmental requirements for Certification, Teachers College, 1969.

[2] Gilbert Voyat, The forgotten people: Cross-cultural study of the cognitive development of the Pine Ridge Indian Reservation. Unpublished report, 1969.

techniques. In the clinical method, each item is first presented in a uniform way, with no intervention from the experimenter; the focus is on the spontaneous thoughts of the child. It is necessary that the child understands the question, and it is only then that the clinical method is applied to see what level of thinking the child may reach. This way the results obtained should indicate the level on which the child is situated.

Other investigators, while realizing the limitations of the standardized testing procedures, have tried to improve upon them by including procedures which attempt to ensure that the child understands the tasks of the questions posed. In this investigation, such procedures took the form of an orientation during which the investigator gave the child practice with important ideas and words in each of the major sections of the interview.

Last, but not least was the practical limitation of the time available for the study. The study was carried out in the last two months of the second term of the school year.

Only a brief description of the tasks is provided below, as the entire English interview schedule is reproduced in Appendix A.

Conservation

In all the conservation tasks, before actual testing, the subject was encouraged to name the items presented, to say what they were used for, and to state whether or not they ever used these items in their homes. Where applicable, as in the case of task two, they were asked to compare two rows of differently coloured buttons that were unequal in number. By taking or adding buttons to alternate rows, they were encouraged to make the numbers in the two rows equal, and were introduced to the use of the words, "same," or "more," which would be used during testing.

Task 1

a. In this task the subject is presented with a set of 11 red buttons and he is asked to count them. They are then bunched and he is asked to indicate, without counting, how many red buttons there are. The buttons are then spread and the question, "How many red buttons do we have here?" is asked.

b. This task is the same as above, except a set of ten yellow buttons is used.

Task 2

During the orientation for this task, the subject compares ten yellow buttons with seven red ones, and adds red buttons to make the rows the same; then compares the rows with one yellow button removed, one yellow added; two red buttons removed, two red buttons added, etc. For the testing the red buttons are bunched and the subject is asked, "Who has more buttons, you or I, or do we both have the same number?" The yellow buttons are then spread apart, and the above question is repeated. After each response of the subject, he is asked, "Why do you think so?"

Task 3

During orientation the subject compares water in two identical glasses, indicating which one has more water than the other, and adjusting the water to indicate when the water is the "same." The experimenter then empties the water from one glass into a shallow glass dish, asking "Now, who has more water, you, or I, or do we both have the same amount?" The experimenter then transfers the water from the dish to a taller, narrower glass, and repeats the above question. After each response of the subject, he is asked for his explanation, "Why do you think so?"

All the three tasks were taken, with modifications, from Almy's study.

Task 4

In this task one of two equal balls of clay is transformed into a "sausage" shape; then back into a ball shape, and finally it is cut up into several pieces. After each transformation the subject is questioned about the equality of the two amounts of clay; and after each response he is asked for his explanation, "Why do you think so?" This task is taken from The Child's Conception of Number.

Task 5

This task was adapted from the Omweso game as described by Nsimbi.[1]

The Omweso game is played on a board in which 32 holes are cut, arranged in four rows of eight holes. Usually 64 pebbles are needed to play the game, which is played by at least two people; although there are variations of this from place to place, and sometimes within the same place, depending upon the age of the players, or upon whether the game is played for money.

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[1] M. B. Nsimbi, Omweso: A game people play in Uganda. Kampala: Uganda Publishing House, 1969.

To start the game the players place two pebbles in each of the 32 holes. Each player has two rows of pebbles (32 pebbles altogether) at the beginning of the game. The players agree on a given set of rules concerning the playing of a particular round, and the procedure for deciding on the person to have the first go at the game. In this task, when the subject's agreement concerning the equality of his pebbles with those of the interviewer is elicited, the interviewer first moves pebbles from his front row to his back row. Secondly, after re-arranging, he moves all pebbles from his front row to the left end hole of that row; and all pebbles in the back row, to the right end hole of that row. Thirdly, after the interviewer has re-arranged his pebbles, the subject is then asked to place all his pebbles into the middle hole of his front row. After each transformation the subject is questioned about the numerical equivalence of his and interviewer's pebbles. After each response, he is asked for his explanation, "Why do you think so?"

Seriation

Prior to testing the subject has an opportunity to order objects according to size. He is given five balls of clay which differ in size, and is told that they are five "boys" who are lining up to enter their classroom after breaktime. He is asked to arrange them from the shortest to the tallest.

Task 1

This task requires the subject to arrange seven toy cows according to size.

Task 2

The materials for the second test consisted of seven cardboard strips, varying in height, on each of which is sketched a stick figure of a woman; and seven corresponding cardboard strips on which baskets are sketched. Three kinds of problems are posed with these materials: arranging the strips in corresponding series from smallest to biggest; identifying ordinal positions after the bunching of one row and the spreading out of the other; and identifying ordinal positions after one of the two corresponding series have been destroyed.

Firstly, the child is asked to place the women in order of size, from the smallest to the biggest. Then he is asked to order the baskets from the smallest to the biggest, giving the smallest basket to the smallest woman, and the biggest basket to the biggest woman. Once the subject has arranged the row of women and that of baskets in correspondence, one with the other, the two rows are left parallel, but the baskets are brought together, and the women are spread out more widely. Touching pre-determined baskets the interviewer asks, "To which woman does this basket belong?" After this questioning the women are then arranged as previously, and the series of baskets is destroyed. Again the interviewer picks predetermined baskets, and asks the subject to identify their owners. All of the strips are coded so that the interviewer can readily record the subjects' responses, and reassemble the strips correctly. The tasks used are similar to those used in the Etuk (1967) and Almy (1967) studies.

Task 3

The material for this task which is taken from The Early Growth of Logic in the Child, consists of ten sticks varying in length from about 10 cm. to 15 cm. The subject's task is simply to arrange the "boys" from the shortest to the tallest. The sticks are coded, to simplify recording of the subject's responses.

Classification

The first two tasks under this category deal with the sorting of an array of objects. The last two tasks deal with part-whole relationship.

Task 1

A mixed array of animals (three cows, three goats, three sheep, and three dogs), one of each of which is red, black, and green, is presented to the subject. He is first asked to name the various animals. The subject is then asked to place animals "that go together" any way at all a group of things is the same. After the subject has done this, he is then asked to explain the basis for his sorting.

Task 2

A mixed array of seeds (nuts, peas, egasia, ekuoro, elira) the last three regarded local to the area and untranslatable, is presented to the subject with the request that he place those "that go together" any way at all a group of things is the same. After the subject has done this, he is asked for the basis of his sorting.

Task 3

The material for this task consists of seven toy cows, and two toy dogs, forming the class of animals (B); one subclass of cows (A), and another of dogs (A'). The subject is first asked to name the animals--the cows and dogs in turn--to provide assurance that he has some notion of the class "animals." He is then asked how many cows there are, and how many dogs. It is not necessary that he give the correct number, merely that he recognize that there are more cows than dogs. The three following questions are then asked:

a. On this table do we have more cows (A) or more animals (B)? Why do you think so?

b. If you took all the cows (A) to your side, and I keep the dogs (A') on my side who would have more animals? Why do you say so?

c. On this table do we have more animals (B) or more cows (A)? Why do you think so?

Task 4

In this task there are eight figures differing in colour and shape. Among the four blue figures are two circles and two squares. The four white figures are all squares. The class of blue figures (B) contains two circles (A) and two squares (A'). The class of squares (D) contains four white squares (C) and two blue squares (C'). The following questions are asked:

a. Are all squares (D) white (C)? Why do you say so?

b. Are all the blue ones (B) circles (A)? Why do you say so?

c. Are there more circles (A) or are there more blues (B)? Why do you say so?

d. Are there more blue things (B) than there are squares (D) or the same (B + D), or fewer (B < D)? Why do you say so?

In the last two tasks, test questions, therefore, are of two kinds: one kind of question poses the subject two options--that is--to indicate whether the superordinate class or a single subclass is larger. Another kind of question poses three options: the superordinate class is larger, or the subclass is larger, or they are the same. In both the tasks, all the sections, except one, contain unequal numbers of objects in subclasses.

Translation and Administration of the Interview Schedule

The English version of the interview schedule which appears in Appendix A was translated into Ateso by two Iteso graduate teachers. The translations were then compared with each other and with that made by the investigator. The translations were then discussed. When this had been done, and modifications had been made, a common Ateso version was agreed upon, which was then given to three different people: one Etesot graduate teacher, one European priest who has participated in the production of the Ateso-English, and English-Ateso dictionaries; and one Etesot primary school teacher who is fairly conversant in the English language. These three people were requested to translate the agreed Ateso version back into English. The new translations were then compared with the original English version of the schedule. This procedure was considered essential in verifying the accuracy of the translations. A final version of the Ateso schedule was made and discussed by the whole group of six people.

All interviews were conducted in Ateso by the investigator himself who recorded the responses of the children in Ateso on record sheets (see Appendix C). Tape recordings were also made of the children's verbal responses. These were later transcribed and used to amplify, where necessary, the records of the children's responses during the interview. The average length of the interview for the two lower classes (P1, and P3) was forty minutes; and that for the upper classes (P5, and P7) was 30 minutes.

After the interviews a random sample of ten protocols was translated into English independently by one of the graduate teachers who had participated in the earlier translations, and the investigator. The two translations were remarkably close, thus giving the investigator confidence in the translation of the rest of the protocols from Ateso into English.

Subjects

Selection of Schools

The subjects were selected from two schools in Ngora county of Teso District. Teso District is divided into eight counties, with roughly equal numbers of primary schools. Ngora county is the most centrally located of these counties, and discussion with the District Education Officer and a number of primary school teachers suggested that for all practical purposes the two schools selected could be considered to be fairly typical of rural primary schools in Teso. One school (School A) was selected from Mukura subcounty, and the other (School B) was selected from Kapir subcounty. Both schools were not far from those used in the pilot study, and were easily accessible from the main arteries of transportation.

Selection of Subjects

The subjects were 160 boys and girls from alternate classes of the primary school (P1, P3, P5, and P7).[1] The age range was about 6-14 years. It was difficult to obtain exact ages of the children since many parents do not reckon their children's age by the year, but in terms of some important events that took place at the time when the children were born. However, if it is assumed, as the Ministry of Education requires, that children start school at the age of six, it could then be said that children in the selected classes in this investigation were aged as follows: P1, about six; P3, about eight; P5, about ten; and P7, about 12. The ages in this study, however, were considered as very rough estimates.

To select children to represent these approximate ages for each of the classes investigated, it was necessary to first take out from the class register children who did not fall into the estimated age for the particular classes. From the remaining group, the required number of children was selected using a table of random numbers, except, as in the case of girls in the upper primary classes (P5, and P7) there were too few of the required number. In the latter cases all the children of a particular category were included.

Table 1 shows the distribution of subjects by school, class, sex and approximate ages in years.

[1] P stands for primary, and the arabic numeral attached stands for the class, so that P1, for instance, means primary class one, and P3, primary class three. These designations will have this meaning throughout the report.

Table 1

School, Class, Sex, and Approximate Age of Subjects

School	Boys	Girls	Total	Approximate Age in Years
A				
P1	10	10	20	6-7
P3	10	10	20	8-9
P5	16	4	20	10-11
P7	16	4	20	12-13
Total	52	28	80	
B				
P1	10	10	20	6-7
P3	10	10	20	8-9
P5	16	4	20	10-11
P7	14	6	20	12-13
Total	50	30	80	
Grand Total	102	58	160	

Background of Teso Rural Children

Despite a number of variations within clans and geographical areas of Teso, and despite the differences in length of exposure to "outside" influences, it is possible to make some generalizations about the background of rural primary school children in Teso. These generalizations could, no doubt, be true of most rural Uganda.

Most rural school children come from rural homes. Their parents are peasant farmers who are mainly traditional, and therefore to a large degree, are conservative. Traditional beliefs--social, magico-religious, and material--therefore dominate the early experiences of rural children. The society is organized into increasingly bigger concentric circles of relationships, beginning with the nuclear family, the extended family, and finally the clan, and tribe.

Geber and Dean[1] have described child-rearing practices in Buganda, which read similarly for Teso. Children are kept close to their mothers in the earliest years and weaned late and very suddenly. Their initial physical and mental growth is fast, but slows down after weaning. Geber and Dean attribute this decreased rate in development, partly to diet, partly to social circumstances; for soon after weaning children cease to enjoy the almost continual adult company of their earlier time, and in some cases are separated from their mothers geographically when they are sent to distant relatives.

There are hardly any opportunities for children to ask questions; opportunities are even fewer when questions are invited from them.

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[1] M. Geber, & R. F. A. Dean, The psychological changes accompanying Kwashiorkor. Courrier, 1956, 6, 1-14.

This state of affairs has been interpreted by some people as typically African, but as a matter of fact is common everywhere among working low class parents. Discipline from parents is usually authoritarian, and children are therefore expected to do as they are told.

From a relatively early age children are assigned duties like minding the baby, fetching water or firewood, or looking after cattle.

The child carries all these social experiences with him to school and they affect his approach to learning, his understanding of what is learned, and his relationship to authority and to his fellow pupils.

There are rules which bind the child to the traditions of the clan, to the magico-religious beliefs of the clan and of the tribe. Customs of marriage; customs surrounding birth; the naming of a child or of twins; customs surrounding death and burial, and inheritance are everywhere still observed. The spirit world and the beliefs in magic and magical causation still persist, even among teachers.

The thinking of the rural child therefore, is tremendously affected by the traditions, practices and beliefs of the area. A rural primary school child therefore, is continually having to make choices between traditional and scientific facts which often contradict each other.

A further influence which acts upon the rural child has to do with lack of what Segall, Campbell and Herskovits[1] refer to as the prevalence of rectangularity in the visual environment. In the rural environment, children are not reared in a "carpentered" environment and so do not see many rectangular houses, windows, objects, and corners. A more

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[1] M. H. Segall, D. T. Campbell, & M. J. Herskovits, Cultural differences in the perception of geometric illusions, Science, 1963, 139, 769-771.

curving rural environment is familiar to them. By the time the rural child reaches school, he will thus have had very limited manipulative or psychomotor experience in a "carpentered" environment. His early primary school experiences are not likely to make up for these deficiencies, as teaching at that level is largely mechanical.

Order of Presentation of the Tasks

The order of presentation was standard. It began with conservation tasks, followed by seriation tasks. The interview was ended with the classification tasks.

The conservation tasks began with the conservation of counting, a task which is not strictly a conservation task, but one which was included in order to prime the subjects for the conservation of number tasks (conservation of a number of buttons, and conservation of a number of pebbles). This task was followed by task two, the conservation of a number of buttons. This task was separated from task five, a task closely akin to it by task three, the conservation of an amount of water, and task four--the conservation of an amount of clay. The two tasks involving the conservation of number were separated from one another in order to avoid the possible carry-over effects from one to the other.

The next section of the interview began with the seriation of cows; this was followed by the seriation of women and baskets, and the arrangement of ordinal correspondence. The final task involved the seriation of ten sticks.

The classification section which ended the interview started with the two sorting tasks--the sorting of animals, and the sorting of seeds. It ended with the two inclusion relation problems.

It is not possible at this time to tell what the possible effects of the order of presentation might be; this can only be settled when different orders have been tried. The present order for the conservation items was suggested from Almy's study[1] in which it is indicated that there were no significant important differences in the number of children conserving in the various presentations. The order of items in the seriation and classification sections was determined by a consideration to present items which appeared more difficult later than those which seemed less difficult.

Reactions of the Children

For each of the classes from which the subjects were selected the class teacher introduced the investigator to the children in his class, before the actual interviews were carried out. The teacher explained in general terms that the investigator was interested to know how children answer questions, and perform certain tasks. The teacher also urged the children to behave well towards "our visitor," and "to answer his questions without fear."

There was, on the whole great interest expressed by the children. As word spread that there were toy animals, and "a machine which records your voice" (a tape-recorder); a number of those children not

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[1] Millie Almy, E. Chittenden, & P. Miller, Young children's Thinking. New York: Teachers College Press, 1966.

selected for the interview clamoured for a turn to be interviewed. During the school break-periods groups gathered outside the window of the staffroom where the interviews were conducted to get a glimpse of what was happening in the staffroom.

Categorization and Scoring of Data

Procedures from Almy's study[1] and the study carried out by Etuk in Nigeria[2] dictated the approaches taken in the categorization and scoring of most of the data since most of the tasks were derived either in direct form, or with modifications from those studies.

By providing some practice or orientation prior to testing in each task the investigator was able to ascertain whether the child's attention was appropriately focussed and whether he appeared to understand the questions. Except in a few cases where the investigator was uncertain as to whether or not the children understood, it was noted that most children seemed to understand what was required of them.

Children's responses were taken at their face value, as the questions were standardized, and as no probing of any kind was included. But the general procedure for each task was the same. It consisted of categorizing the performance for the total task on the basis of the pattern formed by the separate responses to the subsections of a particular task.

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[1] Millie Almy, E. Chittenden, & P. Miller, Young Children's Thinking. New York: Teachers College Press, 1966.

[2] Elizabeth S. Etuk, The development of number concepts among the Yoruba-speaking Nigerian children. Unpublished doctoral dissertation, Teachers College, Columbia University, 1967.

The categorization scheme attempted to separate responses that provided evidence of operational thinking from those that were definitely non-operational or transitional. Based on this differentiation, the evidence for each task could then be categorized as definitely indicating operational thought; definitely indicating thought that was not operational; and transitional.

Conservation of a Number of Buttons, Pebbles and of an Amount of Water, and of an Amount of Clay

There were four[1] conservation tasks, and each of them was categorized independently, but the procedure for each was basically similar. It consisted of weighing the evidence for or against conservation in the child's response to each opportunity presented in a particular task.

For task two, involving the conservation of equality of number of two rows of buttons through two transformations, the child was asked after each transformation, "Now, who has more buttons, you or I, or do we both have the same number?" Then he was asked for an explanation, after each response: "Why do you think so?" Thus task two offered four opportunities for conservation. (See Appendix B for explanations which got counted as conservation explanations.)

Task three involved the conservation of an amount of liquid when it was poured from one of two identical glasses containing the same amount of water, into, in turn, a shallow dish, and a taller, narrower glass.

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[1] Task one, conservation with counting, has been excluded from consideration here, since in retrospect, it is not strictly a conservation task. However, comment on performance on it is made in the section dealing with the results of the study.

After each of the two transformations the child was asked, "Now, who has more water, you or I, or do we have the same amount?" He was also asked for an explanation, each time, "Why do you think so?" Accordingly he had four opportunities to conserve.

Task four, involving the conservation of an amount of clay, offered the child six opportunities to demonstrate conservation. One of two identical balls of clay was rolled out into a "sausage" shape; and then was rolled back into a ball, and finally was cut up into a number of pieces. After each transformation the child was asked a question to determine conservation. After each response he was asked for an explanation, "Why do you think so?"

For task five, involving the conservation of the equality of number of four rows of pebbles through three transformations, the child was asked a question, after each transformation, to determine the conservation of the equality of number. After each response he was again asked for an explanation, "Why do you think so?"

Each interview, therefore, provided each child with 20 opportunities to indicate whether or not he was conserving.

Evidence obtained from the child's responses, for each task, was then classified in one of three categories: definitely conserving; partially conserving; definitely not conserving. After the evidence for each of the opportunities to conserve had been so classified, the evidence for the total task was weighed and the total performance on that task was scored zero if the evidence for conservation was classified as definitely not conserving; one if it was classified as partially conserving, and two if it was classified as definitely conserving.

Seriation and Ordinal Correspondence

The first task consisted of seven cows which the subject was asked to place in one row, from the smallest to the biggest. The interviewer allocated the number one to the smallest cow, and seven to the biggest. The child's response was scored correct or incorrect. If the response was incorrect the order in which the cows were placed was recorded. A correct response was scored two. If a child made two misplacements; that is, if two adjacent objects were interchanged, he was considered able to seriate partially, and his response was scored one. Responses of more than two misplacements were considered as definitely not seriating, and were scored zero.

The seriation task using sticks was scored in a similar way. The sticks were coded with letters and a correct response produced the word CONAMBEKHI. This response was scored two; a misplacement of two adjacent objects was scored one, and a response of more than two misplacements was scored zero.

In the rest of the seriation tasks the interviewer recorded on the child's protocol the identifying letters for the child's response since the cards used in the tasks had been coded with letters. Placement of women in a correct series read FACULTY and that of baskets read ISOMARE. A child who was definitely seriating was the one who made correct placements for both the row of women and the row of baskets. His response was scored two. A child who was partially seriating and whose response was therefore scored one, was the one who made correct placements on either the women's row or the row of baskets, but made mistakes in arranging the second row. More than two misplacements in both rows constituted a category of subjects definitely not seriating. Their responses were scored zero.

In the ordinal correspondence task each of the two subsections was checked for evidence of ability to place objects in ordinal relationship, which was said to be present if the subject responded correctly to the two subsections. This response was scored two. The response was scored one, if the subject responded correctly to one section only. In this case he was considered partially ordinating. A subject who did not respond correctly to either of the two subsections was considered definitely not ordinating, and his response was scored zero.

The total performance for each of the tasks was then scored zero if the evidence for ordinal correspondence was classified as definitely not able to perform ordinal correspondence; one if it was classified as partially able to make ordinal correspondence; and two if it was classified as definitely able to make ordinal correspondences.

Classification

In the first two tasks the interest was in whether the child could sort objects on a consistent basis. In the last two tasks the interest was in whether the subjects could understand inclusion relations.

Sorting Tasks

Each of the two tasks required the subject to sort an array of objects on one consistent basis, or on a number of several possible bases, and to explain the basis for sorting. In a correct sorting the subject used a consistent criterion or consistent criteria to place objects in a group. A correct explanation indicated that the subject had an understanding that a group of objects share a similar property. A correct sorting required both a consistent sorting and a correct explanation. This response was scored two. A partially correct solution of the task was the one in which the subject sorted correctly but was unable to give an adequate explanation for the basis of his sort. This response was scored one. An incorrect solution was scored zero; it was the one in which the subject responded but made no observable consistent basis for sorting, and gave no adequate explanation for the basis of his sorting.

Evidence for the total task was weighed and the total performance of the task was scored zero if the evidence for classification was classified as definitely unable to sort on a consistent basis; one if it was classified as partially able to sort on a consistent basis, and two if it was classified as definitely able to sort on a consistent basis.

Class Inclusion

In each subsection of each of the two tasks an answer and an explanation were required. In a correct answer the subject indicated that there were more objects in the superordinate class than in either of the subclasses forming that superordinate class. A correct explanation either indicated the correct number of objects in it, or focussed upon the defining attributes of the superordinate class. A correct solution of the task required both a correct answer and a correct explanation. A child who definitely understood class inclusion relations; that is, one all of whose responses were correct was scored two. A child who partially understood inclusion relations, one who got two sections correct in task three, and got either of the last two sections of task four correct, scored one. A child who gave no evidence of understanding inclusion relations in any of his responses scored zero.

Again, evidence for the total task was weighed and the total performance on that task was scored zero if the evidence for classification was classified as definitely unable to answer class inclusion problems correctly; one if it was classified as partially able to answer class inclusion problems correctly, and two if it was classified as definitely able to answer class inclusion problems correctly.

Criteria for scoring are outlined in more detail in Appendix B.

Inter-Scorer Reliability

A random selection of 30 protocols was scored independently by the investigator and another student, to determine the reliability of judgments based on these criteria. The student[1] has had experience in scoring similar protocols. The inter-scorer agreement was 100 percent for the conservation of an amount of water task; 97 percent for the conservation of an amount of clay task; 97 percent for both the conservation of number of buttons task and conservation of a number of pebbles task. The average inter-scorer reliability, for conservation tasks, was therefore 97.75 percent.

[1] Miss Paula Jean Martin assisted in scoring the data. The writer extends sincere gratitude to Miss Martin for her kind assistance.

The inter-scorer agreement for the seriation tasks was 100 percent.

The inter-scorer agreement for the sorting tasks was 100 percent; and 90 percent for the inclusion relations tasks. The average inter-scorer agreement for this section was therefore 95 percent.

III - RESULTS AND CONCLUSIONS

Using Piagetian tasks the study dealt with the extent to which the developmental sequence described in Piagetian theory was observable in a section of Uganda primary school children. The study also dealt with the extent to which the abilities of conservation, seriation, and classification are parallel in their development as Piagetian theory asserts. This section presents the results, first of conservation, seriation, and classification; then of the relationships between those abilities; and sex differences in performance.

Conservation

In task one each child was asked to count a set of 11 red buttons, aloud. The buttons were bunched and he was asked how many red buttons there were. The buttons were then spread out and he was asked how many there were. The child was then given a set of ten yellow buttons and a similar procedure of questioning was followed.

This task was included, in retrospect, not strictly as a conservation task, but rather as a priming task for the conservation of number tasks which involved the use of buttons and pebbles.

When asked to count the children embarked on a recital of ordinal number and some of them (16 or ten percent) when asked after counting to 11 in the case of red buttons or to ten in the case of yellow buttons, how many objects there were, failed to know. They were also unable to tell the number of buttons when they had been bunched together or spread out. The majority of the children, however, were not only able to count the ordinal numbers correctly, but having counted a set of objects and arrived at the cardinal number, were able to maintain it through the two transformations of bunching and spreading. But of those who could perform this operation, 63 children (39 percent) were unable to conserve on the tasks involving the conservation of a number of buttons, and conservation of a number of pebbles. Impressions from performance on this task lend support to the frequently heard assertion that much of the arithmetic education children receive at primary level in Uganda schools is learned by rote. They also lend support to Piaget's claim that earlier than the advent of number concept the child may have learned to count, but experiment reveals that the verbal use of names of numbers has little connection with numerical operations as such.

As previously stated, tasks two and five involved the conservation of a number of buttons and pebbles, respectively. Task three involved the conservation of an amount of water. Task four involved the conservation of an amount of clay.

Table 2 indicates the number and percent of children in each of the classes tested who conserved on the various conservation tasks. Figure 1 indicates the percent of children at each class level who conserved on the various tasks. An examination of the table indicates that the number and percent of the children conserving rises from P1 through P7. A similar trend is indicated by Figure 1. These results generally confirm the Piagetian notion concerning the sequence of development of conservation. The results in this connection support

Table 2

Number and Percent of Children Revealing Conservation in the Various Conservation Tasks*

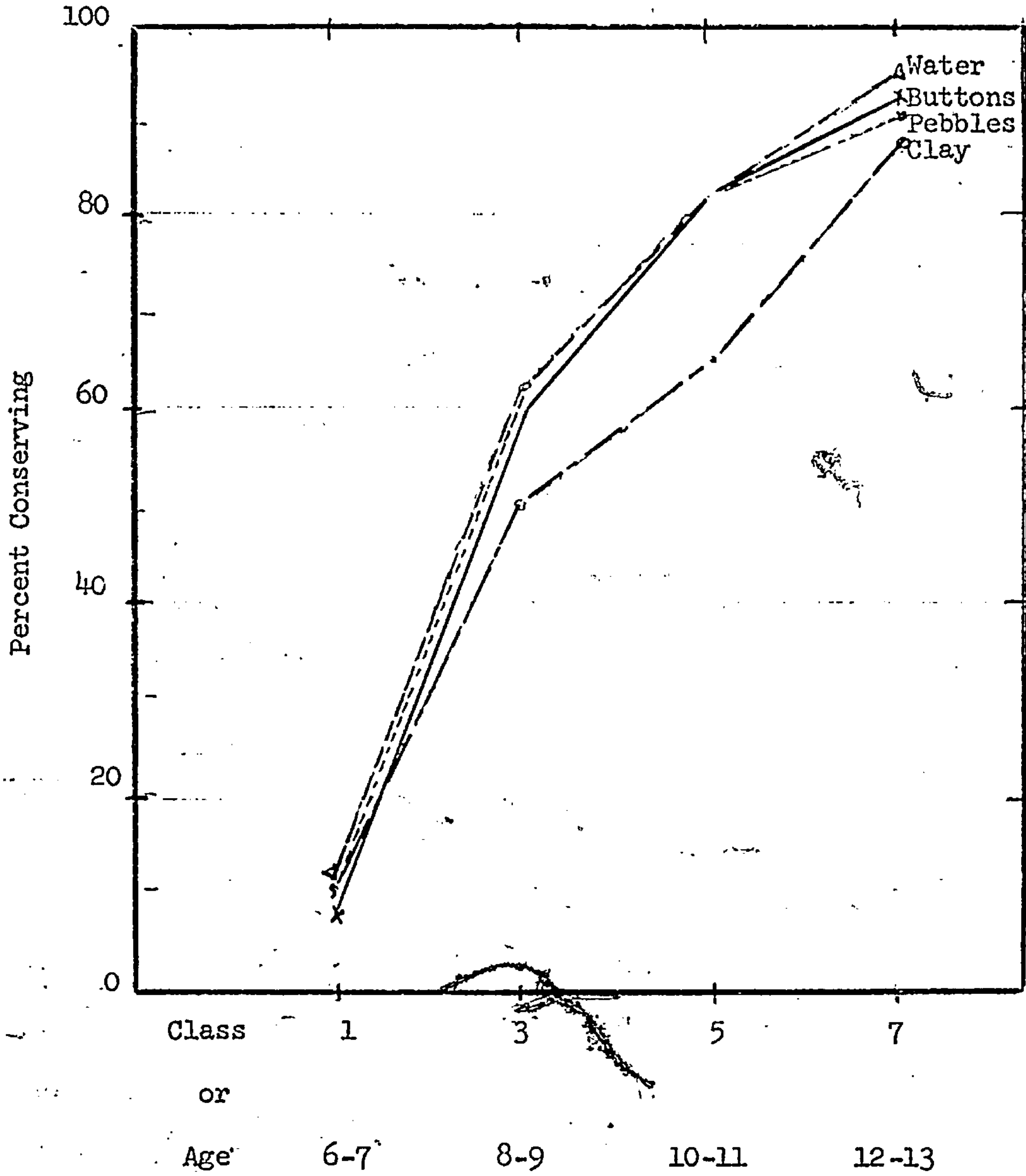
Task in Which Conserving	P1		P3		P5		P7	
	N	%	N	%	N	%	N	%
Buttons	3	7.5	24	60.0	33	82.5	37	92.5
Pebbles	4	10.0	24	60.0	33	82.5	36	90.0
Water	5	12.5	25	62.5	33	82.5	38	95.0
Clay	4	10.0	20	50.0	26	65.0	35	87.5

* There are 40 children in each class.

Figure 1

Percent of Children Revealing Conservation in

Each Class in the Various Conservation Tasks



those of Greenfield,[1] and Price-Williams[2] who worked among the Wolof of Senegal and Tiv of Nigeria respectively.

Piaget[3] has suggested that when 75 percent of the children of a particular age group can successfully complete a task, it can be assumed that children of that age should normally be able to perform that task. When this criterion is applied to this study, it can be seen from Table 2 and Figure 1 that except for conservation of clay task in P5, all children in P5 and P7 meet this criterion. Also, by P3 level at least 50 percent of the children are conserving on all four of the conservation tasks.

The data on conservation were next examined to see whether a sequence in developmental difficulty could be detected. One of the many useful features about Almy's study[4] is the scaling of the three

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[1] Patricia M. Greenfield, On culture and conservation. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966.

[2] D. R. Price-Williams, A study concerning concepts of conservation of quantities among primitive children. Acta Psychologica, 1961, 18, 297-305.

[3] Jean Piaget, Cognitive development in children: The Piaget papers. In Richard E. Ripple & V. N. Rockcastle (Eds.), Piaget rediscovered: A report of the conference on cognitive studies and curriculum development. Ithaca: School of Education, Cornell University, March, 1964. Pp. 6-48.

[4] Millie Almy, E. Chittenden, & R. Miller, Young children's thinking. New York: Teachers College Press, 1966.

conservation tasks she used for developmental difficulty. Among American children conservation of number generally appears before either conservation of discrete or continuous quantity. In support of Piagetian theory discrete precedes continuous quantity conservation. It appears from the Table 2 and Figure 1 that there is parallel development of conservation of an amount of water, and conservation of a number of buttons and of a number of pebbles, but not of conservation of an amount of clay.

The data were then examined to see what pattern of performance on conservation could be detected. Table 3 shows the number and percent of children in each class whose performance fell into one of the five most common patterns--conservation in no task (0 0 0 0); conservation in only the number of buttons' task (1 0 0 0); conservation in only the number of buttons' task, and the number of pebbles' task (1 1 0 0); conservation in only buttons, pebbles, and water tasks (1 1 1 0); and conservation in all tasks (1 1 1 1). The table also shows the number and percent of the children whose performance did not fit these patterns.

From this table it can be seen that the number and percent of children conserving in no task is highest in P1 and decreases in the upper classes. With this decrease there is a corresponding increase of the number and percent of children showing pattern five--conservation in all the four conservation tasks. This pattern includes 17 children (11 percent) who were not conserving on the theoretically less difficult tasks, but were conserving on the theoretically more difficult tasks.

Table 3

Patterns of Conservation Abilities Revealed by Children*

Pattern[a]	P1		P3		P5		P7	
	N	%	N	%	N	%	N	%
1	33	82.5	9	22.5	4	10.0	1	2.5
2	2	5.0	3	7.5	2	5.0	1	2.5
3	-	-	2	5.0	1	2.5	-	-
4	-	-	2	5.0	6	15.0	2	5.0
5	3	7.5	18	45.0	26	65.0	35	87.5
6	2	5.0	6	15.0	1	2.5	1	2.5

[a] Pattern 1 Conserving in no task.

2 Conserving in only the button's task.

3 Conserving in only the button's and pebble's tasks.

4 Conserving in only the button's, pebble's and water tasks.

5 Conserving in all the four conservation tasks.

6 Other patterns.

* There are 40 children in each class.

Seriation and Ordinal Correspondence

Three types of tasks tested the child's ability to seriate. In one task the child was asked to place seven toy cows in a series from smallest to the biggest. In another task he was to place ten sticks from the shortest to the tallest. In a third task on seriation he was requested to place women in a row from the shortest to the tallest and to place baskets in a corresponding series, giving the smallest basket to the shortest woman and the biggest basket to the tallest woman.

In the ordinal correspondence task, once the child had placed (or had been assisted in placing) the rows of women and of baskets in correspondence one with the other, the investigator brought the row of baskets closer together, and spread that of women. The child was then asked to identify the women to which four predetermined baskets belonged. The second section of the task requested the child to identify the women to which predetermined baskets belonged after the series of the row of baskets had been destroyed.

Table 4 shows the number and percent of children for each task, at each level, who solved the seriation and ordinal correspondence tasks correctly. Figure 2 shows the percent of children performing successfully on the various seriation tasks, by class. The three seriation tasks show a clear developmental trend from P1 through P7.

Performance on the ordinal correspondence task was the most difficult. None of the children in the first two classes (P1 and P3) were able to solve it successfully. At P5 level only four (ten percent) children could do this task successfully; and at P7 level only 11 (27.5 percent) could perform it successfully.

Table 4

Number and Percent of Children Revealing Ability to Serialize and to Place Objects in Ordinal Correspondence*

Seriation Tasks	P1		P3		P5		P7	
	N	%	N	%	N	%	N	%
Cows	8	20.0	29	72.5	35	87.5	35	87.5
Sticks	4	10.0	25	62.5	36	90.0	38	95.0
Women and baskets	4	10.0	34	85.0	38	95.0	38	95.0
Ordinal Correspondence	-	-	-	-	4	10.0	11	27.5

* There are 40 children in each class.

When the data are examined in terms of patterns of seriation, it is possible to see, as Table 5 shows, that Pattern 1--seriation in no task is highest in P1; 70 percent of the children being unable to seriate in any of the seriation tasks. It decreases through P7. Pattern 4--seriation in three tasks, in contrast, rises from P1 through P7; and Pattern 5--seriation and ordination in all tasks--shows up only in the last two classes. The information thus provided, ties up with that provided in the Table 4 and Figure 2.

Classification

Two kinds of tasks tapped the children's ability to classify--the sorting and class inclusion problems.

Figure 2

Percent of Children Revealing Seriation in Each Class in the Various Seriation Tasks

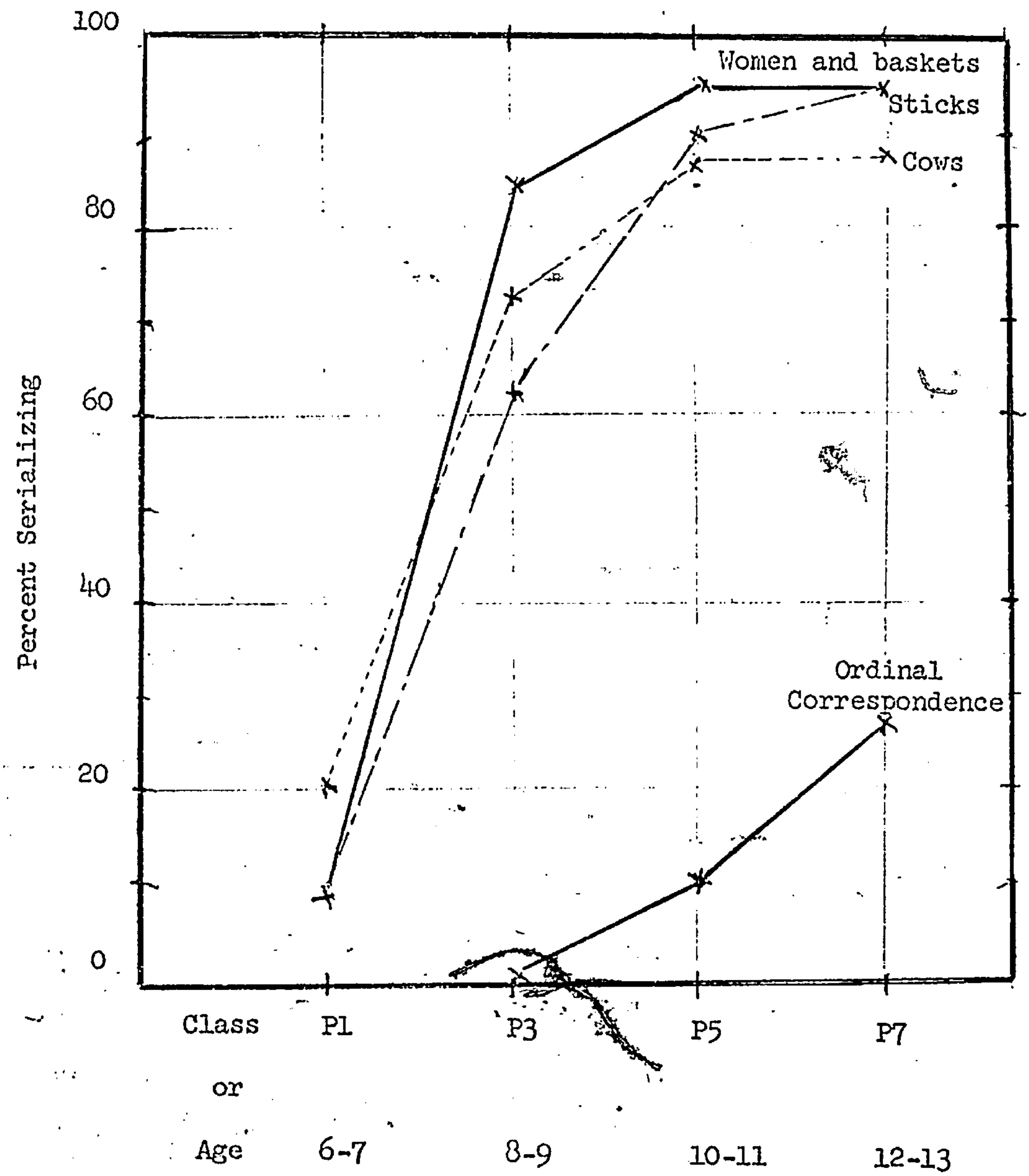


Table 5

Patterns of Seriation Abilities Revealed by Children*

Pattern[a]	P1		P3		P5		P7	
	N	%	N	%	N	%	N	%
1	28	70.0	3	7.5	-	-	-	-
2	1	2.5	2	5.0	1	2.5	1	2.5
3	1	2.5	4	10.0	4	10.0	4	10.0
4	2	5.0	28	70.0	30	75.0	25	62.5
5	-	-	-	-	4	10.0	10	25.0
6	8	20.0	3	7.5	1	2.5	-	-

[a] Pattern 1 Correct seriation in no task.

2 Correct seriation in only the women and basket's task.

3 Correct seriation in only the women and basket's and stick's tasks.

4 Correct seriation in only the women and basket's, stick's, and cow's tasks.

5 Correct seriation and ordination in all tasks.

6 Other patterns.

* There are 40 children in each class.

Table 6 indicates the number and percent of children who sorted correctly and solved the inclusion relation problems, by task and class. Figure 3 indicates the percent of children at each class level who perform correctly each of the three tasks of sorting animals and seeds, and solving the class inclusion relation problem using cows and dogs.

Table 6

Number and Percent of Children Revealing Classification in Each Class in the Various Classification Tasks*

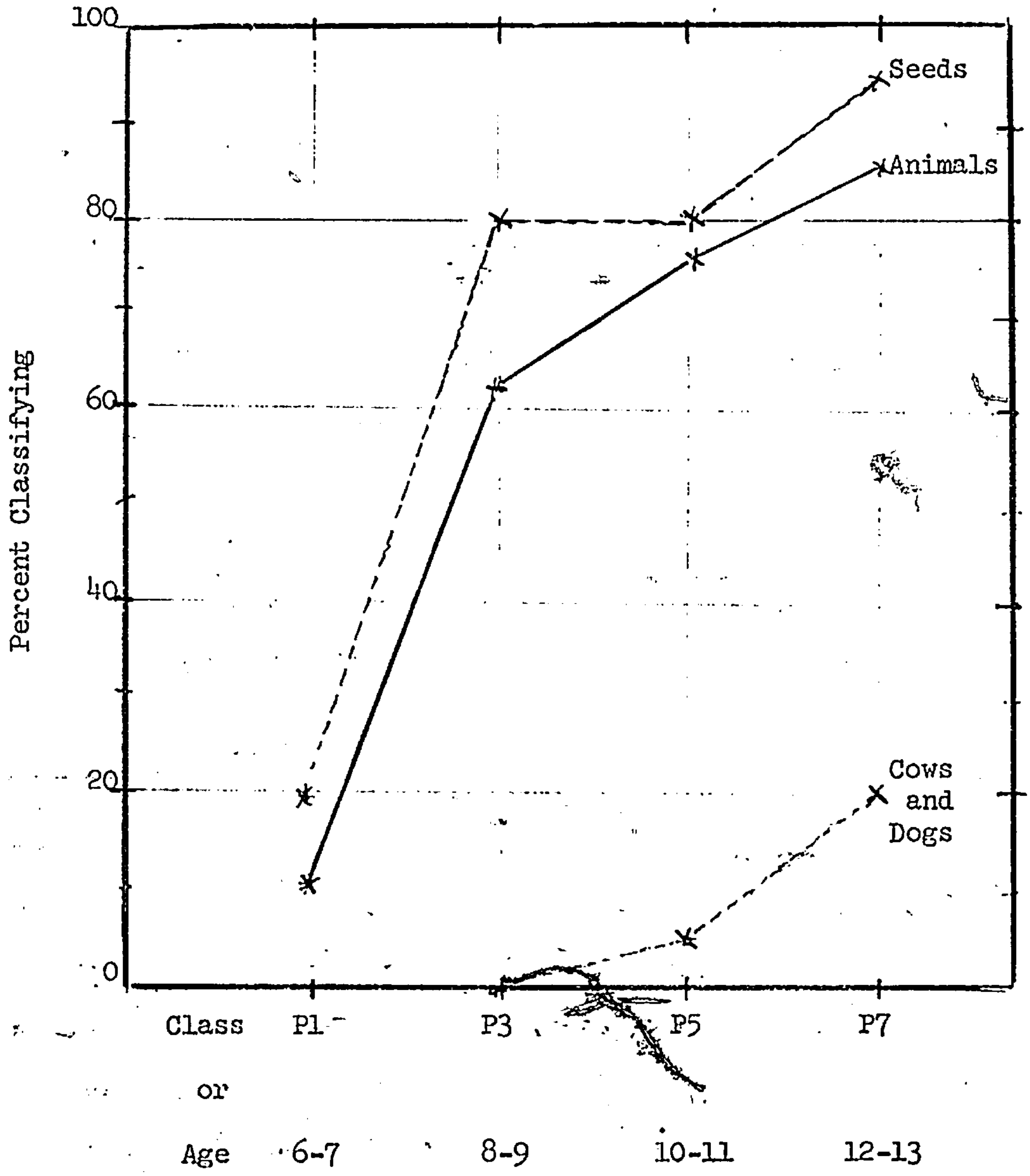
Task in Which Classifying	P1		P3		P5		P7	
	N	%	N	%	N	%	N	%
Sorting Animals	5	12.5	25	62.5	30	75.0	34	85.0
Sorting Seeds	8	20.0	32	80.0	32	80.0	38	95.0
Inclusion: Cows and Dogs	-	-	-	-	2	5.0	8	20.0
Inclusion: Squares and Circles	-	-	-	-	-	-	-	-

* There are 40 children in each class.

There is a clear developmental trend for each of the two sorting tasks; but the sorting of animals was a more difficult task, at each class level.

Figure 3

Percent of Children Revealing Classification in Each Class in the Various Classification Tasks



The tasks involving inclusion relations were the most difficult. In the task using cows and dogs, none of the children in P1 and P3 answered and explained the inclusion relations questions correctly; and only two children (five percent) in P5, and eight (20 percent) in P7 were able to answer correctly. In the task using squares and circles, none of the children in any class solved the inclusion relation questions.

Table 7 indicates the patterns of classification by class and pattern. In P1 the majority of the children fall into Pattern 1--correct classification in no task. In P3 about one-third of the children (32.5 percent) fall into Pattern 2 (correct sorting of only seeds) and about half of the group (47.5) fall into Pattern 3--correct performance in two sorting tasks. In the remaining two classes (P5 and P7), the majority of the children fall into Pattern 3. No child in any class falls into Pattern 5. This again ties in with the observation previously made concerning inclusion relation problems.

The data on class inclusion relations were next analyzed to determine whether the child focussed his attention on the quantitative relationships between subclasses. The results of that analysis are presented below.

Descriptions and Explanations Used by the Children

From responses of the children to the conservation and classification tasks a general picture of how they described and explained the transformations, and how they justified their responses can be obtained.

Table 7

Patterns of Classification Abilities Revealed by Children*

Pattern[a]	P1 N	P1 %	P3 N	P3 %	P5 N	P5 %	P7 N	P7 %
1	28	70.0	3	7.5	5	12.5	-	-
2	7	17.5	13	32.5	5	12.5	5	12.5
3	1	2.5	19	47.5	25	62.5	25	62.5
4	-	-	-	-	2	5.0	7	17.5
5	-	-	-	-	-	-	-	-
6	4	10.0	5	12.5	3	7.5	3	7.5

[a] Pattern 1 Correct classification in no task.

2 Correct classification in only sorting of seeds.

3 Correct classification in only the sorting of seeds and animals.

4 Correct classification in sorting tasks and inclusion of cows and dogs.

5 Correct classification in all things.

6 Other patterns

* There are 40 children in each class.

Description of Conservation Transformations

In tasks two, three, four, and five of the conservation section, after the initial orientation or practice, the interviewer rearranged buttons in task two, and pebbles in task five; and in task three, poured water from one of two identical glasses into the dish, and from the dish into the taller, narrower glass. In task four the interviewer first rolled one of two identical balls of clay into a "sausage" shape, then rolled it back into a ball, and finally cut it up into a number of pieces. The questions posed after each transformation were designed to find out the child's reason for holding to the notion of conservation or non-conservation.

An examination of the protocols indicated that practically all the children who described the buttons or pebbles as more or fewer, and the water or clay as more or less were in P1 and P3. Table 8 therefore shows the number and percent of children giving the various descriptions for those two classes only.

The children whose replies indicated that the equality of number changed tended to agree that there were "more yellow buttons" when the red buttons were bunched. In each of the classes 54 percent of the children who described the buttons as more suggested that there were more yellow buttons, compared to 46 percent who suggested that the red buttons were more. When the yellow buttons were spread out more widely, 64 percent in each class agreed that there were "more yellow buttons" compared to 36 percent who suggested that there were "more red." In both of the transformations on the buttons task, therefore, more children seemed to describe the buttons which were lined up as "more" compared to those which were bunched.

Table 8

Number and Percent of Children in the Lower Classes Describing the Various Transformations as More*

Transformation	Description	P1 N	P1 %	P3 N	P3 %
Red buttons bunched	More yellow	16	53.6	7	53.8
	More red	14	46.3	6	46.2
Yellow buttons spread	More yellow	21	63.8	7	63.8
	More red	12	36.2	4	36.2
Pebbles moved to back row of interviewer	Rows more	5	15.2	5	41.7
	Piles more	28	84.9	7	58.3
Interviewer's pebbles placed in two piles	Rows more	6	18.8	3	33.3
	Piles more	26	81.3	9	66.7
Subject's pebbles placed in one pile	Rows more	3	9.4	1	12.5
	Piles more	29	90.6	7	87.5
Water poured into dish	Dish more	13	42.0	2	20.0
	Standard glass more	18	58.0	8	80.0
Water poured into tall glass	Standard glass more	1	3.0	3	25.0
	Taller glass more	32	97.0	9	75.0
Clay rolled into sausage	Sausage more	26	76.5	8	61.5
	Ball more	8	23.5	5	38.5
Clay rolled back into ball	Former sausage more	10	37.0	2	28.6
	Ball more	17	63.0	5	71.4
Clay cut up into pieces	Pieces more	14	42.4	8	61.5
	Ball more	19	57.6	5	38.5

* There are 40 children in each class.

In the pebbles task, in contrast, more children, in both classes, described the pebbles in "piles" as more compared to those in rows. When the interviewer moved his front row pebbles to the back row, 85 percent of children in P1, and 58 percent in P3, who described the pebbles as "more" agreed that the "piles" had more pebbles. When the interviewer placed his pebbles into two "piles" 81 percent of the children in P1 and 67 percent in P3 describing the pebbles as more agreed that there were more pebbles in the two piles than in the rows. And when the subject placed all his pebbles into one pile the percent of those describing the pile as having more pebbles in P1 and P3 was 91 and 88 respectively.

In the conservation of an amount of water task, when the water was transferred to the dish, 58 percent of the children in P1 and 80 percent of the children in P3 who described the water as more agreed that the standard glass had more water than the dish. When, however, the water from the dish was transferred into a taller, narrower glass, 97 percent in P1 and 75 percent in P3, of those describing the water as more, now agreed that the taller glass had more water than the standard glass. In both transformations, therefore, more children, in both classes, seemed to be paying attention more to the height than to the width of the containers.

Finally, in the conservation of an amount of clay task, when one of the two identical balls of clay was rolled out into a "sausage" shape 76 percent in P1 and 62 percent in P3, of those children describing the clay as more, agreed that there was more clay in the "sausage" than in the ball. When, however, the "sausage" was rolled into the ball shape, more children in both classes now claimed that the original ball had more clay (63 percent in P1 and 71 percent in P3).

When one of the balls of clay was cut up into several pieces, more children in P1 of those describing the clay as more suggested that there was more clay in the "ball" than in the pieces (57 percent). In P3, however, more children (62 percent) now agreed there was more clay in the pieces.

The various descriptions of the transformations in general give a picture, therefore, of the various perceptual situations that the children who described the buttons or pebbles, as more or fewer, or the water or clay as more or less, were focussing on.

Explanations Used by the Children

How do children in the various classes tested justify their responses? From their responses to the questions in the conservation and classification sections of the interview, it is possible to obtain a general picture of the conservation and non-conservation explanations, and classification, and non-classification explanations children used. From this it is possible also to obtain a picture of a number of recurrent explanations that children gave in the two sections of the interview.*

Explanations for Conservation and Non-Conservation

Greenfield[1] has described three types of justification ordered

* As their descriptions and explanations are provided, comparison will be made with results obtained from investigations similar to the present one to provide a picture of how the Iteso children fared.

[1] Patricia M. Greenfield, On culture and conservation. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966.

according to how much they reflect directly perceptible features of the current situation. One class is "perceptual reasons" which refers to the features of the display in front of the child. This would include any description of the buttons or pebbles and their arrangement; description of the glasses and their contents in the case of the conservation of liquid task; and description of the clay and its arrangement. Greenfield also includes under this class of reason the perceptual type of reason which expresses a conflict between the appearance ("it looks more") and reality ("but it's really the same") of the situation.

The second class of reasons--direct action reasons--refers to the act of bunching or spreading buttons or pebbles; the act of pouring water from one of the standard glasses into a dish or taller glass; and the act of rolling the clay into a "sausage" or cutting it up into pieces.

The third class of reasons--transformational reasons--represents a transformation of the situation "in the child's head." Transformation reasons are subdivided into action and identity transformations. Action transformations can be inverse ("if you were to pour it back"), or correlative ("if you were to pour the other"). These action transformations are called indirect-action reasons by Greenfield, in order to emphasize the fact that they are not observed in the experiment. Identity transformations refer to the original state of the system; in this case to the state of the equality in the two standard glasses, and the state of equality of the two balls of clay.

From an examination of the protocols of children giving non-conservation explanations, and of the table of children describing the conservation transformations as more or less, it is possible to select a number of recurrent explanations that refer to perceptual features of the situation. Also, from an examination of the protocols of children giving conservation explanations it is possible to select a number of explanations that can be classified either as action transformation reasons, or identity transformation reasons. In all cases, however, it is difficult to have a system that could encompass all explanations.

For task two (conservation of a number of buttons) the most frequent non-conservation explanations involved references to either the action of the interviewer, or the movement of the buttons, as for example: "You have spread mine"; "Those have been moved." Other perceptual explanations involved the description of one or both sets of buttons, as for example: "Yours are in one pile"; "The others are few"; "Yours are 11, mine are ten"; "Those are red"; "Those are yellow"; "They are many"; or, in the case of children whose explanations were considered transitional, "Because they are the same." A few explanations referred to a situation prior to orientation or practice: "You had seven red buttons, and I had ten." Similar explanations were given for task five (conservation of a number of pebbles).

For task three (conservation of an amount of water), the most frequent explanation for non-conservers involved reference to the action of the interviewer, "You poured it into a dish"; "You poured it into this tall cup"; or a description of the glasses or their contents: "The cup is small"; "This dish is big"; "This is little"; "Yours is full up," or "Mine is little." Other explanations simply stated: "This is the same as that," or "This is much, that is also much." Some explanations bordered on the bizarre. One child suggested that the reason why the water in the dish was more was because "it smells." When the water was transferred to a taller glass he said it was more because "it is red."

In the conservation of an amount of clay task, the commonest non-conservation explanations referred to the action of the interviewer: "You rolled it out"; "You squeezed it"; or "You cut up mine"; to the description of the clay: "It is rolled out"; "It is squeezed too much"; "This is round, that one is long." Other explanations simply stated: "This is big, that is also big," or "This and that are the same." A few children appealed to their own authority as the explanation for the clay being more: "It is more because I say so"; "I just thought out, 'now who has more?' then I knew."

Turning now to conservation explanations, it is also evident from an examination of the protocols of conservers that a number of recurrent explanations for each task emerge--explanations which are either action transformations or identity transformations.

For task two, conservation of a number of buttons, the most frequent explanations referred to the number being the same: "There are ten on each side"; "These are ten, those also are ten"; "The numbers are the same on each side." Other frequent explanations referred to a previous equality: "There were ten here, and ten there"; "Both sides had ten each"; "They were the same number before." Yet other explanations which were common stated: "I equated them already before"; "We equated them already before"; "They were equated already before."

Though few, both inverse and correlative action transformation explanations were given: "If you also spread yours out, they will be the same"; "These are in a row; if they were also brought together in a pile, they would be the same." Similar explanations were given for task five, the conservation of a number of pebbles.

The most frequent conservation explanations for task three (the conservation of an amount of clay) involved reference to the action of the child or of the interviewer, or the joint action of the two: "I have already equated them before"; or "You have already made both amounts equal before"; or "We made both amounts equal before." Other common explanations referred to the previous or present equality of the amounts of water: "They were the same amount before"; "They were equated before"; or "They are still the same." Some explanations referred to a conflict between appearance (it looks little; or it looks more), and reality ("but it is much," or "it is little"); and others to inverse and correlative actions: "If this (from dish) is poured back into here, it will be the same as this"; or "If this also (from standard glass) is poured into here (dish) it will be the same." Other explanations dealt with identity by recapitulation: "Because your water reached this level (pointing to empty standard glass) and mine also reached the same level." A few children gave as their justification for the water still being the "same" the fact that "nothing was spilled," or "We have not increased any." One said, "The same water which was here (empty standard glass) is the water which was poured into here (dish), and it was the same as that (in standard glass)."

Justifications for conservation of an amount of clay followed a similar trend--an appeal to the action of the subject, or of the interviewer; an appeal to previous equality or present equality; a justification by either inverse or correlative action transformation reason; and a justification using an identity transformation reason.

In discussing conservation responses of American children in Frank's experiment, Greenfield[1] has pointed to spontaneous remarks of older American children appealing to necessity of equality (it must be the same). Greenfield did not find one instance of such an appeal to necessity by Wolof children. In the present investigation, for a number of children in the P7 class, after the pattern of equalizing, transforming numbers or amount; asking for a judgment, and asking for an explanation became familiar, they would give explanations which appealed to the necessity of equality. One subject, for instance, stated: "No matter what you do to it; if they were the same before, they must remain the same provided nothing is added or taken away"--referring to the balls of clay.

Greenfield also suggests that when American children use identity as a justification for an equality judgment, they often say, "It's the same water" or "It looks like more, but really it is the same." They make identity a present phenomenon. Wolof children express identity through describing a past state, rather than a present one--identity by recapitulation. In the present investigation the protocols of

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[1] Patricia M. Greenfield, On culture and conservation. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966. Pp. 225-256.

children giving conservation explanations were replete with both types of identity explanations. It should of course be remembered that the oldest of Greenfield's Wolof subjects were from sixth grade, whereas in the present investigation the oldest group came from P7. Also, a wider range of conservation tasks was used in the present investigation, thus making the possibility of a wider range of conservation explanations more likely.

Description and Explanation of Sorting Tasks

In the sorting tasks the child had an opportunity to sort objects (animals in the first task, and seeds in the second), using several possible criteria, including colour, function, size, shape, and type. After each sort the child had an opportunity to explain the basis for putting certain objects together. The data were analyzed with particular reference to previous findings concerning the predominance of colour choices over other criteria in sorting objects by African subjects.

Suchman,[1] for instance, analyzed data of 119 Hausa children aged three to 15 on colour-form preferences. The children were pupils of Koranic schools, where children are taught to recite and memorize the Koran in Arabic characters without understanding them. Suchman found that the children showed no tendency to shift from colour to form preferences as Western children do from kindergarten age onwards.

[1] Rosslyn Gaines Suchman, Cultural differences in children's color and form preferences. The Journal of Social Psychology, 1966, 70, 3-10.

This finding is supported by the work of Greenfield, Reich and Olver[1] who asked unschooled Wolof children to group familiar objects with the possible bases for grouping being colour, form, and function. The investigators state: "For all practical purposes children at all ages base their groupings exclusively on the attribute of colour. The percentage of subjects using colour attributes as a basis for grouping were respectively: 70% of six- and seven-year-olds; 40% of eight-year-olds; 80% of ten- to sixteen-year-olds." But this was not true of the schooled children.

In Uganda too, the work of Evans and Segall[2] suggests the tendency among Baganda adults and children to sort primarily on the basis of colour. In the present study only schooled children were tested and so the results are presented in terms of those children who were able to sort on a consistent basis and those who were not.

For each of the two sorting tasks, two sets of tables were prepared (Tables 9 and 10--animals; Tables 11 and 12--seeds). One set showed the number of children who sorted correctly (Tables 9 and 11), and the other set showed the number of children who were unable to sort on a consistent basis (Tables 10 and 12).

In Table 10 the number of children using colour is 21 (32 percent) out of a total of 66 who were unable to sort correctly. In Table 12

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[1] Patricia M. Greenfield, L. C. Reich, & R. R. Olver. On culture and equivalence: II. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth, Wiley, 1966. Pp. 270-318.

[2] Judith L. Evans, & M. H. Segall, Learning to classify by color and by function: A study of concept discovery by Ganda children. The Journal of Social Psychology, 1969, 77, 35-53.

Table 9

Number and Percent of Children Revealing Correct Sorting of Animals*

Sorting Criterion	P1		P3		P5		P7		Total	
	N	%	N	%	N	%	N	%	N	%
Colour	4	80.0	3	12.0	1	3.3	1	3.0	9	9.6
Type	-	-	21	84.0	28	93.3	33	97.0	82	87.0
Function	-	-	1	4.0	-	-	-	-	1	1.1
Size	1	20.0	-	-	1	3.3	-	-	2	2.1
Total	5	100.0	25	100.0	30	99.9	34	100.0	94	99.8

* There are 40 children in each class.

Table 10

Number and Percent of Children Revealing Incorrect Sorting of Animals*

Sorting Criterion	P1		P3		P5		P7		Total	
	N	%	N	%	N	%	N	%	N	%
Colour	18	51.4	2	13.3	-	-	1	16.7	21	31.8
Type	8	22.9	13	86.7	8	80.0	5	83.3	34	51.5
Function	2	5.7	-	-	2	20.0	-	-	4	6.0
Size	2	5.7	-	-	-	-	-	-	2	3.0
Other	5	14.3	-	-	-	-	-	-	5	7.5
Total	35	100.0	15	100.0	10	100.0	6	100.0	66	99.9

* There are 40 children in each class.

Table 11

Number and Percent of Children Revealing Correct Sorting of Seeds*

Sorting Criterion	P1		P3		P5		P7		Total	
	N	%	N	%	N	%	N	%	N	%
Colour and size	2	25.0	2	6.3	2	6.3	-	-	6	5.5
Type	6	75.0	25	78.1	29	90.6	33	86.9	93	84.6
Colour and shape	-	-	4	12.5	-	-	3	7.9	7	6.4
Edibility	-	-	1	3.1	1	3.1	2	5.3	4	3.6
Total	8	100.0	32	100.0	32	100.0	38	100.0	110	100.1

* There are 40 children in each class.

Table 12

Number and Percent of Children Revealing Incorrect Sorting of Seeds*

Sorting Criterion	P1		P3		P5		P7		Total	
	N	%	N	%	N	%	N	%	N	%
Colour	18	56.3	7	87.5	2	25.0	2	100.0	29	58.0
Function	-	-	-	-	1	12.5	-	-	1	2.0
Size	1	3.1	-	-	-	-	-	-	1	2.0
Edibility	-	-	-	-	1	12.5	-	-	1	2.0
Other	13	40.6	1	12.5	[illegible]	50.0	-	-	18	36.0
Total	32	100.0	8	100.0	8	100.0	2	100.0	50	100.0

* There are 40 children in each class.

the number of children choosing colour as the basis for sorting is the biggest--29 or 58 percent of a total of 50 children who sorted incorrectly. This finding seems to be in accord with others where colour has been found to be more predominant over form in African samples.

There were other children, in lower classes, who when asked to place objects which are alike together, engaged in methodically placing all the animals or seeds into lines, or piles, or into concentric circles, forming what Piaget would describe as a "graphic collection." What was impressive also was the amount of time younger children who were unable to sort correctly spent examining the various animals and seeds, noting: "This is different"; "This has a spot here, it is not like that one"; and separating cows or sheep which had slightly shorter or longer horns than the others and suggesting they were not like the others because of that fact.

In their explanations children gave a variety of justifications which often conflicted each other. Cows were different from sheep because "cows sleep outside and sheep also sleep outside." Peas were like nuts "because these (nuts) are nice, and those (peas) don't sprout."

Turning now to Table 9 showing children sorting on a consistent basis or bases, it is clear that colour plays a minor role as a criterion for sorting. Of the total number of 94 children who sorted correctly on the "animals" task, only nine (9.6 percent) used colour as a basis for sorting. The majority of these came from P1 and P3. In contrast 82 children (87 percent), sorted on the basis of type of animals.

A similar observation applies to the table showing the number of children who sorted correctly on the "seeds" task (Table 11). Out of 110 children who sorted correctly, only 13 (12 percent) used colour in combination with other criteria (size or shape) as a basis for sorting. In contrast 93 children (85 percent) used "type of seed" as the basis for sorting. This result is more significant when it is noted that two of the local seeds (egasia and elira) were both green in colour and could have been placed together, if colour were the more predominant criterion for sorting.

The explanations which the children gave to support the basis for their sort indicated that they were focussing their attention on the appropriate aspects of the situation. Thus goats were put together "because they are all one type of animals." Dogs were put together "because they are used for hunting"' and cows were in one group "because we use them for marrying women." If one kind of seed was separated from another, it was because "they are ovular and spotted," or "their colour and size are the same"; or "they all belong to the group of things we call ..."

The finding regarding correct sorters of animals and seeds seems to suggest that when other possible criteria or bases for sorting are present, colour as a basis for sorting does not appear to be as preponderant as has been suggested, at least for the type of tasks used among this rural sample. This observation seems to be supported by Almy's exploratory work among the Baganda. Regarding performance of the P1 and P3 children she tested she states: "It appears that for at least a quarter of the children at both school levels, form is a more salient property than color, at least in these tasks."[1]

Description and Explanation of Inclusion Relation Tasks

Table 13 shows the number of children in each class who responded to class inclusion questions and to the sub-class comparison questions. When children are asked the question "Are there more cows or more animals?" the majority of the children in each class responded that there were more cows (95 percent in P1; 92.5 percent in P3; 82.5 in P5 and 77.5 percent in P7). Altogether 87 percent of the children described the cows as more than the animals.

When asked to compare the subclass of cows with that of dogs, the majority correctly responded that there were "more cows" than dogs. Of the five children in P1 who did not agree that this was so, four described the dogs as more than the cows and one said there were as many cows as there were dogs.

In the last question in this section the children were asked the question "Are there more animals, or more cows?" Again, the majority of the children judged that there were more cows.

The explanations of the children reflected their descriptions of the cows or animals as "more"; or of the cows or dogs as "more."

The most predominant explanation for judging the cows more referred to there being only two dogs, and seven cows: "There are only two dogs, and seven cows"; "The cows are many; the dogs are few."

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[1] Millie Almy, The usefulness of Piagetian methods for studying primary school children in Uganda. In Millie Almy, J. R. Davitz, & M. A. White, Studying school children in Uganda: Four reports of exploratory research. New York: Teachers College Press, 1970. Pp. 1-24.

Table 13

Number and Percent of Children Describing Inclusion Relations in Task 3* as More**

Question	Description	P1 N	P1 %	P3 N	P3 %	P5 N	P5 %	P7 N	P7 %	Total N	Total %
Are there more cows or more animals?	More cows	38	95.0	37	92.5	33	82.5	31	77.5	139	87.0
	More animals	2	5.0	3	7.5	7	17.5	9	22.5	21	13.0
More cows or more dogs?	More cows	35+	82.5	40	100.0	40	100.0	40	100.0	155	97.0
	More dogs	4+	10.0	-	-	-	-	-	-	4	2.5
More animals or more cows?	More cows	40	100.0	37	92.5	28	70.0	27	76.5	132	82.5
	More animals	-	-	3	7.5	12	30.0	13	32.5	28	17.5

* For the inclusion task involving the use of cows and dogs.

** There are 40 children in each class.

+ One subject said, "same."

Other types of explanation suggested that some children were paying attention to aspects other than the investigator's questions intended. One child, for instance, suggested that the cows were more "because they do not talk." Another said that they were more because "I can tell by looking at their horns that they are many." Other explanations referred to the colour of the cows as the reason why they were more; or to the idea that "they multiply quicker than others" or that "they sleep outside, in the kraal."

Children who judged that the animals were more gave as their justification the fact that they formed the superordinate class of the two subclasses of cows and dogs: "Cows are animals; dogs also are animals"; or "All of them are animals"; or "If you put all of them together, they belong to the group of things called animals."

In the last inclusion relations task, the first two questions test the child's ability to differentiate between subclasses, before the crucial inclusion questions are posed. As is evident from Table 14 most children (97 percent in both questions) were able to differentiate between subclasses.

When the first inclusion relation question "Are there more circles or more blue things?" is posed, very few children described the circles or the blue things as being "more." The majority (114 or 71 percent) suggested that they were the "same." Other children pointed out, in response to the question, that the white squares were "more." The largest number in this category were in Pl.

Table 14

Number and Percent of Children Describing Inclusion Relations in Task 4* as More**

Question	Description	P1 N	P1 %	P3 N	P3 %	P5 N	P5 %	P7 N	P7 %	Total N	Total %
Are all squares white?	Yes	3	7.5	2	5.0	1	2.5	-	-	6	3.8
	No	37	92.5	30	95.0	39	97.5	40	100.0	154	96.3
Are all blue things circles?	Yes	3	7.5	2	5.0	1	2.5	-	-	6	3.8
	No	37	92.5	38	95.0	39	97.5	40	100.0	154	96.3
Are there more circles or more blue things?	More circles	3	7.5	-	-	-	-	-	-	3	1.9
	More blue	4	10.0	1	2.5	1	2.5	3	7.5	9	5.6
	Same	12	30.0	31	77.5	34	85.0	37	92.5	114	71.0
	More white squares	21	52.5	8	20.0	5	12.5	-	-	34	21.5
Are there more blue things than squares or same, or fewer?	More blues	-	-	1	2.5	-	-	-	-	1	0.6
	Same	12	30.0	17	42.5	25	62.5	22	55.0	76	47.5
	Fewer	6	15.0	12	30.0	11	27.5	15	37.5	44	27.5
	More white squares	22	55.0	10	25.0	4	10.0	3	7.5	39	24.4

* Class inclusion problems using squares and circles.

** There are 40 children in each class.

When next the children were asked "Are there more blue things than squares, or the same, or fewer?" a large number (76) described them as "same"; and a sizable number (44) described them as "fewer," and about an equal number (39) suggested that there were more white things.

The children's explanations again reflected their descriptions of the circles or blue things as "more," or "same," or their referring to the white squares as "fewer" or "more."

The most prevalent explanation of those who in comparing circles and blue things or blue things and squares pointed out that they were "same," was directed to a comparison of two blue circles and two blue squares, or to a comparison of four blue things and four white squares. For the subjects who described the white squares as "more," the most prevalant explanation referred to the fact that there were four white squares compared either to the two blue squares or to two blue circles. Explanations which did not fall into any category included one from a P7 child who explained that the white squares were more "because if they were to fight, the white ones would beat up the others as they (blue squares) are only two."

Of those who in response to the last question described the blue things as fewer than squares, quite a number gave as their explanation, the fact that there were six squares compared to four blue things. But the majority again understood the question to refer to a judgment comparing squares with either the two blue circles or the two blue squares.

Ahr and Youniss[1] have found that children of chronological age six and eight consistently responded to their inclusion relation problem as if the investigators had asked them to compare sub-classes within the superordinate class. Older children responded to the intended class inclusion relation. These investigators also found that for both younger groups, but not for the older group, errors increased as the numerical difference between subclasses increased.

In the present investigation most children in all classes tested responded to the inclusion relation questions as if the investigator had asked them to compare subclasses within the superordinate classes. There was a tendency, in fact, for some responses comparing subclasses to increase in the older children. The number of children, for instance, who gave a "same" response to the last two questions in the last inclusion task rose steadily from P1 through P7.

Inhelder and Piaget[2] and Wohlwill[3] have proposed that when the child fails to judge according to the inclusion relations, the reason may be that he is responding to the subclass relations even though the

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1 Paul R. Ahr, & J. Youniss, Reasons for failure on the class inclusion problem. Child Development, 1970, 41, 131-143.

2 Bärbel Inhelder, & J. Piaget, The early growth of logic in the child. New York: Harper & Row, 1964.

3 Joachim F. Wohlwill, Responses to class inclusion questions for verbally and pictorially presented items. Child Development, 1968, 39, 449-465.

investigator's question does not direct him to do so. Wohlwill has further hypothesized that "the perception of two contrasting subclasses, unbalanced as to number, creates a strong tendency to translate a class inclusion question into a subclass comparison question."[1] In the present investigation, it seems both conditions were operating.

There were seven cows and two dogs in the first inclusion problem. Then there were four white squares, two blue squares, and two blue circles in the second problem. The majority of the descriptions and explanations of the children clearly showed that they were responding to the subclass comparisons rather than to the class inclusion questions intended by the investigator.

Relationship Among Abilities

Piaget has suggested that the abilities of conservation, seriation and classification develop concurrently. In an attempt to assess this relationship, contingency tables were prepared to show the relationships within the abilities of conservation, seriation and classification, and then another table was prepared to show the relationship among those abilities. Tables showing relationships within abilities appear in Appendix D.

Relationship Among Conservation Tasks

The extent to which children who were able to conserve in one of the tasks could also conserve in another is shown in Table 15.

Ninety-seven children of the total 160 children conserved in the pebble's task. But of these 97, only 85 had also been able to conserve

[1] Wohlwill, Child Development, 1968, 39, 462.

on the button's task. Of the 101 children who were able to conserve in the water task, only 85 and 93 respectively had also been able to conserve in the buttons and pebbles tasks. Only 85 children of the total 160 children conserved in the clay task. Of these 85 children, 75, 80, and 84 respectively, also conserved in the buttons, pebbles and water tasks.

<u>Relationship Among Seriation Tasks</u>

In Table 16 the relationship among seriation tasks is indicated. One hundred and three children of the total of 160 children were able to make a correct series of sticks. Of these 103 children, only 95 had also been able to make a correct series on the women and basket's task. Of the 107 children who were able to make a correct series in the cow's task, only 96 and 86 respectively had also been successful in making correct series in the women and basket's; and the stick's tasks. Only 15 children of the total of 160 were able to perform a correct ordinal correspondence relationship. Of these, 15, 14, and 15 respectively were also able to make a correct series in the other seriation tasks.

<u>Relationship Among Classification Tasks</u>

Table 17 indicates the relationship among classification tasks. Ninety-three children of the total of 160 children were able to sort correctly in the animal's task. Of these 93, only 79 had also been able to sort correctly in the seeds task. Only ten children answered correctly the inclusion relation question dealing with cows and dogs. Of these, ten and nine respectively had also been able to perform a correct sort in the seed's, and animal's tasks. None of the 160 children were able to answer correctly the inclusion relation question involving squares and circles.

Relationships Among the Abilities

According to Piaget, abilities of conservation, seriation, and classification develop concurrently so that children who are operational on conservation tasks would also be expected to be operational on seriation and classification tasks.

The extent to which children who are operational, transitional or non-operational in one set of abilities, say conservation, were also operational, transitional, or non-operational in another is shown in Table 18.

To determine children considered operational in conservation tasks it was necessary to examine the performance of each child across all the conservation tasks. A child who scored zero across all the four tasks, or a combination of two zeros and two ones was considered non-operational. A child who scored two across all conservation tasks, or who scored two in the two tasks considered theoretically more difficult, but scored zero or one in the theoretically less difficult tasks, was considered operational. A child who got a score between these two extremes was considered transitional. A similar procedure was used to determine children who were non-operational, transitional or operational in the seriation and classification sections.

Table 18

Relationships Among Abilities of Conservation,

Seriation and Classification

Conservation	Seriation: Non-Operational	Transitional	Operational	Total
Non-Operational	28	11	1	40
Transitional	6	28	4	38
Operational	1	71	10	82
Total	35	110	15	160
Conservation	**Classification**			
Non-Operational	32	8	-	40
Transitional	15	23	-	38
Operational	20	62	-	82
Total	67	93	-	160
Seriation	**Classification**			
Non-Operational	30	5	-	35
Transitional	35	75	-	110
Operational	2	13	-	15
Total	67	93	-	160

Of the 82 children who were operational in conservation tasks, only ten were also operational in the seriation tasks. Of the 38 children classified as transitional on the conservation tasks, only 28 were also classified as transitional in the seriation tasks; and of the 40 children classified as non-operational in the conservation tasks, only 28 were also non-operational in the seriation tasks.

The middle section of the table indicates the relationship between conservation and classification. Of the 82 children who were operational in conservation tasks, none were operational in the classification tasks; of the 38 classified as transitional in the conservation tasks, only 23 were also transitional in the classification tasks; and of the 40 children classified as non-operational in the conservation tasks, 32 were also non-operational in the classification tasks.

The first two sections of the table therefore suggest that the close relationship between conservation and seriation, or between conservation and classification abilities as stated in the Piagetian theory is only partially upheld.

The third section of Table 18 indicates that of 15 children classified as operational in seriation tasks, none were so classified in the classification tasks. But of the 110 children classified as transitional in the seriation tasks, 75 are also so classified in the classification tasks; and of the 35 children who are non-operational in the seriation tasks, 30 are also non-operational in the classification tasks. This section of the table suggests that the abilities involved in the seriation and classification are closer to one another than either of the two are to conservation.

Sex Differences

The results of the children performing operationally in each of the tasks presented in this study were examined in terms of sex differences. It was assumed that differences in upbringing of boys and girls might have some effect on their performance in these tasks. In both P1 and P3 there were 20 boys and 20 girls in each class. In P5 there were 32 boys compared to eight girls; and in P7 there were 30 boys compared to ten girls.

Tables 19-22 show the number and percent of boys and girls for each class performing successfully in the conservation, seriation and classification tasks.

Interesting differences are observed in the performance of the two groups. The boys generally perform better in P1--especially in conservation tasks. In P3 the performance of the two groups seems to even out. In P5 and P7 the boys again seem to have a better performance than girls. Table 23 shows the results of all the classes combined. From this table it is clear for each of the tasks that the boys are decidedly better than the girls.

The differences between boys and girls may reflect the social expectation of compliance which may be especially strong for girls. The differences, however, should not be interpreted as significant as there were uneven numbers as between boys and girls in the upper classes, and as the sample was not very big.

Table 19

Number and Percent of Boys and Girls in P1 Revealing Operational Performance in the Various Tasks

Task	Children			
	Boys (N = 20)		Girls (N = 20)	
	N	%	N	%
Conservation				
Buttons	1	5	2	10
Pebbles	4	20	-	-
Water	5	25	-	-
Clay	4	20	-	-
Seriation				
Women and baskets	3	15	1	5
Sticks	3	15	1	5
Cows	6	30	2	10
Classification				
Sorting animals	3	15	2	10
Sorting seeds	5	25	3	15

Table 20

Number and Percent of Boys and Girls in P3 Revealing Operational Performance in the Various Tasks

Task	Children			
	Boys (N = 20)		Girls (N = 20)	
	N	%	N	%
Conservation				
Buttons	11	55	13	65
Pebbles	11	55	13	65
Water	14	70	11	55
Clay	10	50	10	50
Seriation				
Women and baskets	16	80	18	90
Sticks	11	55	14	70
Cows	12	60	17	85
Classification				
Sorting animals	12	60	12	60
Sorting seeds	15	75	17	85

Table 21

Number and Percent of Boys and Girls in P5 Revealing Operational Performance in the Various Tasks

Task	Boys (N = 32) N	Boys (N = 32) %	Girls (N = 8) N	Girls (N = 8) %
Conservation				
Buttons	28	87.5	5	62.5
Pebbles	28	87.5	5	62.5
Water	28	87.5	5	62.5
Clay	22	68.8	4	50.0
Seriation				
Women and baskets	31	96.9	7	87.5
Sticks	30	93.8	6	75.0
Cows	28	87.5	7	87.5
Ordinal correspondence	3	9.4	1	12.5
Classification				
Sorting animals	23	71.9	7	87.5
Sorting seeds	24	75.0	8	100.0
Inclusion: cows and dogs	2	6.3	-	-

Table 22

Number and Percent of Boys and Girls in P7 Revealing Operational Performance in the Various Tasks

Task	Boys (N = 30) N	Boys (N = 30) %	Girls (N = 10) N	Girls (N = 10) %
Conservation				
Buttons	29	96.7	8	80.0
Pebbles	29	96.7	7	70.0
Water	29	96.7	9	90.0
Clay	28	93.3	7	70.0
Seriation				
Women and baskets	29	96.7	9	90.0
Sticks	29	96.7	9	90.0
Cows	27	90.0	8	80.0
Ordinal correspondence	8	26.7	3	30.0
Classification				
Sorting animals	26	86.7	8	80.0
Sorting seeds	29	96.7	9	90.0
Inclusion: cows and dogs	6	20.0	2	20.0

Table 23

Number and Percent of Boys and Girls in All Classes Revealing Operational Performance in the Various Tasks

Task	Children			
	Boys (N = 102)		Girls (N = 58)	
	N	%	N	%
Conservation				
Buttons	69	67.6	28	48.3
Pebbles	72	70.6	25	43.1
Water	76	74.5	25	43.1
Clay	64	62.7	21	36.2
Seriation				
Women and baskets	79	72.5	35	60.3
Sticks	73	71.6	30	51.7
Cows	73	71.6	34	58.6
Ordinal correspondence	11	10.8	4	6.9
Classification				
Sorting animals	64	62.7	29	50.0
Sorting seeds	73	71.6	37	63.8
Inclusion: cows and dogs	8	7.8	2	3.4

Summary of Results

The results of the present investigation have confirmed the relevance of Piaget's theory and method of experimentation to the study of Iteso children.

The performance of the children on conservation tasks indicates a clear developmental trend--with the number and percent of children conserving rising from lower to the upper classes of the primary school. In the seriation section, whereas there is a clear developmental trend in performance on most tasks, performance on the placement of objects in ordinal correspondence is clearly very difficult, even for older children. There is a contrast in the performance on the classification tasks, with the sorting tasks showing the usual developmental sequence, and the class inclusion problems being extremely difficult for all children.

The descriptions of the transformations, and the justifications that the children used in general, underlines the conclusions already obtained from an examination of evidence for or against conservation or classification.

Information from contingency tables indicates that there is only partial support for the assertion concerning the relationship between the abilities of conservation, seriation, and classification.

Performance on the conservation and sorting tasks supports Piaget's claim concerning the relationship between maturation and the development of logical abilities. The poor performance on ordinal correspondence and the class inclusion problems suggests that maturation alone is not enough to explain this development.

It now seems in order to turn to a discussion of these findings and their implications for further research, and for education in Uganda.

IV - DISCUSSION AND IMPLICATIONS

The investigation dealt with two major questions. The first was concerned with the extent to which the validity of Piaget's claim concerning the invariant development of stages of thinking was observable in the African population tested. The second question dealt with the claim concerning the concurrent development of abilities of conservation, seriation, and classification.

The results of the study support, in general, Piaget's claim concerning the sequence of development from pre-operational to concrete operational thought. The judgments and explanations given by children corresponded, in general, to those described by Piagetian studies. Non-conservation answers were invariably justified by reference to the perceptual features of the immediate situation, while conservation responses were justified with reference to past or future situations. Children who were unable to seriate placed objects on a haphazard basis, while those who could seriate correctly applied a more systematic approach. Children who did not sort correctly formed "graphic collections" or used inconsistent criteria for sorting, while those who sorted correctly used consistent criteria. Incorrect solutions to class inclusion problems were invariably justified by reference to subclass comparisons, while correct solutions were explained by reference to the more inclusive, superordinate class. However, by P7 level, conservation was still not achieved by all of the children. Also, some of the tasks, especially the ordinal correspondence task, and the two inclusion relation tasks were extremely difficult even for the oldest subjects. Brief comment on the performance of the present group on the conservation, seriation, and classification tasks in relation to results from previous investigations seem in order. Comment will also be made on the role of experience in relation to the findings from the present investigation. In this connection the investigator's perspective is in part that of one who belongs to the Ateso culture from which the subjects come.

Conservation

The results of the performance on conservation tasks were similar to those obtained in West Africa by Etuk,[1] Greenfield,[2] and Price-Williams.[3]

The results seem to differ from those obtained in Uganda by Vernon,[4] who found that the 11-year-old boys in P5 whom he tested made very low scores on Piagetian tasks he used. He states: "The worst deficiencies were in all the conservation tasks; over 50 percent being non-conservers in every item; they were very low, also, on number concepts."[5] Except

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[1] Elizabeth S. Etuk, The development of number concepts among the Yoruba-speaking Nigerian children. Unpublished doctoral dissertation, Teachers College, Columbia University, 1967.

[2] Patricia M. Greenfield, On culture and conservation. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966.

[3] D. R. Price-Williams, A study concerning concepts of conservation of quantities among primitive children. Acta Psychologica, 1961, 18, 297-305.

[4] Philip E. Vernon, Intelligence and cultural environment. London: Methuen, 1969.

[5] Vernon, Intelligence and cultural environment. P. 184.

for the percent of children in the conservation of an amount of clay, the performance for all the other conservation tasks for the primary five class in this study were 82.5 percent; and in P7 there were at least 87.5 percent children conserving in each task. Vernon's subjects were, however, interviewed in English, and as he himself observes, "much of the difficulty may be one of communication of ideas."[1] But Vernon also observes in another section of his book that magical beliefs and superstitions play a large part in African thinking. He suggests that poor performance on conservation tasks may be explained, in part at least, by belief in magic and superstition: "If we follow Piaget's views, we would expect magical beliefs to be linked with non-conservation as aspects of the pre-operational stage."[2]

Vernon's subjects were selected from an urban area. The children in the present study were selected from a rural area. Yet their performance was much better than that of Vernon's subjects. Apart from Vernon's sample being small, methodological differences as between the two investigations may have been responsible for this difference. The subjects in the present study were interviewed in their own language, by the investigator who is himself an Etesot. Special pains were taken to communicate with the subjects. The interviews were recorded verbatim in Ateso and translated into English later. The interviews were also tape-recorded and the tape-recordings were used to amplify, where necessary, information obtained from the children's protocols. A

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[1] Philip E. Vernon, Intelligence and cultural environment. London: Methuen, 1969. P. 184.

[2] Vernon, Intelligence and cultural environment. P. 82.

number of familiar materials including clay, pebbles, and buttons were used, and these were presented using a local story familiar to the children. The use of the children's own language, and the use of culturally appropriate test materials presented in a culturally appropriate manner, has therefore, provided a more meaningful picture of Ugandan children's performance on conservation tasks.

There is parallel development of the abilities of conservation of a number of buttons, and a number of pebbles, and conservation of an amount of liquid. This finding does not appear to support the developmental sequence of task difficulty found among American children by Almy,[1] although the performance on the conservation of an amount of clay does. The finding, however, seems to agree with the preliminary results obtained in the Yoruba samples used by Lloyd[2] who adapted Almy's tasks. Lloyd seems to suggest that counting and hence number is as difficult, if not more difficult, for Oje children in Nigeria than conservation of discrete quantity. In a forthcoming article, Lloyd,[3] presents her final results on her work on conservation. The results confirm those of the preliminary study concerning Oje children. Lloyd also finds that Oje children's performance is better than American children's performance on task C (conservation of the equality of two amounts of water through

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[1] Millie Almy, E. Chittenden, & P. Miller, Young children's thinking. New York: Teachers College Press, 1966.

[2] Barbara B. Lloyd, Antecedents of personality and ability differences in Yoruba children. Paper read at the conference on African studies, University of Sussex, December, 1968.

[3] Personal communication.

one transformation), but not as good on task A (conservation of the equality of two sets of blocks through two transformations). Additionally, elite Yoruba subjects perform at a consistently higher level than middle class American children of the same age.

In conclusion, performance of Iteso children on conservation tasks has indicated the same developmental sequence found in other African samples, but has also underlined the importance of methodological approaches used in the investigation of such an ability.

Seriation

Performance on seriation tasks indicates a clear developmental trend. This finding supports that of Almy[1] whose exploratory investigation among Baganda children indicates that they have no special difficulty with seriation tasks she used. The use of a simple story based on a sight familiar to children was built around each of the tasks in the present study and may have facilitated performance on them. In task one the children were informed that cows were going to the river to drink water--a sight quite familiar as the Iteso are a cattle keeping tribe. In task two the child was informed about a rich man's seven wives going to the market to sell ground nuts. This too is well known to the children as polygamy is widespread in Teso. In task three, the sticks were "boys" lining up to enter their classroom--a routine children perform several times each school day.

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[1] Millie Almy, The usefulness of Piagetian methods for early primary education in Uganda. In Millie Almy, J. Davitz, & M. A. White, Studying school children in Uganda: Four reports of exploratory research. New York: Teachers College Press, 1970. Pp. 1-24.

Classification

There is a clear developmental trend in ability to sort correctly. This developmental trend indicates that schooled Iteso children have no special difficulty in "abstracting" and naming classes. This finding confirms that of Price-Williams[1] in Nigeria of classification of familiar objects by both the schooled and unschooled Tiv children. It also supports Greenfield's[2] report of the well-developed equivalence grouping of pictures of common objects among Senegalese who attend school, though not among unschooled "bush" children. The finding also supports one of Vernon's findings among the Baganda of Uganda. Vernon found that his sorting task was one of the better done tests in the "Piaget Battery" which he applied to a group of 50 boys in an urban school in Kampala. The boys were 11 years old.

Performance on class inclusion problems was extremely difficult even for older children in P7.

Piaget's own studies have indicated that class inclusion tasks are difficult for even older children. A scalogram study of classificatory development by Kofsky[3] suggests that the particular tasks included here would fall next to the most difficult of the 11 tasks she used.

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[1] D. R. Price-Williams, Abstract and concrete modes of classification in a primitive society. British Journal of Educational Psychology, 1962, 32, 50-61.

[2] Patricia M. Greenfield, On culture and conservation. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966.

[3] Ellin Kofsky, A scalogram study of classificatory development. Child Development, 1966, 37 (1), 191-204.

The finding about class inclusion problems confirms Vernon's[1] earlier work among Baganda in which he attempted to score the "Piaget Battery" for total error. He found that though the conservation tasks yielded the most consistent group factor, the logical inclusion test had to be omitted. He observes: "Perhaps because of its linguistic complexity it was always the least reliable and most specific of the tasks." In the present investigation also the class inclusion problems were the most difficult.

In one of the inclusion relation tasks, the local practice in considering some types of animals, as well as linguistic confusion, may have been responsible for the frequent comparison between subclasses rather than the comparison between the subclasses and the superordinate class which was intended by the investigator's question. In the first inclusion relation task, cows and dogs formed the subclasses of the superordinate class of animals. In discussing or considering cows and dogs, Iteso usually separate edible from inedible things (dogs are inedible) and therefore to have placed cows and dogs together may have appeared rather artificial and unduly distracting. A number of children, in fact, having made their responses to the investigator's questions went on to observe: "These are not put together--they can't share a kraal." Then there is the question of the possible semantic confusion.

The word for animals (itiang), the superordinate class, has the connotation of "wild" as opposed to "domestic" animals; so that to have

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[1] Philip E. Vernon, Intelligence and cultural environment. London: Methuen, 1969. P. 140.

asked children whether there were more cows or more animals whilst pointing to the toys on the table may have had the unwitting effect of forcing them to compare subclasses of cows and dogs.

In summary, whereas performance on sorting tasks follows the usual developmental sequence, performance on class inclusion problems, possibly because of their linguistic complexity, seems most difficult.

Relationship Among Abilities

Piaget asserts that there is a close relationship between underlying abilities in any one stage of development. The results in the present investigation point only to a partial relationship among the abilities of conservation, seriation, and classification.

This finding supports those of previous investigators. Dodwell,[1] for instance, found that there was a low correlation in the performance of problems involving cardinal numbers and logical classes. He explained this finding on the basis that whereas children typically receive considerable instruction in the development of number concepts, little, if any, experience is provided in the nature of hierarchical classifications. Kofsky[2] also found only partial support for Piaget's claim.

Almy's[3] earlier observation is still relevant to all these findings:

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[1] P. C. Dodwell, Relations between the understanding of the logic of classes and of cardinal number in children. Canadian Journal of Psychology, 1962, 16, 152-160.

[2] Ellin Kofsky, A scalogram study of classificatory development. Child Development, 1966, 37 (1), 191-204.

[3] Millie Almy, E. Chittenden, & P. Miller, Young children's thinking. New York: Teachers College Press, 1966. P. 37.

> Differences in the nature of the tasks provided and differences in the age groups studied may account for discrepant results in these and similar studies. Or it may be the two abilities are indeed related as Piaget suggests, but that educational and other experiences have tended to facilitate the development of one and not the other.

In other words, parallel development might occur only where the environment of children is relatively enriched, and where instruction is geared toward providing a favourable opportunity for cognitive growth in all areas.

In conclusion, this study, as previous similar studies, provides better support for invariance of the stages than for the hierarchical and integrative nature of cognitive growth implied by Piaget's theory.

Sex Differences

Boys performed better than girls in all tasks. Quite surprising is the better performance of boys compared to girls in the water, pebbles and buttons tasks, because by tradition girls have a lot more practice with chores involving the use of water, and the ceremonial use of pebbles and in school do a lot more sewing and therefore have more experience with buttons than do boys. But when considered alongside clan taboos (italia) which are by tradition observed more by females than by males this better performance of boys may not be surprising. The taboos or things which must not be done include girls playing with things like pebbles.

Part of the differences in performance between boys and girls may also be accounted for by the fact that there was an imbalance as between the number of older and younger girls. Of the 58 girls interviewed, 18 came from P5 and P7, and the remainder were from P1 and P3.

Another explanation may be that girls may not be motivated to do well as the boys because societal expectations encourage their better performance in other areas. In rural Teso a girl establishes her marriageable quality not by excelling at school or at games that boys play but by working hard at all things concerning the domestic duties of a wife--cooking, gathering firewood, harmonising the affairs of a homestead, and knowing and strictly following clan taboos. The frequently heard assertion by parents that it is a "waste of money" sending girls to school, and the high attrition rate of school girls attest to this fairly prevalent attitude in rural Teso.

In summary, differences in performances of boys and girls may be due to a number of factors including motivational factors, and societal attitudes concerning the role of women.

The Role of Environment and Experiences

Goodnow[1] has suggested that the further one moves away from a technological society, the more there is a tendency for some tasks to shift their difficulty level more than others. Goodnow also suggests that the tasks which shift their difficulty more seem to be "predominantly tasks where the child has to transform an event in his head, has to shift or shuffle things around by some kind of visualizing or imaging rather than by carrying out an overt series of changes." The explanations suggested for differences arising in skills at mental "shuffling" or transforming amongst various groups are placed by Goodnow into two

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[1] Jacqueline J. Goodnow, Cultural variations and cognitive skills. In D. R. Price-Williams (Ed.), Cross-cultural studies. New York: Penguin Books, 1969. Pp. 246-264.

groups; one emphasizing the role of general attitudes; the other stressing more specific experiences.

According to Goodnow's analysis then, cultures would not be expected to differ much on such tasks as conservation, since most cultures provide practice and the pragmatic models needed for judgment of properties like amount. Cultures would be expected to differ more among themselves in the practice they provide in mental as against physical shuffling, as in some cultures a lot of time would be spent in constructing things, putting them together and taking them apart, or matching a drawn shape against the memory of an object. Ordinal relations and class inclusion relations involve "mental shuffling."

In discussing the question of why it is that in the normal course of events conservation appears without any external intervention being required, Wohlwill[1] has recently suggested that conservation occurs as a result of transfer from performance of activities other than conservation but which are presumably functionally linked to conservation.

In examining the life of Iteso rural children one finds that explanations both by Wohlwill and Goodnow seem to hold because there are a number of activities engaged in that could form the basis for transfer to conservation and seriation, or that could constitute action models for the children.

The Iteso are a cattle keeping tribe who live by subsistence mixed farming. Activities engaged in include the building of huts, using

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[1] Joachim F. Wohlwill, The place of structured experience in early cognitive development. Interchange, 1970, 1 (2), 13-27.

sticks and clay; the planting of seeds; weeding of gardens, and harvesting of crops; and cattle herding.

After school boys engage in activities such as helping their fathers to graze the cattle; and girls occupy themselves with the traditional chores of cooking, fetching water from the well, or firewood from the forest. In the evening, since cattle herding is done on a co-operative basis, cows are sorted by the kraal to which they belong, and calves are separated by the hut into which they are driven for the night. Children, therefore, get an experience in separating the cows and their calves by colour, size, or by the kraal to which they belong.

Children get similar experience with various seeds. During the planting season children help in sowing them "broadcast" and during the weeding season there is an encouragement to differentiate between millet or sorghum, and weeds like cockle.

The experience with separating cows from various kraals, or seeds from weeds, may therefore have transferred to the sorting tasks in the present investigation. Similarly, the experience with sticks and clay used in the building of huts, and with water and pebbles, may have transferred to conservation and seriation tasks involving use of those objects. Experience with the various objects, therefore, may have provided the necessary background referred to both by Wohlwill and Goodnow, and confirms Piaget's assertion with regard to the role of experience in the development of logical abilities.

These observations, however, do not fit all the facts of the results from the present investigation. For instance, performance on the conservation of an amount of clay task was most difficult of the conservation tasks. This is surprising when considered along the fact that children have plenty of experience in seeing it being used for building of huts, and in their making clay figures of cows and naming them. But when considered in relation to some beliefs, such as the belief that if children make an excessive use of clay they develop hunchbacks, this finding may not be surprising because if a number of children believe this, as they must if an adult tells them, then their future use of clay is clearly curtailed. The observation is not also surprising when considered from the point of view of Piaget's theory which contends that experiential factors are important, but that they operate under the ambit of maturational factors in the development of logical abilities.

Turning now to poor performance on ordinal correspondence and class inclusion tasks, it may be observed that correct solution of these tasks would involve what Goodnow[1] calls "a shuffling in the head." Goodnow suggests that these tasks are not consistent across cultures, as in some cultures less time is spent in constructing things. Among the games played by Iteso rural children, apart from the making of clay figures of cows, none involves the manipulation of things. This lack of manipulative activity is commented on by Vernon[2] who was working among the Baganda.

In a test applied to four cultural groups--Jamaicans, Ugandans, and Eskimo and Canadian Indians--Vernon found that the Ugandan boys, in

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[1] Jacquiline J. Goodnow, Cultural variations and cognitive skills. In D. R. Price-Williams (Ed.), Cross-cultural studies. New York: Penguin Books, 1969. Pp. 246-264.

[2] Philip E. Vernon, Measurements of learning. In Nevin S. Scimshaw, & J. E. Gordon (Eds.), Malnutrition, learning and behavior. Cambridge, Massachusetts: M. I. T. Press, 1968. Pp. 486-497.

common with other African groups, are the lowest on a test of recognition of perspective or the third dimension in drawing."[1] Vernon reasons that "this can hardly be attributed merely to lack of picture books in the homes because the Eskimos lack these too. More probably the young African child is particularly deprived of experience that underlies visuokinesthetic schemata, the manipulation of objects, toys, and utensils."[2]

Another factor may be the social expectation of compliance, and how this interferes with the demands of the tasks included in the tests. In rural Teso a good boy is one who helps his father in digging in the garden, looking after cows, and who is generally obedient, without questioning the father's authority in running the affairs of the home. A good girl is one who helps her mother in all the chores of the home, observes the tribal traditions, can look after her brothers and younger sisters when the mother has to be away. In short, the Iteso parents expect their children to help them in their daily chores, to obey them, and to respect tribal traditions. Society will usually look at children who are not obedient, or who do not respect elders as "badly brought up," and for this reason the parents, in order to keep a good name for themselves, will usually demand a strict adherance to obedience by their children. This raises the question of whether or not social training in habits such as compliance and unquestioning obedience might affect performance on tasks for which children have no action models in their daily life.

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[1] Philip E. Vernon, Measurements of learning. In Nevin S. Scrimshaw, & J. E. Gordon (Eds.), Malnutrition, learning and behavior. Cambridge, Massachusetts: M. I. T. Press, 1968. P. 490.

[2] Vernon, Measurements of learning. P. 490.

A similar question was raised by Greenfield[1] concerning the responses of unschooled Wolof children to a Piaget conservation task. Greenfield noted that failure to achieve uniformity in perception of quantity is influenced by attitude toward authority. If one is willing to accept a statement as true because someone in authority has said it, other criteria for truth are slower in developing, perhaps because no cognitive contradiction develops. Piaget[2] has pointed out that cognitive contradictions are important in the development of intelligence. He notes that Bovet in her experiments dealing with Algerian children observed that some children who were impermeable to cognitive contradictions, remained at the stage of pseudo-conservation until made aware of the contradiction between their own point of view and that of reality. Then they became pre-operational and started to move toward operational functioning. Thus, one important fact Piaget points out, is permeability to contradiction which may not be existent in a society such as that of Algeria, or that of the Iteso, where compliance and unquestioning obedience in children are highly placed virtues.

A further explanation of poor performance in ordinal correspondence and class inclusion relations tasks may be the lack of close contact between parents and their children in large extended families, and therefore of opportunities for parents to provide explanations for various phenomena. Moreover, in rural Teso, during the few times when

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[1] Patricia M. Greenfield, On culture and conservation. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966.

[2] Jean Piaget, Science of education and the psychology of the child. New York: Grossman Publishers Inc., 1970.

explanations are offered, these explanations have a tinge of witchcraft (ecudet) about them. If your crops fail, someone wished you bad luck, or planted an egg in your garden. If you fall sick, someone must have looked at you "with an ugly eye"' and if your cows die, "there is someone who does not want you to marry."

In summary, apart from the limitations of maturational factors outlined by Piaget and which were confirmed in the present investigation, environmental and experiential factors may have influenced the performance of children.

Implications for Teaching and Research in Uganda

In the Ugandan situation, the ills of poverty, ignorance and disease will not be wiped out tomorrow, so that while some attempts could and should be made by the Government to provide better physical and social conditions, and possibly preschool education, these ideal conditions are unlikely to be fulfilled in the near future. The major problem, therefore, will still be that faced by the schools. It is, therefore, imperative that far more intensive effort and research be put into a study of learning in the school situation, and into the development of methods and techniques of teaching that would ensure the development of basic concepts necessary to all-round intellectual development of Ugandan children. The results from the present investigation suggest some implications for future research along Piagetian lines, and for education and the decisions that need to be taken to effect a new approach to education in Uganda.

Implications for Further Research

Studies of the development of Ugandan children are needed so that educational planning will not have to depend so much, as it has done in the past, on available information about the development of children in other parts of the world, but will be grounded in knowledge of development of Ugandan children.

Results already cited of cross-cultural studies using Piagetian tasks have generally been in agreement with one another in supporting the sequence of development of cognitive abilities, as put forward in Piagetian theory. The results, however, have varied in detail. The findings may reflect not only differences between the groups investigated, but also differences in interviewing procedures.

The present study was carried out within a standardized framework. The child's responses, even where they appeared suspect, were not probed to ascertain the child's full meaning; he was not encouraged to verbalize his responses beyond what the standardized procedure demanded; and the investigator did not provide any explanations to his tasks beyond what the standard procedure specified. Had a more probing approach been adopted, would such an approach have yielded any further information and therefore have provided a more valid assessment? It seems there is need to try out such an approach as a preliminary step toward working out standardized procedures appropriate to Ugandan children of all tribal and ethnic groups.

The most important implication from D'Andrade's[1] work among the Hausa, and McFie's[2] investigation among the Baganda is that poor performance may represent an easily reversible lack of acquaintance and training rather than a stable deficit in cognitive capacities. Just how reversible at various ages, and with what general effect remains a question for further investigation. As previously stated, although training procedures to accelerate development from one stage to another have not been invariably successful, results from those that have been successful seem to suggest that such training is particularly beneficial to children who are in the transitional stages of development. Piaget himself recently indicated this when he said:

> ... most of the results clearly agree with the fact that if a child is already transitional, that is, at stage two, the level at which he manifests vacillation in thinking, it then becomes much easier to introduce and make him aware of other possibilities, including operatory solutions. In other words, the type of learning which works, is a type of learning which pushes rather than a type of learning which changes the point of view of the subject.[3]

In the present investigation, for each task, there were quite a number of children classified as being in the transitional stage. There

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[1] R. G. D'Andrade, Testing and training procedures at Bassawa, Paper 4, Institute of Education, Ahmadu Bello University, 1967.

[2] J. McFie, The effect of education on African performance on a group of intellectual tests. British Journal of Educational Psychology, 1961, 33, 177-186.

[3] Jean Piaget, Science of education and the psychology of the child. New York: Grossman Publishers Inc., 1970, P. 159.

is need to find out how Ugandan children in general, and how children in transitional stages in particular, respond to such training; and there is need to find out what kind of training, under what conditions, seems most efficacious.

Similarly, experimentation with various kinds of seriation and classification tasks seems essential. Different results may be expected depending on the objects used, their familiarity, or the relative salience of their various properties. For example, in light of what has been said about the close family ties, and the encouragement the child gets from a very early age to know various members of the immediate and extended families, and the clan, there is need to find out whether class inclusion problems using toys of "daddies" and "mummies," "uncles" and "aunts" are better done than problems using squares and circles.

In view of what has been suggested concerning the differences between various ethnic groups, and in view of the well known differences in western countries concerning urban and rural environments, there is need to repeat this study with a different ethnic group, and also in an urban area. The present study is based on a rural sample from one ethnic group, and is a cross-sectional study involving P1, P3, P5, and P7 children. The study establishes tentative norms for progress in conservation, seriation, and classification for Iteso rural children. There is need to know whether similar norms would be obtained if the study were carried out in a different setting--in a different ethnic group or in an urban environment. Also, there is need to see whether similar trends would be observable if a longitudinal study were carried out, say for two or three years, of groups of children drawn from those same levels, or from P2, P4, and P6 levels.

LeVine[1] has pointed out that previous cross-cultural studies have been carried out with a replicative intent, to demonstrate the universality of the stages, although sometimes with an additional notion that not all populations reach the final stage. Perhaps there is now need to go beyond that approach, to an examination, in detail, of the antecedents of certain preschool attitudes which the child brings with him to school. A systematic analysis and description of child-rearing and socialization practices along the lines suggested by the work of Geber and Dean,[2] and Ainsworth[3] seems to be necessary, as is indicated in the preliminary results obtained by Schiff.[4] Schiff has conducted a study in Kampala that deals with the rôle of early childhood experience in the shaping of cognitive habits. Her major concern was the relationship of the mother's behaviour and attitudes toward her preschool child and the child's manifest curiosity. Schiff has found that, in general, traditional mothers actively discourage their children

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1 Robert A. LeVine, Cross-cultural study in child psychology. In P. Mussen (Ed.), revised 3rd edition, Carmichael's manual of child psychology. New York: Wiley, 1970.

2 Marcelle Geber, & R. F. A. Dean, The state of development of newborn African children. Lancet, 1951, 1, 1216-1219.

3 Mary D. S. Ainsworth, Infancy in Uganda. Baltimore: The Johns Hopkins Press, 1967.

4 Myra Schiff, Some consequences of child-rearing practices among the Ganda. Paper delivered to the African Studies Association, Los Angeles, October, 1968.

from asking questions, from exploring, and from otherwise learning how to be autonomous. Another area in need of investigation concerns the magical and superstitious beliefs of the children.

The lack of knowledge in the area of magical and superstitious beliefs is unfortunate because of certain widely held views about them. Hunter[1] and Gelfand[2] suggest that the prevalence of magical beliefs inhibits the motivation necessary for development, and this constitutes an obstacle to scientific and technological advance, as Kavadias[3] and Odhiambo[4] suggest. Nduka[5] on the other hand suggests that western education in general and science teaching in particular, has "a shattering effect on superstition." If the latter were true then there would be no need to worry unduly about the possible inimical effects of such belief on development since the steady growth of education will eliminate them. But as Jahoda[6] points out, the psychological assumption underlying such views is that the content of modern western-type

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[1] G. Hunter, The new societies of tropical Africa. London: Oxford University Press, 1962.

[2] M. Gelfand, The African witch. Edinburgh: Livingstone, 1967.

[3] G. Kavadias, The assimilation of the scientific and technological "message." International Social Science Journal, 1966, 18, 362-375.

[4] T. R. Odhiambo, East Africa: Science for development. Science, 1967, 158, 876-888.

[5] O. Nduka, Western education and the Nigerian cultural background. Ibadan: Oxford University Press, 1964.

[6] Gustav Jahoda, Supernatural beliefs and changing cognitive structures among Ghanaian university students. Journal of Cross-Cultural Psychology, 1970, 1 (2), 115-130.

education is either logically contradictory to or dissonant with traditional magical beliefs, but such assumptions may be ill-founded; and as Vernon[1] points out: "If we follow Piaget's views, we would expect magical beliefs to be linked with non-conservation as aspects of the pre-operational stage." There is need therefore to assess the prevalence of magical and supernatural beliefs of the primary school children, and the extent to which they might affect their view of the world around them.

These may seem some of the most outstanding problems of action research in Uganda, encompassing learning, motivation, group behaviour, and other aspects of child development that might affect cognitive development. Their solution will not be found by one man, but by many people from various disciplines. Clearly, multi-disciplinary research is increasingly important in Uganda, and with the recent setting up of the National Research Council to coordinate all research activities, such project development is likely to become a major activity in the next few years with Ugandan scholars playing a leading part.

Implications for Education in Uganda

In one of the few times when Piaget has specifically addressed himself to the problem of the relevance of his theory to pedagogy he has stated:

> The principal goal of education is to create men who are capable of doing new things, not simply repeating what other generations have done--men who are creators, inventors, and discoverers. The second goal of education is to form

[1] Philip E. Vernon, Intelligence and cultural environment. London: Methuen, 1969. P. 82.

> minds which can be critical, can verify, and do not accept everything they are offered ... So we need pupils who are active, who learn early to find out for themselves, partly by their own spontaneous activity, and partly through material we set up for them; who learn early to tell what is verifiable and what is simply the first idea to come to them.[1]

The implications of this statement, which sounds remarkably similar to that already cited, of the Minister of Education in Uganda, for the training of teachers, was elaborated upon by Duckworth.[2] Teachers can learn better by doing things than by being told about them because "if they read about it, it will be deformed, as is all learning that is not the results of the subject's own activity." Teachers should also spend some time questioning children in a one-to-one situation, in order to realize how hard it is to understand what children mean, and even more, how hard it is to make oneself understood by children. Duckworth further suggests that "each prospective teacher should work on an original investigation to find out what children think about some problem, and thus be forced to phrase the problem and establish communication with a number of different children. Facing the difficulties of this type of research will have a sobering effect on a teacher who thinks he is talking successfully to a whole class of children at once."

The most recurrent problems discussed by educators who have attempted to grapple with the implications of Piaget's work for teaching include the problem of transition, as Piaget has described four

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[1] Jean Piaget. In Eleanor Duckworth, Piaget rediscovered. Journal of Research in Science Teaching, 1964, 2, 172-175. P. 175.

[2] Eleanor Duckworth, Piaget rediscovered. Journal of Research in Science Teaching, 1964, 2, 172-175. P. 174.

factors which he believes to be involved in transition from one level of thought to the next. These include maturation, social interaction in the world of adults and peers, physical activity, and "equilibration" or self regulation. In turn these problems involve implications for teacher preparation and teacher effectiveness in matching the level of the child to the level of difficulty of material. Almy and her associates emphasize the aspect of teacher effectiveness when they state:

> We can think of no better safeguard against meaningless verbalization and rote memorization than a teacher who is able both to appraise the difficulty of the concepts and to assess the child's comprehension of them. Accordingly, the most important implications of Piaget's work seem to us to lie in its contribution to the teacher's understanding.[1]

Piaget himself considers equilibration as pedagogically fundamental. He states: "In the realm of education, this equilibration through self-regulation means that school children and students should be allowed a maximum of activity of their own, directed by means of materials which permit their activities to be cognitively useful."[2]

In the Ugandan setting, the implications of these statements direct attention to teacher preparation and teacher effectiveness, because, as Beeby[3] has suggested, two main factors determine the stage of development of any primary school system: the level of general education of its teachers, and the length and type of their professional training.

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1 Millie Almy, E. Chittenden, & P. Miller, Young children's thinking. New York: Teachers College Press, 1966. P. 136.

2 Jean Piaget, Foreword. In Millie Almy, E. Chittenden, & P. Miller, Young children's thinking. New York: Teachers College Press, 1966. P. vi.

3 C. E. Beeby, The quality of education in developing countries. Cambridge, Massachusetts: Harvard University Press, 1966.

Beeby warns, however, that to "speak of the quality of education also depends on what the teachers in the school are capable of accomplishing. It would be unfair to set for teachers in some poverty-stricken African school, themselves with nothing more than a primary school education, the same goals that one would set for trained college graduates in a primary school in a rich American suburb."[1]

Beeby also indicates that any attempt to reform the work in the classroom is most likely to succeed if it is part of a nationwide movement for improvement of social and economic conditions; if it is known to be warmly supported by the Ministry of Education at all levels, as well as by the teachers' own organizations; if steps have been taken to make parents understand the changes, and if the teacher can be made to feel himself less isolated in the classroom.

The position of the Uganda Teachers Association as stated by Kisaka,[2] clearly illustrates the awareness of that body about the need to raise the quality of the teacher at the primary level. The position papers of the Uganda Peoples Congress,[3] the governing and only party, emphasize that means and techniques must be found which reach far beyond the confines of the school and encompass the majority of the adult population. The numerous commissions that have been set in the past to examine education and make recommendations for its improvement; the

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[1] C. E. Beeby, The quality of education in developing countries. Cambridge, Massachusetts: Harvard University Press, 1966. P. 14.

[2] Mr. John Kisaka is the General Secretary of the Uganda Teachers Association.

[3] Uganda. Ministry of Information, Broadcasting and Tourism. Five documents on the move to the left. Entebbe: Government Printer, 1970.

repeated emphasis by various Ministry of Education officials that education should be re-oriented to suit African needs; the setting up of the National Institute of Education, and of several subject panels for the improvement of teaching of various subjects, all attest to Uganda's concern to improve constantly the quality of its education. The Ministry of Education also has various schemes going--the Uganda/UNICEF/UNESCO scheme for the improvement of primary teachers; the African Primary Science Programme for the improvement of the teaching of science, and the African Primary Mathematics Programme, for the improvement of mathematics teaching. Yet it may appear that all these are a matter of patch-work, with no systematization, and overall rationale behind them.

It is against a background of actions already taken, and what no doubt is a genuine concern on the part of the Uganda Ministry of Education to assure a new teaching and learning atmosphere in primary schools that one ventures to reiterate what Coombs[1] considers should be the priorities of developing countries with respect to their educational system. The chief problem which requires attention from Uganda Ministry of Education would appear to be the problem related to a drastic overhaul of teacher training, and the need to make teacher training institutions "intellectually richer, stimulated by pedagogical research, and extended far beyond preservice training into a system for continuous professional renewal and career development for all teachers." An example of the latter aspect is provided in a report prepared by Miel and

[1] Philip H. Coombs, The world educational crisis: A systems analysis. New York: Oxford University Press, 1968. P. 167.

Risetto[1] for the continuous professional development of teachers in Tanzania. The two authors emphasize the need to conduct research and experimentation, among other things, in a centre for education orientation which they recommend be set up for primary teachers.

Related to this problem is one of "modernization" of the learning process. There certainly must be better ways to capitalize on the curiosity of children, or on their individual differences; in short, to do a significantly better job than now, but without commensurately higher costs. As Coombs puts it: "African villages cannot have computerized teaching machines, regardless of how well they work. Neither, for that matter, can American schools except for an occasional experiment. But even old bottle caps, buttons, pieces of string, have sometimes proved effective learning aids in the right context."[2] This ties up with Piaget's emphasis on self-regulation. It is essential that the child be allowed to carry out the actions on these learning aids himself. Piaget points out that the time which seems to be wasted in personal investigation is really gained in the construction of methods. This is a refreshing approach from the prevailing view among Ugandan parents and teachers alike that in school it is a "waste of time" for children to "play with materials" instead of "really learning."

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[1] Alice M. Miel, & H. J. Risetto, A study of curricula and facilities factors relevant to a proposed education orientation center at Bagamoyo, Tanzania. New York: TEEA Program, 1970.

[2] Philip H. Coombs, The world educational crisis: A systems analysis. New York: Oxford University Press, 1968. P. 169.

The basic decisions required to deal with these problems rest with authorities in Uganda, the Ministry of Education in particular. But these decisions must be backed by action. Society and the economy will not adjust unilaterally to the education system. There must be some initiative on the part of educators. Coombs[1] has put this poignantly and succintly: "Nobel prizes are won in science for challenging and upsetting old truths and discovering new ones. The same wholesome irreverence for 'time honored truths' must somehow be instilled into the enterprize that is supposed to breed Nobel Prize winners."

No one questions that the development which Uganda has made in expanding its educational institutions has contributed to the growth of needed personnel to man the industry and administration; at the same time, it must now be questioned if the continued expansion provided for in the Five Year Development Plans, leading eventually to universal primary education in the 1970's may not be breeding a sense of complacency regarding the quality of primary education. The problems which face Uganda at this level, indeed at all levels of the educational hierarchy, at this stage of its development, are problems less of numbers than of quality and priorities.

Piaget's method of experimentation is not an educational panacea, inasmuch as education is not a panacea that will cure all ills of developing countries. Piaget's method will not solve all educational problems of the primary schools in Uganda. Used judiciously, however,

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[1] Philip H. Coombs, The world educational crisis: A systems analysis. New York: Oxford University Press, 1968. P. 167.

it should add to the teacher's weaponry in building in the primary school child those skills and attitudes which both Piaget and the Uganda Minister of Education have stated should be the goal of education.

In summary, implications for education of the present investigation direct attention to improvement in the present methods of teaching. This in turn directs attention to the need to improve both pre-service and in-service training. The responsibility for this and the decisions to be made rest with educational authorities in Uganda.

V - SUMMARY

An investigation patterned after Piaget's work was carried out among Iteso children of Uganda. The main aim was to examine the validity of certain aspects of Piaget's theory in a non-Western, rural population, and the relevance of the Piagetian approach to education in Uganda.

The present investigation employed a standardized interviewing procedure, using Piagetian tasks to investigate two questions. The first question related to the validity of the sequence of development of logical abilities as stated in Piaget's theory. The second question dealt with the Piagetian claim that conservation, seriation, and classification develop concurrently.

The subjects were 160 children from two rural primary schools in Teso District in the eastern region of Uganda. In each school 20 children were taken from each of the alternate classes P1, P3, P5, and P7. There were 20 boys and 20 girls in each of the two lower classes; there were 32 boys in P5, and only eight girls. In P7 there were 30 boys and ten girls. Altogether there were 102 boys compared to 58 girls, covering the age range of about six to 14 years.

An interview schedule consisting of a total of 13 conservation, seriation, and classification tasks was used to investigate the questions. Interviews were carried out in the schools. The data were analyzed on the basis of percent of children successful in conserving, seriating, and classifying in each of the classes. Data were also analyzed on the basis of patterns of conservation, seriation, and classification, as well as on graphic representations of percent successful.

Contingency tables were prepared to indicate the relationship among the abilities of conservation, seriation, and classification.

The results of the investigation in general supported the sequence of development as stated in the Piagetian theory; and also supported in general previous investigations of African samples based on Piagetian tasks. In itself, finding the same succession of stages is an important result and the consequences of having dealt with a large number of conservation tasks, through several transformations, rather than the study of one or two particular conservation tasks, through one or two transformations. On conservation tasks, a more meaningful picture will thus have been provided.

The same comment holds for seriation and classification tasks. In widening the range of both the seriation and classification tasks, it was possible to obtain a clear picture of the level of performance on each of those abilities.

The claim in the Piagetian theory regarding parallel development of conservation, seriation, and classification was supported only partially. This again was in support of previous replication studies.

The performance on ordinal correspondence and class inclusion relation tasks was particularly poor. This finding is important in relation to the basic value of Piaget's approach.

The findings were discussed in relation to the role of experience and age, and the influence of various methodological approaches. Also discussed were the possible implications of the findings for future research and for education in Uganda.

BIBLIOGRAPHY

Ahr, Paul R., & J. Youniss, Reasons for failure on the class inclusion problem. Child Development, 1970, 41, 131-143.

Ainsworth, Mary D. S. Infancy in Uganda. Baltimore: The John Hopkins Press, 1967.

Almy, Millie, The usefulness of Piagetian methods for early primary education in Uganda: An exploratory study. Unpublished report, 1967.

Almy, Millie, Logical thinking in second grade. New York: Teachers College Press, 1970.

Almy, Millie, E. Chittenden, & P. Miller, Young children's thinking. New York: Teachers College Press, 1966.

Almy, Millie, J. Davitz, & M. A. White, Studying school children in Uganda: Four reports of exploratory research. New York: Teachers College Press, 1970.

Beard, Ruth, M. An investigation into mathematical concepts among Ghanaian children. Teacher Education in New Countries, 1968, 9, 132-145.

Beeby, C. E. The quality of education in developing countries. Cambridge, Massachusetts: Harvard University Press, 1966.

Coombs, Philip H. The world educational crisis: A systems analysis. New York: Oxford University Press, 1968.

D'Andrade, R. G. Testing and training procedures at Bassawa. Paper 4, Institute of Education, Ahmadu Bello University, 1967.

Dodwell, P. C. Children's understanding of number and related concepts. Canadian Journal of Psychology, 1960, 14, 191-205.

Dodwell, P. C. Children's understanding of number concept: Characteristics of an individual and of a group test. Canadian Journal of Psychology, 1961, 15, 29-36.

Dodwell, P. C. Relations between the understanding of the logic of classes and of cardinal number in children. Canadian Journal of Psychology, 1962, 16, 152-160.

Duckworth, Eleanor, Piaget rediscovered. Journal of Research in Science Teaching, 1964, 2, 172-175.

Elkind, David, Children's discovery of the conservation of mass, weight and volume: Piaget replication study 11. Journal of Genetic Psychology, 1961, 98, 219-227.

Elkind, David, The development of quantitative thinking. Journal of Genetic Psychology, 1961, 98, 36-46.

Elkind, David, Quantity conceptious in junior and senior high students. Child Development, 1961, 32, 551-560.

Etuk, Elizabeth S. The development of number concepts among the Yoruba-speaking Nigerian children. Unpublished doctoral dissertation, Teachers College, Columbia University, 1967.

Evans, Judith L., & M. H. Segall, Learning to classify by color and by function: A study of concept discovery by Ganda children. The Journal of Social Psychology, 1969, 77, 35-53.

Extract from a speech by Dr. Luyimbazi-Zake, Minister of Education, at the opening of the 1968 Uganda Science Fair.

Geber, Marcelle, and R. F. A. Dean, The psychological changes accompanying kwashiorkor. Courrier, 1956, 6, 1-14.

Geber, Marcelle, and R. F. A. Dean, The state of development of newborn African children. Lancet, 1957, 1, 1216-1219.

Gelfand, M. The African witch. Edinburgh: Livingstone, 1967.

Goodnow, Jacqualine J. A test of milieu effects with some of Piaget's tasks. Psychological Monographs, 1962, 76 (555) 1-22.

Goodnow, Jacqualine J. Cultural variations and cognitive skills. In D. R. Price-Williams (Ed.), Cross-cultural studies. New York: Penguin Books, 1969, pp. 246-264.

Greenfield, Patricia M. On culture and conservation. In Jerome S. Bruner, R. R. Olver, & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966.

Greenfield, Patricia M., L. C. Reich and R. R. Olver, On culture and equivalence; II. In Jerome S. Bruner, R. R. Olver & P. M. Greenfield, Studies in cognitive growth. New York: Wiley, 1966, pp. 270-318.

Hunter, G. The new societies of tropical Africa. London: Oxford University Press, 1962.

Hyde, D. M. An investigation of Piaget's theories of the development of the concept of number. Unpublished doctoral dissertation, University of London, 1959.

Inhelder, Barbel, & J. Piaget, The growth of logical thinking from childhood to adolescence. New York: Basic Books, 1958.

Inhelder, Barbel, & J. Piaget, The early growth of logic in the child. New York: Harper and Row, 1964.

Jahoda, Gustav, Supernatural beliefs and changing cognitive structures among Ghanaian university students. Journal of Cross-Cultural Psychology, 1970, 1 (2), 115-130.

Kavadias, G. The assimilation of the scientific and technological 'message'. International Social Science Journal, 1966, 18, 362-375.

Kofsky, Ellin, A scalogram study of classificatory development. Child Development, 1966, 37 (1), 191-204.

LeVine, Robert A. Cross-cultural study in child psychology. In Paul Mussen (Ed.), Carmichael's manual of child psychology. New York: Wiley, 1970.

Lloyd, Barbara B. Antecendents of personality and ability differences in Yoruba children. Paper read at the conference on African studies, University of Sussex, December, 1968.

Lovell, K., B. Mitchell, & I. R. Everett, An experimental study of the growth of some logical structures. British Journal of Psychology 1962, 53, 175-188.

Lovell, K., & E. Ogilvie, A Study of the conservation of substance in the junior school child. British Journal of Educational Psychology, 1960, 30, 109-118.

McFie, J. The effect of education on African performance on a group of intellectual tests. British Journal of Educational Psychology, 1961, 33, 177-186.

Miel, Alice M., & H. J. Rissetto, A study of curricula and facilities factors relevant to a proposed education orientation center at Bagamoyo, Tanzania. New York: TEEA Program, 1970.

Nduka, O. Western education and the Nigerian cultural background. Ibadan: Oxford University Press.

Nsimbi, M. B. Omweso: A game people play in Uganda. Kampala: Uganda Publishing House, 1969.

Odhiambo, T. R. East Africa: Science for development. Science, 1967, 158, 876-888.

Otaala, Barnabas, The performance of Uganda African children on some Piagetian conservation tasks: An exploratory investigation. Unpublished paper submitted in partial fulfillment of Departmental requirements for certification, Teachers College, 1969.

Parsons, Anne, Translation's introduction: A guide for psychologists. In Barbel Inhelder & J. Piaget, The growth of logical thinking from childhood to adolescence. New York: Basic Books, 1958, pp. viii-xx.

Piaget, Jean, The child's conception of number. London: Routledge and Kegan Paul, Ltd., 1952.

Piaget, Jean, The stages of intellectual development of the child. Bulletin of the Menninger Clinic, 1962, 26, 120-123.

Piaget, Jean, Cognitive development in children: The Piaget papers. In R. E. Ripple & V. N. Rockcastle (Eds.), Piaget rediscovered: a report of the conference on cognitive studies and curriculum development. Ithaca, New York: School of Education, Cornell University, March, 1964, pp. 6-48.

Piaget, Jean, The psychology of intelligence. Paterson, New Jersey: Little Adams and Co., 1966.

Piaget, Jean, The theory of stages in cognitive development. Monterey: McGraw-Hill, 1969.

Piaget, Jean, Science of education and the psychology of the child. New York: Crossman Publishers Inc., 1970.

Price-Williams, D. R. A study concerning concepts of conservation of quantities among primitive children. Acta Psychologica, 1961, 18, 297-305.

Price-Williams, D. R. Abstract and concrete modes of classification in a primitive society. British Journal of Educational Psychology, 1962, 32, 50-61.

Price-Williams, D. R. Cross-cultural studies. New York: Penguin Books, 1969.

Scanlon, David, Education. In Robert A. Lystad (Ed.), The African world: A survey of social research. New York: Frederick A. Praeger, 1965, pp. 199-220.

Schiff, Myra, Some consequences of child-rearing practices among the Ganda. Paper delivered to the African Studies Association, Los Angeles, October, 1968.

Segall, Marshall H., D. T. Campbell, & M. J. Herskovits, Cultural differences in the perception of geometric illusions. Science, 1963, 139, 769-771.

Siegel, Irving E., & F. H. Cooper, Logical thinking in children: Research based on Piaget's theory. New York: Holt, Rinehart and Winston, 1968.

Smedslund, J. The acquisition of conservation of substance and weight in children. II: External reinforcement of conservation of weight and of the operations of addition and substraction. Scandinavian Journal of Psychology, 1961, 2, 71-84.

Suchman, Rosslyn G. Cultural differences in children's color and form differences. The Journal of Social Psychology, 1966, 70, 3-10.

Tuddenham, Read D. Psychometricizing Piaget's methods clinique. In Irene J. Athey and D. O. Rubadeau (Eds.), Educational implications of Piaget's theory. Waltham, Massachusetts: Ginn and Company, 1970, pp. 317-324.

Uganda. Education in Uganda: The report of the Uganda education commission, 1963. Entebbe: Government Printer, 1963.

Uganda. Ministry of Planning and Economic Development. Work for Progress: The second five-year plan, 1966-71. Entebbe: Government Printer, 1967.

Uganda. Planning and Statistical Unit. Education statistics, 1966. Entebbe: Government Printer, 1967.

Uganda. His Excellency the President's Communication from the Chair of the National Assembly on 20th April, 1970. Entebbe: Government Printer, 1970.

Uganda. Ministry of Information, Broadcasting and Tourism. Five documents on the move to the left. Entebbe: Government Printer, 1970.

Vernon, Philip E. Measurements of learning. In Nevin S. Scrimshaw & J. E. Gordon (Eds.) Malnutrition, learning, and behavior. Cambridge, Massachusetts: M. I. T. Press, 1968, pp. [illegible]-497.

Vernon, Philip E. Intelligence and cultural environment. London: Methuen, 1969.

Voyat, Gilbert, The forgotten people: Cross-cultural study of the cognitive development of the Pine Ridge Indian reservation. Unpublished report, 1969.

Wallach, M. A. Research in children's thinking. In H. Stevenson (Ed.), National Society for the Study of Education, 62nd Yearbook, Child psychology. Chicago: University of Chicago Press, 1963, pp. 236-276.

Weiss, Charles, Jr. Science in Africa. Africa Report, 1968, 13, 13-20.

Wohlwill, Joachim F. Responses to class inclusion questions for verbally and pictorially presented items. Child Development, 1968, 39, 449-465.

Wohlwill, Joachim F. The place of structured experience in early cognitive development. Interchange, 1970, 1 (2), 13-27.

Wohlwill, Joachim F. and R. C. Lowe, Experimental analysis of the conservation of number. Child Development, 1962, 33, 153-169.

APPENDIX A

Interview Schedule

Part 1 - Conservation

TASK 1: Conservation With Counting

MATERIAL: 11 red buttons

PROCEDURE: Show the subject a bunch of buttons. WHAT ARE THESE? WHAT DO WE USE THEM FOR? WHAT COLOUR ARE THEY? (If he responds appropriately, proceed.) Put out all the 11 red buttons and say, I WANT YOU TO COUNT THESE BUTTONS ALOUD. HERE, START (gesturing). SO, HOW MANY BUTTONS ARE THERE? NOW, WATCH, I AM GOING TO PUT THEM TOGETHER LIKE THIS (bunch). NOW, HOW MANY RED BUTTONS DO WE HAVE HERE (indicating with gesture). (If he starts to count: CAN YOU TELL WITHOUT COUNTING?) NOW, WATCH, I AM GOING TO PUT THEM APART LIKE THIS (spread buttons.) NOW, HOW MANY RED BUTTONS DO WE HAVE HERE?

MATERIAL: 10 yellow buttons

PROCEDURE: As above.

TASK 2: Conservation With Number (Buttons)

MATERIAL: 11 red buttons; 10 yellow buttons

PROCEDURE: (Take out the yellow buttons.) HERE ARE SOME BUTTONS THAT YOU JUST SAW. I AM GOING TO PUT THEM ON THE TABLE

LIKE THIS. (Place the buttons in a row in front of the child.) THAT IS YOUR ROW OF BUTTONS. HERE ARE SOME MORE BUTTONS. (Take out seven red buttons from the box.) I AM GOING TO PUT THEM ON THE TABLE TOO. THIS IS MY ROW OF BUTTONS. WHO HAS MORE BUTTONS IN HIS ROW, YOU OR I? TAKE OUT FROM HERE (push box with four remaining buttons to subject) SOME MORE BUTTONS AND MAKE MY ROW HAVE AS MANY BUTTONS AS YOUR ROW. NOW, WATCH. I AM GOING TO REMOVE ONE BUTTON FROM YOUR ROW LIKE THIS. (Remove one yellow button and place it in the box.) NOW WHO HAS MORE BUTTONS IN HIS ROW, YOU OR I? WATCH, I AM GOING TO RETURN YOUR BUTTON TO YOUR ROW LIKE THIS. NOW, DOES MY ROW STILL HAVE MORE OR DO OUR ROWS HAVE THE SAME OR DOES YOUR ROW HAVE MORE? WATCH, I AM GOING TO REMOVE TWO BUTTONS FROM MY ROW LIKE THIS. (Remove two red buttons and place them in the box.) NOW WHO HAS MORE BUTTONS IN HIS ROW, YOU OR I? WATCH, I AM GOING TO RETURN THE RED BUTTONS TO THEIR PLACE LIKE THIS. NOW, DOES YOUR ROW STILL HAVE MORE, OR ARE OUR ROWS THE SAME, OR DOES MY ROW HAVE MORE?

TESTING:

1. WATCH, NOW I AM GOING TO DO THIS TO MY ROW (bunch red buttons). NOW WHO HAS MORE BUTTONS, YOU OR I, OR DO WE

BOTH HAVE THE SAME NUMBER? WHY DO YOU THINK SO?

2. NOW WATCH. I AM GOING TO DO THIS TO YOUR ROW (spread out the yellow buttons). NOW WHO HAS MORE BUTTONS, YOU OR I, OR DO WE BOTH HAVE THE SAME NUMBER? WHY DO YOU THINK SO?

TASK 3: Conservation of an Amount of Water

MATERIAL: 1 pitcher (with some water); 2 identical glasses; 1 dish; 1 tall glass

PROCEDURE: Show the subject glasses. WHAT ARE THESE? WHAT DO WE USE THEM FOR? DO YOU HAVE SOME IN YOUR HOME? (If the subject responds appropriately proceed, otherwise tell him about the use of glasses.) PICK OUT FROM THIS GROUP (gesturing) TWO GLASSES WHICH ARE THE SAME SIZE (IDENTICAL). I WILL NOW GIVE YOU ONE OF THE TWO EQUAL GLASSES (push it toward the subject) AND I WILL KEEP ONE. WE WILL PUT THESE OTHER GLASSES AWAY FOR THE TIME BEING. I AM NOW GOING TO POUR SOME WATER INTO YOUR GLASS LIKE THIS. (Fill to two-thirds.) AND I AM GOING TO POUR SOME WATER INTO MY GLASS LIKE THIS. (Fill to one-third.) WHOSE GLASS HAS MORE WATER, YOURS OR MINE? CAN YOU MAKE THEM SO WE BOTH HAVE THE SAME AMOUNT? WATCH, I WILL POUR SOME OF MINE INTO THIS CONTAINER LIKE THIS. (Pour water back into the pitcher.) NOW WHOSE GLASS HAS MORE, YOURS OR MINE, OR DO WE BOTH

HAVE THE SAME AMOUNT? I AM GOING TO POUR SOME WATER BACK FROM THIS PITCHER, LIKE THIS (pour water into the interviewer's glass so the levels are the same). NOW WHOSE GLASS HAS MORE, YOURS OR MINE, OR DO WE BOTH HAVE THE SAME AMOUNT?

TESTING:

1. WATCH, I AM GOING TO POUR MY WATER INTO THIS BOWL LIKE THIS. (Interviewer places dish in child's view.) NOW WHO HAS MORE WATER, YOU OR I, OR DO WE BOTH HAVE THE SAME AMOUNT? WHY DO YOU THINK SO?
2. Place tall, narrow glass in child's view. I AM NOW GOING TO POUR MY WATER INTO THIS GLASS LIKE THIS. (Pour into the taller glass.) NOW, DO WE HAVE THE SAME AMOUNT OR DO YOU HAVE MORE, OR DO I HAVE MORE? WHY DO YOU THINK SO?

TASK 4: Conservation of an Amount of Clay

MATERIAL: 2 identical balls of clay

PROCEDURE: WHAT ARE THESE? WHAT ARE THEY MADE OF? DO YOU MAKE THINGS WITH CLAY IN YOUR SCHOOL? (If the subject says "No," subject adjusts until he agrees the balls are the same.)

Testing:

1. I AM GOING TO ROLL MINE INTO THIS SHAPE LIKE THIS. (Roll into sausage shape about three inches long.) NOW, WHO HAS MORE CLAY, YOU OR I, OR DO WE BOTH HAVE THE SAME AMOUNT? WHY DO YOU THINK SO?

2. NOW, WATCH. I AM GOING TO ROLL THIS INTO A BALL LIKE IT WAS BEFORE. NOW DO WE HAVE THE SAME AMOUNT OR DO YOU HAVE MORE, OR DO I HAVE MORE? WHY DO YOU THINK SO?
3. I AM NOW GOING TO CUT YOUR BALL UP LIKE THIS. (Cut into ten pieces.) DO YOU NOW HAVE MORE CLAY, OR DO WE HAVE THE SAME AMOUNT, OR DO I HAVE MORE? WHY DO YOU THINK SO?

TASK 5: Conservation With Number (Pebbles)

MATERIAL: Mweso board; 64 pebbles

PROCEDURE: Place board and pebbles on the table. WHAT IS THIS (pointing to the board)? WHAT ARE THESE (pointing to the pebbles)? WHAT DO WE USE THEM FOR? IS THIS GAME PLAYED IN YOUR HOME? (If the subject responds appropriately, proceed; otherwise tell him about the game.) LET"S PLAY A SHORT GAME. I WILL PLACE THE PEBBLES IN THE HOLES LIKE THIS (place two pebbles in each hole). THOSE (pointing) ARE YOUR TWO ROWS OF PEBBLES. AND THESE (pointing) ARE MY TWO ROWS. WHO HAS MORE PEBBLES, YOU OR I, OR DO WE BOTH HAVE THE SAME NUMBER? (If the subject denies equality, explain that there are two pebbles in each of the holes on his side of the board, and a similar number in each of the holes on the interviewer's side of the board.) I AM YOUR ELDER, I WILL START PLAYING THE GAME. WATCH.

Testing:

1. I AM GOING TO DO THIS TO ONE OF MY ROWS (place the two pebbles in each of the front row of the interviewer's side into the corresponding hole in the back row). WHO HAS MORE PEBBLES, YOU OR I, OR DO WE BOTH HAVE THE SAME NUMBER? WHY DO YOU THINK SO?
2. Replace the pebbles of the front row of the interviewer. NOW, WATCH. I WILL DO THIS TO MY PEBBLES. (Move all the pebbles in front row to the last hole of that row on the left of the interviewer; and all the pebbles in the back row to the last hole of that row to the right of the interviewer.) WHO HAS MORE PEBBLES, YOU OR I, OR DO WE BOTH HAVE THE SAME NUMBER? WHY DO YOU THINK SO?
3. Rearrange pebbles so there are two in each of the holes. NOW IT IS YOUR TURN TO MOVE YOURS. YOU PLACE ALL YOUR PEBBLES HERE (pointing to a hole about the middle of the subject's front row). NOW, WHO HAS MORE PEBBLES, YOU OR I, OR DO WE BOTH HAVE THE SAME NUMBER? WHY DO YOU THINK SO?

Part 2 - Seriation

MATERIAL: 5 balls of clay--different sizes; 7 models of cows--different sizes; 7 pictures of women, 7 of baskets--different sizes; 10 sticks graded from 9 cm. to 15 cm.

PROCEDURE: Place the five balls of clay haphazardly. THESE ARE

FIVE BOYS. THEY HAVE BEEN PLAYING IN THE SCHOOL COMPOUND, AND NOW BREAK TIME IS UP. THEY ARE GOING TO LINE UP BEFORE THEY ENTER THEIR CLASSROOM. SEE THESE TWO CHILDREN (#2, #4)? WHO IS THE TALLER OF THE TWO? (After the subject has decided, place the smaller of the two to the left, and the bigger to the right of the interviewer.) THIS CHILD IS SMALLER, SO HE STANDS NEAREST TO THE CLASSROOM DOOR. THIS ONE (pointing to #4) IS BIGGER, SO HE STANDS FARTHER AWAY. (Present ball #3.) WHERE WILL THIS BOY STAND? IS HE THE TALLEST AND STANDS HERE (pointing) OR THE SHORTEST AND GOES HERE (pointing) OR DOES HE STAND HERE IN MIDDLE? YOU PLACE HIM (gesturing). (Present ball #1.) WHERE WILL HE STAND? YOU PLACE HIM. (And ball #5) WHERE WILL HE STAND? YOU PLACE HIM. YOU SEE, THE BOYS ARE NOW LINED UP, READY TO GO TO THE CLASSROOM--THE SMALLEST BOY RIGHT HERE (pointing), AND THE BIGGEST ONE RIGHT OVER THERE (pointing).

Testing:

1. Place seven cows on the table. THESE COWS ARE GOING TO THE RIVER TO DRINK WATER. I WANT YOU TO ARRANGE THEM HERE (pointing) IN A ROW FROM THE SMALLEST ONE (CALF) TO THE BIGGEST ONE, LIKE WE DID WITH THE BOYS LINING UP AFTER BREAK TIME.

2. HERE ARE SOME PICTURES OF WOMEN (place cards haphazardly). THEY ARE WIVES OF A RICH MAN. IT IS MARKET DAY, AND THEY ARE ALL GOING TO THE MARKET. THEY LOOK ALIKE BUT THEY ARE DIFFERENT SIZES. CAN YOU PUT THEM IN ORDER? THE SHORTEST ONE LEADS THE WAY AND GOES OVER HERE (pointing) AND THE TALLEST ONE SHOULD GO OVER HERE (pointing). NOW HERE ARE SOME PICTURES OF BASKETS. THE WOMEN ARE GOING TO SELL GROUNDNUTS AT THE DUKAS. CAN YOU PUT THESE BASKETS OF NUTS IN ORDER TOO, FROM THE SMALLEST TO THE BIGGEST? GIVE THE SMALLEST BASKET TO THE SMALLEST WOMAN AND THE BIGGEST BASKET TO THE BIGGEST WOMAN.

3. If subject fails to arrange the rows of women and baskets, assist him. I AM NOW GOING TO DO THIS TO THE BASKETS, WATCH. (Bring the baskets closer together); AND THIS TO THE WOMEN, WATCH. (Spread the women more widely.) Touching baskets 3; 5; 4; 6; in turn, the interviewer asks: "TO WHICH WOMAN DOES THIS BASKET BELONG?"

4. Rearrange baskets and women so that the row of women and that of baskets are again in correspondence with one another. WATCH, I AM GOING TO DO THIS TO THE BASKETS. (Destroy the series of the baskets.) The interviewer picks baskets 2; 4; 6 in turn and asks: "TO WHICH WOMAN DOES THIS BASKET BELONG?"

5. Place the ten sticks in random order. I HAVE HERE TEN CHILDREN. I WANT YOU TO ARRANGE THEM FROM THE TALLEST TO THE SHORTEST. HERE (gesturing) LET'S SEE.

Part 3 - Classification

MATERIAL: 3 cows, 3 goats, 3 dogs, 3 sheep; 1 red, 1 black, 1 green. Groundnuts, peas (edible); elira, egasia, ekuoro (seeds of local trees--inedible and untranslatable). Seven models of cows; 2 of dogs. Four white squares, 2 blue squares; and 2 blue circles

TASK 1: Sorting of Animals

Present the first group of objects and ask the child to name the different types of animals. Then say: THESE ARE DIFFERENT TYPES OF ANIMALS. I WANT YOU TO PLACE THOSE THAT GO TOGETHER. (If the subject asks whether by colour or type of animal) ANY WAY AT ALL A GROUP OF THINGS IS THE SAME. (After the subject has made his selection, the interviewer asks) IN WHAT WAY ARE _____ AND _____ ALIKE OR THE SAME?

TASK 2: Sorting of Seeds

Present the second group of objects, and proceed as in above.

Task 3: Inclusion: Cows and Dogs

PROCEDURE: Ask the child to name the animals in the third group of objects; the cows and dogs, in turn.

HOW MANY COWS ARE THERE? HOW MANY DOGS ARE THERE?

ARE THE COWS ANIMALS? ARE THE DOGS ANIMALS?

1. ON THIS TABLE DO WE HAVE MORE COWS, OR MORE ANIMALS?

   WHY DO YOU THINK SO?

2. IF YOU TAKE AWAY THESE COWS (pointing) AND PUT THEM IN YOUR HALF OF THE TABLE, AND I KEEP THE DOGS IN MY HALF OF THE TABLE, WHOSE BUNCH WILL HAVE MORE ANIMALS, YOURS, OR MINE, OR SHALL WE BOTH HAVE THE SAME NUMBER?

   WHY DO YOU THINK SO?

3. ON THIS TABLE DO WE HAVE MORE ANIMALS OR MORE COWS?

   WHY DO YOU THINK SO?

TASK 4: Inclusion: Squares and Circles

PROCEDURE: Lay out four white squares, two blue squares, and two blue circles in clamps as shown. Ask the child to name the colours and shapes of the various objects

	WS	
WS	WS	BS
	WS	BS
BC		BC

1. ARE ALL SQUARES WHITE? WHY DO YOU SAY SO?

2. ARE ALL THE BLUE ONES CIRCLES? WHY DO YOU SAY SO?

3. ARE THERE MORE CIRCLES OR ARE THERE MORE BLUE THINGS?

   WHY DO YOU SAY THAT?

4. ARE THERE MORE BLUE THINGS THAN THERE ARE SQUARES, OR THE SAME, OR FEWER? WHY DO YOU SAY THAT?

APPENDIX B

Instructions for Categorizing Interview Data

Part 1 - Conservation

TASK 1: Conservation With Counting

1. In this task does the subject maintain the notion that having arrived at the cardinal number (there are 11 red buttons here), that bunching or spreading out the buttons does not alter the original number arrived at by counting?

   Definitely conserving 2

   Subject whose record indicates that he not only stated correctly the ordinal number, but also the cardinal number, and maintained this through the two transformation.

   Partially conserving 1

   Subject whose record indicates that though he may have got the cardinal number wrong, he maintained this wrong number through the two transformations.

   Definitely not conserving 0

   Subject whose record indicates that he not only was unable to identify the ordinal numbers and the cardinal number, but was unable to maintain the cardinal number through the two transformations.

2. Same as above.

These two sections are taken together in considering the final category in this task.

TASK 2: Conservation of a Number of Buttons

Tests one and two are scored separately, but are considered together in allocating the final category for this task. In this task does the subject maintain the notion that the bunching or spreading out of buttons does not alter the original number, and therefore, the equivalence of the two sets of buttons? Does he give an adequate explanation for this notion?

Definitely conserving 2

Subject whose record indicates a "same" response is put in this category unless his explanation falls into the seven and eight categories. In the latter cases he is put in the group of those partially conserving. (Categories follow.)

Categorize explanations as follows:

1. Use of counting and number: e.g., "because there are ten here and ten there."
2. Reference to previous correspondence: e.g., "because they were equal before you bunched (or spread) them."
3. Reference to observed action or present rearrangement: e.g., "because you did not take any away (or add any)"; "you only bunched yours."
4. Reference to reversed situation: e.g., "if you arrange these in a straight line, or if you bunch these also, they will be the same."

5. Reflecting appearance vs reality: e.g., "it looks longer, but they are really the same."
6. Reference to two dimensions of the problem: e.g., "this is merely bunched and the other is a straight line."

Partially conserving 1

Categorize explanations as follows:

7. Expressing conviction: e.g., "I know that they are equal," or simply, "they are equal," without indicating why they are equal.
8. Expressing inability to explain: e.g., "I don't know"; "no reason"; "for nothing."

Definitely not conserving 0

Subject's response indicates that the two sets of buttons have become different in number: "I have more"; "You have more"; and orientation section record shows that he understood. In his explanation about why he thinks the numbers have become different, he refers to the perceptual appearance of things.

Categorize explanations as follows:

1. Use of counting and number: e.g., "because there are 11 here and ten there."
2. Reference to the inequality before the orientation: e.g., "you had seven and I had ten."

3. Reference to observed action or present arrangement: e.g., "two were taken out of mine"; "you took some of yours"; "you put yours together"; "you spread mine out."

4. Reference to two dimentsions of the problem: e.g., "this is round, and the other is a straight line."

5. Merely expressing conviction: e.g., "I know that this is more"; "I have more."

6. Expressing inability to explain: e.g., "I don't know"; "no reason."

7. Focus on only one aspect of the problem: e.g., "these are red"; "these are yellow"; "they are many."

TASK 3: Conservation of an Amount of Water

Tests one and two are scored separately, but are considered together in allocating the final category for this task. In this task does the subject maintain the notion that the transfer of one amount of water to a larger dish or a narrower, taller glass, does not alter the original amount, and, therefore, the equivalence, of the two amounts of water? If so, does he give an adequate explanation for this?

Definitely conserving 2

Subject whose record indicates a "same" response is put in this group unless his explanation falls into the five and six categories, in which case he is put in the group of those partially conserving.

Categorize explanations as follows:

1. Reference to previous equality: e.g., "they were the same amount before."
2. Reference to observed action, or present arrangement: e.g., "because you didn't take any away," or "you only poured yours into here."
3. Reference to reversed situation: e.g., "if you pour this back here they will be the same."
4. Reflecting appearance vs reality: e.g., "it looks more, but they are really the same."

Definitely not conserving 0

Subject's response indicates that the two amounts of water are no longer the same after the transformations: "you have more," "I have more"; when orientation section indicates he understood.

Categorize explanations as follows:

1. Reference to observed action, or present arrangement: e.g., "because you poured it there"; or "because it comes up to here."
2. Reference to two dimensions of the problem: e.g., "this is in a bowl; this is in a glass."
3. Merely expressing conviction: e.g., "I know that this is more." "I have more"; "you have more."
4. Expressing inability to explain: e.g., "I don't know"; "no reason"; "for nothing."

TASK 4: Conservation of an Amount of Clay

Tests one, two, and three are scored separately, but they are considered together in allocating the final category for this task. In the test for task four does the subject maintain the notion that the rolling out ofthe clay ball into a "sausage," or its being rolled back into a ball, or its being cut up into pieces, does not alter the original amount, and, therefore, the equivalence of the two amounts of clay? If so, does he give an adequate explanation for holding on to this notion?

Definitely conserving 2

Subject whose record indicates a "same" response is put in this group unless his explanation falls into the five and six categories, in which case he is put in the group of those partially conserving.

Categorize explanations as follows:

1. Reference to previous equality: e.g., "they were the same amount before."
2. Reference to observed action, or present arrangement: e.g., "because you didn't take any away"; "you only rolled yours"; "you only cut up mine."
3. Reference to reverse situations: e.g., "if you roll this back"; "if you roll this one also out"; "if you put these pieces together"; "if this is also cut up, they will be the same."

4. Reflecting appearance vs reality: "it looks less, but they are really the same."

Partially conserving 1

Categorize explanations as follows:

5. Expressing conviction: e.g., "I know that they are the same," or simply "they are the same," without indicating why they are the same.
6. Expressing inability to explain: e.g., "I don't know"; "no reason."

Definitely not conserving 0

The subject's response indicates that the two amounts of clay are no longer equal after the transformations: "you have more"; "I have more," and he agreed before the test that the two balls of clay were equal.

Categorize explanations as follows:

1. Reference to observed action, or present rearrangement: e.g., "because you rolled this one"; "because this one is long"; "because this one is round"; "because this has many pieces."
2. Reference to two dimensions of the problem: e.g., "this one is a ball; the other one is long."
3. Merely expressing conviction: e.g., "I know that this one is less."
4. Expressing inability to explain, "I don't know."

TASK 5: Conservation of a Number of Pebbles

Tests one, two, and three are scored separately, but are considered together in allocating the final category for this task. In this task, does the subject maintain the notion that a rearrangement of pebbles does not alter their original number, and therefore, the equivalence of the subject's and interviewer's pebbles? If so, does he give an adequate explanation for this notion?

Definitely conserving 2

Subject whose record indicates a "same" response is placed in this group, unless his explanation falls into the seven or eight categories. In the latter case, he is placed in the group of those partially conserving.

Categorize explanations as follows:

1. Use of counting and number: e.g., "because you have 32 and I have 32."
2. Reference to previous correspondence: "because they were equal before"; they were arranged in two's before"; "the holes were the same."
3. Reference to observed action or present arrangement: e.g., "because you didn't take any away"; "you put yours together"; "I put mine in a pile."
4. Reference to reversed situation: e.g., "if you put these back into those holes, they will be the same."

5. Reflecting appearance vs reality: e.g., "those look more, but they are really the same."

6. Reference to two dimensions of the problems: e.g., "these are merely piled up, and those are in rows."

Partially conserving 1

Categorize explanations as follows:

7. Expressing conviction: e.g., "I know that they are equal," or simply "they are equal" without indicating why they are equal.

8. Expressing inability to explain: e.g., "I don't know"; "for nothing."

Definitely not conserving 0

Subject's response indicates that his pebbles are no longer numerically equivalent to those of the interviewer after the transformation: "You have more"; and there is no evidence to suggest that he disagreed with the investigator on the equivalence of the number of the subject's and the interviewer's pebbles. In his explanation of why the numbers have become different, he refers to the perceptual appearance of things.

Categorize explanations as follows:

1. Reference to observed action of present arrangement: e.g., "because you put yours there"; "because mine are in a pile."

2. Reference to two dimensions of the problem: e.g., "these are in a pile; those are in rows."

3. Merely expressing conviction: e.g., "I know that these are more."
4. Expressing inability to explain: e.g., "I don't know"; "no reason."

Part 2 - Seriation

In tasks one and three, does the subject understand how to coordinate a series of relationships when a number of objects are compared? Can he realise that a given element n is at one and the same time bigger than n-1, and smaller than n + 1; that is, that cow #6 is bigger than cow #5 but smaller than cow #7? Or that stick #9 is longer than stick #8 but shorter than stick #10?

TASK 1 (cows) and TASK 5 (sticks)

Definitely seriating 2

All placements correct.

Partially seriating 1

Subject makes two misplacements; that is, if two adjacent objects are interchanged (records may indicate five or six correct, in the case of task one, or eight or nine, in the case of task three).

Definitely not seriating 0

More than two misplacements.

TASK 2 (women and baskets)

In this task can the subject produce a one-to-one correspondence of women and baskets?

Definitely seriating 2

Subject makes correct placements for both the row of women and that of baskets.

Partially seriating 1

Subject who makes correct placements either on the women's row or on the row of the baskets (without the interviewer's assistance), but makes mistakes in arranging the second row, is placed in this category. That is, if the score is seven correct in one of the rows, and any other score on the second row, this constitutes partial seriation.

Definitely not seriating 0

More than two misplacements in both rows.

TASK 3 and 4 (ordinal correspondence)

In these tasks check each of the responses separately. The two sections, however, are considered together in deciding on the final category for ability at ordinal correspondence.

Definitely ordinating 2

All responses correct.

Partially ordinating 1

Response to one subsection correct.

Definitely not ordinating 0

Less than half of respones correct in both subsections.

Part 3 - Classification

In the first two tasks the interest is in whether the subject can sort objects on a consistent basis. In the last two tasks under this section, the interest is in whether the subject can understand inclusive relations, such as cows being part of a larger, more inclusive category of animals.

TASK 1 (sorting animals); TASK 2 (sorting seeds)

Definitely able to sort 2

1. Subject uses a consistent criterion or consistent criteria to place objects in groups; e.g., colour, type, size, edibility, etc. In task one, if sorting is done on the basis of colour, there should be three groups--red, green, and black. If by type, there should be four groups--cows, goats, sheep, and dogs; and if by edibility there should be two groups: that of dogs on the one hand and that of sheep, goats, and cows, on the other.

   In task two, if sorting is done on the basis of type, there should be five groups: groundnuts, peas, egasia, elira, and ekuoro. If by edibility, there should be two groups: groundnuts and peas on the one hand; and egasia, elira, and ekuoro, on the other.
2. For explanation the subject shows understanding that members

of a group share a similar property: e.g., "these are the same colour"; or shows understanding of how they differ.

Partially able to sort 1

1. Subject who is able to sort but cannot give an adequate explanation for the basis of his sorting.

2. Subject is able to sort using one observable criterion, but when asked for the basis of sorting he shifts to another criterion.

Definitely unable to sort 0

Subject responds but makes no observable consistent basis for sorting, and gives no adequate explanation for the basis of his sorting.

TASK 3 (cows and dogs)

Simply check each of the sections one, two, three, for understanding of inclusion relations.

Definitely understands inclusion relations 2

All responses correct, with correct explanation.

Partially understands inclusion relations 1

Two responses correct, with correct explanation.

Definitely does not understand inclusion 0

Unable to respond correctly to either of the last two sections, three and four.

APPENDIX C

Abbreviated Interview Schedule

Code ______________________ Date ______________________

Name ____

Sex ______________________

Age ______________________ Date of Birth ______________

School ____________________ Class ____________________

Taped Interview ______________ Length of Interview __________

Part 1 - Conservation

TASK 1 Conservation With Counting

TESTING:

1. (i) Numbers child mentions ______________

(ii) So, how many red buttons are there? __________

(iii) Now how many red buttons do we have here? ________

(No attept to count ________ wanted to count but was deterred ________ counted ________.)

(iv) Now how many red buttons do we have here? ________

(No attempt to count ________ wanted to count but was deterred ________ counted ________.)

2. (i) Numbers child mentions ______________

(ii) So, how many yellow buttons are there? ________

(iii) How many yellow buttons do we have here? ________

(No attempt to count ________ wanted to count but was deterred ________ counted ________.)

(iv) Now how many yellow buttons do we have here? ______

(No attempt to count ________ wanted to count but was deterred ________ counted ________.)

TASK 2 Conservation of Number (Buttons)

ORIENTATION:

Child understood throughout ______________

Prompting needed before child understood ____________

Appendix C, continued

Doubtful if child ever understood ______

Other ______

TESTING:

1. Now who has more buttons, you or I, or do we have the same number?

   Subject more ______ Interviewer more ______

   Same ______ Why do you think so? ______

   ______

   ______

2. Now who has more buttons, you or I, or do we both have the same number?

   Subject more ______ Interviewer more ______

   Same ______ Why do you think so? ______

   ______

   ______

TASK 3: - Conservation of an Amount of Water

ORIENTATION:

Child understood throughout ______

Prompting needed before child understood ______

Doubtful if child ever understood ______

Other ______

TESTING:

1. Now who has more water, you or I, or do we both have the same smount? Subject more ______ Interviewer

more ________ Same ________ Why do you think so? ______

____

____

2. Now do we have the same amount or do you have more, or do I have more? Subject more ________ Interviewer more ________ Same ________ Why do you think so? ________

____

____

TASK 4: Conservation of an Amount of Clay

TESTING:

1. Now, who has more clay, you or I, or do we both have the same amount? Subject more ________ Interviewer more ________ Same ________ Why do you think so? ________

____

____

2. Now do we have the same amount or do you havemore, or do I have more? Subject more ________ Interviewer more ________ Same ________ Why do you think so? ________

____

____

3. Do you now have more clay, or do we have the same amount, or do I have more? Subject more ________ Interviewer

more __________ Same __________ Why do you think so? ____

____

____

TASK 5: Conservation of Number (Pebbles)

TESTING:

1. Who has more pebbles, you or I, or do we both have the same number? Subject more __________ Interviewer more __________ Same __________ Why do you think so? __________

____

____

2. Who has more pebbles, you or I, or do we both have the same number? Subject more __________ Interviewer more __________ Same __________ Why do you think so? __________

____

____

3. Now who has more pebbles, you or I, or do we both have the same number? Subject more __________ Interviewer more __________ Same __________ Why do you think so? ____

____

____

Appendix C, continued

Part 2 - Seriation

ORIENTATION:

Child understood throughout ____________

Prompting needed before child understood ____________

Doubtful if child ever understood ____________

Other ____________

TESTING:

1. Correct ____________

   Errors made ____________

   Order in which child placed them (if errors made) ____________

   ____

2. Correct without help ____________

   Help given ____________

   Initial ordering before help given ____________

2a. Correct ____________

   Errors made ____________

   Order in which child placed them (if errors made) ____________

   ____

3. To which woman does this basket belong?

   #3 ____________

   #5 ____________

   #4 ____________

   #6 ____________

4. To which woman does this basket belong?

#2 ______________________________

#4 ______________________________

#6 ______________________________

5. Correct __________________________

Errors made ______________________

Order in which child placed them if errors made ________

____

Part 3 - Classification

TASK 1

1. Naming response

Correct without help ________ Help given (describe) ______

____

2. Size ________ Type ________ Colour ________ Number of groups ______________________________ Other (specify) ______________________________

Why are ________ and ________ alike or same? ________

____

____

____

____

____

Appendix C, continued

TASK 2

1. Naming response

   Correct without help ________ Help given (descirbe) ______

   ____

2. Size ________ Edibility ________ Shape ________ Number of groups ______________________________

   Other (specify) ______________________________

   Why are ________ and ________ alike or same? __________

   ____

   ____

   ____

   ____

   ____

TASK 3

ORIENTATION:

Child understood throughout ____________________

Prompting needed before child understood ________

Doubtful if child ever understood ______________

Other ______________________________________

TESTING:

1. More cows ________ More animals ________ Why do you think so? ______________________________

   ____

2. Whose bunch has more animals, yours or mine, or shall we both have the same number? Subject more ______ Interviewer more ______ Same ______ Why do you think so? ______

______

______

3. More animals ______ More cows ______ Why do you think so? ______

______

______

TASK 4

Naming response

1. Correct without help ______ Help given (describe) ______

______

2. Are all squares white?

Yes ______ No ______

Why do you say so? ______

______

3. Are all blue ones circles?

Yes ______ No ______

Why do you say so? ______

______

4. Are there more circles or are there more blue things?

   More circles __________ More blue things __________

   Why do you say so? ______________________________

   ____

5. Are there more blue things than there are squares, or the same, or fewer?

   More blue __________ Same __________ Fewer __________

   Why do you say so? ______________________________

   ____

APPENDIX D

Supplementary Tables

Table 15

Relationship Among Conservation Abilities

Buttons	Pebbles: Conserving	Pebbles: Not Conserving	Total
Conserving	85	12	97
Not conserving	12	51	63
Total	97	63	160
Buttons	**Water**		
Conserving	85	12	97
Not conserving	16	47	63
Total	101	59	160
Buttons	**Clay**		
Conserving	75	22	97
Not conserving	10	53	63
Total	85	75	160
Pebbles	**Water**		
Conserving	93	4	97
Not conserving	8	55	63
Total	101	59	160
Pebbles	**Clay**		
Conserving	80	17	97
Not conserving	5	58	63
Total	85	75	160
Water	**Clay**		
Conserving	84	17	101
Not conserving	1	58	59
Total	85	75	160

Appendix D, continued

Table 16

Relationship Among Seriation Abilities

Women and Baskets	Sticks		
	Correct Seriation	Incorrect Seriation	Total
Correct seriation	95	19	114
Incorrect seriation	8	38	46
Total	103	57	160
Women and Baskets		Cows	
Correct seriation	96	18	114
Incorrect seriation	11	35	46
Total	107	53	160
Women and Baskets		Ordinal Correspondence	
Correct seriation	15	99	114
Incorrect seriation	-	46	46
Total	15	145	160
Sticks		Cows	
Correct seriation	86	17	103
Incorrect seriation	21	36	57
Total	107	53	160
Sticks		Ordinal Correspondence	
Correct seriation	14	89	103
Incorrect seriation	1	56	57
Total	15	145	160
Cows		Ordinal Correspondence	
Correct seriation	15	92	107
Incorrect seriation	-	53	53
Total	15	145	160

Appendix D, continued

Table 17

Relationship Among Classification Abilities

Sorting Seeds	Sorting Animals: Correct Sort	Incorrect Sort	Total
Correct sort	79	31	110
Incorrect sort	14	36	50
Total	93	67	160
Sorting Seeds	**Inclusion Animals: Correct Inclusion**	**Incorrect Inclusion**	
Correct sort	10	100	110
Incorrect sort	-	50	50
Total	10	150	160
Sorting Seeds	**Inclusion Squares & Circles**		
Correct sorting	-	110	110
Incorrect sorting	-	50	50
Total	-	160	160
Sorting Animals	**Inclusion Animals**		
Correct sorting	9	84	93
Incorrect sorting	1	66	67
Total	10	150	160
Sorting Animals	**Inclusion Squares & Circles**		
Correct sorting	-	93	93
Incorrect sorting	-	67	67
Total	-	160	160
Inclusion-Animals	**Inclusion Squares & Circles**		
Correct inclusion	-	10	10
Incorrect inclusion	-	150	150
Total	-	160	160

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