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PREFERENCE, TRAINING, AND DEVELOPMENTAL TRENDS IN THE CLASSIFICATION BEHAVIOR OF BUKUSU (KENYA) SCHOOLCHILDREN

by

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DISSERTATION

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PREFACE

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CHAPTER I

INTRODUCTION

In the development of cognitive skills, classification is a fundamental process. Classification is concerned with the labeling and identifying of stimuli, but more importantly, it involves the imposition of organization on material objects (Sigel, 1953). This dissertation is concerned with classification behavior. Specifically, it deals with the cultural influences on, and developmental trends in, classification. A major concept in the attempt to understand the development of classification skills is "preference." By preference is meant the tendency to choose a certain modality when classifying objects which offer a variety of ways to be sorted. These modalities might be either perceptual (based on superficial characteristics) or conceptual (based on mediated characteristics).

The major focus of this dissertation involves the interaction between preference, as determined by a preliminary free-sorting task, and the type of sorting task to be learned.

An important characteristic of the dissertation is that its subjects, children, have been reared, and reside in a non-western setting.

The central question of this dissertation is: Could information about a non-western child's preference on a free-sorting task enhance prediction of his performance on a learning task involving either the same or different modalities? Before this essential question could be answered, however, several preliminary questions had to be investigated: What were the materials that could appropriately be used in this setting? What dimensions were likely to be preferred by children in this non-western society? Would children in this society demonstrate the same developmental sequence in their classification strategies that children in the western world have shown? Because the last question has been of considerable theoretical interest to psychologists, existing findings with regard to developmental trends in, and cultural influences on, classification behavior will be discussed first. Then there will follow a discussion of the problem of preference in a sorting task, and finally some methodological issues pertinent to cross-cultural investigation of these problems will be considered.

Classification: Cultural Influences and Developmental Trends

It may be argued that classification behavior is shaped by cultural experience similar to the way perceptual predispositions appear to be determined by culture (Segall, Campbell & Herskovits, 1966). According to these authors perceptions are greatly influenced by inferential habits. This does not mean that people from essentially different environments are not capable of perceptions other than those they reveal in their free responses to visual illusions. The Segall *et al.* argument is that people from different environments will respond in essentially different ways simply because of the strength of certain inferential habits. If one were to apply this kind of argument to classification behavior, one might predict that a child would exhibit certain preferences when asked to perform a free-sorting task, but that while these preferences reveal certain habits, they do not preclude capacity for other sorting strategies.

Some students of cross-cultural behavior have argued that cultural experience has a more pervasive effect on cognitive processes than suggested by an extension of the Segall _et al._ view. Some investigators have gone so far as to claim that "primitive" (non-western) people _think_ in a totally different way from western people. Hallowell's conclusions (1955) from his observations of the Salteaux Indians of the midwest U. S. might be interpreted as an example of this position:

> The psychological organization of a human described in his mind and personality, is a function of his membership in a social group as much as inherited organic equipment . . . (p. 5)
>
> Cultural heritage limits or promotes the manner in which and the terms in which the individual deals with spatial attributes of the world about him (Hallowell, 1955, p. 215).

Levy-Bruhl (1926) discussed the cognitive dispositions of a large number of non-western peoples in terms of their "prelogical mentality" and thought he discerned a tendency to process experience perceptually:

> We see that the languages of primitive peoples always express the idea of things and actions in the precise manner in which they are presented to the eye or ear (Levy-Bruhl, 1926, p. 158).

According to these early investigators the experience of non-western peoples appears to be _perceptually_ based, and their thinking seems to be of a more concrete nature than that of western peoples. This interpretation goes far beyond the Segall _et al_. view in its attribution of a profound influence of culture on the thinking process. For Levy-Bruhl and like-minded observers of non-western behavior culture influences thinking in a profound qualitative way. This would mean that classification strategies in a non-western setting might in no way resemble strategies observed in the western world. Or, it might mean that non-western peoples fixate, as it were, at an earlier developmental stage, the perceptual one.

An interpretation similar to the relativistic views mentioned above emphasizes the influence of language on thinking. The relationship between language and cognitive processes has been an area of widespread controversy for many years. This aspect of cultural experience was thought to have deep-seated effects on non-linguistic behavior by Sapir (1921) and by Whorf (1940, 1956). Whorf articulated his hypothesis which later was to become the object of psychological inquiry (Brown & Lenneberg, 1954; Carroll & Casagrande, 1958), in terms of the linguistic relativity principle:

> The linguistic relativity principle means in informal terms that the users of markedly different grammars are pointed by their grammars toward different types of observations and different evaluations of externally similar acts of observation and hence are not equivalent observers but must arrive at somewhat different views of the world (Whorf, 1956, p. 221).

Thus, some anthropological and linguistic theorists would militate for a very relativistic view of cognitive processes, wherein it would be expected that every culture imposes not only the content of classificatory systems but also the order of their acquisition on its members.

Opposed to these three culturally relativistic positions are those who argue that there exist universals in nature so that all cultures will "discover" them and as a result, "invent" similar classificatory systems. On an a priori basis it may be assumed that those attributes that are common to all humans should be discovered as classificatory concepts by all groups. Such attributes might include sex, parts of the body, and form. Although there has been no cross-cultural verification, the continuing preference for the form dimensions (over color and function) has been observed by Bearison and Sigel (1968) and by Pendergrass (1969) in American children from the ages of seven to twelve. In the Pendergrass study the preference for form in a free-sorting situation was not significantly affected by training sessions which emphasized competing dimensions. The suggestion of innate predispositions to certain dimensions was made on the basis of work done by Salapatek and Kessen (1966), T. G. R. Bower (1966), and Hershenson (1967); the results of this research indicated that neonates are already equipped with certain abilities to perceive form and attend to novelty. Some physiological evidence for the presence of different cortical mechanisms in cats for the handling of different stimuli has been presented by Hubel and Wiessel (1962). If such innate predispositions exist, then the argument for invariant classificatory systems across different cultures is strengthened. Evidence related to the dominance of the form dimension across different age levels and specific neonatal preferences, however, awaits further cross-cultural investigation.

Something that has often been demonstrated in the African setting, however, is the salience of the color dimension. Evans and Segall (1969), using a learning task with primary school children in Uganda, discovered a strong tendency for these children to sort objects by color rather than by function. Suchman (1966) also found a strong preference for color when compared to form in a free-sorting task performed by Koranic-educated children who ranged in age from three to fifteen. Thus, preference for a specific dimension whether it be color or form, across different cultures has not yet been determined. But some perceptual dimension, of which color and form are both exemplars, may be universally a primary basis for classification.

It has in fact been argued that the developmental sequence of classificatory tendencies is a product of nature. For example, the invariant stage level theory of Piaget (Piaget & Inhelder, 1969), which has enjoyed wide popularity and has generated a great deal of cross-cultural investigation, asserts that as any child moved from the pre-operational stage to the concrete operational stage, his strategy for classifying things would change from one based on immediate, perceptual attributes, such as color, to mediate, conceptual attributes of things, such as their function. Other investigators have also employed this theoretical framework to describe what happens in the development of classificatory strategies.

Sigel (1953) employed three categories of sorting strategies to describe age level differences in sorting behavior among seven, nine, and eleven-year-old children. At the perceptual level, the least sophisticated, most primitive mode, classification is determined by the nature of the surface qualities of the stimuli. This mode was operationalized by Sigel as groupings based on various superficial attributes of stimuli. At the conceptual level objects are classified into deliberately conceived categories, and in order to be considered conceptual sorters, children had to designate a class name when grouping objects. Sigel also described an intermediate level which he called miscellaneous. Strategies employed at this level were characterized by mixing of perceptual and conceptual attributes and treating these mixed classifications as perceptual. A thematic (grouping according to a story) strategy was also incorporated into the miscellaneous mode.

In a somewhat similar fashion Olver and Hornsby (1966) grouped children's responses to a set of 42 pictures and several verbal items in a free-sorting situation into three major categories--thematic, complexive, and superordinate, in increasing order of abstraction. In this study, Ss varied in age from six to eighteen years. Summarizing developmental patterns of these equivalence groupings, they stated:

> With the development of symbolic representation the child is freed from dependence upon moment-to-moment variation in perceptual vividness and is able to keep the basis of equivalence invariant. A first step away from domination by the perceptually salient comes when the child, at about age nine, takes himself egocentrically as a reference point for establishing equivalence among things (Olver & Hornsby, 1966, p. 84).

Stones and Heslop (1968) examined the developmental changes in the sorting behavior of Vygotsky items (from the Vygotsky Test or Concept Formation Task) and the ability to generalize conceptual behavior to an extension task which utilized plasticine figures. The school children studied were British and varied in age from six to eleven years. Stones and Heslop classified responses into three categories similar to those described by Olver and Hornsby; the categories were precomplexive, complexive, and conceptual. The predominance of conceptual responses was found to be positively related to success on the extension task; that is, children who were capable of eliciting conceptual, i.e., abstract, classifications were also able to transfer their concepts to a novel situation.

Developmental changes in sorting behavior, i.e., changes with age or grade level, reflect some consistency in American studies although cross-cultural findings are ambiguous. The early preference for superficial, perceptual characteristics of stimuli has been demonstrated repeatedly in America; also, as children advance in grade level, the use of abstract, representational concepts increases, the transition being somewhere between the ages of seven and nine. Such findings are consistent with Piagetian notions of the stage level theory of development, though it is not clear whether these sorting tendencies are acquired through the schooling experience or whether they emerge from a natural enfolding process. With reference to specific dimensions, it has been found that a preference for the concept form emerges in young preschoolers up to age three, but that from ages three to six color is the preferred dimension (Brian & Goodenough, 1929). After age six to seven a return to form preference emerges and for children in the first five grades of school the preference for this dimension continues (Mitler & Harris, 1969; Odom & Mumbauer, 1971). If tested on their ability to learn to sort in various dimensions, third graders demonstrate better facility with concepts such as number, function, and name than do younger children. Parker and Day (1971) more recently have demonstrated the phenomenon of developmental progression from perceptually based strategies in the younger child to abstract, conceptually based strategies in older children, with an intermediary level which they call "functional," in which S attends to the utilitarian properties of stimuli.

Flavell (1970) in a review of this area elaborated on the developmental phenomena manifested in sorting behavior; according to this notion, as development progresses, there is an increasing ability to use superordinate classes in class-inclusion problems. Such superordinate classes would include lists of subordinate classes in a hierarchical fashion and are exemplified by headings such as "animals," "living things," "tools." More critically, however, what distinguished the cognitively developed child from the undeveloped is the ability to simultaneously hold in mind both superordinate and subordinate classes.

The continuing theme of early preference for sorting strategies based on superficial, phenomenological attributes of stimuli and the later emergence of preference and facility for the more abstract, conceptual groupings has been extended to the area of cross-cultural investigation with only limited success.

Although several investigators (Evans & Segall, 1969; Greenfield, Reich & Olver, 1966; Suchman, 1966) have noted the early preference for perceptual dimensions, there is considerable controversy about subsequent developmental changes, particularly in African children. Notions about age-related trends in classificatory skills have followed three basic lines. One view--that is seldom given any credence by contemporary psychologists--is that the cognitive development of African children is arrested at a certain point, usually around puberty. Concerning South African blacks Loades and Rich (1917) concluded: "Our results indicate the post-pubertal development of the mind is different in Natives from what it is in Europeans" (Loades & Rich, 1917, p. 383). Using Piaget's conservation tasks, Greenfield (1966) found that for <u>unschooled</u> children performance on these tasks did not change after nine years of age, but this was attributed to lack of schooling and not to deficiencies in the "Native mind." A second view, not entirely different from the one above, maintains that the very nature of the thinking of Africans is different from that of western people and, in effect, of a "lower" level of development. Levy-Bruhl's (1926) reference to the "pre-logical" thinking of natives has already been mentioned. Some psychologists (Carothers, 1953; Haward & Roland, 1955) have also espoused such views in describing the performance of Africans on psychological tasks as being concrete. This view would predict that since Africans are incapable of abstract thinking, they would not utilize conceptual strategies when they classify objects, and more to the point, could not learn to do so.

According to a third view which is quite distinct from the two previously mentioned approaches, the cognitive development of African children proceeds in a manner quite similar to that of western children. The reason this has not yet been verified is that cultural artifacts[1] mask this process. If investigators were to use culturally meaningful materials, Africans would display the same developmental sequence as western children. Jahoda (1956) has been among those who argue against the use of westernized methods and materials to assess abilities of Africans. Price-Williams

[1]"Artifacts" is used here in the statistics-research design sense, and not in the archaeological sense.

(1962) heeded his advice, and using culturally appropriate animals and plants for the Tiv of Nigeria, he discovered a change from perceptual to conceptual classificatory strategies as children advanced in age. This methodological problem will be discussed further below.

Recent cross-cultural studies of classification behavior have produced conflicting results. As mentioned earlier, Evans and Segall (1969) used pictures of objects such as a dress, banana, matches, and a hat and found that Ganda children in East Africa learned to sort these objects much more easily on the basis of color than by function (although function sorting was clearly learnable, particularly by school-going children). This facility for learning to sort by color occurred among groups of children who differed in grade level (grades one, three, and five), schooling (schooled, unschooled), and environment (rural and urban), while the facility for learning to sort by function increased with grade in school. In an earlier study in Senegal, Greenfield et al. (1966) reported that unschooled children (ages six to sixteen) showed very little reliability in their equivalence groupings and did not exhibit the "usual" developmental trends, i.e., early preference for perceptual dimensions of color and form and later preference for the function and name dimensions. The significant factor related to differences in sorting behavior in the Senegal study appeared to be the degree of schooling experience of these children; those children who attended western-type schools and were of the same age as the unschooled children demonstrated the age-related preference for abstract dimensions. Similar differences, though not as striking, were also found between rural and urban Senegalese children. The conclusion, of course, from such evidence is that any developmental patterns that do exist in classificatory tendencies from perceptual to abstract preferences emerge when the children are stimulated by westernized school experience.

Kellaghan (1968) administered free-sorting tasks, using both familiar objects (not described in detail) and alien objects (Goldstein-Scheerer Cube Test and Weigl-Goldstein Colour-Form Test) to a group of 12 year old Yoruba children of Nigeria. Thedimensions most frequently used by Yoruba children were those of color and material; furthermore, the number of objects which the Yoruba children used in their sortings were small compared to those used by Irish children. However, in the test where familiar objects were used, Yoruba Ss showed a greater number of abstract sortings than they did when the cubes were used.

A modified version of the third viewpoint presented above might argue that all children are capable of so-called advanced conceptual behavior, but that the order of emergence of classificatory strategies is not fixed. Such a viewpoint would emphasize the plasticity of classificatory tendencies and their susceptibility to environmental and instructional variables. Training to sort according to more representational dimensions was the critical variable in a study done by Okonji (1970) among 11-12 year old Ibo children of Nigeria. Using plasticine models of familiar animals that varied according to domestic, carniverous, reptile, and edible dimensions, he induced Ibo children, who originally sorted these objects by superficial features,

to sort by

to sort by more superordinate concepts. He claimed that such findings support the contention made by Inhelder and Piaget (1958) that "the realization of an individual's or group's potentiality to perform logical operations can be accelerated or retarded as a function of cultural and educational conditions" (Inhelder & Piaget, 1958, p. 29). Both Edwards (1969) and Fredrick and Klausmeier (1968) reported similar findings with regard to instructional set in studies done with American children; Ss given a verbal cue describing the basis for matching objects (Edwards) and an instructional set to attain a concept (Fredrick & Klausmeier) made more inferential sorting responses than those not given instructional cues. In each case the authors argued that sorting strategies can be manipulated by experimental conditions to a significant degree.

A clear and unequivocal interpretation of cross-cultural studies is clouded by the fact that some studies utilized a free-sorting task (Kellaghan, 1968; Price-Williams, 1962), while others (Evans & Segall, 1969; Greenfield et al., 1966; Okonji, 1969) used a learning paradigm. Indeed, what children prefer--in a free-sorting situation--and what they are capable of--in a learning task--may be quite different. Perhaps the discrepancies in the cross-cultural findings can be attributed to the utilization of these two very different tasks to assess cognitive level.

Preference

The results of the studies reviewed above indicate that, indeed, there may be several sorting strategies _available_ to a child at a given age, and available concepts can be manipulated by experimental conditions and educational milieu; but what may be more meaningful than availability is which strategies are _preferred_ in the sense of being higher in the habit hierarchy. This distinction between ability and preference was discussed by Birch and Bortner (1966) and by Parker and Day (1971). Irwin and McLaughlin (1970) provided one operational distinction:

> _Ability_ to sort by a dimension was operationally defined by the use of the dimension by any one of successive sorts. _Preference_ for one dimension over another was defined by the order of use, given that both dimensions were eventually used (Irwin & McLaughlin, 1970, p. 16).

It has been argued that these two constructs, ability and preference, are not orthogonal but are related in a meaningful way. Suchman and Trabasso (1966), working with four and five year olds, and Mitler and Harris (1969), working with five, six, and nine year olds, administered learning tasks to the same Ss who had been given free-sorting tasks. Both studies indicated that concepts along the preferred dimension (form) were discovered more easily in the subsequent learning situations than were non-preferred dimensions.

On the other hand, it is conceivable that African children, like any children, are capable of sorting in several dimensions; that is, in a learning situation they would show a capacity for sorting objects by color, by function, and by other dimensions. When presented with a free-sorting task, however, children will reflect the influence of their cultural milieu and prefer a single dimension over others. Such a preference may simply be the result of well established habits of classification that their culture has demanded, but this preference need not preclude the existence of abilities in other dimensions. Evans and Segall (1969) made such a point:

> That learning to sort by color was a simple matter for the researchers' own Ss, and that Ss in the free-sort experiments employed color predominantly, must, therefore, be considered no surprise. That some of these Ss, specifically, the relatively advanced school children learned just as easily to sort by function in an interesting point. To do this they had to engage in a search for the less obvious, process this less obvious information appropriately, and report correctly their conclusion (Evans & Segall, 1969, p. 51).

Such a distinction between ability and preference leads to a discussion of the relative advisability of using a free-sorting task versus a learning task when investigating classificatory behavior. The free-sorting task typically requires that S sort those items that belong together in any number of groups he chooses and in any way he chooses. This one-trial method may be helpful for determining preference but may not provide much information about ability since the strength of unchosen responses is not considered. Free sorting has been used extensively in studies of sorting behavior, and unfortunately, conclusions concerning ability have consistently been drawn (Bearison &

Sigel, 1968; Gardner, Holtzman, Klein, Linton & Spence, 1959; Rosen & Connaway, 1968; Sigel, 1953). The learning situation, on the other hand, by requiring Ss to reach criterion on various concepts, both preferred and non-preferred, can provide comparative data concerning the ability with different concepts and their limitations. In cross-cultural investigations both have advantages. The free-sorting task can be used initially to determine what concepts are relevant for a specific group and what strategies are preferred, while the learning situation can be applied in subsequent experimentation to determine children's ability, the relation between preference and ease of learning, and to search for any psychological invariants that may emerge between cultures.

Thus, preference, which reflects culturally determined habits may be observed in a free-sorting situation while ability may be more appropriately measured by a learning task. The essential question in this investigation is the relationship between preference as revealed in the free sorts and performance on a learning task. In some cases the task to be learned will employ the same modality that was preferred in the free-sorting situation and in other cases it will employ a different modality.

Methodological Considerations

It has already been noted that a plausible explanation for the discrepancy between studies of African children and studies of western children with regard to age-related changes in sorting strategy may be an artifact of the stimuli used in such studies. It is conceivable that if an adequate effort is made to discover culturally relevant objects African children may show a developmental progress similar to that shown by western children.

Many investigators of non-western societies have entered these societies, imposed unfamiliar tasks, and in most cases neglected to precede experimental work with observation or elicitation of culturally meaningful classificatory systems using familiar objects. An example of such observers who entered a non-western society and estimated, themselves, what were familiar to their Ss can be seen in the Senegal study by Greenfield et al. (1966).

In this investigation it was claimed that familiar objects were employed in the sorting tasks, but in fact, these objects were selected by the experimenters from the Dakar market and subsequently used to test urban and rural children. If it may be assumed that different cultures have different classificatory systems then the primary task in any cross-cultural investigation of this type is first to identify the concepts and materials that are appropriate to a particular culture. This problem of eliciting and identifying culturally appropriate concepts and materials is related to an important methodological issue in cross-cultural psychology.

In cross-cultural psychology investigators have attempted in one way or another to use either internal or external descriptions of behavior, and research has basically followed methodologies on a continuum somewhere between the emic and the etic poles, two terms originally coined by Pike (1966) for linguistic study. To study a culture emically is to utilize a conceptual investigative scheme which is intrinsic to the culture, while to study etically implies that measurement tools and assumptions behind those tools are external to the culture. The investigator who employs the emic method typically studies behavior from within the system, examines a single culture, discovers the structure of the culture, and reports criteria that are relative to internal characteristics; the etic investigator, on the other hand, studies behavior from outside the system, examines many cultures, creates the structures of the cultures, and reports criteria that are absolute or universal. By extending the assumption of the emic method to its logical conclusion leads one to a dilemma which in anthropological circles is referred to as the Malinowskian Dilemma:

> Malinowski was most insistent that every culture be understood in its own terms, that every institution be seen as a product of the culture within which it is developed. It follows from this that cross-cultural comparisons of institutions is essentially a false enterprise, for we are comparing incomparables (Berry, 1969, p. 120).

Malinowski's warning, however, need not prevent the psychologist from first making culturally sensitive observations and later making cross-cultural comparisons.

If meaningful stimuli are discovered, emically, then it may be possible to proceed with free-sorting and learning tasks to determine if Ss in a non-western setting will show a stage-level developmental sequence in sorting strategies. A number of attempts using this approach have been made in Africa.

Price-Williams (1962) studied classificatory strategies of the Tiv of Nigeria, and he concluded that despite differences in schooling experience, Tiv children, with increasing grade level, classified animals into general categories of edible and inedible. Using both literate and illiterate children who varied in age from six and a half to eleven and a half, he elicited in a free-sorting task, categories of culturally meaningful plants and animals. Defining concrete, i.e., perceptual, classifications as those based on attention to immediate sensory quality of a stimulus, Price-Williams concluded that when there is an interest, i.e., meaningful stimuli are employed, abstract categories are formed by both schooled and unschooled children.

In a recent study done among the Mano people of Liberia (Irwin & McLaughlin, 1970), two types of sorting objects were used--geometrical objects represented on cards and bowls of rice (a culturally appropriate stimulus for the Mano), which varied according to the size of the bowl, type of rice, and cleanliness of the grain. Ss included a sample of illiterate adults and two groups of school children--upper level (grades four through six) and lower level (grades one through three). Ability to shift dimensions, latency of sorting responses, and ability to articulate reasons were scored for all Ss presented with the two different stimulus types in a learning situation. With geometrical objects, both color and number dimensions were easier than form for adults and children, but in the rice-sorting task size of the bowl was the easier dimension to learn. The ability to shift, mean latencies, and ability to articulate the basis for sorting all indicated better performance in the rice-sorting situation compared to the geometrical picture task, especially for adults. Thus, classificatory tendencies, in this study, varied with the cultural meaningfulness of the material sorted.

The Irwin and McLaughlin study was stimulated by the earlier work of Michael Cole (Cole & Gay, 1969; Gay & Cole, 1967; Gay & Cole, 1968) who examined classificatory systems of the Kpelle people of Liberia. In most of his experimentation Cole used school children and illiterate children (both groups ranging in age from 10 to 14) and illiterate adults. In the "elicitation" phase of his study he employed such techniques as the "substitution" method in order to elicit the cognitive map of the Kpelle. In the substitution method Ss are individually asked such questions as "______________ is a ______________;" the first term is a member of the class named by the second term. Either word could then be replaced by a question word to elicit further discriminations and generalizations of the hierarchy of classifications. Cole found that these peoole classified material objects, at the highest level of their hierarchy, into a "town-forest" dichotomy. Further work with equivalence groupings among the Kpelle led to a culturally relativistic interpretation of classificatory systems when comparing different cultures. Cole reported that for the Kpelle equivalence is not the same as resemblance; rather, the basis for equivalence in Kpelle culture is what Cole called "activity;" that is, when asked why two objects such as a hoe and an axe went together, Kpelle Ss responded by saying that the axe and the hoe perform the same action, i.e., that of fracturing a surface. For Kpelle adults, then, classificatory strategies seem to be based on functional, i.e., activity, characteristics of stimuli rather than on perceptual aspects, i.e., inherent superficial attributes of stimuli, such as color or form. In describing the purposes of his investigations, Cole stated, " . . . that wherever possible the inferences about differences between cultures with respect to a given psychological process rest on evidence from the pattern of differences within the culture being compared" (Cole & Gay, 1969, pp. 17-18). Cole avoided the Malinowskian Dilemma by arguing that preliminary emic study of various cultures, followed by experimentation with culturally appropriate materials can lead to the discovery of some psychological invariants or absolutes across cultures. Thus, the adoption of the emic methodology may not preclude the possibility that certain invariants exist across cultures.

From the findings of culturally sensitive observers concerning cognitive development in Tiv, Mano, and Kpelle cultures, one is led to the conclusion that African children--like children everywhere--develop beyond the level of perceptual groupings of objects, but that this is only apparent when culturally meaningful stimuli are used. It is highly likely, therefore, that children of any society, when presented with familiar objects to sort will exhibit the same developmental changes reported for American and European children, Indeed, the familiarity of objects to be sorted may affect the sorting strategy a subject chooses, usually in the direction favoring more functional or conceptual categories. That is, the frequency of perceptual sorting diminishes with increasing familiarity of objects, as Sigel (1964) reported, "When meaningful materials are used children at ages seven, nine and eleven tend to ignore such structural properties as color, texture, and material"

(Sigel, 1964, p. 21). More recently Olmsted and Sigel (1970) demonstrated that with Negro kindergarten children form preference emerged when geometrical objects were used, and color preference when real objects or pictures of real objects were used. They concluded that color/form preference is not a generalized response. Cross-culturally similar findings regarding the ability of familiar objects to elicit culturally meaningful functional dimensions have also been reported by Kellaghan (1968) and by Okonji (1970).

In any cross-cultural investigation it is important to gain insights from consideration of performance within a culture; using as a basic datum the coherence of ideas within a culture, one can construct hypotheses about the rules which tie behavior together in a specific society. Having first determined some of these rules, it would then be possible to impose on that culture various tests according to the etic strategy in order to determine the bounds of certain cultural rules and whether hypotheses can be made about constants across cultures. In such a way an investigator would not become bogged down in the Malinowskian

Dilemma by a pure relativistic approach to every system that he encounters, and he might be able to draw some conclusions about the reliability of psychological invariants across cultures.

The primary goal of this study then is to investigate the relationship between preference, as measured by a free-sorting task, and learning to sort. The free-sorting task will be referred to as Phase I and the learning task as Phase II. The purpose of Phase II will be to determine the ability of Ss to sort according to certain classificatory modalities.

Such a procedure is not entirely new; it was recently recommended by Okonji (1970):

> Already some psychologists (Silvey, 1963) are of the opinion that the best approach to mental testing in Africa is to combine it with some training so as to be able to get at what Luria (1961) has called the 'zone of potential development' (Okonji, 1970, p. 22).

In a similar vein, Evans and Segall argued:

> In light of the findings and the interpretation offered here, the authors feel that the results reported by other researchers in Africa who employed free-sort tasks should not be interpreted as revealing a maturational unfolding of conceptual

> ability. Rather, they probably reveal that unless Ss are induced by the E to look for some less obvious characteristic, and unless they have some countertendency established by prior experiences of the kind gained in school, they will employ the most obvious one available as the basis for sorting (Evans & Segall, 1969, pp. 50-51).

Before this experimentation can be conducted, however, certain information about the culture must be determined.

In one East African society, in which the present research was conducted, appropriate concepts and materials were determined in an "elicitation" process, employing some emic-like procedures, such as those used by Gay and Cole. They were administered to children of various age levels in this culture. The elicitation part of this study will be referred to as the "emic phase." The final definition of the experimental phase was delayed until this emic phase was complete.

In Phase II training tasks which varied with respect to their preferability of classification modalities were employed. These tasks were administered to children from a narrow range of the grade levels used in Phase I. Half of the children whose preferred modality was perceptual were trained in the learning task to sort perceptually and the other half were trained to sort conceptually. Similarly, half of the conceptually preferring sorters were trained to sort conceptually while the remaining half were trained to sort by the perceptual modality. For the purposes of this investigation "modality" will signify the general strategy employed, either perceptual or conceptual. A modality may consist of several "dimensions," and the latter will be used to signify specific sorting strategies, such as color, edibility, etc.

For illustrative purposes let us assume that in Phase I a meaningful and preferred dimension for a particular S was "purchased/non-purchased" (a conceptual modality with the dimension being purchasibility), while for another S the preferred dimension was form (a perceptual modality). In Phase II we would present to these Ss stimuli that could be sorted either perceptually or conceptually with Ss assigned to one of four groups in a two-by-two factorial design, as shown in Table 1. In Groups I and II the perceptual modality is preferred and would be, as in this

Table 1

Example of Factorial Design Showing Independent Variables of Training Conditions and Modality Preference

Modality Preference	Training Condition: Perceptual	Training Condition: Conceptual
Perceptual	Group I	Group II
Conceptual	Group IV	Group III

Interaction Prediction: III-II > I-IV

example, form. In Groups III and IV the conceptual modality is preferred and would be, in this example, purchasibility. Ss in Group I would be given a learning task involving the precise dimension they preferred in Phase I, e.g., form; Ss in Group II would be given a task involving the conceptual modality. In Group III Ss would be given a task where a conceptual modality must be learned, e.g., purchasability, while those in Group IV would be given a task involving the perceptual modality. If preference, per se, affects ease of learning to sort, differences in scores should occur across the rows in Table 1 (i.e., Groups I and II would differ from Groups III and IV). It might further be predicted that ease of learning to sort conceptually will be different from the ease of learning to sort perceptually (i.e., Groups I and IV would differ from Groups II and III). It might also be predicted that ease of learning would vary across conditions in an interactive way, viz. that learning to sort conceptually would be facilitated by a conceptual preference more than learning to sort perceptually is facilitated by a perceptual preference.

In other words, the difference between Groups II and III would be greater than the difference between Groups I and IV. In summary, there are three predictions. Two of them are "main effects" and the third is an interaction.

A secondary goal of this dissertation research was to observe the developmental trends in the classificatory strategies in this non-western society. It is hypothesized that when culturally appropriate objects are used in free-sorting and in a learning task the same developmental trends observed in western children will be observed in this non-western setting.

CHAPTER II

METHOD

The Cultural Setting: The Babukusu[1]

The Babukusu (singular - Omubukusu) are a subtribe of the Abaluyia conglomeration who inhabit western Kenya south to the border of the Nilotic Luo, north to Mount Elgon, east to the Nandi escarpment, and west to Lake Victoria and near the Uganda border (see Figure 1). The Babukusu consider themselves kin to the Bagishu (Lafontaine, 1959) who inhabit eastern Uganda near Mount Elgon, but more generally they are considered to be part of the Interlacustrine Bantu tribes (Lafontaine, 1959; Mudrock, 1959). In the ethnographic literature the Babukusu have been referred to as the Kitosh (Lafontaine, 1959; Wagner, 1956), The Gishu or Bagishu (Lafontaine, 1959; Roscoe, 1966), and as the Masaba or Bamasaba (Osogo, 1966; Wagner, 1956). Included among the Interlacustrine Bantu are such groups as the Baganda, the Banyankole, and the Basoga of Uganda, the

[1]The prefix "ba-" in most Interlacustrine Bantu languages is used to refer to people. The prefix referring to language is "olu-." The root word referring to this ethnic group is "Bukusu" and will be used in this paper as any noun which is not a person or not a language in this culture, and as an adjective to describe any person or thing pertaining to this culture.

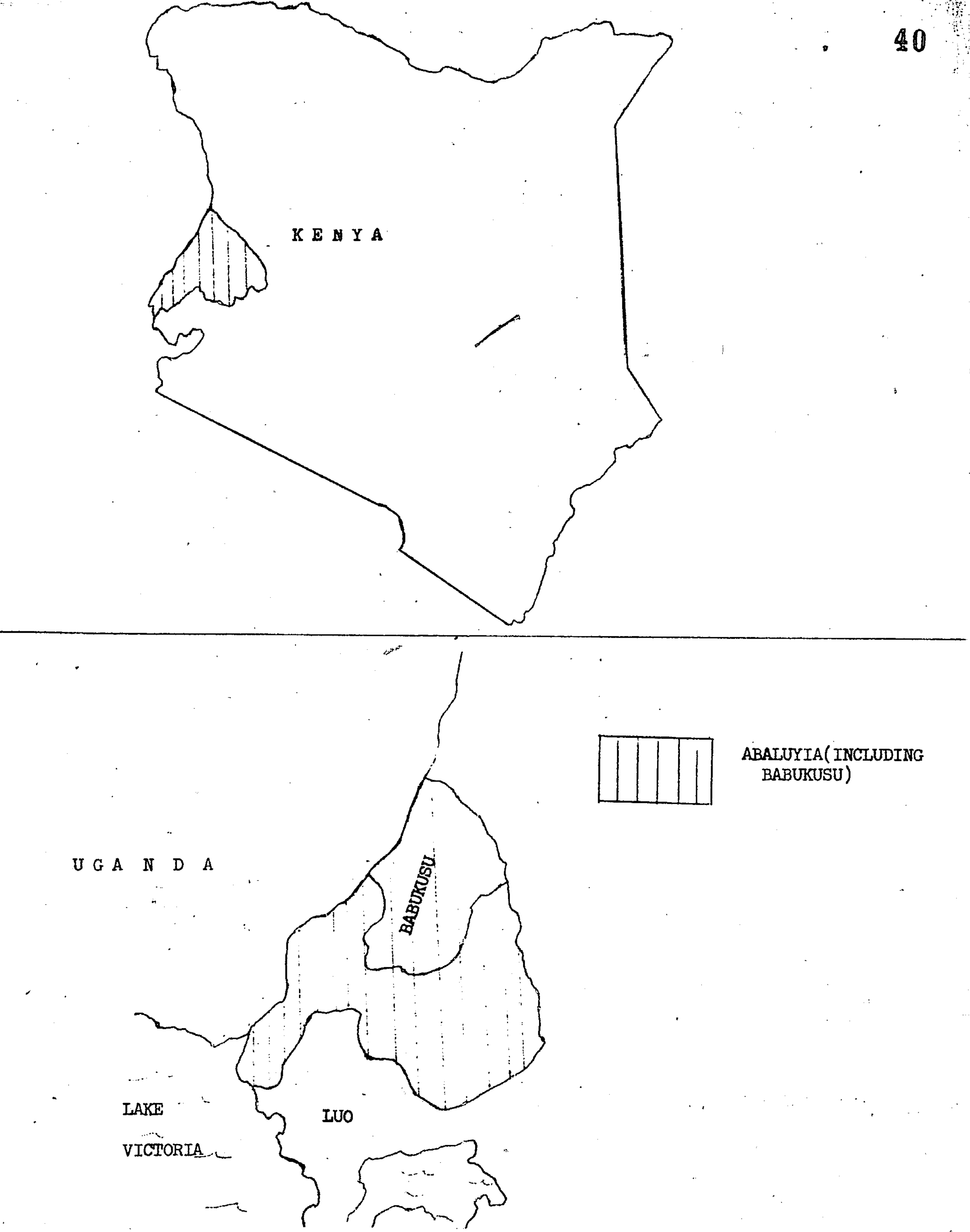

FIGURE 1 - THE ABALUYIA AND BABUKUSU IN RELATION TO KENYA AND NEIGHBORING AREAS.

Bahaya and Wazanaki of Tanzania, and the Abaluyia of Kenya. The Babukusu, who number approximately 300,000 (Kenya Population Census, 1969) are the northern-most sub-tribe of the Abaluyia, inhabiting the savanna plains around Bungoma up to the forested slopes of Mount Elgon. They are distinguished ethnographically (Roscoe, 1966) and linguistically (Guthrie, 1967) from the other Abaluyia sub-tribes to the south. The most notable distinctions between the Babukusu and other Abaluyia tribes is the relative importance which the Babukusu place on cattle (Wagner, 1956) and on their highly cohesive exogamous clans (Roscoe, 1966). The wealth and prestige of a Bukusu clan is measured almost exclusively by the quantity of cattle which the clan possesses. Birth, death, circumcision, and marriage are all significant social institutions which are marked by strictly prescribed rules regarding the transfer of cattle between clans. Wagner (1956) has documented the vast amount of litigation that surrounds the transfer of cattle among the Babukusu. Furthermore, the language of the Babukusu (Olubukusu) is said to contain at least 16 words to describe different types of cows and at least 18 words to describe the different colors of cows (Wagner, 1956). A Whorfian interpretation of this important bit of cultural datum might be that the language of the Babukusu leads them to unique perceptions of their environment. According to such an interpretation the fine linguistic distinctions that are made in this culture with regard to cattle should also be made in non-linguistic behavior. Supportive evidence for the Whorfian view would be obtained if the sorting behavior of Bukusu children reflected linguistic references to cattle. The role of cattle and other domestic animals in the ultimate value of glorification of the clan was described by Wagner (1956):

> . . . . from an African point of view any beast (with the exception of certain clearly defined categories) is primarily valued as a means of obtainingwomen and thus--indirectly--of securing male offspring and thereby increasing the clan community (Wagner, 1956, p. 196).

Although cattle are highly valued in this society, most Babukusu occupy themselves with the task of cultivating their eight to fifteen acres of farm land. Most land is devoted to the cultivation of corn which is both sold for cash and used as food; but sorghum, finger millet, beans, and leafy vegetables are also grown for local consumption, and occasionally coffee is cultivated as a cash crop.

The Bukusu child spends a great deal of time tending cattle if he is a boy and helping with household chores, such as fetching water and firewood, preparing vegetables, and cooking, if she is a girl. By far the most significant event that occurs in the life of a male Bukusu is circumcision which usually is performed when the boy is 13 to 15 years old. Despite the fact that most Bukusu boys go to primary schools and finish at least standard (grade) four, the circumcision ceremony with all its embellishments is still performed once every two years on virtually all Bukusu males. Although female circumcision existed in the past (Wagner, 1956), there is no such institution for females among the present-day Babukusu.

The present investigation was conducted in the Kimilili Division of Bungoma District which is inhabited predominantly by Babukusu. The population of this division according to the most recent census (Kenya Population Census,

1969) is 152,707. A division consists of locations, and locations consist of sub-locations. The country is broken down hierarchically in this fashion for administrative purposes. In conducting this study the investigator crossed two locations within the above-mentioned division. Kimilili Division is located on the southern slopes of Mount Elgon and is somewhat different from other areas inhabited by Babukusu in the greater fertility of the soil, the greater rainfall, and higher population density.

There were several reasons why this site was chosen for this investigation. First and most important was the cooperativeness of the people; compared to other groups in Kenya Abaluyia peoples are known for their cooperation and friendliness. Other areas such as the Moslem coast and Kikuyu highlands are comparatively less open to inquisitive outsiders. Another criterion was population density and the need for an area where several primary schools could be reached with minimal difficulty. Related to this need was the requirement that the group be relatively homogenous so that assumptions about the culture would be applicable to the whole population. Such is the case with rural Babukusu who are less tainted from the influence of other Kenya tribes, Moslem culture, or western culture. When all these criteria were weighted and considered along with other practical considerations, such as where a temporary home could be obtained and where potential contacts lived, the Bukusu people and the particular area described above were finally selected for investigation.

Subjects

Children who were administered the free-sorting task were selected from standards (grades) one, three, five, and seven within six schools in Kimilili Division. These children were chosen at random for testing within each class of the standards mentioned above, in all schools there was only one class of each of these standards. All six schools were within a four mile radius of the investigator's residence near Kimalewa market in the Bokoli Location, and more than 90 percent of the pupils in each of these schools were Bukusu. Themean ages with standard deviations and the sex distribution of children from each grade level are presented in Table 2.

Procedure

The study was done in three major parts: the emic phase, Phase I (free-sorting task), and Phase II (learning task). The emic phase was begun with observations in Bukusu homes, interview with teachers, observations of early primary school curricula, and group interviews with mothers and secondary school girls. Later in the emic phase a taxonomy of material objects and a comprehensive list of material objects were constructed on the basis of interviews with standard seven school children in three schools. Phase I arrays of objects were presented to children for free-sorting in an individual-testing situation. Phase II involved the training of particular sorting strategies to children who were selected from the Phase I sample on the basis of their individual preferred sorting behaviors.

TABLE 2

Mean Ages with Standard Deviations and Sex Distribution for Four Grade

Levels in Phase I.

		Age in Years		Sex	
Group	N	Means	S.D.	Frequencies	
				Male	Female
Std. I	25	10.28	1.79	17	8
Std. III	25	12.36	2.34	14	11
Std. V	25	14.20	2.08	14	11
Std. VII	25	16.32	2.12	18	7
All Groups	100	13.29	3.05	63	37

Emic Phase

The purpose of the emic phase was to elicit appropriate stimuli and some salient concepts for this non-western setting. Before doing the individual elicitation in Phase I free sorting it was decided that observations from a wide variety of the Bukusu child's experience would have to be made in order to collect a culturally meaningful sample of objects to sort.

When the investigator had settled in the area with his wife, who taught during the period in a self-help secondary school, a local assistant was obtained to help with problems of translation and interpretation. The assistant was a resident of the area and was familiar with all six schools. She spoke Olubukusu, Swahili, and English fluently and was educated up to Form II (tenth grade). She was 22 years old, had three children of her own, and was selected because of her ability to understand the investigator's instructions and to put children at ease in an individual-testing situation.

In order to familiarize himself with the preschool and home experience of the Bukusu child, the investigator visited nearby homes with his assistant and observed children and material objects around the home. A list of familiar objects which was combined with written descriptions of familiar objects (Osogo, 1966; Wagner, 1956) was begun at this point; later this list was modified and expanded on the basis of group discussions with schoolchildren.

Two discussions were then conducted with groups of experienced child rearers in the area. The first discussion took place at the Kanduyi Red Cross Centre in Bungoma where mothers are brought for three to four weeks with their children to be taught proper nutritional care. During this discussion questions concerning toys children use, games children play, and "concept training" by mothers were asked. "Concept training" was an elusive idea to express to most of these mothers; the question, "What concepts do you first teach your children?" was phrased in many different ways, but finally it was discovered that the best question to ask was, "What distinctions and what generalizations do you first teach your children?" A similar discussion was held in a secondary school for girls, all of whom admitted to experience in child rearing. All mothers and secondary school girls in these samples were Babukusu.

The final step in this "observational" portion of the emic phase took place in the schools from which Ss were later to be tested. Teachers of the early primary grades were asked what concepts they taught children and observations of the class and teacher were made. Because most teachers mentioned their dependence on nationally prescribed syllabuses for lesson planning, these documents together with textbooks were obtained and examined for concept training and particular objects used.

Thenext step in the elicitation phase was to compose a comprehensive list of material objects known to Bukusu school children. On the basis of information obtained from Osogo (1966) and Wagner (1956), a priori categories of objects were established, and two groups of children, each from different schools, consisting of five standard seven children were simply asked to name what they considered to be the most common objects in these categories. The categories were: foods, clothing/decorations, household items, plants, animals, outdoor tools, personal effects, stones/minerals, games/musical instruments, and school items.

The development of a taxonomy of material objects for Bukusu school children involved a more formal procedure. In three of the six schools among the six that were to be tested, a group of three standard seven pupils were selected. These pupils were selected by the teachers of their classes as being those who would most readily express themselves before a stranger.

The method of questioning was similar to that used by Gay and Cole (1968) and originally suggested by Metzger and Williams (1966), but with some modifications. In this investigation the pupils were told in Olubukusu, "Give me the name of a thing--anything." Having given the response X, the respondents were then asked, "What is another thing which is like X?" They were continually asked to give other things like X until latencies between responses exceeded

10 seconds. Next the respondents were told, "Give me the name of a think which is not like X." After the response Y, the following question was posed: "What is another thing which is like Y?" Again the group of "Y" things was terminated when latencies exceeded 10 seconds. Three groups of things were elicited at a time in this manner. After three groups had been elicited, respondents were asked whether all the groups were the same in any way and then how the things within each group were like each other. In order to break down groups of wide category breadth, the respondents were also asked how the things in each group were different from each other. Then another set of three lists was generated. This procedure was followed until the respondents in each group had exhausted their possible categories and could name no new things that could not be included in any of the lists already generated. The children were then asked to give the best name they could think of for each category. The names of each list were then written on a small card, and respondents were asked to group each category name according to how things went together. For

example, theywere asked whether the list of animals was in any way like the list of insects. This was done in order to generate some superordinate categories. In each school group the children were encouraged to reach a consensus about their decisions on all these questions. In the event of disagreement Ss discussed the matter until agreement was reached. The respondents expressed a desire to speak in English to the experimenter while answering these questions, but they were encouraged to use Olubukusu whenever possible.

From the responses to these questions a taxonomy for each school group was constructed. The taxonomies elicited by each school group were then shown to every other group. The children observed discrepancies between the taxonomies and discussed within their groups resolutions to each conflicting category. From the three revised taxonomies a single taxonomy, which included all categorizations elicited by each group, was finally constructed. Even after discussion of the three taxonomies, however, some discrepancies remained; these discrepancies are noted in the final version of the taxonomy. The final version of the taxonomy was constructed in such a way that it would reflect the consensus view of the respondents interviewed. E made no attempt to revise the taxonomy himself so that it would be logically consistent for him. Furthermore, the exact wording of respondents' statements was maintained when they spoke English, and a direct translation of Olubukusu was recorded and entered in the taxonomy when that language was used.

Phase I

Pilot Testing

It was at this point in the investigation that preliminary selection of sorting objects took place. As many categories of the taxonomy as were feasibly possible were represented among the various objects selected. A large number of children were then pilot-tested under a variety of situations. There were several purposes to this pilot testing:

1. To acquaint the experimental assistant with the basic procedures of individual testing such as standardization and objectivity, as well as to acquaint her with the

process of probing and questioning children's responses;

2. To test the understandability of the instructions and to eliminate any problems related to language in the instructions;

3. To determine those objects that were recognizable to school children;

4. To determine the best number of sorting objects per array and the best number of arrays for maintaining attention and consistent sorting within Ss.

5. To make preliminary observations on sorting strategies of school children.

The children used for pilot testing were pupils in non-government supported primary schools, called "nursury schools" in Kenya. These schools are usually deficient in books, equipment, buildings, and quality and quantity of teachers when compared to government-aided schools, but it was thought that any procedures established in such an educationally deficient situation would be usable in government-aided schools. Most children who were tested in pilot sessions were standard one or two children.

The experimental assistant was trained to standardize instructions for all children and to probe the child with questions following ambiguous responses. For example, when a child said that certain things "look alike," the assistant then asked, "How do they look alike?" If the child said "the color is the same," the assistant asked, "What color?" By the time pilot testing began E was familiar with enough Olubukusu to understand the instructions, ask questions, and understand most responses to questions. The assistant was corrected when she deviated from the instructions, and for several children she was tape recorded in the absence of E. Discrepancies in her questions and instructions between the taped sessions and the sessions when E was present were pointed out to the assistant, and she was urged to make them consistent. The most difficult aspect of the training of the assistant was inculcating the idea that all responses in this elicitation phase could be correct and that there could be no correct or incorrect answers. The assistant at first had a strong tendency to respond differentially to children who sorted in different ways.

The instructions were first written out in English, translated into Olubukusu by the assistant, and back translated into English by two other bilinguals according to the method described by Brislin (1970). After revisions in Olubukusu on the basis of back translation the instructions were tried with nursury school children. It was found that the Bukusu translators had been too diligent in their use of pure Olubukusu so the whole process was redone with several key words such as "group" translated into their Swahili-ized or anglacized versions--a version more understandable to these children. The instructions are presented in Appendix A. Two words in the instructions caused notable difficulties. Most of these young children could not understand any of the pure Bukusu words for "group;" the word for "group" which was most frequently understood was the anglacized version "ekurupu." Children were asked in the instructions if they knew what the work "group" meant; if they said that they did not know they were asked to proceed with the task as best they could. The other word that caused difficulty was the verb "faanana," which in

Olubukusu means "look alike." This was the word that translators used for the English word "go together." It is interesting to note that Evans and Segall (1969) encountered the same problem in Luganda with the very same word. Such a word, it was thought, might have biased children to make perceptual responses in that it would lead children to attend to those attributes of the stimuli that look alike rather than those attribures that more generally "go together." Alternatives were sought and the word "-alala," meaning "go together" or "are one in the same" was finally settled on. This word is not as common a verb as "-faanana," but was understood by most of these children.

Several objects that had been selected on an a priori basis as being familiar objects to Bukusu children turned out to be difficult for them to recognize. Certain less common seeds and leaves, when presented to a child in an experimental situation could not be named. Furthermore, a whole array of wood-carved representations of wild and domestic animals could not be used because most children could not recognize the animal which the carving was intended to represent. This phenomenon was especially true of wild animals and perhaps can be attributed to these children's dearth of experience in seeing wild animals. Any object which was correctly named by 90 percent or more of the children was retained for use in later presentation to primary school children. The criteria for names of these objects was established during sessions with a group of three standard seven children, the assistant, and E. Acceptable names in Olubukusu for all objects used in pilot runs and in the final arrays were decided by consensus among the group.

In the pilot sessions objects were presented in a wide variety of ways. As many as 40 or as few as four were presented within an array. With a large number of objects it was discovered that children left many objects unsorted, and with small arrays children were not given enough opportunity to demonstrate a variety of preferences. Four arrays, each with ten objects, proved to be the best procedure for keeping children's attention throughout the whole task and for providing enough diversity of stimuli. Another concern in the mode of presentation was that Phase I arrays be amenable to training procedures in Phase II, where Ss would be required to learn certain strategies. This meant that all stimuli within each array had to be potentially sortable along a variety of dimensions; for example, an array consisting of cassava, a banana, various seeds, and wild leaves might be sorted on the basis of planted/not planted dimension, but such an array could not be used to train children to sort on a purchased/not purchased dimension. This became an especially thorny problem in the presentation of stimuli that offerred potential sorting alternatives based on color and based on functional attributes, such as planted/not planted. To increase the salience of perceptual attributes, such as color and material, several of the stimuli were presented in containers which were bright red, green, or metallic. The use of containers also solved the problem of how to present small and elusive objects like seeds. Thus, four arrays, each containing ten objects were finally selected (see Table 1 of Appendix B); these objects could have been sorted on the basis of the conceptual attributes, such as edibility, cultivability, or on the basis of perceptual attributes, such as color or material. In several cases the child had to attend to the container rather than to the object inside in order to make a perceptual sort. Several objects, like the leaves and fruits, being perishable, had to be replaced each day. Care was taken so that these objects had the same appearance from day to day.

Free Sorting

In the experimental situation children were seated, greeted by the assistant and by E and were asked some personal information. They were first asked their given names and then their fathers' names. Further questions concerned their grade level in school, total number of years in school (whether the child had repeated any grades), whether the mother or father were Babukusu, and the child's age. Responses to the last question were often difficult to obtain. Almost none of the children knew in which month they were born but most knew the year. Records of births are rarely kept in rural Africa, and the only way a child can know when he was born is to ask his parents. Some standard

I children could not give the year of their birth; in these cases the teacher was consulted.

After preliminary information was obtained children were given instructions for the task and at the same time presented with the first array; that is, the array was presented and then the instructions were read to the child. The order of presentation of arrays was randomized across all children (see Table 2 of Appendix B for order), and for each array there was a fixed pattern of object position (see Table 3 of Appendix B). The ten objects were placed on the table before the child according to the prescribed pattern. The child was asked to put the objects together that went together and to give his reasons for putting the objects together. This "open" method was sometimes difficult to administer to children, but it was thought that such a method would provide a better picture of preferred sorting than would the more traditional method used by Sigel (1953) and by Okonji cross-culturally (1970) in which the child is required to match several objects to a key object. The latter method appears to be restrictive in that potential dimensions are limited by those attributes present in the key object only. A further modification of the traditional sorting task used by Sigel and others occurred in the identification of objects. Rather than children being asked to identify objects before they sorted, they were asked this after sorting of a particular array was completed. This modification was made in order to avoid any sorting bias that may have been suggested in the actual naming of the stimuli. If a child failed to identify more than two of the stimuli in all arrays, according to the criteria mentioned above, he was rejected for possible use in Phase II. In all cases the child was allowed to touch and manipulate objects if the wished. Bearison and Sigel (1968) claimed that the handling of objects should not significantly affect sorting strategies.

Scoring Technique for "Preference"

There were two criteria used to determine a child's preferred sorting strategy: first, his actual sorting behavior and second, the reasons he gave for sorting. It is believed that the latter would indicate most accurately a child's sorting strategy. Previous investigators have placed great importance on children's verbalized reports of sorting strategies. Stones and Heslop (1968) concluded, "the ability to state defining attributes of groups of stimuli is the acid test of conceptual thinking," and Greenbaum, Rakover, Stein and Minkowitch (1968) supported this view--"the ability to carry out a concept-formation task depends upon the ability to verbalize intentions." Thus, the primary criterion for determining sorting strategy was the child's verbalized responses to questions asked about his reasons for sorting.

The criterion for selection of Phase II Ss was based on S's performance in Phase I. That is, those children who demonstrated in the Phase I either a predominant "perceptual" or "conceptual" strategy were tested in Phase II of the study. Perceptual dimensions were defined as groupings which are based on the physical attributes of stimuli, or as Piaget described them (Inhelder & Piaget, 1958), groupings which provide an "immediate" apprehension of objects. Sigel, Jarmian, and Hanesian (1967) and Kagan, Moss, and

Sigel (1963) employed a similar definition of "descriptive" categories which they claimed are based on manifest, objective, physical attributes of stimuli. Examples of perceptual dimensions are form, color, size and texture. Conceptual groupings, on the other hand, are based on independent attributes of stimuli and furnish a "mediate" knowledge of stimuli (Inhelder & Piaget, 1958). Conceptual responses have been referred to as "superordinate" (Olver & Hornsby, 1966) groupings, or "categorical-inferential" (Sigel *et al*., 1967) groupings, but the common ground for this variant terminology is the fact that such groupings appear to be based on *inferred* characteristics of stimuli. Some conceptual dimensions for this non-western population, for example, might include store-bought/not store-bought, edible/inedible, or planted/not planted. Groupings for which no verbal reason was given and groupings for which the name of the object was persistently given as the reason for sorting it were classified as "unscorable" responses. Thus, a child's verbalized reason for grouping the stimuli was scored as *perceptual* if it referred to some superficial attribute of the stimuli such as color and as _conceptual_ if it referred to an implied attribute of the stimuli such as edible and as _unscorable_ if no reason was given or if the name of the object was given as the reason.

Those children whose perceptual reasons represented 67 percent or more of their total perceptual and conceptual reasons were considered to be preferred perceptual sorters. Similarly, _S_s whose conceptual reasons constituted 67 percent or more of their total conceptual and perceptual reasons were considered to be preferred conceptual sorters.

Selection of Ss

Twenty-five children in each of four grade levels, standards one, three, five and seven were tested and scored in this manner. For each grade level the numbers of predominant perceptual and conceptual sorters were noted. That grade level that gave the best approximation of a 50-50 split between preferred perceptual and preferred conceptual sorters was then selected for the Phase II experimentation study. It was found that standard III children divided themselves almost equally between conceptual and perceptual sorters, and so more children at this grade level and proximal grade levels were tested so that the initial sample of 25 children from standard III who showed a preference was expanded to 104. These 104 were employed as Ss. Children from standards two and four were included as Ss for practical reasons; the six schools did not have enough standard three children, who hadnot been tested before, so that the total number of preferred (67 percent or more of their responses being either perceptual or conceptual) sorters could be raised to 104. In order to obtain 104 predominantly preferring Ss, many more than that number had to be tested in the Phase I situation. The same number of preferred perceptual and conceptual sorters were chosen from both standards two and four. And so, 104 Ss who differed only in the preference of their sorting strategies were finally obtained for use in Phase II. Half of these, i.e., 52 Ss, were predominantly perceptual sorters and the other half were predominantly conceptual sorters.

Phase II[1]

In this experimentation phase of the study there were two basic conditions, preference and training condition. Preference, as determined in Phase I, was defined dichotomously as either the conceptual modality or the perceptual modality, and the training procedure varied according to whether a conceptual or perceptual task was taught to the child. Thus, perceptually preferring Ss were randomly assigned to one of two training conditions: half were trained on a perceptual task and half were trained on a conceptual task. Conceptually preferring Ss were also randomly assigned to the same two conditions.

Phase II was conducted immediately after the completion of Phase I. All testing of children in Phase I and Phase II was conducted from May through July, 1971, the second term of a three-term academic year, for primary schools.

The Phase II sessions began with a set of instructions that were prepared in the same manner as the Phase I

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[1]At the end of Phase I the original experimental assistant terminated her duties voluntarily without any advance notice. Within a week a new assistant was obtained. Because Phase I work was completed, the new assistant was trained only in phase II. He also had attained a Form II education at the time, was a resident of the area and was tri-lingual. He was single, 24 years old, and had spent one year in teacher training. He was selected over other alternatives because of his ability to follow E's instructions, his patience, and his ability to put children at ease in an unfamiliar testing situation. In the investigator's view his qualities in the latter respects surpassed those of his predecessor.

instructions (see Appendix A). S was shown an array of ten familiar objects (see Table 1 of Appendix B) which were different from any of the Phase I arrays and told to sort them as he did in the game he played before, i.e., Phase I. The purpose of this "demonstration" array was two-fold: first, from S's sorting behavior and the reasons he gave for sorting his consistency in sorting from Phase I to Phase II could be determined, and secondly, upon completion of the free sorting the particular sorting strategy for S's training procedure could be demonstrated by E. After S had sorted the objects, he was asked to identify them. Then he was told that his sorting demonstrated one way to play the game, but that E wanted him to play in another way. E then demonstrated with the objects of the first array how he wanted S to sort subsequent arrays. S was presented with the same four arrays--with some modifications--that he was shown in Phase I. He was required to sort the objects in each of these arrays dichotomously, as E had done in the demonstration array. For example, if S was being trained to sort on the edible/inedible dimensions, he had to divide the ten objects into two groups, those things that were edible and those that were not edible. In addition, S was required to state the reason, i.e., the defining attributes of the stimuli, why each group was distinct; for example, a correct reason might be, "these things are edible and these are not" (pointing to the appropriate groups). At no time in the training task was any material reinforcement used. Ss were trained to sort only by example and encouragement provided by E and his assistant. If S learned to sort three consecutive arrays in this manner and also to give the correct reasons for his sorting for all three consecutive successes, he was shown another different array, called the "transfer" array. If S failed to sort three consecutive arrays after the four arrays were shown once, each of the four arrays was shown a second time--eight total presentations--before the transfer array was presented. The transfer array was shown to all Ss regardless of their success on the four experimental arrays. Conceivably, it would have been possible for a S to memorize the placement of objects in the four experimental arrays and to make ostensibly correct sortings; the purpose of presenting the transfer array was to test S's ability to generalize the sorting strategy to a new set of stimuli and to restate the defining attributes for the groups he had made. Thus, the criteria for learning in the experimental situation were three consecutive correct sorts, correct verbalizations of the reasons why each group of each array was distinct (two reasons for each array), and correct sorting and verbalization on a transfer task.

In the case of the perceptual training task, Ss were placed in one of two groups; in one group Ss were required to sort by the color dimension and in the other group by the material dimension. These two dimensions were found to be the most common, and indeed almost the only, perceptual reasons given in Phase I. All color-training Ss were trained on the color green; that is, they were required to sort each array into green or not-green things. Those in the material-training conditions were required to sort each array into metal and not-metal things. All objects in the demonstration array, the experimental arrays, and the transfer array were potentially sortable into these categories.

In the conceptual-training condition of Phase II, Ss were also placed in two groups; one group was required to sort by the edibility dimension and the other by the cultivability dimension. Although there were other dimensions that were more common than cultivability, this dimension fit in best with the other dimensions and the objects that were employed. In the edibility-training condition each array had to be sorted dichotomously according to those things that were edible and those things that were not edible. In the cultivability-training condition objects had to be sorted according to those things that were cultivated (planted and cared for) and those things that were not cultivated. Again all objects could have been potentially sortable into any of these categories. Also none of the categories were completely confounded; for example, all edible things were not also all cultivable things. A sisal leaf, for instance, was cultivable but not edible. There were, however, some objects that could have been sorted according to more than one of the relevant attributes. The vegetable leaf, for example, was edible, cultivable, and green.

Of those Ss who were classified as conceptually preferring sorters from Phase I, half were trained perceptually (the non-preferred modality) and half were trained conceptually (the preferred modality). Among the perceptually trained Ss in this group some were trained on color and some were trained on material. But the conceptually trained in this group of conceptual preferrers were all trained in the same dimension they preferred in Phase I. Perceptually preferring Ss were also divided into two groups. Half were trained in their preferred dimension (in the perceptual modality) and half were trained in a non-preferred dimension (in the conceptual modality). Among the conceptually trained Ss in this group some were trained on edibility and some were trained on cultivability. For example, if S had been a conceptual sorter he would have had an equal chance of being trained in his preferred dimension (the same dimension he used in Phase I) or in a non-preferred dimension of a perceptual modality. If he had been trained in his non-preferred modality, he would have had been trained to sort by color or by material dimensions. By the same token if S had been a perceptual sorter, he would have had an equal chance of being trained in his preferred dimension or in a non-preferred dimension. If he had been trained in a non-preferred dimension, he would have had been trained to sort by edibility or by cultivability. Thus, half the Ss were trained in the same modality which they had preferred in Phase I, while the other half were trained in the opposite modality. Those Ss who were trained in the opposite modality were given one of two possible opposing dimensions. This design is represented diagramatically in Figure 2. The rationale for having two sub-conditions in the non-preferred modality and one condition in the preferred modality was that S's preference in a particular dimension may have been specific to that dimension and not general to other dimensions within that modality; that is, Ss who preferred color need not be considered the same in their cognitive strategy as Ss who preferred material. The safest assumption after

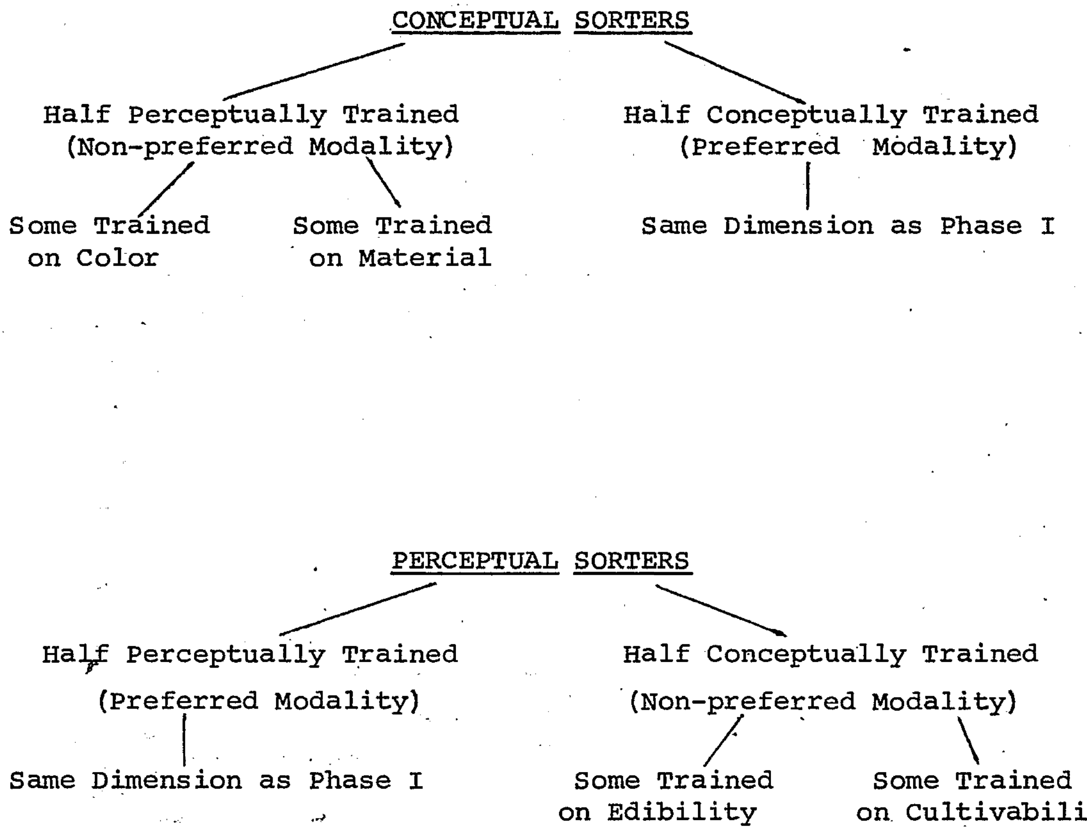

Fig. 2.--Diagram of Phase II Design Showing Assignment of Ss to Appropriate Groups.

determining that S prefers color is that his preferred dimension is color and not necesarily all dimensions in the perceptual modality. His ability to sort in other perceptual dimensions, and by the same token the conceptually preferring S's ability to use strategies in the non-preferred modality was more important than Ss' ability to use strategies in other preferred dimensions.

Phase II, then, provided an opportunity to determine experimentally the ability to apply different sorting modalities, sometimes preferred, sometimes non-preferred, to a new situation.

CHAPTER III

RESULTS

Training and Preference

The relationship between training (TRN) in Phase II and Modality Preference (PRF) in Phase I was tested by comparing performances on the Phase II learning task of all four groups. Success on this task was measured in two ways: first, success or failure, i.e. whether or not S reached the criterion for learning, defined as three consecutive trials and success/failure (CTTCT), and second, the number of trials S took to reach criterion (TTC).

The first set of data--success/failure--was subjected to a chi-square analysis in which the observed frequencies in cells of a three-dimensional (two x two x two) table (TRN, PRF, CTTCT) were compared to expected frequencies in these cells (Winer, 1971). A summary of the partitioning of expected and observed frequencies is presented in Table 3, and the partition of the chi-square analysis is shown in Table 4. Since the Training X Success/Failure

TABLE 3

Partitioning of Expected and Observed Frequencies of Success/ Failure by Two Training Conditions and Modality Preferences

Modality Preference	Training Condition: Perceptual				Training Condition: Conceptual			
	Correct		Incorrect		Correct		Incorrect	
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Perceptual	2	13	24	13	9	13	17	13
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Conceptual	13	13	13	13	22	13	4	13

Correct Trials to Criterion	Training: Perceptual		Training: Conceptual	
	f_o	f_e	f_o	f_e
Correct	15	26	31	26
	f_o	f_e	f_o	f_e
Incorrect	37	26	21	26

Correct Trials to Criterion	Modality Preference: Perceptual		Modality Preference: Conceptual	
	f_o	f_e	f_o	f_e
Correct	11	26	35	26
	f_o	f_e	f_o	f_e
Incorrect	41	26	17	26

TABLE 4

Partition of Chi-Square Analysis of Two Training Conditions, Modality Preference, and Success/Failure

Source	Chi-Square	*df*
Total:		
Training (A), Preference (B), and Success/Failure (C)	36.611**	3
A x C	10.036**	1
B x C	21.728**	1
A x B x C	1.850	1

** $p < .01$

and Preference X Success/Failure interactions contain only one degree of freedom, the Yates correction factor (Hays, 1963) was made. Values presented in Table 4 show the corrected chi-square values for these two interactions. As can be seen in this table the predicted three-way interaction was not significant. Although the total chi-square value is significant ($\chi^2 = 36.611$, df = 3, $p < .01$), partitioning indicated that both training and preference acted independently upon success/failure. In the training conditions there were significantly more successes and fewer failures under training to sort conceptually than there were under training to sort perceptually. The frequencies of successes and failures for Ss of varying preferences followed a similar pattern; there were more successes and fewer failures among the conceptual Ss than there were among the perceptual Ss.

Thus, according to this analysis, preference in Phase I was related to success in Phase II; those Ss who were conceptually preferring tended to succeed more on the learning task than perceptually preferring Ss, irrespective of the modality that the learning task entailed. By the same token, the type of task that was to be learned affected performance on the learning task. If a task in the conceptual modality was to be learned, it was more likely that Ss would succeed, regardless of their Phase I preference, than if a perceptual task had to be learned.

The obtained relationship between training and preference on success/failure is presented graphically in Figure 3. The proportion of Ss who succeeded in each condition is represented along the ordinate; these figures were derived from the obtained and expected frequencies shown in Table 3. Along the abscissa the two modality training conditions are represented. From inspection of the figure the strong main effects for conceptual preference and for conceptual training are apparent. Furthermore, the predicted interaction between preference and training is also apparent, but this interaction is much smaller than that which was predicted. The predicted relationship is depicted in Figure 4. As can be seen from this figure, conceptual preference was to have a

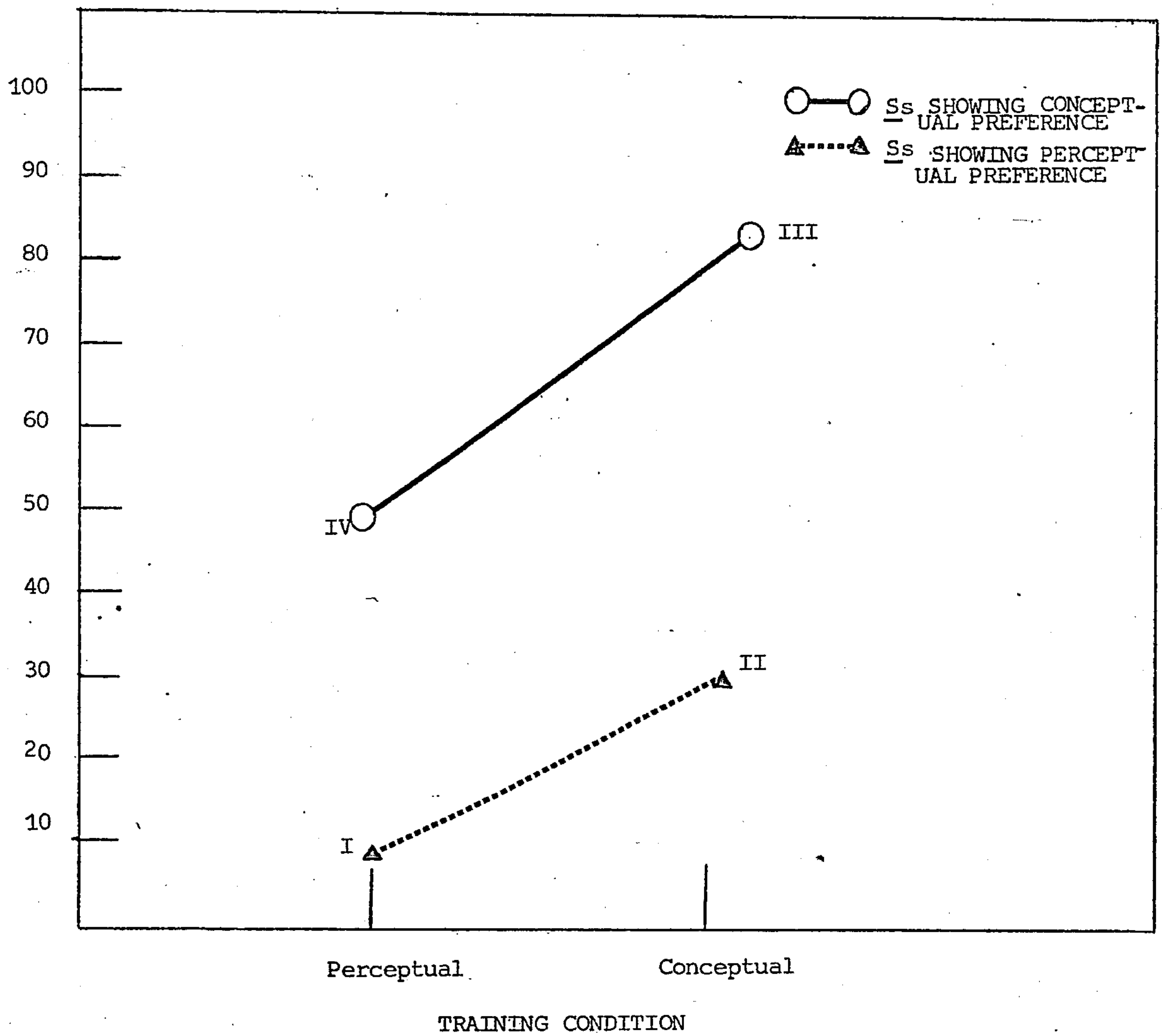

FIGURE 3 - EFFECTS OF TRAINING CONDITIONS AND PREFERENCE ON THE PROPORTION OF Ss WHO SUCCEEDED ON PHASE II LEARNING TASK.

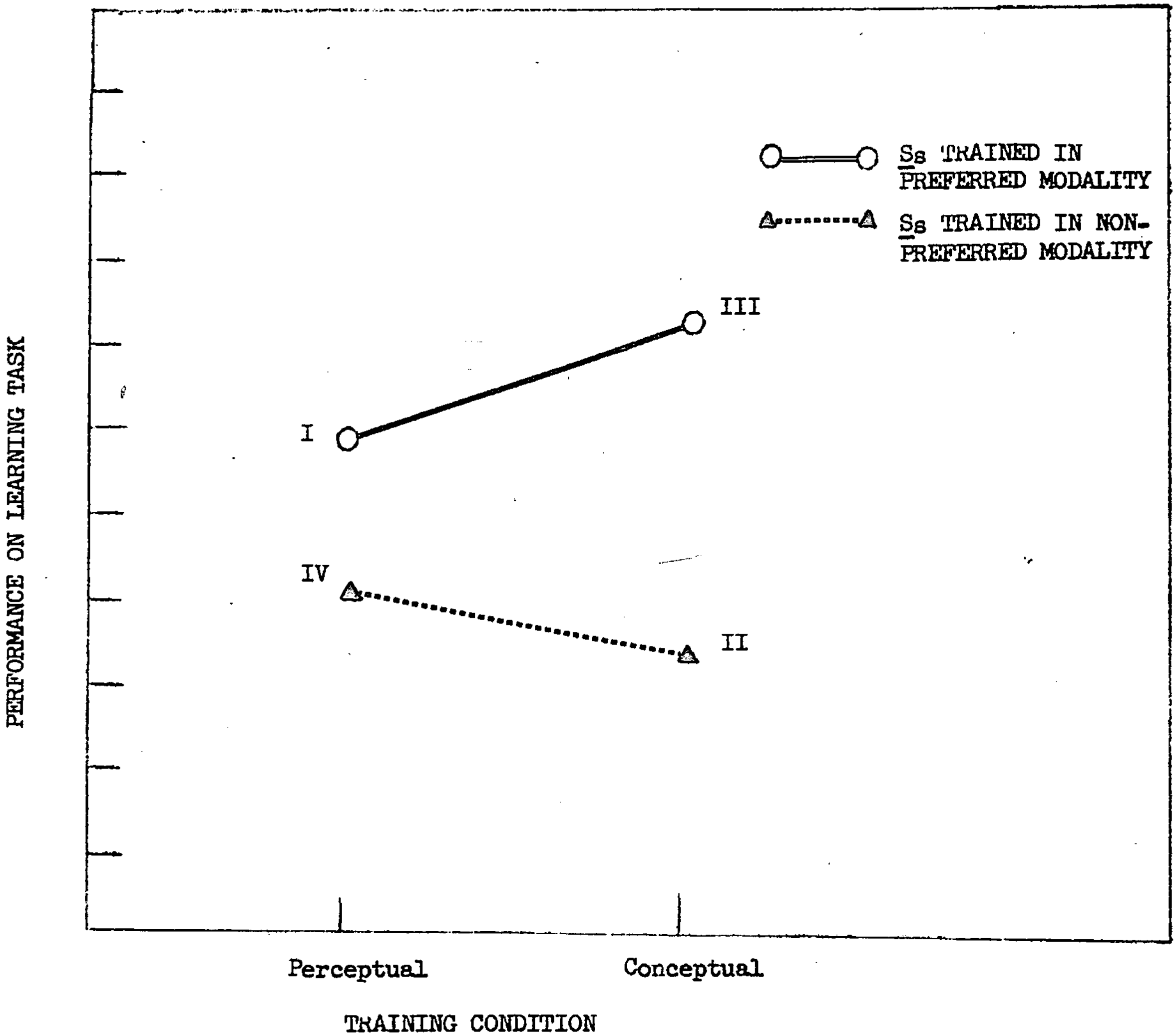

FIGURE 4 - PREDICTED EFFECTS OF TRAINING CONDITIONS AND PREFERENCE ON PERFORMANCE IN PHASE II LEARNING TASK.

Interaction Prediction: III - II > I - IV greater facilitating effect on the corresponding learning task than perceptual preference would have on its corresponding learning task. That is, perceptual preference should have facilitated perceptual learning but not as much as conceptual learning should have facilitated conceptual learning. Returning to Figure 3, it can be seen that, in fact, perceptual preference was an <u>inhibitor</u> of perceptual learning. Thus, the predicted interaction between training and preference was amplified to such an extent that perceptual preferrers did worse on the learning task than conceptual preferrers who were performing a task dissonant with their preference. The striking main effects for both training and preference, however, outweigh this interaction; had the predicted interaction obtained, it could not have been explained away by the main effects.

In order to examine more closely the nature of these differences between the number of successes in the training and preference conditions, it was necessary to break down these two modalities into their specific sorting dimensions. The effects of the four specific training procedures, material, color, edible, and planted, were analyzed in a manner similar to the previous analysis. In Table 5 the partitioning of the expected and observed frequencies is presented, and in Table 6 the partitioning of the chi-square analysis is shown. The Preference X Success/Failure interaction is the same as the corrected value shown in Table 4 from the previous analysis since these are the same two variables. These findings are similar to the findings from the previous analysis where the training conditions were combined into two groups, but there is one important qualification. In this analysis the chi-square value for the training conditions is much greater than it was in the analysis above. An examination of the cell frequencies in Table 5 reveals the sources of these differences. Successes in proportion to failures were very low in the material and planted training conditions, but in the edible training condition there were considerably more successes than failures. In other words, irrespective of Phase I

TABLE 5

Partitioning of Expected and Observed Frequencies of Four Training Conditions, Modality Preference and Success/Failure

Modality Preference	Training Condition															
	Material				Color				Edible				Planted			
	Corr.		Incorr.		Corr.		Incorr.		Corr.		Incorr.		Corr.		Incorr	
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Perceptual	2	11.5	21	11.5	0	1.5	3	1.5	9	6.5	4	6.5	0	.5	13	6.
	Corr.		Incorr.		Corr.		Incorr.		Corr.		Incorr.		Corr.		Incorr	
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Conceptual	5	6.5	8	6.5	8	6.5	5	6.5	19	11	3	11	3	2	1	2

Correct Trials to Criterion	Training Condition							
	Material		Color		Edible		Planted	
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Correct	7	18	8	8	28	17.5	3	8.5
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Incorrect	29	18	8	8	7	17.5	14	8.5

TABLE 5--Continued

Correct Trials to Criterion	Modality Preference			
	Perceptual		Conceptual	
	f_o	f_e	f_o	f_e
Correct	11	26	35	26
	f_o	f_e	f_o	f_e
Incorrect	41	26	17	26

TABLE 6

Partition of Chi-Square Analysis of Four Training Conditions, Modality Preference and Success/Failure

Sources	Chi-Square	df
Total:		
Training (A), Modality Preference (B) and Success/Failure (C)		
	49.375**	7
A x C	33.160**	3
B x C	21.728**	1
A x B x C	6.518	3

** $p < .01$

preference, learning to sort by edibility represented a significantly easier task than learning to sort along other dimensions.

This finding concerning the apparent facility of learning in the edible domain is both striking and unexpected. Having discovered a strong effect of the edibility dimension, the next logical step in the analysis was to determine whether the facility in this dimension operated for preference in Phase I. That is, would preference for the edibility dimension in Phase I, as opposed to preference for other dimensions, account for success in Phase II irrespective of the training condition?

To answer this question a partition of the chi-square analysis was computed using Training (two groups), Success/Failure, and Preferred Dimension (PRD), i.e. color, material, edibility, etc. Because frequencies of specific strategies in the cases of material and planted dimensions were so low, only the frequencies of color and edibility could be examined. The observed frequencies together with the expected frequencies in these cells are shown in Table 7. The facility of the edibility dimension, as measured by success on the learning task, is apparent from an examination of these frequencies. Correct responses occur much more often when the preferred dimension is edibility and when the training condition is in the conceptual modality. The relative strength of these relationships is indicated in the partitioning of the chi-square analysis (see Table 8). Both Training (χ^2 = 9.274, df = 1, $p<.01$) and Preferred Dimension (χ^2 = 18.858, df = 1, $p<.01$) acted upon success in the learning task, but PRD yielded a greater chi-square value. The values shown for Training $\times$ Success/Failure interaction and Preferred Dimension $\times$ Success/Failure interaction have been corrected by the Yates factor. Inspection of frequencies Table 7 reveals that there were many more successes than expected by chance when the edibility dimension was preferred and many more failures on the learning task than expected when the color dimension was preferred. It is apparent from these results that

TABLE 7

Partitioning of Expected and Observed Frequencies of Two Training Conditions, Preferred Dimension, and Success/Failure

Preferred Dimension	Training Condition							
	Perceptual				Conceptual			
	Correct		Incorrect		Correct		Incorrect	
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Color	2	11.5	21	11.5	8	12.5	17	12.5
	Correct		Incorrect		Correct		Incorrect	
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Edibility	11	12	13	12	19	11	3	11

Correct Trials to Criterion	Training Condition			
	Perceptual		Conceptual	
	f_o	f_e	f_o	f_e
Correct	13	23	27	23
	f_o	f_e	f_o	f_e
Incorrect	34	23	20	23

Correct Trials to Criterion	Preferred Dimension			
	Color		Edible	
	f_o	f_e	f_o	f_e
Correct	10	24	30	23
	f_o	f_e	f_o	f_e
Incorrect	38	24	16	23

TABLE 8

Partition of Chi-Square Analysis of Two Training Conditions, Preferred Dimension and Success/Failure

Source	Chi Square	df
Total:		
Training (A), Preferred Dimension (B) and Success/Failure (C)	32.475**	3
A x C	9.274**	1
B x C	18.858**	1
A x B x C	1.459	1

** $p < .01$

knowledge about the preferred dimension in a free-sorting task is very informative of performance on a subsequent learning task. A child who prefers to employ the edibility dimension on a free-sort task is much more likely to succeed on a learning task, regardless of the modality it entails, than a child who prefers the color dimension.

Trials to Criterion

The strong relationship noted above between training procedure and learning in Phase II and between preference in Phase I and learning also obtained when Trials to Criterion (TTC) were considered. Since the distribution of TTC ranged from only three to eight trials[1] and was negatively skewed, an arc-sine transformation was performed on these data before they were analyzed (Natrella, 1963). Training conditions were merged into two cells, the perceptual modality (consisting of the color and material dimensions) and the conceptual modality (consisting of the edibility and planted dimensions).

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[1]Eight was the maximum possible score, and all Ss who failed were arbitrarily assigned that score.

These merged training conditions were analyzed with the two modality preference conditions in a two-by-two analysis of variance. There was a significant main effect for Training ($F = 16.19$, $df = 1/100$, $p < .001$) and for Preference ($F = 24.39$, $df = 1/100$, $p < .001$). The transformed means for these conditions are presented in Table 9, and a summary of the analysis of variance is shown in Table 1 of Appendix C. In each case learning, as measured by TTC, was significantly easier in the conceptual conditions. In addition the interaction effect was significant ($F = 4.37$, $df = 1/100$, $p < .05$), indicating that being a conceptually preferring sorter is of greater benefit in the conceptual learning task than being a perceptual preferring sorter is in the perceptual learning task. Contrary to the findings of the chi-square analysis above, this finding is in line with the prediction that conceptual preference will be a stronger facilitator of learning than perceptual preference. Such an interaction effect, however, is

TABLE 9

Transformed Mean Trials to Criterion for Two Training Conditions and Modality Preference

	Training					
Modality Preference	Perceptual	N	Conceptual	N	Totals	N
Perceptual	1.09	26	0.98	26	1.06	52
Conceptual	1.02	26	0.73	26	0.85	52
Totals	1.04	52	0.87	52		104

overshadowed by the striking main effects of these two variables.

Focusing on the specific preferred dimensions in Phase I reveals similar and even more striking findings. Since the numbers of Ss in other preferred dimension conditions were too small to be considered, the two dimensions, color and edibility, were analyzed with the merged training modalities, perceptual and conceptual. TTC data were again transformed by the arc-sine method in order to conform more closely with the assumptions of analysis of variance. A summary of the analysis of variance is presented in Table 2 of Appendix C. As can be seen by inspection of the means in Table 10, there was a main effect for Training (F = 22.32, df = 1/90, p <.001), conceptual tasks being easier to learn than perceptual tasks; this is quite similar to the training effect mentioned above. Furthermore, the main effect for Preferred Dimension was stronger than the effect for Modality Preference in the previous analysis (F = 29.85, df = 1/90, p <.001); the learning task was

TABLE 10

Transformed Mean Trials to Criterion for Two Training Groups and Two Preferred Dimensions

	Training Condition					
Preferred Dimension	Perceptual	N	Conceptual	N	Totals	N
Color	1.09	23	0.98	24	1.05	47
Edibility	1.01	25	0.67	22	0.82	47
Totals	1.04	48	0.84	46		94

much easier for Ss who had a preference for the edibility dimension than it was for color preferrers. The interaction effect also reflects the same pattern as shown above ($F = 7.91$, $df = 1/90$, $p < .01$); preference for the edibility dimension appears to be a better facilitator of learning a conceptual task than color preference is for the learning of a perceptual task.

In summary, the observed relationship between preference in Phase I and training condition in Phase II is slightly different from what was expected. It had been predicted that Training and Preference would interact in such a way that conceptual preference would enhance learning in a conceptual task more than perceptual preference would enhance learning in a perceptual task. When the number of Ss who reached criterion was compared to the number who did not reach criterion for the Training and Preference conditions, this interaction was masked by very strong main effects for both Training and Modality Preference; as shown in the table of expected and observed frequencies, there were many more successes than expected by chance in the conceptual training condition. Similarly, in the conceptual preference conditions there were more successes than expected by chance. In other words, Ss trained to sort conceptually, regardless of preference, learned best, and Ss who, on Phase I, revealed a conceptual preference learned best, regardless of what they were taught.

When the number of trials to criterion were analyzed, similar findings emerged. Conceptual preference, especially for the edibility dimension, and conceptual training, especially in the edibility dimension, accounted for success on the learning task. There was a significant interaction in the analysis of variance between Training Condition and Preference, indicating greater facilitation for conceptual preference in its corresponding learning task, but the main effects of Training Condition and Preference were much stronger.

In order to measure the strength of association between Phase II performance and Preference and Training Condition phi coefficients (Hays, 1963) were computed, based on the chi-square analyses. The results of this computation are presented in Table 11a. It should be noted that the phi coefficient, unlike the omega-square statistic, does not give any information about reduction of variance but merely the strength of association between certain variables. Employing two training conditions, perceptual and conceptual, the strength of association was .311. When all four training dimensions (color, material, edibility, planted) were considered, however, the degree of association for Training exceeded that for Modality and for Dimension Preference. Modality Preference and Preferred Dimension both yielded stronger associations with Success/Failure (CTTCT) than did Training (two conditions). From these statistics we may conclude that when all the information about training is taken into account, i.e. all training conditions, Training appears to be a more potent variable than either Modality or Dimension Preference. On the other hand, if the two general training modalities (perceptual and

TABLE 11

Indeces of Association between Training in Phase II and Preference in Phase I on Correct Trials to Criterion and Number of Trials to Criterion

Source	Index of Association
(a) CTTCT	φ Coefficient[a]
Training (TRN), two modalities	.311
TRN, four dimensions	.565
Modality Preference (PRF)	.457
Preferred Dimension (PRD)	.426
(b) TTC	ω^2[b]
TRN (with PRF), two modalities	.104
PRF	.160
TRN x PRF	.023
TRN (with PRD), two modalities	.111
PRD	.190
TRN x PRD	.045

[a] (Hays, 1963)

[b] (Ibid.)

conceptual), are considered then Preference appears to be a more potent variable.

When number of trials to criterion for the Training and Modality Preference Conditions were examined, omega square could be computed but only for the two training conditions. This was due to the fact that the number of Ss in the planted and material conditions were too few to allow an analysis of variance to be computed. The greatest reduction in variance of TTC (ω^2 = .190), as shown in Table 11b, occurred when Preferred Dimensions were analyzed. PRF also reduced variance, but to a lesser extent than PRD, while Training accounted for approximately ten percent of the variance. These figures compare favorably with the above figures for CTTCT where Preference appeared to be the more potent variable when only the two merged training conditions were considered. The interaction between Preference and Training, though statistically significant, accounts for less than five percent of the variance and must be considered a factor of minor importance.

Thus, the interaction between Preference and Training was inconsequential when compared to the more potent main effects of these variables. A child who showed preference for the conceptual modality performed better on the learning task than a child who preferred the perceptual modality, irrespective of the nature of the task. Furthermore, a conceptual task, specifically a task involving the edibility dimension, was much easier to learn than other tasks. By inspection of the observed and expected frequencies in the edibility-training condition shown in Table 7, one is led to the conclusion that the edibility dimension is a potent facilitator of learning. It appears that the cultural salience of the edibility dimension, for the most part, vitiates cognitive preferences that S brings with him into the experiment in such a way that learning can be achieved in this dimension without regard to previous preference.

This is not to say that cognitive preference, as measured in Phase I, is of no consequence to the learning task. On the contrary, knowledge about a child's sorting strategy can be quite informative of his performance on a learning task. Success on such a task seems to be related positively to preference for the conceptual modality, and failure seems to be positively related to preference for the perceptual modality. The evidence from the table of expected and observed frequencies for Modality Preference and Preferred Dimension supports this conclusion; there are more correct responses than expected in the conceptual conditions and more incorrect responses than expected in the perceptual conditions.

It is apparent that both Training Condition in Phase II and Preference in Phase I are both potent variables in affecting performance on a learning task. When all the dimensions that were used in the learning task are considered, that variable--Training--appears to be more potent than Preference. When the two most salient preferred dimensions are considered, however, Preference seems to be the more potent variable. Although there is some evidence for the predicted interaction between Preference and Training, that relationship is less important than the independent effects of Training and of Preference. In both cases--Training and Preference--the conceptual modality and the edibility dimension appear to be associated with success in the learning task while the perceptual modality and the color dimension appear to be associated with failure on the learning task.

The suggestion in the previous analysis that Phase I preference was strongly related to Phase II performance led to a broader question. Are there other Phase I variables that are related to Phase II, and can knowledge about Phase I sorting provide predictive information about performance on Phase II? In order to compare these two domains of variables, Phase I and Phase II, a canonical correlation was computed.

<u>Canonical Correlation</u>[1]

The first set of eight variables (Set A) consisted of Grade Level (GRL), Number of Color Responses in Phase I (CLR), Number of Edible Responses in Phase I (EDR), Number of Conceptual Reasons in Phase I (CNR), No Reason Responses in Phase I (NR), Preferred Dimension in Phase I (PRD), perceptual versus conceptual modality Preference in Phase I (PRF), and Training Condition in Phase II (TRN). The training condition to which <u>S</u>s were assigned in Phase II was considered a possible "predictor" of performance in the learning task since it was something known about <u>S</u> before he began the learning task. TRN was coded[2] such that higher values correspond to training in the conceptual modality and lower values correspond to training in the perceptual modality.

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[1]A canonical correlation, as described by Cooley and Lohnes (1971), is the maximal correlation that can be developed between a linear function of one set (Set A) of variables and a linear function of a second set (Set B) of variables. Each pair of canonical functions is derived from inter-correlations of the elements of Set A, the intercorrelations of the elements of Set B, and the cross correlations between Sets A and B. Pairs of canonical variates

[2]In the Training Conditions a score of one signified color training, two material training, three edibility training, and four cultivability training.

A second set of variables was composed of six Phase II performance measures: whether or not S reached trials to criterion (CTTC), Number of Trials to Criterion (TTC), whether or not S reached Trials to Criterion

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are generated such that the correlation between a new pair of canonical variates is maximized subject to the restriction that they be entirely orthogonal to all previously derived linear combinations. The generation of canonical variates is similar to factor analysis in that it is an exploration of the extent to which individuals occupy the same relative positions in one measurement space as they do in another; measurement space refers to the latent factors which, in this case, are the canonical variates. A test of significance is performed on each pair of canonical variates, testing the null hypothesis that Set A is not related to Set B. The structure of canonical variates may be described from the correlations between the canonical variates and the elements of Sets A and B. In addition, the relative weights of each element of the two sets for all the canonical variates are provided, but these weights usually provide less information than the previously mentioned correlations.

One of the most significant advances in the interpretation of canonical correlation was made by Stewart and Love (1968) who developed the index of redundancy. Previous to this development a including the Transfer Task (CTTCT), Number of Correct Positive and Negative Reasons (CRRPN), Number of Correct Trials (CR), and Number of Correct Sortings irrespective of correct reasons (CRS). The means for these Set A and Set B variables are presented in Table 3 of Appendix C.

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canonical correlation could give a description of the measure of overlap between two canonical batteries but no measure of the predictive value of one given set of variables for the second set. The index of redundancy, algebraically, is the product of the canonical correlation of the predicting variables and the proportion of variance from the predicted variables ($R_{dx} = \frac{s1s1}{p} R_c2$). A verbal description of the redundancy factor is given by Cooley and Lohnes (1971):

> The new coefficient R_{dx} is intended to show what proportion of the variance in vector z_1 is found through the first canonical correlation to be redundant to the variance in vector variable z_2 if the latter is already available (pp. 170-171).

It will be recalled that the Phase II task involved learning to sort arrays of objects into two groups according to a prescribed strategy. S gave a correct positive reason if he was able to say, for example, that the reason the edible objects went together was that they were "edible." He gave a correct negative reason if he could say that the rest of the objects in that array were together because they were "inedible." CRRPN represents the number of times S gave both positive and negative reasons that were correct.

Thus, the index of redundancy provides the interpreter of canonical correlation with a tool that measures the actual overlap between two batteries, which is contained in the canonical correlation, as seen from one set of variables added to an already available set.

In discussing the canonical correlation analysis, the results will be presented in the following manner: first, the two within-groups correlation matrices; second, the between-group correlation matrices; third, the canonical factors, their relation to the variables, and the redundancy of the two sets; finally, the components of the redundancy measure.

The within-group correlations for Set A are presented in Table 12. The several significant correlations foreshadow the findings of the canonical correlation and hence, are noteworthy. Variable CLR (number of color responses), a dimension in the perceptual modality, was negatively related to the conceptual variables EDR, number of edible reasons ($\underline{r}$ = -.73, $\underline{df}$ = 102, p <.005) and CNR, number of conceptual reasons ($\underline{r}$ = -.84, $\underline{df}$ = 102, p <.005). Higher values on PRD indicate conceptual preferences, e.g., edible, planted, while lower values indicate perceptual preferences. CLR was also negatively related to this variable. PRF was coded in just the opposite fashion such that a score of

TABLE 12

Within-Group Correlation Matrix for Eight "Set A" Variables, 104 Subjects

Set A Variables	Set A Variables							
	GRL	CLR	EDR	CNR	NR	PRD	PRF	TRN
GRL	--	.03	-.09	-.03	-.20*	.01	.00	.01
CLR		--	-.73**	-.84	-.07	-.91**	.85**	-.03
EDR			--	.69**	.00	.73**	-.75**	-.06
CNR				--	.00	.89**	-.86**	.02
NR					--	.03	.00	.06
PRD						--	-.95**	.02
PRF							--	.04
TRN								--

*p <.025

**p <.005

two represented perceptual preference and a score of one conceptual preference. As expected, CLR was positively related to this variable; that is, a large number of color responses was associated with predominantly perceptual sorting. Correlations of EDR with the other variables reflects a mirror image of the CLR variable. EDR, number of edible reasons, was positively related to PRD ($\underline{r}$ = .73, $\underline{df}$ = 102, $\underline{p}$ <.005) and negatively related to PRF ($\underline{r}$ = -.75, $\underline{df}$ = 102, $\underline{p}$ <.005).

The correlations between the variables of Set B, Phase II, indicate that these variables, for the most part, were highly interrelated (see Table 13). The three variables, CTTC, TTC, and CTTCT, are, of course, not orthogonal to each other so the obtained strong relationship is expected. A high score on trials to criterion indicates that $\underline{S}$ took several trials to learn the task and in many cases failed to learn the task in the eight trials given. CTTC, correct trials to criterion, and CTTCT, correct trials to criterion including transfer, were scored in such a way that a

TABLE 13

Within-Group Correlation Matrix for Six Phase II (Set B) Variables, 104 Subjects

Set B-Phase II Variables	Set B-Phase II Variables					
	CTTC	TTC	CTTCT	CRRPN	CR	CRS
CTTC	--	.71**	.96**	-.68**	-.86**	-.33
TTC		--	.74**	-.37**	-.62**	-.13
CTTCT			--	-.70**	-.87**	-.30*
CRRPN				--	.86**	.33**
CR					--	.41**
CRS						--

*p <.005

**p <.0005

score of one indicated success and a score of two indicated failure. Since a high score on these three variables signifies failure on the task, it also fits expectations that CRRPN and CR were negatively related to these factors; that is, the more correct reasons S had, the less likely he was to have failed the task. The significant relationship between Correct Sorting (CRS) and Correct Reasons (CR and CRRPN) suggests that the ability to sort the objects correctly and the ability to provide a reason for this sorting were essentially similar phenomena.

The intercorrelation matrix of Set A variables and Set B variables is presented in Table 14. The most outstanding finding from this matrix is the obtained relationship between the three trials-to-criterion variables--a high score indicating failure--and the Phase I sorting strategies. Failure on the learning task in Phase II, then, is associated with a large number of color responses (CLR) and with a predominantly perceptual preference (PRF). Furthermore, failure is negatively related to a large number of conceptual

TABLE 14

Intercorrelation Matrix for Eight Set A and Six Set B Variables, 104 Subjects

Set A Variables	Set B Variables					
	CTTC	TTC	CTTCT	CRRPN	CR	CRS
GRL	.00	.03	-.03	.10	.06	.08
CLR	.36**	.36**	.39**	-.20	-.31*	-.02
EDR	-.34**	-.47**	-.38**	.13	.30*	.03
CNR	-.39**	-.38**	-.43**	.20	.34*	.05
NR	.00	.01	.01	-.14	-.09	-.10
PRD	-.43**	-.38**	-.47**	.24	.36**	.06
PRF	.37**	.37**	.42**	-.21	-.33	-.04
TRN	-.17	-.22	-.22	-.19	-.16	-.25

*p <.005

**p <.0005

reasons (EDR and CNR) and to a predominantly conceptual dimension preference (high score on PRD). To summarize, this means that success in the Phase II experiment is related positively to a predominantly conceptual strategy in Phase I; that is, those Ss who preferred a sorting strategy based on dimensions such as edibility, tended to do well on the Phase II task. Clearly, then the canonical correlation analysis, to this point at least, leads to conclusions which, as we saw earlier, follow from the chi-square analysis and the analysis of variance.

This pattern is also apparent in the structure of the canonical variates and receives substantial support in the canonical analysis. Six canonical variates were generated from these two domains of variables. Two of these variates resulted in a significant chi square ($\lambda_1 = .374$, $\chi^2 = 45.265$, $df = 13$, $p < .0001$; $\lambda_2 = .190$, $\chi^2 = 20.314$, $df = 11$, $p < .05$). The two canonical factors, their relation to the specific variables, the canonical correlations, and the redundancy of the two sets are presented in Table 15. The redundancy of Set A given

TABLE 15

Two Canonical Correlations, Correlations between Original Variables and Derived Variates, and Indeces of Redundancy

Set A	Factor I $R_c = .61$	Factor II $R_c = .44$	Set B	Factor I $R_c = .61$	Factor II $R_c = .44$
GRL	.01	.10	CTTC	.73	-.37
CLR	.66	-.18	TTC	.85	.26
EDR	-.75	-.20	CTTCT	.84	-.38
CNR	-.72	.22	CRRPN	-.44	.21
NR	-.03	.13	CR	-.64	.16
PRD	-.75	.38	CRS	.15	.33
PRF	.70	-.19			
TRN	-.55	-.15			
Factor Redundancy	.14	.01	Factor Redundancy	.16	.02
Total Redundancy	.17		Total Redundancy	.20	

Set B, as indicated is .14, and the redundancy of Set B given Set A is .16. The total redundancy, that is the overlap of all of Set A given Set B, is .17, and for all of Set B given Set A is .20. Thus, these two sets have moderate predictive strength of each other and are nearly symmetrical in their prediction of each other.

An analysis of the components of the redundancy measure revealed the relative importance of the six canonical roots extracted. This analysis is presented in Table 16. In the column labelled "Proportion of Total Redundancy" it can be seen that the first root, or factor, accounts for almost 80 percent of that redundancy. The second factor, though statistically significant, contributes only about five percent of the redundancy and may be considered a factor of minor importance.

Given the small amount of redundancy accounted for by the second canonical variate, that factor will not be examined further. The first canonical factor, however, is of considerable interest because for both

TABLE 16

Components of Redundancy Measure of Canonical Analysis for Set A and Set B Variables

Root	Canonical R	R Squared	Variance Extracted	Redundancy	Proportion of Total Redundancy	Cumulative Proportion of Redundancy
Set A						
1	.6119	.3744	.3576	.1339	.7927	.7927
2	.4357	.1898	.0434	.0082	.0488	.8415
3	.3330	.1089	.1482	.0161	.0956	.9371
4	.2444	.0597	.1554	.0093	.0549	.9920
5	.0985	.0097	.1042	.0010	.0060	.9980
6	.0670	.0045	.0758	.0003	.0020	1.0000
Set B						
1	.6119	.3744	.4299	.1610	.7984	.7984
2	.4357	.1898	.0877	.0166	.0825	.8809
3	.3300	.1089	.0961	.0105	.0519	.9328
4	.2444	.0497	.1983	.0118	.0588	.9916
5	.0985	.0097	.1628	.0016	.0078	.9994
6	.0670	.0045	.0252	.0001	.0006	1.0000

sets it accounts for a large portion of the variance extracted and a large portion of the redundancy. The structure of Factor I is quite clear, as seen in Table 15. On the conceptual variables, i.e. variables for which a high score indicates preference for or training in conceptual dimensions (EDR, CNR, PR, and TRN), the relationship is strongly negative. On the perceptual variables (CLR and PRF) the relationship is strongly positive. Thus, as far as Set A is concerned, Factor I may be considered a "perceptual-preference/training" factor. With regard to Set B the structure is also quite distinct. High scores on the trials-to-criterion variables (CTTC, TTC, and CTTCT), it will be recalled, indicate poor performance on the Phase II task. The number of correct reasons, however, reflect to some extent success on this task. As can be seen from Table 15, Factor I is positively related to the trials-to-criterion variables and negatively related to the correct-reason variables. Such a relationship indicates that for Set B, Factor I is a "poor-performance" factor. When information from the two sets concerning Factor I is considered, it is apparent that _preference for perceptual dimensions and poor performance are strongly related_. By the same token, preference for conceptual dimensions and _success_ on the Phase II task are also strongly related. The weights for the elements of each set suggest the same canonical factor structure; they are presented in Table 4 of Appendix C.

Subject Variables

Having discovered this strong relationship between Phase II performance and Phase I preference, the next analytic step was to investigate other subject data to determine if any relationship between Phase I sorting and subject demographic variables could be found. That is, could knowledge about _S_'s sex, age, school, etc. provide predictive information about Phase I sorting preferences. A second canonical correlation analysis was performed using the same Phase I variables that were used in the previous analysis. This battery was compared to a second battery of demographic variables including age, school experience, sex, school of attendance, and experimental assistant. The data base was the results from the 104 Ss who were tested in Phase II. The index of redundancy for these two sets was approximately seven percent. None of the canonical variates reached significance, and the two sets showed minimal overlap. Thus, demographic characteristics provide very little information about the sorting strategies of these Ss. Canonical correlations, proportions of variance, and indeces of redundancy are shown in Table 5 of Appendix C for this analysis.

The findings, thus far, are compelling in their consistency; children who, for whatever reason, have progressed in their sorting strategies beyond the perceptual modality, i.e., preference for superficial attributes of stimuli, perform much better on a learning task than those who have not reached such a level. Knowledge about preference in a free-sorting task, especially when it is known which dimension was preferred, can indeed be informative about performance on a subsequent learning task; preference for the perceptual modality should indicate failure on a learning task, while preference for the conceptual modality should indicate success. One must not overlook, however, the effect of a culturally salient dimension on learning. Indeed, knowing that a specific learning task involves a culturally meaningful dimension, e.g., learning to sort on the basis of edibility, may be more informative than knowledge about previous modality preference.

A Closer Look at Phase I Free Sorting: Evidence for Developmental Trends

The means and standard deviations for all Phase I sorting variables are presented in Table 6 of Appendix C. Material, color, shape, and size dimensions were all considered to be part of the perceptual modality. Functional, edibility, planted, tree, school-related, and nominal reasons were all considered part of the conceptual modality. When a child explained that the reasons he sorted various objects the way he did were that some were used "for cooking," others were used "for building houses," all such reasons were scored as functional reasons. If he gave for his rationale that the objects he put together were all from trees, such reasons were scored as tree reasons. When a child gave as his reason that certain objects were "animals" or "tools," these were scored as nominal reasons. Reasons such as "this is from a chicken," "these are from the ground," were considered conceptual reasons and scored as "other conceptual reasons."

The most frequently used dimensions, in order of most to least were: functional, color, material, and edible. Of the two modalities conceptual was much more frequently used than perceptual. In addition to reasons, the actual sorting of the objects was scored in order to determine whether discrepancies occurred between the actual sorting of the objects and the reason the child gave for sorting. The type of sort employed, e.g., color, edibility, was assessed by E since the children's verbal responses were not considered. Since the distribution of actual sorts paralleled closely that for reasons, and since reasons provided a more accurate assessment of children's sorting rationale, sorts were not considered in subsequent analyses.

A major question of theoretical concern was whether children of different developmental periods used different sorting strategies in this open-ended task. The effects of three developmental variables on sorting rationale were considered: grade level, age, and school experience.[1] Sorting rationale, i.e., reasons given by the child for putting a certain object in a certain group, were examined with regard to the number of perceptual reasons (PCR), including the dimensions of color, material, shape, etc., number of edible reasons (EDR), i.e., stating as a reason that all objects in a group were edible, number of conceptual reasons (CNR), including the dimensions of edibility, function, planted, etc., number of no-reason responses (NR) where the child failed to give any reason for his sorting, and the preference score (PRS).

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[1] In East Africa it is often the case that when parents lack school fees their child will drop out of school. When school fees are later obtained the child will reenter school but will repeat a standard. Even among those children who do not drop out, many will repeat standards, especially at the higher levels of primary school. Consequently, there are a number of children in each school who have been in school for many years though they have not advanced appreciably in grade level. It was thought that such children might perform differently from others on the sorting task.

Preference score in the case of predominantly perceptual sorters was the proportion of perceptual reasons given to the total number of reasons given; and in the case of conceptual sorters it was the proportion of conceptual reasons to the total number of reasons.

Since the distribution of these variables violated rather seriously the assumptions of analysis of variance (Hays, 1963), certain transformations were performed so that these data conformed more closely with these assumptions. For positively skewed data Natrella (1963) recommended the use of a log transformation ($Y = \log_{10} X$) and for negatively skewed data an arc-sine transformation ($Y = \text{arc sin}\sqrt{X}$). Hence, log transformations were performed on the variable PCR, EDR, and NR and the arc-sine transformation on PRS.

Grade Level

A summary of these one-way analyses of variance is presented in Table 7 of Appendix C. The effects of grade level on edible reasons, on conceptual reasons, and on no-reason responses were significant: EDR

(F = 4.48, df = 3/99, p <.01), CNR (F = 7.61, df = 3/99, p <.01), and NR (F = 8.33, df = 3/99, p <.01). The means for each of these conditions are shown in Table 17 and are presented graphically in Figure 5. As can be seen in Table 17, the means for CNR and EDR increase as grade level increases. This trend suggests that as children advance in grade level their tendency to use the conceptual modality in a free-sorting task increases. Post-hoc Scheffé multiple and pairwise comparisons of means (Kirk, 1969) revealed more precisely the nature of these differences. Significant intergroup differences occurred on the variables EDR and CNR. Multiple comparison of EDR means indicated that grades one and three were significantly different from grades five and seven (p <.01); that is, there were significantly more edible reasons in grades five and seven than there were in grades one and three. For the variable CNR, number of conceptual reasons, the findings are a bit different; in grade seven the number of CNR responses was greater than the combined average of grades one, three, and five. A comparison of

TABLE 17

Mean Number of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Grade Levels, 25 Subjects in Each Grade Level

	Mean Number of Reasons				
Grade Level	PCR[a]	EDR[a]	CNR	NR[a]	PRS[b]
1	1.76	0.77	7.96	1.38	1.13
3	1.97	0.84	10.52	0.73	1.00
5	1.83	1.19	10.88	0.50	0.98
7	1.33	1.39	17.12	0.31	1.06

[a]Log transformation

[b]Arc-sine transformation

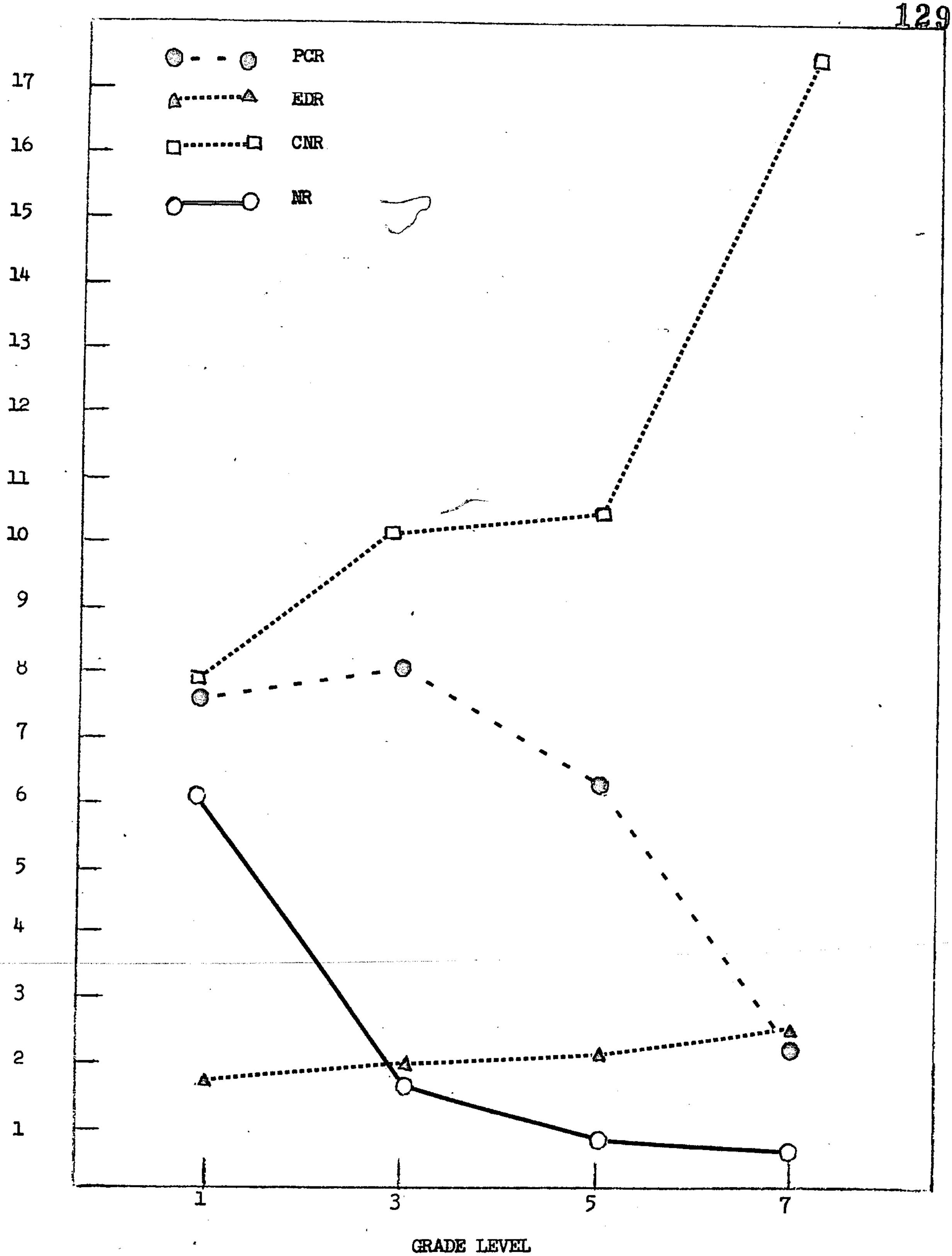


FIGURE 5 - MEAN FREQUENCIES OF RESPONSES FOR FOUR GRADE LEVELS IN PHASE I.

NR (no reason) means for the four grade levels yielded a mirror image of the CNR findings; the mean for grade one was significantly greater than the combined means for grades three, five, and seven. The intergroup differences on NR indicate that as children progress in grade level there is less of a tendency to be unresponsive on a free-sorting task. It is apparent that the least responsive children were those in grade one.

The distribution of preferred strategies (PRF) in the four grade levels was also considered. The frequency of perceptual sorters, i.e., those who displayed a predominantly perceptual rationale for their sorting, and the frequency of conceptual sorters were determined for each of the four grade levels. As shown in Table 18, a comparison of these frequencies with expected frequencies yielded a significant chi square ($\chi^2 = 15.90$, $df = 3$, $p < .005$). Major differences between the two sorting rationales seem to have occurred at the upper grade levels where there were fewer perceptual sorters and more conceptual sorters than expected by chance.

TABLE 18

Summary of Chi-Square Analysis of Perceptual and Conceptual Strategies in Four Grade Levels

Preferred Strategy	Grade Level							
	1		3		5		7	
	f_o	f_e	f_o	f_e	f_o	f_e	f_o	f_e
Perceptual	12	7.75	12	7.75	6	7.75	1	7.75
Conceptual	13	17.25	13	17.25	19	17.25	24	17.25

$\chi^2 = 15.90$, $\underline{df} = 3$, $\underline{p} < .005$

Thus, preference for the conceptual modality increases with advances in grade level, and preference for the perceptual modality decreases as grade level increases.

School Experience

As with age, Ss were divided into four groups depending on the number of years they had been in school. Ss in the first group had been in school for three years or less, the second from four to five years, the third from six to seven years, and the fourth for eight or more years. The same dependent measures, appropriately transformed, were tested by analyses of variance, which is summarized in Table 8 of Appendix C. This variable appears to have acted in the same way as age, producing significant effects on PCR ($F = 2.76$, $df = 3/99$, $p < .05$), EDR ($F = 4.79$, $df = 3/99$, $p < .01$), CNR ($F = 6.28$, $df = 3/99$, $p < .01$) and NR ($F = 6.33$, $df = 3/99$, $p < .01$). The means of the dependent measures for the four school-experience groups are presented in Table 19.

TABLE 19

Mean Number of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four School-experience Groups

	Mean Number of Reasons				
School Experience	PCR[a]	EDR[a]	CNR	NR[a]	PRS[b]
Three years or less, 24 Ss	1.69	0.87	8.58	1.29	0.19
Four-five years, 23 Ss	2.07	0.71	10.13	0.79	0.18
Six-seven years	1.80	1.17	10.58	0.63	0.18
Eight or more years, 27Ss	1.39	1.38	17.59	0.28	0.19

[a]Log transformation

[b]Arc-sine transformation

No post-hoc comparisons were significant when PCR means were examined. With EDR, however, a similar result to that found under the grade level conditions was obtained; the two less experienced groups had significantly lower means than the two more experienced groups. When the CNR means for these four groups were compared, the results paralleled the findings for the effects of age. The most experienced group differed significantly from the other three groups. A similar pattern emerged when NR means were considered; the least experienced group gave significantly more of these responses than the combined average of the other three groups.

Age

Ss were divided into four age groups: 9-11 years, 12-13 years, 14-16 years, and 17 years and older. A summary of the one-way analyses of variance using these four age groups as the independent variable and the four dependent measures mentioned above is presented in Table 9 of Appendix C. These data on the dependent measures were transformed as in the previous analysis. The variable age had significant effects on PCR ($F = 3.03$, $df = 3/99$, $p <.05$), EDR ($F = 4.63$, $df = 3/99$, $p <.01$), CNR ($F = 7.22$, $df = 3/99$, $p <.01$), and NR ($F = 4.13$, $df = 3/99$, $p <.01$). The means of the four dependent measures are presented in Table 20.

The comparison of means for the four age groups are quite similar to the comparisons of the grade level groups. A multiple comparison of the PCR means revealed that there were significantly fewer PCR responses in the older group than there were in the combined mean of the three younger groups. The EDR means for age groups differed in precisely the same way they did for grade level groups; the two younger groups had significantly lower scores on this variable than the two older groups. One comparison of CNR means for age groups also resulted in the same pattern as that for grade level groups; the oldest group elicited significantly more CNR responses than the combined mean of the three younger age groups.

TABLE 20

Mean Number of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Age Groups

	Mean Number of Reasons				
Age Groups	PCR[a]	EDR[a]	CNR	NR[a]	PRS[b]
9-11 years, 17 Ss	1.85	0.57	6.71	1.35	0.19
12-13 years, 28 Ss	1.91	0.98	9.43	0.71	0.18
14-16 years, 34 Ss	1.81	1.12	12.91	0.64	0.18
17 years and older, 21 Ss	1.24	1.40	17.43	0.40	0.18

[a]Log transformation

[b]Arc-sine transformation

A second multiple comparison of the two oldest and the two youngest groups, however, indicated that the combined means for these two groups were also significantly different.

So far, then, major intergroup differences in these sorting variables seem to be accounted for by a comparison of the two superior (in age and grade level) groups with the two inferior groups.

Comparison of NR means for the four age groups again reflected grade level differences; the mean of the youngest group was significantly greater than the combined mean of the older groups.

A notable consistency has emerged from the analysis of these three developmental variables. For grade level, age, and school experience an increase in the level of any of these variables resulted in an increase in the number of conceptually related rationales. Usually these differences could be accounted for by the combined differences between the two youngest (least schooled) and the two oldest (most schooled) groups or by the differences between the oldest (most schooled) and the remaining three groups. Similarly, the tendency not to respond (NR) was most evident among the youngest (least schooled) children. Thus, there appears to be no essential difference between these three developmental variables in terms of the effects they have on certain sorting variables. It seems that as far as the effects on sorting is concerned, advances in grade level, age, or years in school are basically the same for these children.

Furthermore, these results from the free-sorting task are consistent with Piagetian notions about the utilization of abstract, mediate strategies, e.g., edibility, by older children as compared to the use of perceptual, immediate strategies, e.g., color, by younger children.

Other Phase I Variables

Another aspect of sorting strategy that was examined was the tendency for children to sort objects separately (SEP) or by pairs (PR). It has been reported previously (Kellaghan, 1968) that African children display a tendency to place objects in small groups when asked to do a sorting task. The smallest groups that a child could possibly employ in his sorting groups consisting of one or of two objects. The variables SEP and PR denote this strategy. The distributions of both these variables were positively skewed so log transformations were performed. A summary of the analyses of variance, using grade level as the independent variable, is presented in Table 10 of Appendix C. Significant differences between the grade level groups were obtained on SEP ($F = 5.43$, $df = 3/99$, $p < .01$) and on PR ($F = 4.63$, $df = 3/99$, $p < .01$). The means of these two measures for the four grade levels are presented in Table 21.

Developmental differences also appear when these sorting variables are considered. A post-hoc pairwise comparison of SEP means revealed significant differences between grade one children and grade seven children; that is, children in grade one displayed a stronger tendency to place objects alone than did grade seven children.

TABLE 21

Mean Number of Times Objects Sorted Separately and Number of Times Objects Sorted in Pairs for Four Grade Levels, 25 Subjects in Each Level

	Mean Number of Times	
Grade Level	SEP[a]	PR[a]
1	2.87	3.00
3	2.47	2.68
5	2.64	2.73
7	2.33	2.56

[a]Log transformation

With the tendency to place objects into pairs the same difference--grade one versus grade seven--was the only significant comparison. No multiple comparisons were significant on either of these dependent measures. Thus, children who were the most advanced in school usually preferred to place objects in larger groups, while the less schooled tended to use groups of one or two when sorting. This may reflect the ability of the older children to simultaneously keep in mind a similar attribute of several objects (Flavell, 1970), something which the younger children may not be able to do.

Sex

When the effect of sex of the child on sorting variables was considered, it was found that females displayed considerably more CNR (conceptual reasons) than males ($F = 3.95$, $df = 1/99$, $p < .05$). There were no other significant differences on the other dependent measures (CLR, EDR, PCR, and NR) due to sex. A summary of these analyses of variance where the effect of sex of the child is tested is presented in Table 11 of Appendix C.

If one may assume from this result that females prefer a more cognitively complex modality (CNR) than males, then one would also expect females to show more EDR responses and fewer PCR responses than males. This is indeed what occurred although the differences between the two groups are not significant.

<u>Order of Presentation</u>

In order to determine possible effects of the order of presentation of stimulus arrays, <u>S</u>s were arranged into four groups according to which of the four stimulus sets was presented first. There were no significant differences between these groups on any of the four transformed dependent measures mentioned above (see Table 12 of Appendix C for summary of analyses of variance).

<u>Specific Schools</u>

In Phase I children from only four schools were tested. To examine for possible effects of child's school analyses of variance were computed for the same four dependent variables with appropriate transformations (see Table 13 of Appendix C). There were significant differences between schools on PCR ($\underline{F}$ = 4.21, $\underline{df}$ = 3/99, $\underline{p}$ <.01) and on EDR ($\underline{F}$ = 2.70, $\underline{df}$ = 3/99, $\underline{p}$ <.05). These were the only sorting variables for which an effect of school of testing was found. The means for sex, order of presentation, and school of testing are presented in Tables 14, 15 and 16 of Appendix C.

For the purposes of examining the relative influence of each of the developmental variables and the influence of sex and school, omega-square analyses (Hays, 1963) were performed on all the analyses of variance reported above. As shown in Table 22 slightly more variance can be attributed to the effects of grade level than to the effects of age or school experience. The differences in percentages between grade level, age, and school experience on EDR (number of edible reasons) and CNR (number of conceptual reasons) appear to be negligible, but NR appears to be more strongly related to Grade Level and School Experience than it does to age.

TABLE 22

Percentages of Total Variance of Sorting Variables Attributable to Developmental Groups, Sex, and School as Estimated by ω^2 Method.[1]

Source	Percentage
Grade Level	
EDR	9.4
CNR	16.5
NR	18.0
SEP	11.7
PR	9.8
Age	
PCR	5.7
EDR	9.8
CNR	15.7
NR	8.5
School Experience	
PCR	5.0
EDR	10.2
CNR	13.6
NR	13.7
Sex	
CNR	2.8
School	
PCR	8.7
EDR	4.9

[1] (Hays, 1963)

This suggests that an important effect of schooling for these children is to make them more responsive in a testing situation.

Sex appears to be of minimal importance compared to the more potent effects of developmental variables, accounting for less than three percent of the variance on only one sorting variable.

The effects of schools where testing was conducted were not expected. Post-hoc analyses of means indicated that on one sorting variable, PCR (number of perceptual reasons) only one pairwise comparison was significant. In Kimalewa School children gave significantly more PCR responses than they did at Kapkateny School. These are both government schools employing the N.P.A. Examination of original protocols revealed that many children at Kimalewa used predominantly color-sorting strategies. It is likely that some communication took place between children outside the experiment about the nature of the task and the "correct" way to do it. Although children were told after they left the experiment not to inform their classmates and friends about the nature of the task, several of the teachers warned E that such communication between children cannot be totally prevented.

To summarize, developmental variables, when compared to such variables as sex, school, order of presentation, are a potent influence on free sorting. Among the developmental variables, grade level appears to be slightly more important than age or school experience when its influence on sorting variables is considered.

Demonstration Task

The data from Phase I were based on the performance of four groups of children, each consisting of 25 children from grade levels one, three, five, and seven. Phase II Ss, on the other hand, were selected from grades two, three, and four. On the basis of the earlier Phase I work, it was expected that continuing Phase I free sorting in these grade levels (two, three, and four) would yield approximately the same number of perceptually-preferring children as conceptually-preferring children. Thus, all Phase II Ss were tested on the Phase I free-sort task in order to determine their preferred sorting strategies before being administered the experimental Phase II task. Prior to an examination of Phase II performance data, however, it was necessary to determine the degree of correspondence between Phase I sorting and the demonstration task. The demonstration task involved the free sorting of ten objects which were different from those used in Phase I. S was merely asked to sort as he had done before; when he had completed his free sort, he was asked his reasons and was then given a demonstration of the appropriate sorting procedure for his training condition.

Point-biserial correlations were computed on Modality Preference (PRF) between Phase I and the demonstration task and on Preferred Dimension (PRD) between these two occasions. A product-moment correlation between Ss' preference scores on the same two occasions was also computed. These correlations are presented in Table 23. All three correlations are statistically significant; but only PRF (r = .747, df = 102, p <.001, r^2 = .558) and PRD (r = .771, df = 102, p <.001, r^2 = .594) show a considerable amount of shared variance between the two testing occasions.

Emic Phase

Prior to the experimental free-sort task some field observations were made; these consisted of observations in Bukusu homes, interviews with experienced child rearers (mothers and adolescent girls), examination of school materials, interviews with teachers, and finally the generation of a taxonomy of salient material objects for Bukusu schoolchildren. These observations provided data on culturally important concepts that child rearers and teachers inculcate into Bukusu children. Because the information from these data is meant to be salient and not exhaustive, the methodology used was not as systematic and rigorous as that used in the free-sorting task and in the subsequent learning task.

TABLE 23

Correlations of Modality Preference, Preferred Dimension, and Preference Score between Phase I and Phase II for 104 Ss

	PRF	PRD	PRS
	Demonstration		
Phase I - r	.747**	.771**	.303**
r^2	.558	.594	.092

**p <.001

Home Observations and Interviews with Child Rearers

The experimenter and his assistant visited six traditional Bukusu homes where a mother and child were present. After introductions and a brief explanation of the purpose of the visit, each mother was asked what concepts she considered to be most important for her children to learn. In response to this question all six of the mothers mentioned specific tasks that children had to learn around the home such as fetching water and helping on the farm, but four of the six stated that the most important thing a Bukusu child learns is to distinguish between the work of a boy and the work of a girl. The tasks of a boy involve such activities as taking care of cattle, building houses, hunting, and cultivating the family farm. Girls, on the other hand, must learn to fetch water, grind flour, cook, and tend to the vegetable garden adjacent to the house. Both the boys and the girls gain experience in their respective tasks through the games they play.

Boys often use grasshoppers whose wings are plucked or clay models to represent cattle, and girls use mud to represent stiff porrige. Using such representations, children play various games and model their parents' behavior.

Learning in the home, then, involves immediate experience with external objects through manipulation of familiar objects and modeling of the parents' behavior. The learning of specific tasks, rather than general principles, is what is emphasized, and the distinction between the roles of each sex may be the most important thing that a Bukusu child learns at home. Subsequent interviews with mothers at the nutrition-training center and with adolescent girls confirmed this conclusion.

At the Red Cross Training Centre at Kanduyi the interview was conducted as a group discussion. There were 12 mothers in this group who had volunteered to spend three weeks living at this center with their youngest children in order to learn how to cultivate, prepare, and feed their children foods of higher nutritional content than they ordinarily prepare in their homes. In most cases their children had recently been discharged from the district hospital after treatment for kwashiorkor. The mean number of children each mother had reared was four. At first, in response to the same question that was asked by E in the homes, these women mentioned specific tasks that they teach their children and after some further discussion concluded that these tasks involved the essential distinction between the work of a man and the work of a woman. Girls learn to prepare bananas, potatoes, and stiff porrige often before the age of five; they learn to follow their mothers and not to play with such things as bells. Boys follow their fathers as they tend their cattle and cultivate the farm; they play games amongst themselves with certain leaves, pretending they are bells in preparation for the all-important circumcision ceremony that will take place when they reach about 13 years of age. Circumcision marks the turning point of almost every male Bukusu's life when he is officially regarded as a man; most schoolboys are in the fifth grade when this occurs. Such a ceremony for girls, though practised in the past, has not been carried out since 1921 (Wagner, 1956).

The third group that was asked this question about concept learning consisted of secondary school girls in Form II (tenth grade). There were fifteen in this group whose ages ranged from 16 to 21 years, and all of them claimed to have had experience taking care of children. As is the case in many parts of Africa, in Bukusu-land elder female children assume a large responsibility in the care of their younger brothers and sisters. The discussion with the school-girls, as opposed to the other interviews, was conducted in English without an interpreter.

The most important aspect of a child's home experience, according to this group, is the learning of the distinction between relatives and non-relatives; that is, who is in the clan and who is not. This corresponds to reports from ethnographic sources (Wagner, 1956; Osogo, 1966), which have noted the importance of the clan in Bukusu culture. These students also mentioned the concept of edibility, that is, learning what can be eaten and what cannot, and the distinction between domestic utensils, such as wash basins, cooking implements, and farming tools, such as hoes, axes and plows. Contrary to the other groups interviewed, schoolgirls omitted mention of the male-female dichotomy.

School Materials and Teacher Interviews

In the mid-sixties, shortly after Independence, the Ministry of Education of Kenya instructed all schools to change over from the use of the vernacular tongues in the first four grades of primary school to the use of English as the medium of instruction beginning at the first grade. A series of publications including readers, picture books, and teachers' manuals were recommended as materials for this New Primary Approach (N.P.A.). One teacher's manual, called The New Peak Course: Standard I (Special Centre, 1966), The New Picture Book (Special Centre, 1963), and The New Link Reader (Special Centre,

1963) were examined in order to determine the central concepts emphasized in these materials which cover the first year of school. Five out of the six schools where testing took place have used all three of these books, while the sixth has used wall charts from the old curriculum.

The teacher's manual describes the following stages of language work that should take place in the first grade: naming things in the class, number rhymes, naming uncountables, the use of the present continuous tense, standards of measurement, buying things in a shop, telling time, what things are made of, counting forward and backward, labeling things in the home, labeling things in the shop, and naming domestic animals and what they do. No effort is made to teach separate academic subjects, such as arithmetic, geography, history; all knowledge in the first grade is presented in the context of language work. The methods recommended for teaching this sequence involve word and picture matching, sorting objects by size, shape or color, painting, drawing with pencil and learning word lists.

The New Picture Book is the pupil's own reference for "training in the senses." It contains illustrations of objects of different shapes, such as triangles and circles, of different sizes and of different bright colors. In the latter part of this book there are illustrations of objects and scenes typical of an African setting, e.g., the marketplace, the cooking hut. These scenes become progressively more complex as a pupil works through the book, and for each depiction the pupil is expected to describe, in English, the objects and what is happening. The stated purposes of this picture book are to provide training in discriminating shape, size, and color, to provide a foundation for arithmetic, to give the pupil experience in reading skills, such as left-to-right eye movement, memory and shape discrimination, and to begin training in grouping and classifying things.

The New Link Reader contains similar illustrations but includes a text which describes the objects and depicted actions. Again the depicted scenes include objects found in most African homes and farms. Pupils are asked to locate details in the pictures, name shapes and objects, and later in the book tell a story from a picture.

For the purposes of this study it should be noted that the sorting of geometrical objects and of familiar objects is a task with which all pupils in Kenya should be familiar. In five of the six schools tested all children, grades one through seven, had been taught by the N.P.A., and had been exposed to these materials and teaching techniques.

Teachers of the early primary grades were asked what concepts they taught to their pupils and which of them received the greatest emphasis. The results of this questioning in the six schools are presented in Table 24; the underlined concept is the one receiving greatest emphasis, according to the teacher. The most outstanding result of this questioning was, of course, the stress most teachers report they place on the color concept. Although, according to the child rearers' reports this concept receives little emphasis in the

TABLE 24

Summary of Teachers' Responses in Six Schools Concerning Important Concepts in the Primary School Grades

School	Grade Level		
	Standard I	Standard II	Standard III
	Concepts		
Kuywa[a]	Color Size Shape	no response	Color Size Function
Kimalewa[b]	Color	Color Size Shape Function	Shape Color Size Material
Baraki[c]	no response	Size Shape	Size Shape
Chebukwabi[d]	Color Function	Color	Color Function
Kapkateny[e]	Color Shape Size Function	Color Shape Size	Function
Lukhome[f]	Color	Color	Color Animals Plants

[a]Two teachers
[b]Three teachers
[c]One teacher
[d]Two teachers
[e]Three teachers
[f]Two teachers

home, in the school the child is exposed to materials of bright and distinctive colors and is continually reminded of their importance by the teacher. The one school that does not use the N.P.A., Baraki School, did not seem to emphasize the color concept as much as the other schools.

Comprehensive List of Material Objects

The results of this elicitation are presented in Appendix D. The name of the object in Olubukusu is shown on the left and opposite each is the English equivalent or a brief description of the object in English. There is no Olubukusu-English distionary, and for many words the direct English equivalent is not known by E; in such cases the object is described in terms of its appearance or use. It is important to note that this list was elicited without regard to the classification system used by Bukusu children to group these items. The categories listed are taken from similar lists in Osogo (1966) and in Wagner (1956).

The purpose of eliciting this list was not to obtain an exhaustive, all-inclusive list of Bukusu objects but merely to determine which objects are salient. During the process of elicitation the pupils participating were asked to name only those objects which they considered the most common in any given category. In pilot testing and in the free-sorting task objects for presentation were selected from this list.

Even though the categories were constructed by E and not by Bukusu Ss, a rough indicator of the relative importance of some domains of objects can be observed by looking at the number of objects in a particular category. Plants, animals, and foods appear to be the biggest categories and the most important, if one may assume that the more salient a category, the easier it is to generate names of objects in that category. The weakness of this category system, however, is demonstrated by the appearance of names in the "Plant" list that could just as easily have been placed in the "Food" list.

Taxonomy of Material Objects

The final taxonomy, which was derived from the three independently elicited taxonomies, is presented in Figure 6. The most striking aspect of this taxonomy is the lack of superordinate categories, especially with regard to "Mammals," "Things that Lay Eggs," and "Flowering Plants." The western observer would quickly note that these things share the common attributes of being alive and reproductive and would probably group them into a larger category that might be called "Living Things." For these seventh graders, however, they are exclusive categories as are the seven others shown in the diagram. The categories are presented in the order in which they were given; that is, for two of the three groups of children the list of mammals was elicited first, for two of the groups "Birds" were elicited second, and for two of the groups "Trees" were elicited as the third list.

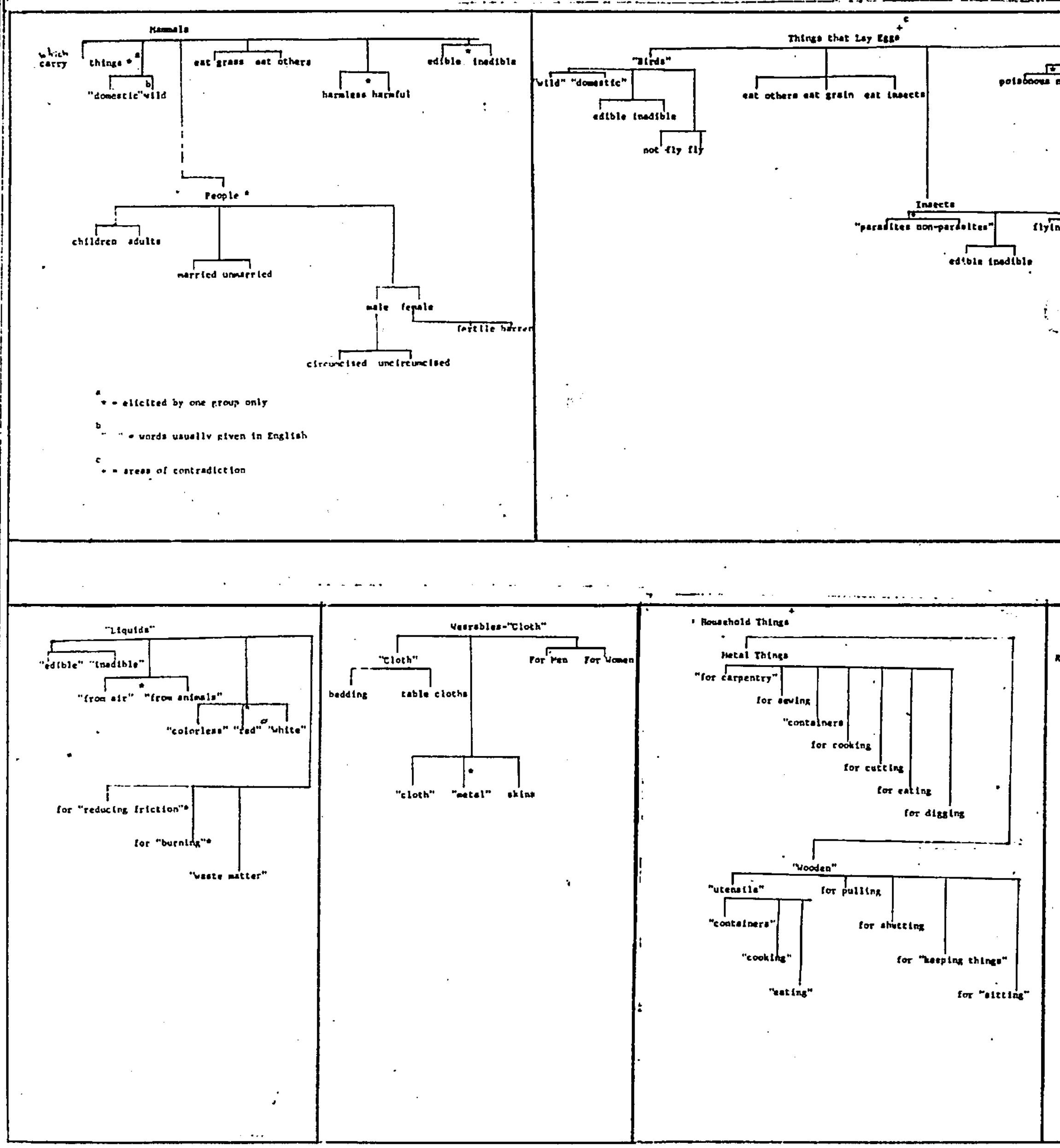
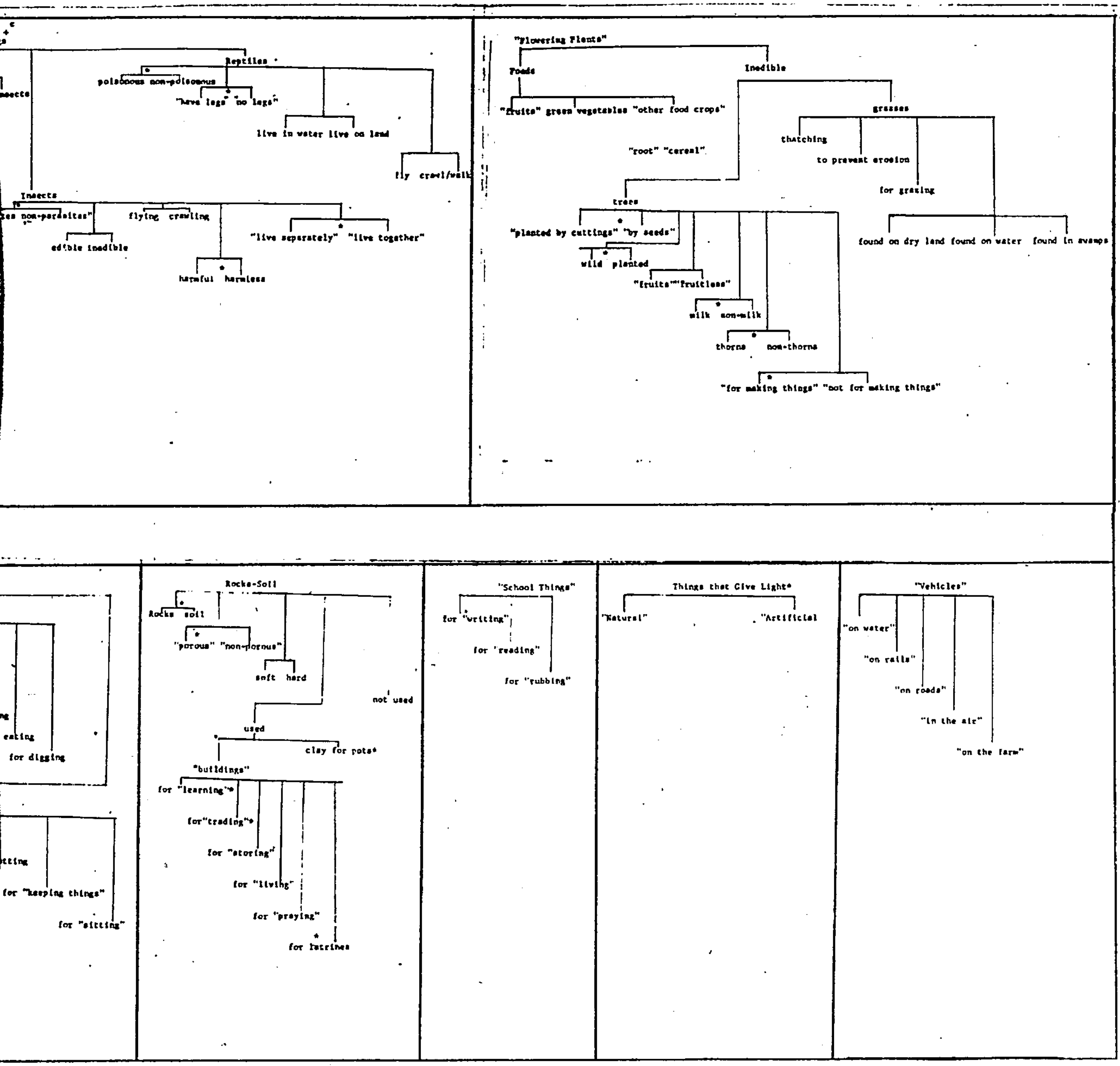


FIGURE 6 - TAXONOMY OF MATERIAL OBJECTS FOR BUKUSU SCHOOLCHILDREN.



Reptiles
poisonous non-poisonous
"have legs" "no legs"
live in water live on land
fly crawl/walk
Insects
non-parasites"
edible inedible
flying crawling
harmful harmless
"live separately" "live together"
"Flowering Plants"
Foods
Inedible
"fruits" green vegetables "other food crops"
"root" "cereal"
grasses
thatching
to prevent erosion
for grazing
trees
"planted by cuttings" "by seeds"
wild planted
"fruits" "fruitless"
milk non-milk
thorns non-thorns
"for making things" "not for making things"
found on dry land found on water found in swamps
eating
for digging
for "keeping things"
for "sitting"
Rocks-Soil
Rocks soil
"porous" "non-porous"
soft hard
not used
used
clay for pots
"buildings"
for "learning"
for "trading"
for "storing"
for "living"
for "praying"
for latrines
"School Things"
for "writing"
for "reading"
for "rubbing"
Things that Give Light
"Natural"
"Artificial"
"Vehicles"
"on water"
"on rails"
"on roads"
"in the air"
"on the farm"

CHILDREN.

In some instances one group of children disagreed with the classification system of the other two. These disagreements occurred after each "committee" of children had seen what the other committee had done and are indicated as "Areas of Contradiction" in the diagram. One committee preferred to include "Things that Lay Eggs" with the "Mammals" and applied the English label "Living Things" to this superordinate category. Under the category of "Flowering Plants" one committee preferred to include "Wooden Things," which for the other two committees was included under the rubric "Household Things." A third area of contradiction also occurred in the area of "Household Things." One committee wanted to place "Metal Things" in a separate category which would also include "Vehicles."

Several of the subcategories, as indicated by the asterisk (*), were originally elicited by only one of the committees. There was agreement among each of the other committees, however, after each committee had seen what the other had done, on the existence of such subcategories and agreement as to where they should be placed.

If other committees had been queried by the same method, it is likely new subcategories would have emerged and a more comprehensive taxonomy arrived at. For this reason the taxonomy presented here must be considered only as a classification of <u>salient</u> objects and not as an exhaustive listing of the material objects known to this population. Since this taxonomy provides qualitative information and since the specific information from one committee is not the same as that from other committees, these data are not amenable to quantitative analysis or tests of reliability. What this taxonomy does provide, however, is a base from which to select objects for the individual-testing phase of this research and a framework to assist in the interpretation of results of the free-sorting task.

Objects

The rationale Ss used for sorting objects into various groups was not the only source of information to determine preferences in Phase I. Ss' responses to individual objects were also examined. Each of the 40 objects used in Phase I (see Table 1 of Appendix B for description of objects) was analyzed in terms of the other object with which it was most frequently placed (OOG-1) and the other object with which it was next most frequently placed (OOG-2). These data together with the number of times the object was placed with its "favorite mate" (XOOG-1) and the number of times it was placed with its second most "favorite mate" (XOOG-2) are presented in Table 25. The maximum frequency possible for XOOG-1 is 100, and in all cases XOOG-2 is less than XOOG-1. The most frequent grouping occurred with objects numbered 13 and 18, the two bunches of leaves. Although these objects came from trees that are considered quite distinct from each other, their immediate visible similarity is compelling. The green

TABLE 25

Most Favorite and Second Most Favorite Mates for Each Object and the Number of Times the Object Was Placed with These Mates in Phase I

Object Number	Favorite Mates and Frequency of Placement			
	OOG-1	XOOG-1	OOG-2	XOOG-2
Array A				
1. Cassava	10	51	3	45
2. Hat	5	96	7	76
3. Egg	1	45	10	30
4. Red Pen	0	56	10	17
5. Bookbag	2	96	7	38
6. Bracelet	8	51	0	12
7. Handkerchief	2	76	5	38
8. Bell	6	51	19	13
9. Kimiti stick	0	77	8	13
10. Corn flour	1	51	3	30
Array B				
11. Cooking stick	0	61	17	36
12. Candy	16	33	19	12
13. Kimiti Leaf	18	92	11	9
14. Butterfly	19	57	17	24
15. Feather	0	42	14	15
16. Wild fruit	0	33	0	22
17. Chalk	0	68	11	36
18. Kumutoto leaf	13	92	11	8
19. Grasshopper	14	57	15	14
20. Banana fibre	0	61	15	26

TABLE 25--Continued

Object Number	OOG-1	XOOG-1	OOG-2	XOOG-2
Array C				
21. Crabgrass	29	75	23	25
22. Nail	25	57	0	47
23. Sisal	0	63	21	25
24. Sarati leaf	26	45	30	13
25. Razor blade	22	57	27	30
26. Meat	24	45	0	22
27. Pencil	0	59	25	30
28. Corn kernels	30	64	24	28
29. Broom	21	75	23	24
30. Sarati seeds	28	64	24,29	13
Array D				
31. Matches	40	85	34	26
32. Sand	39	47	35	43
33. Bread	36	59	37	39
34. Tobacco	0	47	40	29
35. Stones	32	43	39	38
36. Cassava	33	59	37	44
37. Guava	38	61	36	44
38. Wild berries	37	61	36	40
39. Clay	32	47	35	38
40. Matchbox	31	85	34	29

To a lesser extent the same seems to be true for the two matchboxes, though one is empty, and for the two types of grasses, though one is in the form of a broom. Several objects such as the pen, the chicken feather, the pencil, the chalk, and the tobacco were more often placed separately than with any other object. The salience of the edibility dimension, described in the analysis of Phase I and Phase II, is evident in the preference for grouping the edible objects with one another. An edible object was rarely placed by itself, and as can be seen in Table 25, such objects as corn flour, sarati leaf, meat, guava, and wild berries, were usually placed with other edible objects.

CHAPTER IV

DISCUSSION

Phase I and Phase II

Bukusu children, who varied according to their predetermined sorting preferences, had to learn within eight trials with four sets of familiar objects to sort on the basis of an imposed sorting strategy. Learning to sort conceptually was generally easier than learning to sort perceptually; learning, generally, was easier for children who had, earlier, demonstrated a "preference" for conceptual sorting; and preference facilitated learning to sort in the preferred modality only for conceptual preferrers. A striking fact is the poor performance of perceptual preferrers in both training conditions, but especially when they were trained to sort perceptually.

What might this mean? Those who show, in a free sort, a tendency to sort conceptually are more advanced cognitively, and hence, better able to learn any task.

Those who sort perceptually on a free sort are not yet dealing with mediated attributes and have difficulty when put into a learning task. That conceptually free-sorting is "developmentally" more advanced is consonant with this interpretation.

But of these two variables, preference and training, which is more important with regard to performance on the learning task? When all the available information about the types of learning tasks was used, this variable turned out to hold the strongest relationship with performance on the learning task (see Table 11). Two pieces of evidence, however, argue for the primacy of Phase I preference in predicting Phase II performance: fist, is the substantial portion of variance reduced by both Modality Preference and by Preferred Dimension; second, is the result of the canonical correlation which indicated that Factor I (the only important factor derived from this analysis) was highly loaded on PRF and PRD (see Table 15).

The influence of Phase I preference on learning is noteworthy in light of the findings concerning developmental trends in sorting strategies. Preference for the conceptual modality, it will be recalled, was related to success on the learning task while preference for the perceptual modality was related to failure. Although a caveat was made in Chapter I that inferences about cognitive ability should not be drawn exclusively from information based on free-sorting tasks, the conclusion here is unavoidable. In Phase I there were definite age-related and grade-level related changes in modality preference. Older children and children who were more advanced in school showed a definite preference for the conceptual modality, i.e., the more cognitively complex strategy. Since success on Phase II was so strongly related to preference for this modality, it must be assumed that Phase I preference provided a potent and reliable prediction of Phase II performance.

Elsewhere (Evans & Segall, 1969), it has been argued that preference for certain sorting dimensions may reflect prevailing habits and that the capacity for sorting by other dimensions may not be precluded by specific preferences. It has been demonstrated here, however, that a strong predictive relationship does exist between preference and ability on a learning task. Perhaps the relationship discovered in this investigation between preference and learning can be attributed to the care that was taken in the selection of culturally appropriate stimuli and the mode of presentation of these stimuli. Had investigators like Evans and Segall (1969), Greenfield _et al_. (1966), and Kellaghan (1968) employed _both_ a free-sorting task and a learning task, they would have been in a better position to make conclusions about abilities with certain dimensions. One problem in cross-cultural psychology is that developmental conclusions are made on the basis of either a learning task or a free-sort task but seldom on the basis of both. Furthermore, had these investigators elicited culturally meaningful objects, they might also have come up with different findings concerning abilities with certain dimensions. Indeed, it has been demonstrated both in the United States (Sigel, 1964) and in Africa (Irwin & McLaughlin, 1970) that when unfamiliar objects are used _S_s will sort them according to superficial attributes, i.e., perceptually. But even if familiar objects are used and are presented in a photograph or a drawing--as done by Evans and Segall--attention will be given to their superficial attributes rather than to their mediated attributes. Sigel (1968) has articulated this view in what he calls the "distancing hypothesis":

> The distancing construct is consonant with Piaget's, Bruner's, and Werner and Kaplan's definitions of representation. In each case there is the implicit or explicit statement that the representation and its referent are separated by physical or psychological distance. Be it the image, the picture, the symbol, or the sign, each one is distant from its referent. The distance may be temporal, as between a past event and a present recall; spatial as with a picture image and the pictured or the imaged; in its modality, the name of the object; or in the degree of detail, a sketch of the object and the object itself (Sigel, 1968, p. 5).

In this investigation the representation of the object was minimally distant from its referent; that is, there was no verbal, pictorial, or temporal representation of the object--the object appeared in its real-world, unaltered form. When this is the case, it is likely that

<u>S</u>s will invoke mediated attributes when asked to sort objects. This does not mean that in all instances objects will be sorted by the conceptual, mediated modality, for it has been demonstrated here that many children, and indeed most of the younger children, chose to utilize superficial attributes in sorting such objects.

With regard to the distancing hypothesis, a topic of further investigation might be the ability of school children in such a non-western setting to employ certain dimensions when objects are presented at a greater psychological distance than they were here. Could African children learn to sort by the edibility dimension as easily as they did here if these objects were presented verbally or pictorally? Perhaps in this investigation <u>color</u> might have emerged as the salient dimension if the objects were presented photographically. It would be informative to know whether cognitive development is arrested at a certain point, i.e., the use of conceptual modality fails to emerge, or whether it proceeds as it does in this free-sorting task when objects are presented in a more "distant" form.

There is a more fundamental question, however, that must first be answered in cross-cultural psychology. To date the evidence with regard to the ability of Africans to perceive photographs, drawings, and other representational depictions of objects is limited. Findings in this area have been confounded with the ability of Ss to recognize what the object being depicted is. It may be the case that even schoolchildren experience difficulty in perceiving represented depictions and in seeing three dimensions in two dimensions and that school materials presently being utilized are inappropriate.

One might argue at this point that it would be of theoretical interest to examine representational competence in unschooled children. It may indeed be helpful to know what competence a non-western child brings with him when he first enters the classroom, but in modern Kenya, for example, it is becoming increasingly difficult to find a child who is totally untainted by the schooling experience. Among the Bukusu almost every child has experienced at least a couple of years of school. In fact, the question of the unschooled child is losing practical significance in Africa as more and more children are going to primary school. Efforts should be made at this point to examine the interaction of the home experience and the school experience and to develop more culturally appropriate materials for the schools. One method for discovering culturally appropriate materials is to utilize elicitation procedures such as those used in the emic phase of this study.

Emic Phase

Taken by themselves, the findings from the home observations and interviews with child rearers are readily interpretable. To reconcile these findings, however, with the results of the experimental sorting tasks is a bit more difficult. Two recurrent messages seem to be running through the interviews with child rearers: first, that a child learns through immediate, direct experience the tasks that are considered important and necessary in the home; second, that sex roles and the appropriate tasks associated with them seem to be the most critical aspect of learning in the home. The kind of immediate task learning that Bukusu children experience is directly opposed to what happens in the westernized classroom where the immediate and abstract are discussed in an objective fashion.

The secondary school girls seemed to offer a completely different interpretation of the Bukusu child's experience from that offered by the mothers. They mentioned the importance of the edibility dimension--and they were the only group to do so--and the distinction between domestic implements and farm tools. These students stressed above all, however, the salience of the clan in Bukusu life. Although on the surface this claim by the school girls seems to seriously contradict what the mothers had said, it is possible that both groups may be referring to the same central concept. The contradiction probably lies in the differing experience of these two groups in objectively communicating to others what is central to their lives. Having experienced a western-oriented school system for so long, the secondary school students might have understood more readily than the mothers the purposes of an objective discussion aimed at describing superordinate principles. None of the mothers knew English and few of them had even reached the fourth grade. It may well be that the schoolgirls in referring to the importance of the clan may have been indicating a more central cultural attribute than the male-female distinction. Indeed, the learning of appropriate sex roles is interwoven with the identification of the clan when one considers the cultural rules concerning exogamous marriage, gift-giving, and litigation.

If, then, learning of sex roles and the meaning of the clan is so critical to Bukusu children, why did these concepts not emerge in the free-sorting task? The answer to this question probably reflects as much about the two methodologies employed as it does on salient concepts for Bukusu schoolchildren. An interview technique such as that used in gathering information from child rearers may be useful for gaining general insights into the culture. The results of several different interviews might describe a range of cultural attributes or even a central cultural attribute, but specific information from such interviews is often unreliable. It is likely that sex-role differentiation did not occur in the sorting of objects because the objects employed were "neuter." It might have been observable from the performance of domestic tasks and children's games, but not from the domain of objects used in Phase I. Such a methodology of open-ended questioning is potentially useful in delimiting the range of culture traits, but other techniques should be used to determine more specific information.

The interviews with teachers and examination of school materials revealed another aspect of a Bukusu child's life which is quite distinct from his experience in the home. At no time did child rearers mention that they taught their children to recognize and identify colors, but teachers were almost unanimous in their reports that color was the most significant concept taught in the early grades. The only school where this was not mentioned was the non-government school, Baraki, where the New Primary Approach is not used. The strong preference for color-sorting strategies in the early grades is demonstrated by the results of the free-sorting task. One may assume in a Piagetian sense that a preference for a dimension like color is "natural," but if that is so, it seems to be greatly enhanced by a strong environmental influence that occurs in the school. It is likely that the intensive exposure to colors that occurs in the early grades is having its maximal effect on children who are cognitively "ready" for acquiring skill with this dimension. Furthermore, the fact that this testing took place in the schools may have increased the likelihood of the color strategy being employed simply because the school is the place where the color dimensions is most frequently applied. This preference for immediate attributes of stimuli then gives way to a preference for more mediate, culturally salient dimensions, such as edibility.

Some definite clues concerning culturally salient dimensions are provided in the taxonomy of material objects. The categories "Things that lay eggs" and "Flowering plants" were elicited early in the sessions and were highly elaborated when compared to other categories. Although these are two major categories where committees could not agree, in general, agreement between the three committees was surprisingly good. The first three categories "Mammals," "Things that lay eggs," and "Flowering plants" were usually elicited first and were more elaborated than the categories that followed. It is likely, then, that these categories represent the most salient categories for Bukusu schoolchildren. A striking aspect of the taxonomy to the western observer is the degree to which the categories are mutually exclusive. Superordinate categories, such as "living/nonliving," "store bought/home made," were rarely mentioned. One may assume from this taxonomy and from the interview that the Bukusu child's world is highly compartmentalized and situation-specific. Sex-role differentiation, though important in the learning of chores around the home and in interacting with relatives, does not emerge as an overiding concept in the classification system of material objects, except at lower levels when distinctions are made between clothes and between people. Colors are critical in the life of the early primary school child, but there is little residue of this experience in taxonomies generated by older children. Some categories, though, are probably based exclusively on knowledge gained in the school. This can be traced through the use of the English language in the taxonomy to describe certain categories such as "School things," "Things that give light," and "Vehicles." The more salient categories, however, were usually described in Olubukusu.

Another important aspect of Bukusu life that is not reflected in the taxonomy is the role of cattle. It has been suggested that a Whorfian interpretation of the linguistic elaboration in the area of cattle would predict that distinctions made for cattle should be demonstrated in some way in the taxonomy or in the Phase I sorting. Such distinctions, however, are not in evidence. Again it may be argued that the Whorfian interpretation is inappropriate since the classification of objects appears to be situation specific.

The lack of superordinate categories in the taxonomy corresponds to a similar deficit in the Phase I sorting task. The preference in Phase I for color, functional, and edible dimensions and the facility for edibility learning in Phase II, on the other hand, could not be predicted from the taxonomy. The taxonomy did provide, however, a range of possible dimensions and a domain of objects from which to choose Phase I stimuli. For example, it was apparent from the elicitation of the taxonomy that mammals, egg-layers, and flowering plants are important domains of objects for Bukusu children. It seldom occurred in Phase I, except with the younger children, that objects representing these large categories were placed together.

A conclusion similar to the one drawn from child-rearer interviews may also be drawn here. The taxonomy was useful in tapping a broad range of possible dimensions and in suggesting some salient ones. But in order to gain more specific knowledge about the relative importance of certain dimensions, other techniques, such as free sorting, should be used.

One may conclude, then, that these African children employ the same cognitive strategies that western children do; and indeed, it is likely that they proceed through the same developmental sequence that western children follow. Nonetheless, important cultural differences in the content of cognitive experience do exist for these children. The implications for education are quite clear. These African children are similar in their developmental sequence to children everywhere, but certain materials and concepts, e.g., edibility, when used in an educational setting might be more effective than others. The extensive use of colors in primary school grades seems appropriate for children who are probably cognitively "ready" for such learning. It would also be appropriate, however, to relate school experience to culturally salient concepts. Perhaps more of the schooling process should involve the use of culturally meaningful objects. In the early primary grades real objects might be used in the classroom and children asked to identify these objects and point out mediated attributes, e.g., edibility, cultivability. Later in schooling such objects could be represented verbally or through pictures, and similar tasks employed. Such a procedure might be more meaningful and stimulating for children as well as being more educationally productive.

An important question of educational concern might involve the ability of African children to learn, when actively instructed to do so, to attend to inferred or mediated attributes of stimuli. If such training could be established, would it be persistent and transferrable to other arrays of objects and other tasks? The use of Piagetian conservation tasks would be appropriate to measure persistance and transferrability, and indeed, performance on these tasks might be related to sorting strategies on a classification task. If appropriate simuli were used, it might be possible to obtain a predictive relationship between free-sorting and performance on conservation tasks, similar to the relationship found in this study.

The study of sorting behavior in a non-western setting might proceed more meaningfully if children were asked to sort the same objects along different dimensions and different modalities. Flavell (1970) suggested that, in a Piagetian sense, this is the critical factor in sorting behavior--the ability to hold in mind, simultaneously, competing attributes of stimuli. Again, objects presented in a variety of psychological distances from their referents might be used and Ss asked to sort objects by edibility, color, cultivability, etc. It would be of interest to the cross-cultural psychologist whether children from a non-western setting could utilize several dimensions simultaneously and what those dimensions might be.

The use of elicitation procedures, such as those mentioned in this study, have been limited almost exclusively to non-western settings. This methodology, employed for the most part by anthropologists, might be applied to the

American setting for similar purposes. The emic method, it would seem, should be amenable to investigation of sub-cultural groups, such as "disadvantaged" and relatively isolated people. Cole and Bruner (1971) have already suggested the use of culturally sensitive elicitation procedures for studying ghetto children. Such procedures would allow for the discovery of culturally appropriate objects and perhaps some salient dimensions for children of a sub-culture; based on elicitation information, psychological testing could then proceed at a more meaningful level for such children. Indeed, it would be informative to know what type of classification system middle-class American children would generate. Possibly developmental differences in taxonomies would emerge; one would assume that such taxonomies would be quite different from taxonomies elicited by African children. Similarities might exist, however, in the degree to which superordinate categories are used or the level of elaboration of salient categories.

In general, it appears that the use of elicitation techniques, combined with individual testing, is an appropriate methodology for cross-cultural, and possibly sub-cultural, investigation. Elicitation can provide the psychologist with appropriate tools for his research as well as some clues concerning important concepts while the psychological experiment, especially a learning task, can provide more specific information about the interaction of, and ability to use, salient concepts in the culture.

CHAPTER V

SUMMARY

This study investigated the relationship between preference, as measured by a free-sorting task (Phase I) and training on a learning task (Phase II) in a sample of Bukusu (Kenya) schoolchildren. It was predicted that preference in the conceptual modality would be a better facilitator in the corresponding (conceptual) learning task than perceptual preference would be in the perceptual learning task.

Developmental trends in sorting behavior were also investigated using children of different ages and years of school experience. Before the sorting tasks were administered, several elicitation procedures were employed with other Bukusu respondents in order to discover culturally appropriate objects and some generally preferred dimensions in this cultural setting. Among these procedures were interviews with child-rearers, interviews with teachers,

elicitation from children of a comprehensive list of material objects and of a taxonomy of material objects.

After the elicitation procedures were completed, 100 schoolchildren, twenty-five in each of four grade levels (standards one, three, five, and seven), were given the free-sorting task. Using four stimulus arrays, each consisting of ten objects, the children sorted them and explained their sorting strategies. In analyses of variance of several scores derived from the sorting behavior of these children grouped by age and school experience, it was found that the children showed Piagetian developmental trends in the strategies they employed. Younger and less schooled children preferred the perceptual modality, i.e., they sorted and gave rationales on the basis of superficial attributes, while older and more schooled children preferred the conceptual modality, i.e., they sorted and provided rationales based on mediated attributes.

An additional 104 Bukusu children from standards two, three, and four were then employed as Ss and administered two tasks. First they performed this same free-sort in order to determine their individual modality preferences. Then half of these Ss were given a Phase II learning task in which they were encouraged to sort in their preferred modality, and half were given a learning task in which they were trained to sort in their non-preferred modality. Specific training dimensions included color and material, as exemplars of the perceptual modality. All four of these dimensions were meaningful in this cultural setting, as determined from the elicitation phase of this research.

Partitioning of chi-square analyses, analysis of variance, and a canonical correlation analysis all revealed support for the prediction that there would be a relationship between training and preference, but with both preference and training producing main effects on ease of learning. The specific interaction obtained but was overshadowed and accounted for by the main effects.

Conceptual preference, especially for the edibility dimension, and conceptual training, especially for the edibility dimension, were both related to success on the learning task, while perceptual preference and perceptual training were both related to failure.

Results of the free-sorting task and the experimental learning task were discussed in light of the findings of the emic phase. It was suggested that Bukusu children compartmentalize their world in such a way that salient concepts observed in the taxonomy of material objects and in the interviews with child-rearers are not utilized when children are asked to sort selected objects.

It was further suggested that future investigations might examine developmental trends in sorting behavior when objects are represented at varying psychological distances. A similar question concerns the training of children from a non-western setting to use the conceptual modality. The success of such training could be evaluated by performance on subsequent multiple classification tasks (using competing dimensions to sort the same objects) or by performance on Piagetian conservation tasks. The conclusion was made that a methodology which employs elicitation procedures followed by psychological experimentation is appropriate for cross-cultural investigation.

APPENDICES

APPENDIX A

INSTRUCTIONS OF PHASE I AND II

INSTRUCTIONS

PHASE I

We are going to play a game together. There is no right or wrong answer, and there are many ways to play. We just want to know how you play the game. I will put some objects in front of you, and you are to put them in groups. --any way you wish, with as many in one group as you wish. Just group the things that go together in one group and others that go together in another group. After you have finished, I will ask you the reason why you put the things into certain groups.

Remember, there is no right or wrong answer. Do you understand? Do you know what I mean by "groups"? (Show 10 objects)

Here are some things you have seen around the home and school and which you probably know very well. Put these objects into groups according to those things that go together--any way you wish. Just group the things that go together in one group, other objects that go together in another group, others in another group, and so on. You can put as many objects into any one group as you wish. You may even make groups of one thing. I will ask you the reason why you put the things into certain groups after you have finished. Do you understand? Alright, begin putting them into groups.

INSTRUCTIONS

PHASE II

We are going to play a game which is similar to the one which we played with you last time. Do you remember it? Let's see if you can play it today. Group these things the same way you did last time. (Subject sorts objects)

Very good. That is one way to play the game. Now we are going to play the game in a different way. The teacher (E) is going to take these objects and group them in another way. (E resorts objects)

Do you know the reason why he grouped them this way?

Now I want you to group these other things in the same way that he grouped these--not the way you did it at first, but the way the teacher just showed you. Do you understand?

Also I want you to give me the reason that, you think, these things go together.

So group these things in the same way the teacher just did, and tell me the reason that they go together.

APPENDIX B

DESCRIPTION OF ARRAYS OF SORTING OBJECTS

Table 1

Four Arrays of Sorting Objects Used in Phase I, Demonstration Array, and Transfer Array Used in Phase II

Phase I

Array A:

1. Dried cassava in small metal container
2. Khaki-colored hat with brim
3. White egg in shell
4. Red ball-point pen
5. Khaki-colored bookbag
6. Metal bracelet, locally made
7. White handkerchief, folded
8. Circumcision bell
9. Kimiti (wood used for building) stick, six inches long
10. Corn flour in large red bottle top.

Array B:

11. Wooden cooking stick
12. Yellow candy in transparent wrapper
13. Bunch of fresh 'kimiti' leaves in small red box
14. Yellow and black butterfly in large red bottle top
15. Chicken feather
16. Wild yellow fruit, inedible
17. Piece of blackboard chalk
18. Bunch of fresh 'kumutoto' (wild, milky tree) leaves
19. Edible grasshopper in matchbox
20. Banana fibre, three inches long.

Table 1--Continued

Array C:	
21.	Fresh piece of 'lukhafwa' grass (similar to crabgrass) in white box
22.	Two-inch nail
23.	Strand of dried sisal string
24.	Fresh 'sarati' (green leafy vegetable) leaf in black tin can
25.	Used razor blade
26.	Piece of cooked, dried meat
27.	Green sharpened pencil with erasure
28.	Kernels of dried corn in round green container
29.	Locally made broom (all grass)
30.	Sarati seeds in small metal box.
Array D:	
31.	Wooden matches in matchbox
32.	Sand in small metal box
33.	Slice of stale white bread
34.	Local sniffing tobacco in matchbox
35.	Stones in tin can
36.	Cassava root, unpeeled, undried
37.	Unripe guava
38.	'Busangura' (wild, edible berries) in small black box
39.	Round ball of hardened clay
40.	Empty matchbox.
Phase II	
Demonstration Array:	
41.	Unripe sweet banana
42.	Wooden match
43.	Beans in small tin can

Table 1--Continued

44.	Finger millet in matchbox
45.	Sour milk in small, transparent bottle
46.	Metal teaspoon
47.	Small young sisal plant
48.	Square wooden block
49.	Kerosene in soda bottle
50.	Sewing needle, store-bought
Transfer Array:	
51.	Small safety pin
52.	Thin green textbook
53.	Thorn from sisal plant
54.	Pair of scissors
55.	Aspirin pill
56.	Green candy in transparent wrapper
57.	Fresh red flower
58.	Ten-cent piece (Kenya currency)
59.	Piece of cactus
60.	Fresh scone

Table 2

Order of Presentation of Arrays in
Phase I and in Phase II

Trial Number	Subject Number											
	1	2	3	4	5	6	7	8	9	10	11	12
Phase I												
1.	A	D	C	C	B	A	D	B	C	D	B	A
2.	B	A	B	A	D	D	B	A	B	C	C	C
3.	C	C	A	D	A	C	C	D	D	B	D	D
4.	B	D	B	C	B	A	C	A	A	A	B	D
Phase II												
Demonstration	Dem[a]	Dem	Dem	Dem	Dem	Dem	Dem	Dem	Dem	Dem	Dem	Dem
1.	A	D	C	C	B	A	D	B	C	D	B	A
2.	B	A	B	A	D	D	B	A	B	C	C	C
3.	C	C	A	D	A	C	C	D	D	B	D	D
4.	D	B	D	B	C	B	A	C	A	A	A	B
Transfer	Trf[b]	Trf	Trf	Trf	Trf	Trf	Trf	Trf	Trf	Trf	Trf	Trf

Note: At subject number 13 the same sequence that begins at subject number one was restarted.

[a]Demonstration array was shown to every subject at this point in Phase II.

[b]Transfer array was shown to every subject after successful trials to criterion or after eight unsuccessful trials.

Table 3

Object Positions for Four Phase I Arrays,

Demonstration Array, and Transfer Array

Phase I

Array A:

Bracelet

Cassava   Handkerchief   Bell

Hat   Pen   Stick

Bookbag

Egg   Cornflour

Array B:

Feather

Candy   Kumutoto Leaves

Cooking stick   Kimiti Leaves   Chalk   Grasshopper

Butterfly   Wild fruit   Banana fibre

Array C:

Blade   Sarati seeds

Crabgrass   Pencil

Nail   Sisal

Corn

Sarati leaf   Meat   Broom

Array D:

Cassava

Wild Berries

Matches

Bread   Guava

Sand   Stones   Clay

Tobacco   Matchbox

Table 3--Continued

Phase II
Demonstration Array:
Kerosene Millet
Banana
Needle Milk
Spoon
Match Sisal Block
Beans
Transfer Array:
Book
Aspirin
Pin Coin Scone
Thorn Scissors
Flower
Cactus Candy

APPENDIX C

TABLED DATA

Table 1

Summary of Analysis of Variance of Trials to Criterion for Modality Preference in Phase I and for Training in Phase II

Source	df	MS	F
Between Ss	3	.647	
Training (A)	1	.700	16.19**
Preference (B)	1	1.054	24.39**
A x B	1	.189	4.37*
Within Ss	100	.043	

*$p < .05$

**$p < .001$

Table 2

Summary of Analysis of Variance of Trials to Criterion for Preferred Dimension (Color and Edibility) in Phase I and for Training (Two Groups) in Phase II

Source	df	MS	F
Between Ss	3	.815	
Training (A)	1	.909	22.32**
Specific Preference (B)	1	1.215	29.85**
A x B	1	.322	7.91*
Within Ss	90	.041	

*$p < .01$

**$p < .001$

Table 3

Means and Ranges for Set A and Set B Variables Used in Canonical Analysis, for 104 Subjects

	Means	Range
Set A		
GRL	3.00	2.00-4.00
CLR	7.62	0-12.00
EDR	2.18	0-15.00
CNR	9.91	0-20.00
NR	1.93	0-10.00
Set B		
TTC	6.93	3.00-8.00
CRRPN	2.85	0-9.00
CR	1.60	0-8.00
CRS	2.76	0-9.00

Table 4

Weights for Two Canonical Factors of Eight Set A Variables and for Two Canonical Factors of Six Set B Variables for 104 Subjects

	Factor I $R_c = .61$	Factor II $R_c = .44$
Set A		
GRL	-.03	.01
CLR	-.33	.20
EDR	-.50	-.18
CNR	-.15	-.07
NR	-.01	.03
PRO	-.59	.86
PRF	-.18	.41
TRN	-.48	-.08
Set B		
CTTC	-.46	-.15
TTC	.24	.50
CTTCT	.82	-.73
CRRPN	.08	-.01
CR	-.07	-.43
CRS	.21	.12

Table 5

Components of Redundancy Measure of Canonical Correlation Analysis for Subject Data and Phase I Variables

Root	Canonical R	R Squared	Variance Extracted	Redundancy	Proportion of Total Redundancy	Cumulative Proportion of Redundancy
Set A--Subject Data						
1	.41	.17	.14	.02	.36	.36
2	.29	.09	.18	.02	.23	.58
3	.24	.06	.47	.03	.40	.98
4	.16	.03	.04	.00	.02	.99
5	.15	.02	.02	.00	.01	1.00
Set B--Phase I						
1	.41	.17	.20	.03	.46	.46
2	.29	.09	.23	.02	.28	.74
3	.24	.06	.14	.01	.11	.85
4	.16	.03	.21	.01	.08	.93
5	.15	.02	.23	.01	.07	1.00

Table 6

Mean Number of Responses and Standard Deviations on Sorting Variables in Phase I, 100 Subjects

Number of Objects Placed Separately	10.85[a] 5.85[b]	Number of Naming Reasons	1.65 11.43
Number of Times Objects Placed in Pairs	8.12 3.48	Number of No-reason Responses	2.39 4.32
Number of Material Reasons	2.67 2.64	Number of Material Sorts	2.64 2.63
Number of Color Reasons	4.05 5.89	Number of Color Sorts	3.06 4.47
Number of Shape Reasons	0.15 0.66	Number of Shape Sorts	0.12 0.60
Number of Size Reasons	0.04 0.32	Number of Size Sorts	0.04 0.32
Total Number Perceptual Reasons	6.88 6.22	Total Number Perceptual Sorts	5.71 4.96
Number of Functional Reasons	4.16 4.17	Number of Functional Sorts	4.14 4.22
Number of Edible Reasons	2.57 2.07	Number of Edible Sorts	2.58 2.10
Number of Planted Reasons	0.66 1.07	Number of Planted Sorts	0.66 1.05
Number of Tree Reasons	0.66 1.05	Number of Tree Sorts	0.64 1.05
Number of School-related Reasons	1.09 1.25	Number of School-related Reasons	1.09 1.25

Table 6 --Continued

Number of Nominal Reasons	0.94	Other Conceptual Sorts	2.62
	1.06		3.18
Number of Other Conceptual Reasons	1.72	Total Number Conceptual Sorts	11.36
	2.95		7.67
Total Number Conceptual Reasons	11.62	Preference Score	0.83
	7.72		0.13

[a] Means

[b] Standard Deviations

Table 7

Summary of Analyses of Variance of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Grade Levels

Source	df	MS	F
PCR			
Between Groups	3		
Grade Level (GRL)	3	1.886	2.59
Within Groups	96	.728	
EDR			
Between Groups	3		
GRL	3	2.164	4.48**
Within Groups	96	.483	
CNR			
Between Groups	3		
GRL	3	378.360	7.61**
Within Groups	96	49.693	
NR			
Between Groups	3		
GRL	3	5.496	8.33**
Within Groups	96	.660	

Table 7 --Continued

Source	df	MS	F
	PRS		
Between Groups	3		
GRL	3	.114	1.365
Within Groups	96	.083	

**p < .01

Table 8

Summary of Analyses of Variance of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four School-Experience Groups

Source	df	MS	F
PCR			
Between Groups	3		
School Experience	3	1.998	2.76*
Within Groups	96	.725	
EDR			
Between Groups	3		
School Experience	3	2.294	4.79**
Within Groups	96	.479	
CNR			
Between Groups	3		
School Experience	3	322.751	6.28**
Within Groups	96	51.430	
NR			
Between Groups	3		
School Experience	3	4.395	6.33**
Within Groups	96	.694	

Table 8 --Continued

Source	df	MS	F
	PRS		
Between Groups	3		
School Experience	3	.003	1.612
Within Groups	96	.0002	

*$p < .05$

**$p < .01$

Table 9

Summary of Analyses of Variance of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Age Groups

Source	df	MS	F
PCR			
Between Groups	3		
Age	3	2.179	3.03*
Within Groups	96	.719	
EDR			
Between Groups	3		
Age	3	2.230	4.63**
Within Groups	96	.481	
CNR			
Between Groups	3		
Age	3	362.432	7.22**
Within Groups	96	50.190	
NR			
Between Groups	3		
Age	3	3.039	4.13**
Within Groups	96	.737	

Table 9 --Continued

Source	df	MS	F
Between Groups	3		
Age	3	.0001	0.59
Within Groups	96	.0002	

*$p < .05$
**$p < .01$

Table 10

Summary of Analyses of Variance of Number of Times S Placed Objects Alone and Number of Times S Placed Objects in Pairs for Four Grade Levels

Source	df	MS	F
Separately			
Between Groups	3		
Grade Level	3	1.338	5.43**
Within Groups	96	.246	
Pairs			
Between Groups	3		
Grade Level	3	.871	4.63**
Within Groups	96	.188	

** $p < .01$

Table 11

Summary of Analyses of Variance of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Males and Females

Source	df	MS	F
	PCR		
Between Groups	1		
Sex	1	1.813	2.41
Within Groups	98	0.752	
	EDR		
Between Groups	1		
Sex	1	0.675	1.27
Within Groups	98	0.533	
	CNR		
Between Groups	1		
Sex	1	228.990	3.95*
Within Groups	98	57.924	
	NR		
Between Groups	1		
Sex	1	.001	.001
Within Groups	98	.815	

Table 11--Continued

Source	df	MS	F
	PRS		
Between Groups	1		
Sex	1	.000	.206
Within Groups	98	.001	

*p < .05

Table 12

Summary of Analyses of Variance of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Orders of Presentation

Source	df	MS	F
	PCR		
Between Groups	3		
Order	3	.835	1.10
Within Groups	96	.761	
	EDR		
Between Groups	3		
Order	3	.701	1.32
Within Groups	96	.529	
	CNR		
Between Groups	3		
Order	3	130.351	2.27
Within Groups	96	57.443	
	NR		
Between Groups	3		
Order	3	.175	0.21
Within Groups	96	.826	

Table 12--Continued

Source	df	MS	F
PRS			
Between Groups	3		
Order	3	.001	0.46
Within Groups	96	.002	

Table 13

Summary of Analyses of Variance of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Schools

Source	df	MS	F
	PCR		
Between Groups	3		
School	3	2.927	4.21**
Within Groups	96	.695	
	EDR		
Between Groups	3		
School	3	1.371	2.70*
Within Groups	96	.509	
	CNR		
Between Groups	3		
School	3	33.568	0.55
Within Groups	96	60.467	
	NR		
Between Groups	3		
School	3	1.027	1.28
Within Groups	96	.799	

Table 13 --Continued

Source	df	MS	F
	PRS		
Between Groups	3		
School	3	.001	0.53
Within Groups	96	.002	

*$p < .05$

**$p < .01$

Table 14

Mean Number of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Males and Females

Sex	Mean Number of Reasons				
	PCR[a]	EDR[a]	CNR	NR[a]	PRS[b]
Males, 63 Ss	1.83	0.98	11.46	0.73	0.18
Females, 37 Ss	1.55	1.15	14.59	0.73	0.18

[a]Log transformation

[b]Arc-sine transformation

Table 15

Mean Number of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Orders of Presentation

Order of Presentation	Mean Number of Reasons				
	PCR[a]	EDR[a]	CNR	NR[a]	PRS[b]
Array A first, 27 Ss	1.93	0.91	8.93	0.77	0.19
Array B first, 19 Ss	1.79	0.87	10.53	0.84	0.19
Array C first, 35 Ss	1.54	1.18	13.03	0.64	0.18
Array D first, 19 Ss	1.71	1.19	13.95	0.73	0.18

[a]Log transformation

[b]Arc-sine transformation

Table 16

Mean Number of Perceptual Reasons, Edible Reasons, Conceptual Reasons, No Reason, and Preference Score for Four Schools

School	Mean Number of Reasons				
	PCR[a]	EDR[a]	CNR	NR[a]	PRS[b]
Kuywa, 27 Ss	1.82	1.15	11.45	0.82	0.18
Kimalewa, 28 Ss	2.01	0.83	10.79	0.50	0.18
Kapkateny, 29 Ss	1.27	1.30	13.14	0.94	0.19
Baraki,[c] 21 Ss	1.87	0.87	10.81	0.65	0.19

[a]Log transformation

[b]Arc-sine transformation

[c]Non-government school

APPENDIX D

COMPREHENSIVE LIST OF MATERIAL OBJECTS

Bukusu	English
Foods	
Busuma	stiff porrige (corn flour)
busuma bwe bulo	stiff porrige (finger millet)
menula	stiff porrige (cassava and sorghum)
chinyeni	vegetables (generic)
kamaondo	pumpkins
kamahindi	corn
kamapwoni	sweet potatoes
kamakanda	beans
chibalayo	chick peas
kamatore	bananas (generic)
mchele	rice
enyama	meat (generic)
kumukate	bread
enyama yembusi	goat meat
enyama yelikhesi	mutton
enyama yengokho	chicken meat
kamaki	eggs
kumutunda	fruits (generic)
chumbe	salt
pilipili	pepper
chinyanya	tomatoes
esukari	sugar
vinjare	curry powder
echai	tea, coffee, or cocoa
kamabele	milk
kameji	water
kamalwa	local beer (most common, least alcoholic)
enguli	local beer (made from sorghum and corn, more alcoholic than 'kamalwa')
esoda	soda pop
endali	banana juice
buyu	porrige
kamafura	cooking oil

kumunyu kumukhelkha	local salt made from ashes of corn
busangura	wild berries
kumuhogo	cassava
lichungwa	orange
endimu	lemon

Clothing, Decorations

engubo	clothes (generic)
lishati	shirt
esuruali	shorts
evesti	undershirt
kamakutu	animal skins (as clothes)
birere	amulets (worn on wrists and arms)
bibyuma	string of beads worn around stomach
kumukofu	necklace of cowrie shells
lusinga	wire necklace
lusire	ornate wire necklace
chindekwe	wire anklets
chinyimba	cricumcision bells
kamarinda	small dresses
sichenje	rattles worn on the leg
ekofiya	hat (generic)
ekofiya yabuusi	threaded hat (worn by women)
ekamisi	petticoat
sitambaa	headscarf
sitweya	underwear
sikamata	brassiere
birara	shoes
lukokelo	tie
likoti	coat

Household Items

sibumba	clay bowl for vegetables
lulwelo	wooden tray for bananas
sibwili	wooden bucket
ekhaye	small wooden spoon

luucho	clay pan for cooking
kumukango	cooking stick
emuka	calabash for storing milk
esesi	calabash for drinking
enyungu	water pot (of clay)
esachi	clay pot for cooking vegetables
endebe emBukusu	four-legged wooden stool
kiti moto	low-lying seat for children
embanga	large clay pot for storing beer
sipoko	cup (generic)
kumupira	rubber baby bottle
sitero	small bowl made of sticks and mud
sikono	large container made of mud and sticks
lukhendo	small wooden spoon for cooking
kumubano	knives (generic)
engeso	knife for cutting finger millet
siyeywe	broom
namatiki	small tin lamp
etaa elibuyu	kerosene lantern
sibiriti	matches, or matchbox
sijiko	metal spoon
chikho	firewood
lususi	grinding stone
eleko	grinding mill (operated by hand)
enengo	small basket made from reeds
lutelu	small tray made of sticks
likopo	tin can

Plants

bulo	finger millet
kamaemba	sorghum
kamamera	yeast
kamahindi	corn
kamakanda	beans
kamapwoni	sweet potatoes
chibalayo	chick peas

kamatore kamaBukusu	cooking bananas
kamatore kamazungu	sweet bananas
simsim	sesame seeds
sikhobi	green leafy vegetable
murere	green leafy vegetable
chisaka	green leafy vegetable
sarati	green leafy vegetable
litoto	green leafy vegetable
kimiro	green leafy vegetable
bitunguu	onions
kabachi	cabbage
kamakongwe	sisal
waneloba	wild fruits
chifutu	figs
kamapera	guavas
bufutumbwe	small figs
chinduli	small bushes usually planted around home
kamananasi	pineapples
kumuhonge	tree with large leaves and milky sap
kumukalukha	large tree like oak
kumulaa	large tree like acacia tree
kumwiti	cedar tree
kumutua	cactus
bukararambi	wild berries
namasambu	weed like golden rod
kwekwe	reeds
kamaambakhesi	short grass
kamasindakusi	long grass used for thatching
nabuyeywe	long grass used for making brooms
kamararandra	wild fruit tree (inedible)
kamaondo	pumpkins
kamakhendu	short reeds
lunai	large thorny bush

Animals

ekhafu	cow (general)
eunwa	bull
emosi	small cow or bull
eeyi	ox
emasoti	young cow (not yet fertile)
sisonga	cow
embwa	dog
epusi, epaka	cat
likhesi	sheep
embusi	goat
ememe	kid
limiku	ram
lisubeni	ewe
endrume	large ram
engokho	hen
etwaya	rooster
chinywinywi	chicks
esenye	non-laying hen
libata	duck
ekhisi	bushbuck
enduyu	hare
endemu	snake
ekhilakhima	black mamba snake
embakilia, namukhokhome	lizard
ekhendu	green mamba snake
mukoyobaka	python
ekhima	monkey
eng'eni	fish (general)
kumukoye	mudfish
naambale	tilapi fish
likhare	crab
sing'eng'e	mosquito
esi	fly
sibrubru	butterfly
embuko	tsetste fly
litere	grasshopper

esike	locust
namufunda	termites
kamaaramba	wasp
enjuki	bee
kamake	ants
kamakoye	beetles
kamasilili	cockroaches
chisusi	bedbugs
chiswa	edible termites
chukunwe	black ants
liusi	pigeon
likhanga	guinea fowl
khooro	crow
ng'ooli	crested crane
kisilili	hawk
wamboto	bat
embeba	rat
lamuchunjusi	mouse
kanyuru	edible rat
efukho	mole
chinda	lice

Outdoor Tools

embako	hoe (general)
luberero	grass cutter
lipango	machete
embako emBukusu	locally-made hoe
lijembe	store-bought hoe
esungura	plow
eaywa	axe
enyundo	hammer
kimisumari	nails
kumubasu	rat trap
lurimba	net (for catching fowl)
kumunyololo	chain
kamachoki	yoke

luyingo	bow
lusali	arrow
lifumo	spear
kumusumari	nail
engabo	shield
embalu	sword
lisakha	larger sword
lifunguo	key
ekofulo	lock
lubata	hinge
musiomeno	saw
kumukoye	rope
chingoye	string (used for thatching)
kamakhola	banana fibre

Personal Effects

sikioo	mirror
sichanuo	comb
sikurachi	plastic hair brush
lusenelo	tooth stick
kamafura	hair oil
nambaa	local medicine for jaundice
nabululu	local medicine for stomach trouble
liyuli	local medicine for measles
embuka	local medicine for coughing
aspro, cafenol	store-bought medicine for pain
nivoquin, malaroquin	store-bought medicine for malaria

Minerals

lulwanda	rocks (general)
kamasengeli	iron ore
limomolo	coarse sand used to make floors
liloba	clay
kamachanga	fine sand

Games, Musical Instruments

ekitaa	guitar
litungu	seven-stringed instrument, smaller than guitar
silili	small drum with string bowed over it
kumulele	metal flute
efilimbi	metal whistle
eng'oma	drum (general)
lukho	game board with 18 holes; two men pass and capture each others' beads as they are placed in holes
kamaloo	stones used to play 'lukho'
kamafunda	ball made from scrap bloth or plastic
sichiriba	clay whistle
bukhasikhasi	toy houses usually made of sticks
chakora	girls' game like jacks and ball
khokhopachisimbi	four cowrie shells rolled like dice

School

echoka	chalk
lubao	blackboard
edeski	desk
endebe	chair
litabakuu	boxes
ekabati	cupboards
khukhumbaliloba	any model made from clay
kamabuku	books
bukondo	colors
chisaala	sticks sued for counting
esaa	clock, watch
chikalamu	pencils
ewembe	razor blade (for sharpening pencils)
eraba	erasure
kumufuko	bookbag
eyukutu	letter of the alphabet

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