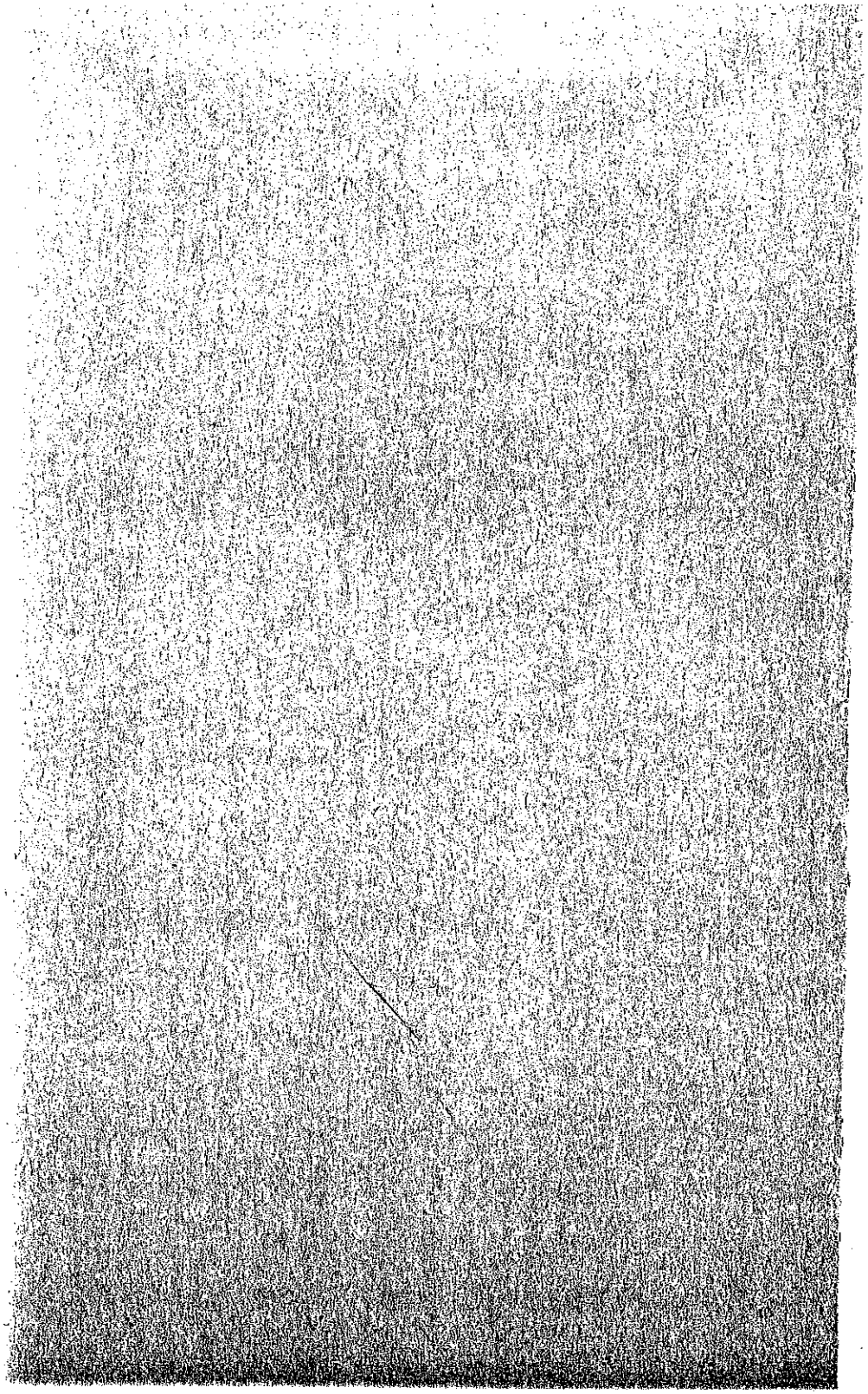

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CULTURE AND COGNITIVE GROWTH[1]

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Culture et progrès cognitif. — L'article est consacré à la relation entre différences culturelles et progrès cognitif. Après avoir passé en revue et critiqué les tentatives antérieures d'approche anthropologique et psychologique du problème, les AA. étudient deux foyers de variations culturelles, à savoir l'orientation des valeurs et le langage, dans leur rapport avec le développement. Une grande partie des faits sur lesquels ils s'appuient provient de recherches expérimentales sur la conservation de la quantité et la formation des concepts chez les Wolofs du Sénégal. Ils discutent, en terminant, de l'interaction des contraintes culturelles qui sont variables et de la maturation biologique qui est universelle.

We shall ask, in the pages that follow, what it means, intellectually, to grow up in one cultural milieu and not another. It is, of course, a form of the old question of how heredity and environment relate : how, in this case, does intellectual development depend upon external influences; in what respects is it a series of unfolding maturational states ? But the question is now in qualitative terms. The older debate on heredity *vs* environment was without a possible solution. For there is no psychological phenomenon without a biologically given organism nor one that takes place outside an environment. But we can, nevertheless, study the intersect in growth of biological background and cultural milieu with the more modest aim of learning what kinds of cultural difference make an intellectual difference, at what points in development and how it comes about in some particular way.

It is not a new idea that cultural variation yields variation in modes of thought. It is a persistent theme in anthropology (*e.g.*, Boas, 1938; Mead, 1946; Whorf, 1956). Psychologists have also interested themselves in cultural influences on cognitive development. Alas, however, the methods used have rarely been equal to the task at hand. Anthropology's most recent and most promising approach, ethnoscience, explores qualitative cognitive variation by exploring the native terminology used for a particular objectively definable domain such as plants or disease or kinship (Sturtevant, 1964). Ethnoscience is limited as a

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method for investigating cognitive processes precisely because it does not deal with *processes* at all, but with intellectual *products* as embodied in language. Like the older anthropological strategy of inferring living cognitive processes from static cultural products such as myth, ritual and social life (*e.g.*, Durkheim and Mauss, 1963; Levi-Strauss, 1962), ethnoscience infers the mind of the language user from the lexicon he uses. When we know the culturally standard system for kinship or disease classification, we still do not know how the system developed or how it is used in novel situations. It is a bit like studying the growth of logic and thought in children of our own society through an analysis of grammar or logic in the books found in the library. It may help to define the idealized version of logical thought in the culture to do this. But it can tell little about the processes involved.

In the 1930's and 40's, psychologists carried I.Q. tests around the world. They had learned little more than that " natives " fared worse than standardization groups at home when projective tests came into vogue in the 50's (Lindzey, 1961), and cross-cultural attention shifted from intellect to affect. Again, the intrinsic value of intelligence tests was limited, abroad as at home, by the fact that the I.Q. is not a *process*, but the *product* of many complex cognitive processes that other methods would have to unreveal — and a product closely geared to school achievement in Western European culture at that. An ideological factor further complicated this work. As Strodtbeck (1964) points out, you can " prove " the power of heredity if you assume your test is " culture-free " (*e.g.*, Porteus'Maze), whereas differences are due to environmental factors on the assumption of a " culturally relative" test. The assumption in a particular study probably reflected personal bias more than any other factor. Later the absurdity of this distinction, parallel to that of choosing between heredity and environment, became evident.

The point of view animating the present discussion is that intelligence is to a great extent the internalization of " tools " provided by a given culture. Thus, " culture-free " means " intelligence-free ". Such a view of cognitive development has been put forth elsewhere (Bruner, 1964). Here we shall examine it by comparing intellectual development in cultures with radically different technologies.

The most interesting and oldest lines of cross-cultural work in cognition are through the study of sensation and perception. More than one intelligence tester noted that performance tests often seemed to put foreigners at as much of a disadvantage as verbal tests and was forced to conclude that perceptual as well as verbal habits could vary radically from culture to culture (Cryns, 1962; Jahoda, 1956; Wintringer, 1955). If this were so, then the study of perception could be fundamental in understanding any psychological process involving a response to the outside world.

The classical work on perception was done by the Cambridge Anthropological Expedition to the Torres Straits. An intriguing finding was that of Rivers (1905) concerning the lesser susceptibility of the Murray Islanders to the Müller-Lyer illusion. The Todas of India yielded a similar finding. This result has been interpreted to mean that the Todas, unaccustomed to inferring three dimensions from two dimensional displays, were less subject to the illusion; for as soon as three dimensional stimulus materials were used, cultural differences disappeared (Bonte, 1962).

This work, suggesting the effect of particular cultural conditions, such as the absence of pictures, has been followed up with studies of illusions in new places (*e.g.* Allport and Pettigrew in South Africa, 1957) and by carefully controlled experimentation with line drawings. The latter have shown the interpretation of Rivers' work to be a correct one (Hudson, 1960). The effects obtained appear to depend upon perceptual inference; members of different cultures differ in the inferences they draw from perceptual cues, not in the cues they are able to distinguish. Such an interpretation suggests the value of studying more directly the way in which the cues are assimilated to different schemata in different cultures with the effect of producing large cultural differences.

Our own cross-cultural work has followed other lines, lines of more recent historical development. We have asked first the naive question : where in a culture should one find differences in the processes of thought ? The anthropological linguists (*e.g.* Whorf) suggested a concrete answer : where there are language differences, there may (or should ?) be cognitive differences. Our results have led us away from the parallelism of Whorf toward the instrumentalism that is more typical of Vygotsky (1961) and Luria (1961). Language as a tool and a constraint on cognitive development will be discussed below in more detail.

We, like most others who work on development, were strongly influenced by Piaget. But although Piaget has given us our richest picture of cognitive development, it is one that is based almost entirely on experiments in which age alone is varied. While he admits that environmental influences play a role, the admission is *pro forma*, and inventive experiments remain confined to Western European children, usually middle-class children at that. Where Piaget's work has been extended to non-Western societies, the emphasis has been almost entirely quantitative. Such work has been confined largely to timetable studies, to the time " lag " in the development of " foreign " children in contrast to children in Geneva or Pittsburgh or London (Flavell, 1963). A series of experiments carried out by the Harvard Center for Cognitive Studies has explored the role of culturally transmitted technologies in intellectual growth by the use of instructional techniques and cross-cultural studies (Bruner, Olver, Greenfield *et al.*, in press). By comparing children of different ages in extremely different cultures, we can ask the developmental question in its most radical form. We are not the only ones to have gone abroad with such an intention and we shall also use the work of others in specifying the impact of culture on growth.

We shall, in what follows, focus on two kinds of cultural constraints operating in development : value orientation and language. They seem fruitful for organizing our findings and illustrating the problems involved.

VALUE COMPLEXES AND COGNITIVE GROWTH

Let us, in the interest of specificity, limit our discussion of value orientations to the cognitive implications of one particular value contrast : collective *v.* individualistic orientation. Kluckhohn (Kluckhohn and Strodtbeck, 1961), in her studies of basic value orientations, attests to the fundamental nature of such a " decision " about orientation, commenting upon its importance for individual coping as well as for social solidarity.

We begin with a series of studies carried out by Greenfield (Bruner, Olver, Greenfield *et al.*, in press) in Senegal, the westernmost tip of former French West Africa, in 1963-1964. These studies explored two main areas of cognitive development : concept formation and conservation in the classic Piagetian sense. The two areas complement each other nicely, for much of intellectual growth can be summarized as the development of equivalence or conservation, the equivalence rule of concepts being more " internal " and that of conservation more " external " in orientation. The subjects in both sets of experiments were all Wolof, members of the country's dominant ethnic group. The children were constituted into nine groups, better to discern the effect of cultural differences : three degrees of urbanization and education were represented, with three age levels within each.

The cultural milieu of our first group, rural unschooled children and adults, had neither schools nor urban influence. Although their traditional Wolof village had an elementary school, they had never attended it. The three age groups were : six- and seven-year-olds, eight- and nine-year-olds, eleven- to thirteen-year-olds. There was also a group of adults. The second major group, the bush school children, attended school in the same village or in a nearby village. This group was partitioned among first graders, third graders and sixth graders, corresponding as closely as possible to the three age levels of the unschooled groups. The third major group comprised city school children. These children lived in Dakar, Senegal's cosmopolitan capital, and, like the second group, included first, third, and sixth graders. All the children were interrogated in Wolof, although French was the official language of instruction.

Returning now to the question of collective and individualistic orientations, we find that they have cognitive manifestations so basic as to render certain experimental procedures possible or impossible. In both the conservation and the concept experiments, the children were asked to give reasons for their answers. With both American and European children, this type of question is usually put something like this, " Why do you say (or think) that thus and such is true ? " Specifically, in a conservation problem, a child might be asked, " Why do you say that this glass has more water than this one ? " But this type of question would meet with uncomprehending silence when addressed to the unschooled children. If, however, the same question were changed in form to " Why is thus and such true ? " it could often be answered quite easily. It would seem that the unschooled Wolof children lack Western self-consciousness : they do not distinguish between their own thought or statement about something and the thing itself. Thought and the object of thought seem to be one. Consequently, the idea of explaining a statement is meaningless, it is the external event that is to be explained. We might expect from all this that the relativistic notion that events can vary according to point of view may be absent to a greater degree than in Western culture. This expectation is confirmed in Greenfield's concept formation studies, where the unschooled children can group a given set of objects or pictures according to only one attribute, although there are several other possible bases of classification. Let it be noted that the Wolof schoolchildren do not differ essentially from Western children in this respect. It appears that school tends to give them something akin to Western self-consciousness, for they can answer questions implying a distinction between their own psychological reactions and external events; and, as they advance in school, they become increasingly capable of categorizing the same stimuli according to several different criteria or " point of view ".

Piaget has proposed that intellectual growth begins with an egocentric stage, based on the inability to make a distinction between internal and external (Piaget, 1930). This stage is then followed by a more developed egocentrism in which inner and outer are distinguished, but confused. When inner psychological phenomena are attributed to inanimate features of the external environment, we have " animism "; when psychological processes are given characteristics of the inanimate, external world, we speak of " realism ". These two tendencies are supposed to be complementary and universal forms of childish thought. Their mutual presence indicates a preliminary distinction between inner and outer.

In contrast to this formulation, we should like to propose that in traditional, collectively-oriented societies, this distinction never gets made, that the world stays on one level of reality, and that this level is realistic rather than animistic. Animism, we realize, has often been considered the characteristic of " primitive " thought *par excellence*. We rather suspect it is only the " powerful ", well-cared for, competent child who sees the world in the pattern of his own feelings, and not the malnourished child of many traditional subsistence cultures like the Wolof. Kardiner (1965), too, has made this point with respect to the psychoanalytic conception of the " omnipotence of thought ", noting that it is only where the child's every whim is satisfied that he is led to believe his thought omnipotent. Our claim is more severe. It is that animism does not develop where there is no support given for individualistic orientation. In place of the cultivation of individual subjectivity, there is instead a reinforcing of the idea of " reality ", " people-in-a-world-as-a-unity. "

Consider the following evidence in support of this point. In an equivalence experiment done in the United States by Hornsby (Bruner, Olver, Greenfield *et al.*, in press), children were shown an assortment of pictures and asked to put the similar ones together. They were then asked the reasons for their groupings. Children as they grow older form groups increasingly by the rule of superordinate grouping (those things go together that share a common attribute). The earlier pattern is more complexive in the sense that things go together because they fit into a story together or whatnot. The transition from the earlier to the later mode of grouping is handled by egocentrism. Things are alike by virtue of the relationship that " I " or " You " have to them. This is the picture in the United States. But Reich (Bruner, Olver, Greenfield *et al.*, in press), using parallel techniques with Eskimo children in Anchorage, Alaska, finds that they do not express the function of things in terms of personal interaction with them nearly so often as do the American children of European descent. The Eskimo value system stresses self-reliance but strongly suppresses any expression of individualism as an attitude toward life. The Eskimos are a subsistence culture that requires group action in its economic activity. Eskimo children develop superordinate structure without this kind of egocentrism. Thus, it cannot be a universal stage, not even in the development of superordination. Instead, it appears clearly relative to cultural conditions and values.

It should be clear by now that the kind of implicit egocentrism where one cannot distinguish different personal viewpoints, the kind that we have been

calling realism, is strikingly different from the type that explicitly relates everything to oneself. Indeed an explicit concept of self implies some sort of idea of not-self, for every concept must be defined as much by what it excludes as by what it includes. Or to use Piaget's terminology, we could say equally well that an undifferentiated egocentrism that ends in realism is diametrically opposed to the kind that ends in " artificialism, " the tendency to see all physical phenomena as made by and for men. It is the artificialistic type of egocentrism, closely related to animism, that appears in Olver and Hornsby's experiments and is probably typical of individualistically-oriented industrial societies.

This unself-conscious realism was clear at yet another point in the experiments. Here too one sensed its origin in the absence of control over the inanimate world characteristic of indigenous societies. In the classic experiment on the conservation of a continuous quantity (Piaget, 1952), one of two identical beakers was filled with water to a certain level. The Wolof child poured an equal amount in the second beaker. Then the experimenter poured the water from one beaker into a longer, thinner beaker, causing the water level to rise. The child was then asked if the two beakers contained the same amount of water, or if one had more than the other, and why. He was then asked for a reason. A type of reason in support of non-conservation judgments appeared that we had not seen before among American children (Bruner, Olver, Greenfield *et al.*, in press), although Piaget (1952) reports one example in a Swiss four-year-old. This was the " magical " action reason; the child would say, " It's not the same " because " you poured it. " The shift from equality to inequality was being resolved and justified by recourse to the experimenter's action. A natural phenomena was being explained by attributing special " magical " powers to intervening human agents. More likely, as Köhler (1937) points out, this as well as other cases of magical causation are made possible by realism, in which animate and inanimate phenomena occupy a single plane of reality.

Note well that school suppresses this mode of thinking with astonishing absoluteness. There is not one instance of such reasoning among either bush or city Senegalese children who have been in school seven months or longer. Once again school seems to promote the self-consciousness born of a distinction between psychological processes and external physical phenomena.

We can argue that just as soon as the child is endowed with control in the situation, his realism and magical reasoning will disappear. And so it turned out to be. The experiment was done again; everything remained basically the same with one exception : this time, the child did *all* the pouring himself. Would he find yet another " magical " explanation for the seeming inequality of the water ? Or, indeed, would he be as likely to believe that the water in the two beakers was uneven ? We would reason that he would not. For while the child would be perfectly willing to attribute " realistic " powers to an authority figure like the experimenter, he would not attribute any special powers to himself, for his experience had taught him that he had none.

Our suspicion was well confirmed by the results. Among the younger children, two-thirds of the group who transferred the water themselves achieved conservation, in contrast to only one-quarter of the children who had only watched the experimenter pour. Among the older children, the contrast was equally dramatic : eight in ten of those who did the pouring themselves, as

compared with slightly less than half of the others, achieved conservation. When the child poured himself, his reasons were dramatically different from those given when an adult was pouring. Magical-action virtually disappears when the unschooled children themselves pour. What emerges instead are identity reasons reference to the initial state of the system. The child who pours on his own now uses his initial equalizing operation as the basis for his justification of conservation : " They were equal at the beginning. "

Price-Williams' (1961) study of conservation among Tiv children in Nigeria lends further weight to the point. He found that all of the Tiv children had achieved conservation of both continuous and discrete quantity by age eight, in sharp contrast to our upper limit of 50 % with much older Senegalese children. The description given by Price-Williams of the children's behavior during the experiments indicates that Tiv culture is quite different from Wolof in promoting an active manipulative approach to the physical world. He describes the children's behavior like this : " These children would spontaneously actually perform the operation themselves... Furthermore, they would reverse the sequence of operations, by, for example, pouring back the earth from the second container to the first " (Price-Williams, 1961, p. 302). Such self-initiated action was never observed among unschooled Wolof children, and may well be the key to the great disparity between the two cultures in spontaneous conservation results. It is a moot question whether, along with this more active manipulative approach, there may not also develop a kind of competence and control over the environment that would be a base upon which some kind of distinction might emerge between " natural " and " person-initiated." We do not know, but surely the matter merits study. The relative absence of such manipulativeness among the Wolof could not help, but impress us.

All of this suggests some special role as causative agent of authority figures in the sort of extreme realism we are discussing. One might well expect that where the natural and the social, the animate and the inanimate, are all placed on a single level of reality, all equally good causes, there would be some typical " confusions " (at least in Western eyes). For one thing, one would expect stronger and more widespread effects from " bigger " natural or " bigger " social or " more " powerful animate things. The experimenter, in the conservation experiment earlier mentioned, should be capable of producing all kinds of effects, the least of which is causing water to change in amount. Only when there is growth in a sphere of competence and control, where one can produce predictable effects on one's own, does one begin to distinguish between animate and inanimate causal centers. It is then that the edge of a new " nominalistic " consciousness begins to fragment the unitary realism of which we have been speaking[2]. It is perhaps for this reason that going " outside " the group and learning new techniques makes it so hard for indigenous people to return to earlier belief systems (*e.g.*, Vogt, 1951).

When the social and physical constitute but a single level of reality, neither

[2] It is interesting to note that, even in Western society, radical dissent from political beliefs, unwillingness to accept conventional ideas about social causality, develops most readily among groups who develop special competencies in the use of skills exercised away from the main social centers, isolated trawler crews, timber crews, miners, etc. (*cf.* A. Tingsten, *Political Behavior*. Tottowa, N.J. : Bedminster Press, 1963).

type of explanation should take precedence. To us who give precedence to physicalistic explanations, however, it may often appear that traditional peoples emphasize the social. This impression may be exaggerated by the fact that they often have greater knowledge about the social than the physical realm. Since a social explanation is considered perfectly adequate, we would not expect such people to press on for a physical account.

Gay and Cole's (1965; Gay, 1965) research among the Kpelle of Liberia furnish many other indications of the way in which people-as-causative-agents can play an extraordinary role in the traditional structure of knowledge. In school, facts are true because the teacher says them, and so there is often no attempt at understanding other reasons why or proving the fact for oneself. This same observation has been noted many places in Africa, for example, by Lapp in Cameroun (1965). His experience was similar to ours in this respect, for he found that way to combat this tendency in teaching natural sciences was to have the students rather than the teacher do the demonstrations.

One other example from Cole and Gay : among the Kpelle, arguments are won when they are unanswerable. Again the ultimate criterion is social — does the other person have a comeback ? — rather than " objective " or external. What is being argued about takes a back seat to the arguers.

What is most interesting is the fact that, on a broader cultural level, this very same quality has been recognized by the poets of *négritude* or the African personality as setting off black from white. Lilyan Kesteloof (1962) in her book on Aimé Césaire, the originator on the concept of *négritude*, contrasts its elements with the " valeurs-clefs" of Western civilization. In opposition to " l'Individualisme (dans la vie sociale) " of European cultures, she places " solidarité, née de la cohésion du clan primitif " (p. 84). This complex, moreover, is held to be found in all African societies, and to stem from common cultural features.

Léopold Sédar Senghor, poet and President of Senegal, defines *négritude* in more psychological terms as " participation du sujet à l'objet, participation de l'homme aux forces cosmiques, communion de l'homme avec tous les autres hommes " (Monteil, 1964, p. 31).

We have come far afield from intellectual development, but what is so intriguing about these ideologies is that they should be so strongly reflected in the details of cognitive growth. Bear in mind, however, that the distinctions we are proposing are not all-or-none, although they have been so presented for the sake of clarity. Our evidence, furthermore, is thus far all from Africa. Many different ethnic groups seem to have much in common, but, on the other hand, we do not really know to what extent this social or collective orientation may be typical of all non-industrial, traditional, or, perhaps, oral cultures. It may not hold even for every single African society. Finally, although we started out talking about the ramifications of a collective orientation, we do not really know what causes what in the whole complex of features that we have ended up discussing.

LANGUAGE AND COGNITIVE GROWTH

Our second cultural constraint is language. What does it mean intellectually to speak one language rather than another ? What does it mean to write a language as well as to speak it ?

Language at the highest level of generality can be divided into two components, a semantic and a syntactic. Most experiments attempting to relate language to thought have emphasized the semantic side in the style of Benjamin Lee Whorf (1956). Here the linguistic variable is the richness of the lexicon that a language has available to represent a given domain. Implicitly, but not explicitly, these experiments deal with the vocabulary of any one language at a single level of generality, its words rather than any structural relation among them.

A second kind of semantic linguistic variable is more structural. It deals with the number of levels of generality that can be encoded by a given language for a particular domain. We shall be interested in the relation of both these kinds of semantic variable to concept formation.

Finally, there are the syntactic properties of language to relate to the logical structure of thought. Hitherto the study of the relation between syntax and thought has been sorely neglected cross-culturally, although a recent paper (McNeill, 1965) proposes that there is reason to believe that lexical encoding of events is but a special (and perhaps trivial) case of grammatical encoding. It is perhaps Sapir (1921) who was the earliest to think explicitly and clearly about the manner in which syntax can shape thought.

In the view of linguistic relativity inspired by Whorf, language is seen as a system of related categories that both incorporates and perpetuates a particular world view. On the lexical level, every language codes certain domains of experience in more detail than others. It has been suggested that when a given language symbolizes a phenomenon in a single word, it is readily available as a classifying principle to speakers of that language. Although any familiar experience can be coded in any language through the simple expedient of a periphrase, experiences that must be expressed in this way are supposed to be less available to speakers of the language (Brown, 1958). Some experiments have focused on this sort of difference between languages. Others have focused on the fact that grammatical considerations force certain classificatory dimensions on speakers of a given language (*e.g.*, time for speakers of English, shape for speakers of Navaho) and derive the hypothesis that the dimensions thus emphasized should be more available for cognitive use in categorization, discrimination, etc. to speakers of that language than for speakers of another language without such obligatory distinctions.

Why have experiments generated by these ideas yielded such diverse and confusing results ? Under what conditions, if any, can a relatively rich or poor lexicon, defined only by number of terms, affect nonlinguistic cognitive activity ? These are the issues that concern us in this section.

Now, hypotheses about the effect of " numerical richness " can be based on a comparison of different languages with respect to the same domain or a comparison of different areas within a single language. Research has for the most part yielded ambiguous or negative results for studies of the first kind (interlingual) while a good number of the intralingual studies have confirmed the " richness " hypothesis. A close look reveals, however, that these two types of research differ in other ways than their results. The intracultural studies have used as their cognitive measure some memory task such as recognition of the identity of denoted stimuli earlier encountered. One classic experiment, done by Brown and Lenneberg (1954), showed, for example, that ease in naming

colors made recognizing them easier when they appeared in a larger array. The cross-cultural studies, on the other hand, have usually dealt with judgments of similarity among stimuli rather than with the identity of a single stimulus over time. A classic experiment was done by Carroll and Casagrande (1958), in which children were asked which of two stimuli (*e.g.*, a yellow block and a blue rope) would go best with a third item which was like one of the pair in color and like the other in shape. The subjects were Navaho-dominant and English-dominant Navaho children and white children from three to ten years of age. The Navaho-dominant children were expected to be more sensitive to form than the other groups because Navaho has an obligatory distinction in its verbs : the form of an object dictates the verb of handling. The Navaho-dominant Indian children did indeed classify by form more frequently than did the English-dominant ones, but, alas, the white children who knew no Navaho used form most frequently of all ! Other experiments have found much the same kind of anomaly (*e.g.*, Doob, 1960; Maclay, 1958).

McNeill (1965), in reviewing this literature, concludes that language does not influence perception but only memory. He proposes that a perceptual representation consists of both a schema — the verbal label — and a correction — the visual image —, but with time the correction tends to be lost, thus accounting for the influence of language on memory[3]. The implication is that the cross-cultural studies mentioned above were unsuccessful because they dealt with present perceptual processes. Indeed, the one unambiguously successful cross-cultural study (Lenneberg and Roberts, 1956) involved a memory task. Before evaluating this formulation, consider one of our own experiments (Bruner, Olver, Greenfield *et al.*, in press). Children were presented with pictures in sets of three. They were asked to choose the two out of each three that were most alike and to give a reason for their choice. In each of the triads, two pictures were similar in color, two were similar in form and two were similar in the function of the object pictured. French or Wolof was the language of our subjects, who took part in the experiment in a manner presently to be related.

But consider first the Wolof and French lexicons available for dealing with the task. In Wolof, it is impossible to justify the three color groupings by reference to an abstract word for color, for no such word exists in the lexicon. Moreover, in the last set of three pictures, the French word *bleu* must be used if one is to specify the basis of grouping by naming the color, for there is no single word for this color in Wolof. In the second set, color grouping involves contrasting a pair of predominantly orange pictures with a predominantly red one. Wolof codes both colors with a single word (*bonka*), so that verbalizing the basis of the grouping by means of the Wolof word would not be as satisfactory as using the French word *orange*, for it would not distinguish the pair from the third member of the set. For the first set of three pictures, Wolof does almost as well with coding the relevant colors as French, although yellow, the color involved in forming the color pairs, is not as codable by Wolof according to the

[3] The expression " tend to get lost " is advisable, for it is sometimes the case that the correction is not lost but magnified, producing exaggeration in memory, the familiar opposition between " levelling " and " sharpening " introduced long ago by Bartlett (1932) and the Gestalt theorists (*e.g.* Koffka, 1935).

criterion (suggested by Brown, 1958) of agreement between speakers of the language. In fact, the same word is sometimes used to name both yellow and orange, the " contrasting " color of the third picture in the triad. As for the codability of shapes in French and in Wolof, the relative merit of the two languages is much less clear. With regard to functional grouping, both languages easily find ways of saying " These things are to eat, to wear, to ride in ", and one has no difficulty in either in coding at least those features demanded by the functional groups in this experiment.

On lexical grounds, then, one would at very least expect that monolingual Wolofs would be less color-oriented and more functionally oriented in the content of their groupings than bilinguals and both of these groups would form fewer color and more functional groups than monolingual French children, in a forced-choice situation where one type of attribute must be used at the expense of others.

The results, however, were unambiguously contrary to these expectations. The Wolof monolinguals, that is, the unschooled bush Wolofs, could use nothing but color as a grouping principle even when given a chance to make second choice groupings ! The other groups of children, in sharp contrast, used color less and less with age and increasingly turned to the other types of attribute. Obviously, the lack of color words does not stop monolingual Wolofs from grouping by color.

But does it make their color discriminations less accurate ? In asking this question, our experiment becomes in one respect like the intracultural tests of the Whorfian hypothesis described above; the task now involves the accuracy of color discriminations. It is no longer a matter of choice between color or form as a basis of grouping. Wolof monolinguals should make color errors most frequently; Wolof-French bilinguals should make these errors next most frequently and French monolinguals not at all. The errors are quite straightforward. For example, in one set of pictures there are two orange and one red objects. An error is counted when a red and orange object are called most alike on the basis of their color. The results are exactly as predicted. At every age bilinguals commit these errors less frequently than Wolof monolinguals and they never occur among French monolinguals of similar age. These errors, by absolute standards, do not occur frequently in any group of children. The maximum is among the youngest group of unschooled Wolof children where 30 percent of the color reasons accompany discrimination errors. These perceptual errors decrease with age until at last they are completely eliminated in all groups. It appears that age brings increasingly accurate perceptual discriminations even when a culture's lexicon lacks the distinctive items that should facilitate discrimination. We may conclude that, with age, perceptual requirements increasingly overcome language, if one opposes the other.

Is it, as McNeill (1966) suggests, that such findings prove merely that people learn to see ? Clearly language influences perception and not just memory, at least during childhood. As early as 1915 Peters (cited in Smith, 1943) experimentally produced color matching errors in children through teaching them an artificial vocabulary in which certain colors were lexically indistinguishable. Later, when the children were taught these lexical distinctions, the corresponding perceptual discriminations also appeared. Even earlier Tucker (1911) observed

this same situation naturally and intraculturally; he found that children would group together different colored wools called by the same name. Lenneberg, on the other hand, confirms the notion that this influence of lexicon on perception diminishes with age; for he finds that the absence of certain terminological color distinctions that adversely affects color memory in Zuni adults (Lenneberg and Roberts, 1956) and present color perception in Wolof children does not affect present perception in Zuni adults (Lenneberg, 1961). Even adults, however, may fall back on language to aid perception when conditions become particularly difficult, as, for example, when all the relevant stimuli are present but spatially separated (Bruner, Postman, and Rodrigues, 1951). Indeed, in terms of the eye movements necessary to visual perception, spatial separation may be translated into a mild form of temporal separation.

McNeill's hypothesis about language affecting only the memory pattern is plainly false. Yet his notions of " schema plus correction " may still hold. In fact, Ranken (1963) shows that linguistic coding in the form of assigning names can help when it is a matter of ordering shapes relative to one another where it is not necessary to remember their exact form, but that it can hinder performance in tasks where the precise image of the same stimuli must be utilized, as in a mental jigsaw puzzle. We interpret this outcome to mean that the label helps where a general schema suffices for the cognitive task in question, but that it produces deceptive vagueness where the task actually involves both schema and correction, *i.e.*, an exact image.

A schema can operate only when called into play; language affects cognition only if a linguistic coding occurs, that is only if the stimulus is given a verbal representation. It is possible that these conditions prevail only when a task is difficult to perform by means other than linguistic coding. But that is a moot point much in need of further investigation. Perhaps, too, different cultures vary in their tendency to use such linguistic encoding. Unschooled Wolof children in our experiment, for instance, showed a much stronger tendency to use ostensive, as opposed to verbal, reasons for their groupings. That is, they would " explain " their grouping choice by pointing to the common pictorial elements. Such ostensive definition may have counteracted the detrimental effects of an inexact vocabulary, by bypassing language altogether. We do well to remember, in assessing cross-cultural studies, that most cultures are non-technically traditional, less verbally oriented than our own.

In summary, it appears from our own and other work that linguistic encoding of the stimuli relevant to a given problem situation can affect the ordering of stimuli by providing a formula for relating them across time (Brown and Lenneberg, 1954; Van de Geer and Frijda, 1961; Lantz, 1963; Lantz and Stefflre, 1964; Koen, 1965) or space, as our Wolof results and the Bruner, Postman, Rodrigues (1951) experiment show. The influence of encoding becomes stronger as cognitive conditions become more difficult making an ikonic approach to the problem increasingly ineffective and a symbolic approach more crucial. Such conditions are produced as the situation becomes less " simultaneous " and more a matter of memory and as the number of stimuli to be dealt with simultaneously approaches 7 ± 2, the limit of immediate perception and memory (Miller, 1956; Brown and Lenneberg, 1954). These generalizations about the conditions under which linguistic encoding will affect other cognitive operations must be further

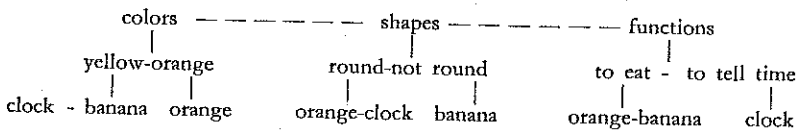
qualified. They hold only if a linguistic representation is available to the person in question and has been activated.

Whether or not the linguistic effect will be positive or negative depends on the fit between linguistic representation and situation. If linguistic encoding is inappropriate to the task at hand either because the labels do not encode all the necessary information, *e.g.* in the mental jigsaw puzzle in Ranken's experiment or because the labels cut the domain in places other than what the task demands, linguistic organization can have an adverse affect on task performance (*e.g.*, Lenneberg and Roberts, 1956). Whether or not a label encodes all the necessary information depends not only on the task but also on the array of stimuli. A given label becomes ineffective in distinguishing a given stimulus if it must be discriminated from others to whom the name could also apply (Lantz and Stefflre, 1964).

We began by considering the part that a lexicon plays in determining the content of equivalence groupings. We must conclude that factors other than lexicon determine the bases or dimensions of equivalence, but that lexicon may influence the " band width " of the individual categories that constitute the dimension. In the end, we have seen that the equivalence of two spatially separated stimuli is affected similarly by lexical conditions as that of two temporally separated stimuli. Thus, " equivalence " and recognition have much in common.

Let us turn now from the role of labels *per se* to the role of a set of hierarchically organized labels, that is, to the role of lexical richness defined in structural terms. There has been much controversy about the role of superordinate words in conceptual thought. Does the absence of the general word " color ", in the Wolof language mean, for instance, that the Wolofs have no general concept of color and, if not, of what consequence is this seemingly grievous deficit ?

Consider the following diagram :



It is one possible representation of the hierarchical structure of the first set of three pictures used in the present experiment.

If this hierarchical organization corresponds to the type of structure generated by the subject to deal with the task, then his use of the general words " color " or " shape " should indicate that the person is operating at the top of the hierarchy and has access to the entire hierarchy. One would predict, then, that he would be able to supply more than one kind of attribute if pressed. For he is plainly contrasting, say, color with shape or with use. By the same reasoning, his use of lower level names alone (*e.g.*, " round ", " yellow ") would mean that he was " cut off " from the top of the hierarchy and its connections with other branches, for " round " is related only to other shapes, " yellow " to other colors. He would therefore be less likely to operate in branches other than the one in which he is.

If this reasoning is correct, then one would expect that if a subject ever used an abstract word like " color " or " shape ", he would also vary his choice of

grouping attributes when asked to form two different pairs in all three sets of pictures. But if he used only a concrete word like " red ", then one would expect him to form nothing but color groupings on the tasks. Our results do indeed indicate that there is a significant association between use of superordinate words like " color " and " shape " and the number of different types of attribute used in the six grouping tasks. And this relationship holds when all other factors such as knowledge of French and school grade are held constant. Thus, if a Wolof child uses a superordinate word, his chances of grouping by a variety of attributes are twice as great as those of a child who utilizes no superordinate vocabulary. Recall that when a Wolof child uses the word " color ", it is a French word that he is introducing into his Wolof narrative.

Although all our experimentation was carried out in Wolof, we also ran additional sixth grade Wolof groups in French in order to assess the effect of using one language or another when all other factors are held constant. The relationship between use of superordinate words and variety of attribute used is weakest under this condition. But before interpreting this finding, consider one further observation. The experiment was also carried out in French with French children in the sixth grade. It is in this experiment that the strongest relationship is found. If a French child uses an abstract " top-of-the-hierarchy " label, he is almost certain to vary his basis of grouping at least once. So we must conclude that access to the pure conceptual hierarchy as diagrammed is indicated by the use of abstract terms only if the linguistic terms have been thoroughly mastered in all their semantic implications. Our results indicate that such is the case under normal conditions of spontaneous use in the context of one's native language. But when the Wolof children are interrogated in French, their use of superordinate language seems to have a forced character and indicates little about hierarchical structure and where they are in it.

The reasons for color preference among the Wolof are too complicated to discuss here. What needs emphasis is that the basis of equivalence is not an either/or phenomenon, as so much experimentation has assumed. It is, rather, a matter of adding new bases to old and of integrating them in a hierarchically organized structure. Everybody is more or less limited in the range of classificatory bases available to him. It is not that one person uses color, the other shape. Rather, one can use color, the other can use shape and color. It is the structure of the lexicon and not simply its list of terms that is crucial.

Superordinate class words are not just a luxury for people who do not have to deal with concrete phenomena, as Roger Brown (1958) hypothesizes. In a way quite different from that envisaged by Whorf in the lexical version of his hypothesis, we seem to have found an important correspondence between linguistic and conceptual structure. But it relates not to words in isolation but to their depth of hierarchical imbedding both in the language and in thought. This correspondence has to do not with quantitative richness of vocabulary in different domains or with " accessibility ", but with the presence or absence of higher order words that can be used to integrate different domains of words and objects into hierarchical structures. No matter how rich the vocabulary available to describe a given domain, it is of limited use as an instrument of thought if it is not organized into a hierarchy that can be activated as a whole.

Consider now the grammatical aspect of language. In previous work (Vygotsky, 1961; Inhelder and Piaget, 1964; Bruner, Olver, Greenfield *et al.*, in press) the structure of equivalence groupings was found to become increasingly superordinate with age and less complexive and thematic. Superordinate structure is not the same as the use of a general or superordinate word. The attribute that organizes a superordinate group may be general or specific, but it must be explicitly stated to be shared by every member of the group in question. Thus, " They are all the same color " would have the same structural status as " They are all red ". In terms of this structural criterion, all the children studied in Senegal conformed to the usual developmental trend. But although the grouping choices of our unschooled Wolof group got increasingly systematic with age, their explanations showed a somewhat different form. Instead of explicitly connecting the common attribute to every member of their groupings in the manner described above, they would explain their grouping with a single word, saying, for example, nothing more than " red ". What may we make of this ?

Consider the matter in purely grammatical terms. For perhaps we can find a connection between conceptual organization and grammatical rules. Let us posit, first, three stages of symbolic reference. The first is the ostensive mode : mere pointing at the object of reference. The second, the labeling mode, involves nothing more than a verbal tag. This tag replaces or accompanies the operation of pointing. The third mode is sentential. Here the label is integrated into a complete sentence. In the present experiment, these three modes were defined as follows and the definitions applied to grouping reasons : (1) pointing — no verbal response; (2) labeling — label only, no verb in utterance, for example, " This ", " Round " or " This-round "; (3) sentential placement — complete sentence, for example, " This is round, " " These are the same color ".

Among the French monolinguals, pointing is nonexistent even among first graders. Pointing, however, occupies a definite position in the reasoning of all the youngest Wolof groups, especially the unschooled, but disappears in all the groups by the sixth grade. Thus far, the difference is quantitative. The other differences are qualitative and set the unschooled children apart from all the school children. In the unschooled groups, labeling increases with age. But the use of sentential placement does not increase with age, but remains at a constantly low level. In all the school groups, both Wolof-French bilingual and French monolingual, the simple labeling mode gives way to sentential placement with age and increased schooling. There is, let it be noted, virtually no difference on any criterion between the oldest French monolinguals and the oldest Wolof-French bilinguals when the experiment is run in French. The superiority is slightly on the side of the French when the experiment is carried out in the native language of each group. The contrast that is most dramatic is between Wolof children in school and those not in school, with virtually no overlap in the distributions. Some 97 percent of the 11-13 year-old Wolof monolinguals (the unschooled Wolof children) use the labeling mode; 90 percent of the Wolof sixth graders, doing the experiment in French, use the sentential mode.

These results reveal larger differences between the groups who know French and those who do not than the results obtained with the earlier, less grammatical definition of grouping structure. We may hazard a guess that school is operating on grouping operations through the training embodied in the written language.

But there is something more here as well. The written language, as Vygotsky (1961) points out, virtually forces remoteness of reference on the language user. Consequently, he cannot use pointing as an aid, nor can he count on simple labelling that depends upon the present context to make clear what one's label refers to. Writing, then, is training in the use of linguistic contexts as independent of immediate reference. Thus, the embedding of a label in a sentence structure indicates that it is less tied to its situational context and more related to its linguistic context. The implications of this fact for manipulability are great; linguistic contexts can be turned upside down more easily than real ones; this linguistic independence of context produced by certain grammatical modes may favor the development of the more context-independent superordinate structure manifested by the school children.

Note the recurrence of a theme that has been running through all of our results: it is always the schooling variable that makes qualitative differences in directions of growth. Wolof children who have been to school are more different intellectually from unschooled children living in the same bush village than they are from city children in the same country or from Mexico City, Anchorage, (Alaska) or Brookline, (Massachusetts) (Bruner, Olver, Greenfield *et al.*, in press). Similar results demonstrating the huge impact of school have emerged from the Belgian Congo (Cryns, 1962) and South Africa (Biesheuvel, 1949; Schmidt, 1966).

How then do school and language interrelate? We may hypothesize that it is the fact of being a written language that makes French such a powerful factor in the cognitive growth of the children we have studied. For all of the semantic and syntactic features that we have discussed in relation to concept formation, a rich vocabulary that is hierarchically organized, syntactical embedding of labels, etc., become necessary when one must communicate out of the context of immediate reference. And it is precisely in this respect that written language differs from spoken. But school itself provides the same opportunity to use language out of context, even spoken language, for to a very high degree, what one talks about are things which are not immediately present.

CULTURE AND BIOLOGICAL GROWTH

Lest it be thought that we espouse a view of complete cultural determinism, which we do not, we conclude with some remarks on the interaction of cultural constraints and universal biological maturation.

Because the doctrine that ontogeny recapitulates phylogeny was given too literal a form in biology, a more sophisticated consideration of the relation between phylogeny and ontogeny was also given up. Species specific behavior does not appear out of the blue. It has evolutionary history, and that history reflects itself in the early growth of the young. We are primates and our primate heritage affects our growth. All cultures must work on the stuff of the biological organism, specifically on man's primate constraints.

One of the huge discontinuities in man's evolution was his capacity for language and symbolism, and this only gradually achieves realization through training. Sapir (1921) may have been perfectly right in pointing out that no human language can be shown to be more sophisticated than any other and that

the speech used by the member of the Academy is no more complex than that of a Hottentot. But again it was Sapir (1921) who pointed out that it is in extracting from our use of language the powerful tools for organizing thought that peoples differ from each other. The intellectual nurturing that makes it possible eventually to use language as a tool of thought requires long years and complex training.

It is here that the difference comes. If that intellectual training is not forthcoming, if language is not freely employed in its pragmatic function of guiding thought and action, then one finds forms of intellectual functioning that are adequate for concrete tasks, but not so for matters involving abstract conception. As Werner (1948) points out, "Development among primitive people is characterized on the one hand by precocity and, on the other, by a relatively early arrest of the process of intellectual growth" (p. 27). The formulation is telling with respect to the difference between school children and those who have not been to school. The latter stabilize earlier and do not go on to new levels of operation. The same "early arrest" characterizes the differences between "culturally-deprived" and other American children, (*e.g.* Deutsch, 1965).

In short, some environments "push" cognitive growth better, earlier, and longer than others. What does not seem to happen is that different cultures produce completely divergent and unrelated modes of thought. The reason for this must be the constraint of our biological heritage[4]. That heritage makes it possible for man to reach a form of intellectual maturity that is capable of elaborating a highly technical society. Less demanding societies, less demanding intellectually, do not produce so much symbolic imbedding and elaboration of first ways of looking and thinking. Whether one wishes to "judge" these differences on some universal human scale as favoring an intellectually more evolved man is a matter of one's values. But however one judges, let it be clear that a decision not to aid the intellectual maturation of those who live in less technically developed societies can not be premised on the careless claim that it makes little difference. If this article shows anything, it is that it makes a huge difference to the intellectual life of a child simply that he was in school.

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[4] This constraint is however somewhat variable in that widespread malnutrition can affect the neurological and mental functions of large groups of people (Biesheuvel, 1943, 1949, 1956, 1963).

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