varying in length from 4 to 32 inches. Each subject was asked first to estimate the length of the stick (using hand-spans as his unit of measurement) and then to measure the stick using his hand-span. The same three groups of subjects (with the addition of 20 fifth and sixth-grade American students) participated in this experiment. The results are shown in Figure 11.

Although the Kpelle adults are slightly superior to the American adults on this task, the differences appear to be minor and confined for the most part to the longer sticks. Granting that one might expect the Kpelle to be more skillful at this sort of measurement (based on results like those obtained from the rice estimation experiment), why are the differences so small? One answer might be to assume that the Americans are again translating hand-spans into inches and using this familiar
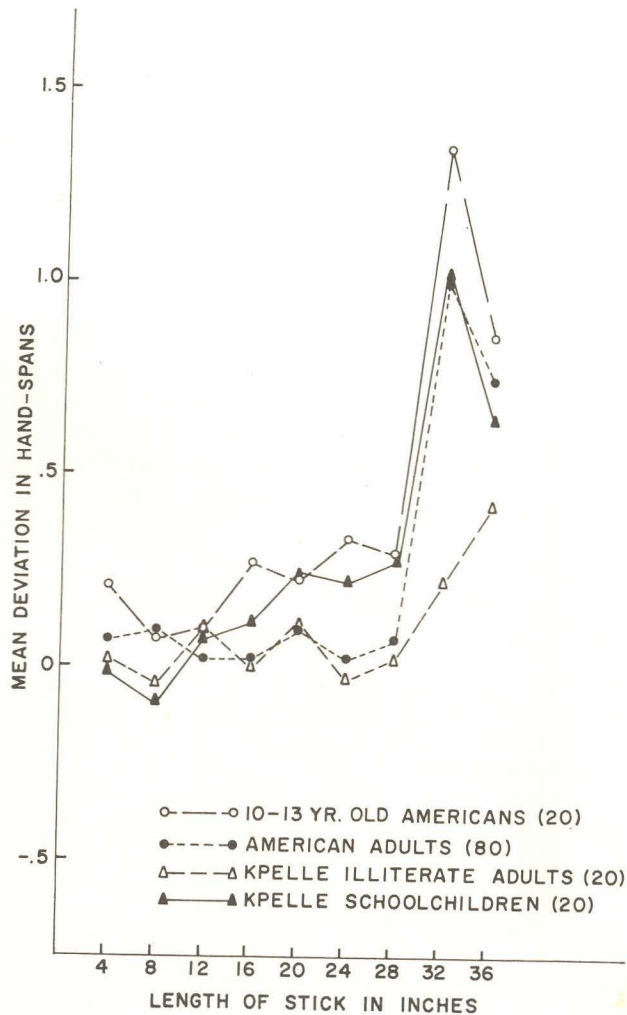
measure to mediate their responses. A factor we believe plays no small role in the results is that for the Kpelle, a hand-span is a very rigidly defined unit. Our Kpelle subjects invariably made meticulous measurements, placing thumb and middle finger together at the very edge of the stick and extending the middle finger to the utmost before bringing the thumb up to meet it. The Americans, on the other hand, exhibited a strong tendency to vary their hand-span to fit the estimate! They were "cheating" in a way that the Kpelle would not think of doing.

Length measures for longer distances are simply not used. If one asks a Kpelle person how far, in distance, it is to a nearby town, he may be told a fanciful number of arm-spans. He may receive a nonquantitative reply, as in the delightful Liberian-English expression "It's big small." He may simply be told "It's far," or "It's not far," which conveys almost no information to someone who does not already know the route. Or he may be given the distance in terms of time: ("It's a one-day walk").

TIME

The measurement of time differs from the measurement of money, volume, and length in that certain terms which appear to measure time cannot be numbered. Such terms might be called intensive measures of time rather than extensive measures. They measure the quality of the moment, not the quantity. The same phenomenon appears in English. For instance, we refer to morning or evening, but we would not count mornings, unless in some specialized context, such as working half-days. Many of our time words are of this type, such as autumn, spring rains, and twilight, usually referring to some meteorological fact.

Even countable units of time in Kpelle fundamentally indicate the quality of the moment. There are four such basic terms: *gele-kuu,* "day," *lôku,* "week," *gálon,* "month," and *kóra*n, "year." All show the character of the time, rather than the passage of a definite amount of time. The day is the time of light, when the sun is up. The term *géle* also refers to sky and life, and is opposed to *kpini,* "night." One informant denied that a night and a day make a day. Day is different from night. We in English have the same ambiguity in our word "day," but we easily switch meanings when required.

The week is the time leading up to a market day. In former times markets may have been held every five days or every six days. The days of the week were counted or named with reference to market day. Weeks are sometimes counted, but reference is rarely made to more than two or three weeks.

The term for month is even less quantitative. One informant was asked how many days or weeks make a month. His response was *kwa gálon lôno no nélei sù,* "We count a month only in the sky." The ambiguities in his response are particularly interesting. He used *lôno,* which can mean "speak" or "count," and he used the term for day, *géle,* but used it in its primary, nondurative sense, referring to the sky. The month is the time of a moon. So the month is beginning when *nálon aâ too,* "the moon has stood up." The terms for month and moon are related in English—but in Kpelle they are the same. The different months have different characters. There are months for

Fig. 11. Mean errors of Kpelle and American subjects in estimation of lengths in hand-spans.

making farm, felling trees, burning underbrush, burning farm, scratching rice, harvesting rice, months for rainy season and dry season, and months for fishing. One can refer to the month when a child was born. Months, however, are rarely counted, and then only in numbers no higher than about three. There are traditional names for the months, but these are probably of non-Kpelle origin. They relate to the agricultural cycle.

The year is marked by the cycle for growing rice. It begins in the dry season when it is time to begin cutting the bush for a farm, and ends when the harvest is over. Thus—by pure coincidence—the Kpelle new year roughly coincides with January first, so they will celebrate New Year's Day at the same time and in much the same way we celebrate. Most Kpelle, incidentally, are now aware of the Western calendar.

Our informants had no idea how many months were in a year, or how many years had elapsed since some long-past event. It is true that they can remember, and count, the years since some recent event, such as the birth of a baby. But they do not know the age of persons more than four or five years old. Important years are those when one is born, joins the Bush school, and dies—but the intervening years are not counted. Adults do not know their own ages, and when asked are likely to make outlandish estimates. They may refer to such important dates in terms of the rule of one of Liberia's presidents, e.g., *bâkle nòtâlisù,* "in Barclay's time."

There was formerly no abstract word for time in the Kpelle language. The word *tâi* has been borrowed from English, but this word is used structurally to replace "when," not as an abstract noun. Its primary use is in such sentences as *mí tâi bé í pà là,* "When did you come here?" or the expression *tāida,* "once," "sometime," or "perhaps." Thus we must not attribute too great significance to this term or treat it as an equivalent of its English cognate.

There are expressions for relative times, which answer questions such as "When did you come here?" One can reply that he came today, yesterday, tomorrow, the day before yesterday, the day after tomorrow, or even the second or third day after tomorrow. It is also grammatically possible to speak of last week or next week, last month or next month. It is interesting to note, however, that a single expression refers to either last week or next week, and one to last month or next month. Only by context can one tell whether these expressions refer to past or future.

We conducted an experiment to determine the perception of short intervals of time. We realized in advance that the Kpelle had no terms by which to measure, or even indicate, such short periods; we realized, also, that they did not have an abstract word for time which would allow them to label short intervals. But we felt that a comparison of American and Kpelle performance might be interesting. We anticipated that the Kpelle would do more poorly than their American counterparts, because they are not part of the time-conscious Western civilization.

The first test required the subject to pace a distance of 20 yards while the tester timed him. He was then asked to stand at the starting line and mentally pace off the distance and report when he felt that he had completed it. The subject then paced off distances of 40, 60, and 80 yards, following the same procedure. The
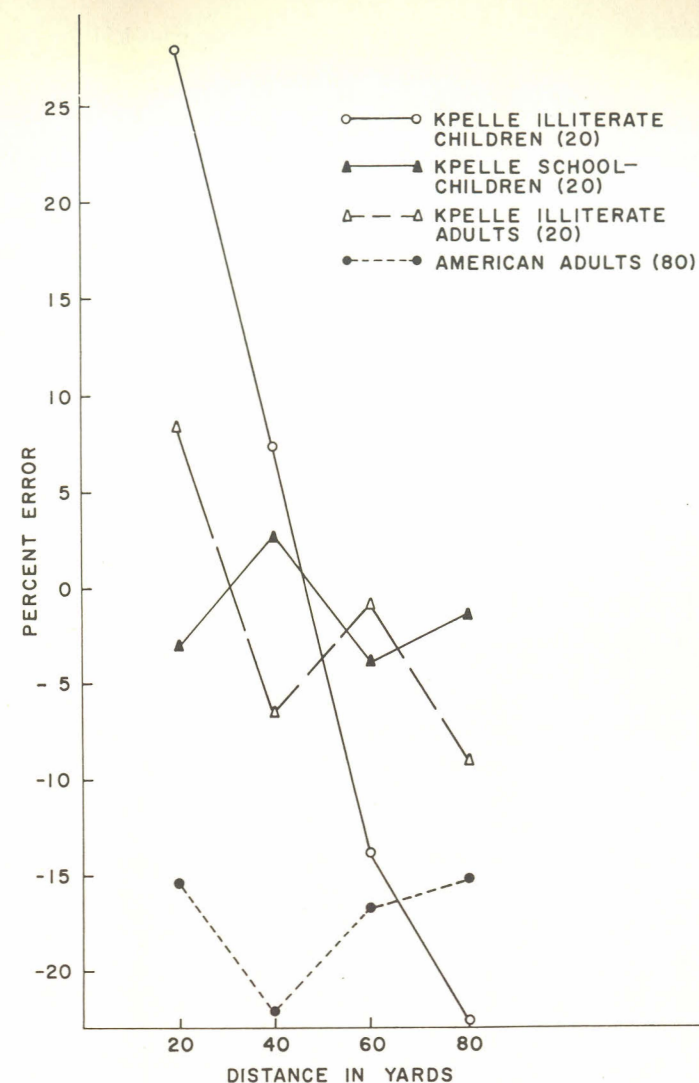
Fig. 12. Mean percent errors of Kpelle and American subjects in estimation of times required to pace distances.

measure of performance was the difference between the time actually taken to pace off the required distance and the subject's estimate of the time. The best scores on this task were obtained by the Kpelle schoolchildren, as shown in Figure 12. The Kpelle adults were almost as accurate, but the Americans consistently underestimated the amount of time it took to pace off the required distance.

The second task was administered as follows. The tester showed the subject a stop-watch and let him observe it tick off 15 seconds. The tester then held the stop-watch where the subject could not see it, started the watch and asked the subject to tell when the hand had reached the same place. This procedure was repeated for 8

different intervals ranging up to 2 minutes. The Kpelle schoolchildren once again gave the best performance (Figure 13) but except for the shortest (15 seconds) interval, the Kpelle and American adults are almost equally accurate. However, in the performance of the two groups, there is a clear tendency for the Americans to underestimate the time while the Kpelle adults overestimate.

The most obvious conclusion one can draw from these results is that broad statements to the effect that Africans have no sense of time, are nonsense. The results suggest other questions which we can only raise at this time, but which point to interesting possibilities for future research. Our American subjects obviously (and audibly) used the simple device of counting to mediate their time estimates, but we have no clue as to how the Kpelle managed their rather accurate time estimates for pacing distances. However it was done, the system is apparently more accurate than our "one-and-two-and" timing behavior. What is the nature of Kpelle timing be-
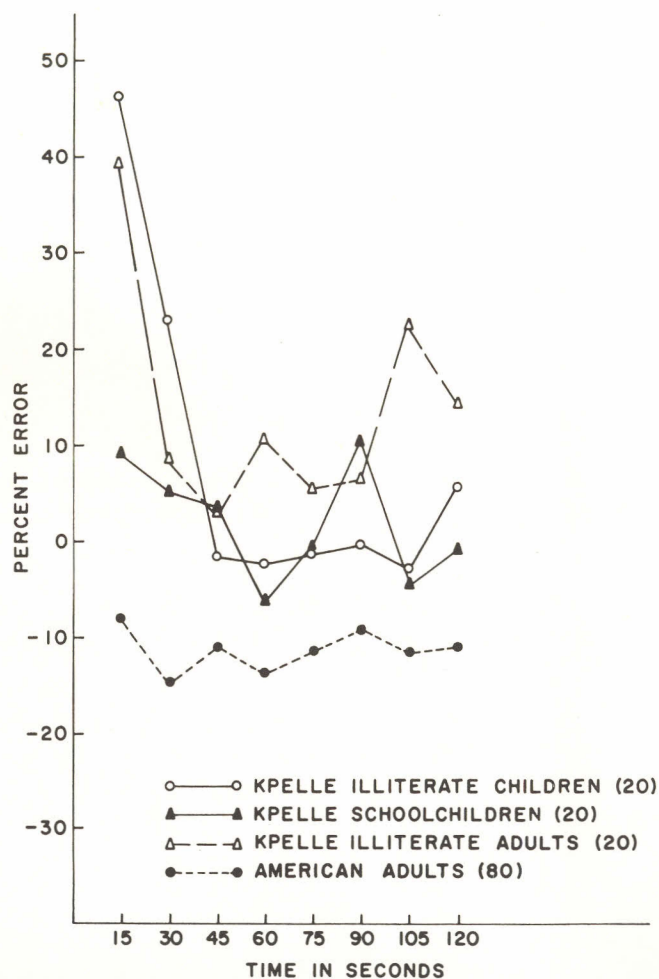

Fig. 13. Mean percent errors of Kpelle and American subjects in estimation of times on a stop-watch.

havior? Is it mediated by language, and if so, how? Perhaps the Americans have lost their sense of time by their dependence on the mechanical aid of a clock or watch. The similarity of performance when estimating times on a stop-watch suggests this possibility.

In summary, there are several important things we have observed about the measurement behavior of the Kpelle. The most important thing is that measurement is used where it is needed. The Kpelle measure the length of cloth, rope, sticks, and other objects in village life. They measure the volume of rice, water, oil, and other agricultural products. They measure money, since Western economic activity is an increasingly important part of their lives. And they measure time, but primarily in a qualitative way.

Second, units of measure are, in general, not parts of an interrelated system but are specific to the objects measured. Certainly days, weeks, months, and years are interrelated. The various length measures are used only when they are needed, and are not incorporated into a system. It is true that rice measures are interrelated and coordinated—but this exception is a function related to the importance of rice to the people. Other volume measures are not interrelated. Monetary units are related to one another but only because the relation is imposed by Western culture.

Third, most measurements are approximate, unless there is a real need for exactness. The phenomenal ability of Kpelle illiterate adults to estimate numbers of cups of dry rice depends on their need to buy and sell rice. The Kpelle can speak of exact and approximate measurement—but these terms would be relevant only in the case of trade goods.

Fourth, these measures are made quantitative primarily in economic activities. Length, money, and volume are all quantified because there is an economic need. People have farms, produce crops, sell their surplus, buy other goods, and do so quantitatively. Time is rarely quantified, because it is not as important economically. It is true that some economic factors enter in—the week is the market cycle, the month and year are tied to farming. But time is primarily qualitative, reflecting the character of the moment, not its numerical relation to other moments.

10 / Language and logic

KPELLE SENTENCE STRUCTURE

A CLAIM OFTEN MADE by uninformed persons is that non-Western languages have no structure or grammar. (In a book written only a few years ago, the author made the statement that a particular South African language was only a collection of grunts and whistles.) Every serious investigator has shown this to be totally false. Every language has a complex, sophisticated structure, independent of the level of material culture of its speakers. Kpelle is no exception.

In this chapter we will consider certain structures of the Kpelle language which are relevant to mathematics and logical reasoning. We will not present in detail here the evidence which supports our claims. In Welmers' analysis of Kpelle (Welmers, 1948), and in our monograph now in preparation, the subject is treated in depth. Only at two or three points will we discuss the linguistic evidence, those where Kpelle structure diverges most significantly from English patterns.

Kpelle statements describe the world of experience according to a definite pattern. Kpelle terms fall into several classes, according to their positions in these statements. Therefore, every complete sentence in Kpelle has a subject and a predicate. The subject is a noun phrase or a pronoun. The predicate can take one of two forms. It may be simply an adjective, or it may have the following structure: pronoun, time adverb (optional), object noun phrase (optional), verb phrase, adverb phrase (optional). These terms are applied to the parts of a Kpelle sentence by analogy with English. However, the terms have a much more clear-cut application in Kpelle than in English because a word of one type cannot appear in the position reserved for a word of another type. Nouns, adjectives, adverbs, verbs, and pronouns form distinct, nonoverlapping classes, in sharp contrast with English, where words can, in many cases, fall into several different classes. For instances the word "light" can be used in English as an adjective, a noun, a verb, and even as an adverb. Only rarely does such a phenomenon appear in the Kpelle language.

Structural distinctions can be made within these basic classes of words. Nouns can be classified in three ways: (1) Some nouns appear freely but other nouns appear only with a free noun. (We call the latter dependent nouns.) (2) Nouns can be either personal or impersonal, the distinction being shown in the pluralization and the relation to pronouns. (3) Nouns can be countable or noncountable, depending on whether they can be directly modified by numerals.

Verbs can also be divided into two classes: Some verbs do not take object noun phrases in the predicate, but some verbs require such phrases. By analogy with English, we call these verbs intransitive and transitive, respectively. In this case, the classes are not separate, since some verbs have both transitive and intransitive uses.

NOUNS

It is necessary to consider next the range of meanings of words in these classes. Analysis of a large sample of free nouns shows that for the Kpelle each of these terms stands for some sensed, physical object. In English we might class some of these objects as qualities of other physical objects. For instance, the Kpelle include *meni,* "news," and *puru,* "hunger" in the set of free nouns. For them news is a heard object, and hunger is an ever-present physical reality—a sensed object.

Free personal nouns specify men, women, and children in terms of their functions within the society. Free impersonal nouns name animals, household goods, geographical features, plant products, money, units of time, food, tools, clothing, and the like. Most of these nouns are countable, such as b*oli,* "goat," or *kpolo,* "basket." Some, mostly those referring to food (such as *molon,* "rice"), are not countable because they comprise very small pieces. In the case of *ya,* "water," because of its continuous form is usually not counted, although in the sense of a river or swamp it is counted.

Most free nouns are concrete and particular, but even the most abstract refer to classes of sensed, physical objects. For example, the terms *nuu,* "person," *sen,* "thing," *wuru,* "tree" or "stick," *mii-s*en, "food," *meni,* "news" or "affair," and *sua,* "animal" or "meat," are among the most general terms in the language. Yet they obviously have a close tie with concrete reality. Notably absent are nouns which name qualities or attributes of objects and actions, such as reality, beauty, or justice.

Dependent nouns can be either personal or impersonal, but must be always be used with a free noun. Personal dependent nouns name all the relations a person may have. For instance, in Kpelle a person cannot be simply a mother—she must be someone's mother.

Impersonal dependent nouns are of two main types—the parts and functions of the body, and locations. There are a few other such nouns—*sii,* "type of" and *kana,* "purpose of." All these impersonal dependent nouns indicate attributes or aspects of other objects, and are similar to the set-words discussed in previous chapters. The difference between them is that the dependent nouns name attributes which the Kpelle think cannot be isolated, such as a man's arm or the purpose of an object. The set-names and measure-names, such as *seèi,* "set" or *kôpi,* "cup,' 'can be considered independent objects, limiting or containing other independent objects.

ADJECTIVES

Adjectives also name qualities or aspects of experience objects, but not the same ones as those named by dependent nouns or by set-words and measure-words. The qualities named by adjectives are not used as subjects of sentences, and are not

given even the status of dependent nouns. The class of adjectives includes terms for big, small, near, far, heavy, light, short, long, full, and empty, all of which we might class as geometrical. It also includes terms for hot, strong, plenty, clear, sweet, and good, which are nongeometrical. The Kpelle make no structural distinction between these two types, because both can be measured: to ask about them is to measure the object to which they refer.

In some cases there actually is a Kpelle word which quantifies the quality represented. The numerical measures for length, volume, and money correspond to adjectives. There is no adjective for time, however, which may help to explain the only partially realized quantitative temporal system.

COMPLEX PROPOSITIONS

We have considered thus far the main points of interest in the simple Kpelle proposition. The Kpelle language does not limit itself, of course, to such simple propositions. It can express more complex ideas, by using simple propositions to construct more complicated sentences. It does this in two ways—by structure words and sentence order. Structure words are of several types, including question words, interjections, demonstratives, and connectives. We are particularly concerned here with the connectives, since they allow the construction of complex sentences from simple sentences.

The simplest case is that in which the complexity is introduced into one or more of the noun phrases in a sentence. Here the pronoun *da,* "they," is used as a conjunction, *sumo da fúlomo da pâi,* "Sumo and Flumo are coming." The term *da,* "they," acts as a conjunction, so the sentence should be literally translated, "Sumo they Flumo they coming." First and second person pronouns are used as conjunctions in the same way.

NEGATION

On a higher level are complex sentences whose component parts are simple sentences. Such complex sentences can be put into two main classes. One class consists solely of the negation, whereby a simple affirmative sentence is denied. Some form of the negative particle *fé* is always used to form such negations, but there is no simple way to describe the operation.

BINARY SENTENCES

The second class of complex sentences consists of all those where two propositions are linked together by a connective. All subsequent complex sentences can be reduced to these binary sentences, so we need not consider sentences with three or more component parts.

It is possible to sort binary sentences into five types, on the basis of the truth and falsity of their components. In the first type, the truth of the resulting sentence requires the truth of both halves. We call this a conjunctive sentence. In the second

(inclusive disjunction), the truth of the resulting sentence requires only that both halves not be false at the same time. In the third (exclusive disjunction), either half must be true, but not both. In the fourth (implication), the truth of the first requires the truth of the second, but not vice versa. And in the fifth, the truth of the resulting sentence depends only on the truth of the first. We call this not truth-functional because of the irrelevance of the second component proposition. We will take up the five types in order, discussing briefly how each is constructed in Kpelle.

CONJUNCTION

There is no simple way to create conjunctive statements in Kpelle. Some typical cases are the following: *ná lì ǹà ná tíi ké,* "I went there and worked"; *è wòlo gé yèle,* "He laughed and cried (together)"; *sumo è sàa; kpéni fêi, di wúlu kè ǹà,* "Sumo died; it was not for nothing, they bewitched him"; *tuna fe pûi, maa-mêni mà ǹoii kpâlâi,* "It is not raining; therefore, the ground is dry"; and *kpôlo ká ní da molon pû zù,* "This is the basket they put rice in."

These five sentences represent five basic types of conjunction in Kpelle. The first shows that one event follows another. The second shows that two events occur simultaneously. The third shows that one event is the reason for another. The fourth shows that one event is the result of another. The fifth has one statement amplifying another.

The first two types of conjunction are interesting in that the two events mentioned must be related in some way. It is impossible to use statements of these types to relate two physically unrelated events. Thus they could not be used to say, "This book is about mathematics; and I am sleepy" (unless, of course, the reader wishes to establish such a connection).

The third and fourth types of conjunction also show a relation between events, in this case a causal relation. It has been pointed out that statements of cause and statements of reason are logically equivalent to conjunctive statements. Such statements intend to establish more than a simple conjunction—but that "more" lies in the realities of the experience and the psychology of the hearer rather than in the logic of the statement. The Kpelle conjunctive sentence bears this out in that the antecedent and consequent of the connective can be interchanged. In the examples concerning Sumo's death and the dry ground, the order of the clauses could be reversed without greatly altering the meaning.

DISJUNCTION

The second type of statement is the inclusive disjunction, as in the statement *a pâi zegei wáâi à wàla ké tí vé pâi ǹáa mii,* "He will wash the clothes; if that does not happen, he will not eat." There are two main propositions in this statement: "he will wash the clothes" and "he will not eat." There is also the auxiliary proposition, "if that does not happen," which really acts as a connective rather than as an independent proposition. Consider the two principal statements. If the first statement is true, namely, that he washes the clothes, then the second may be either true or false—he

might eat or he might not eat. If he does not wash the clothes, however, then we know he will not eat; if he eats, we know he must have washed the clothes. It is possible for either or both statements to be true, but not for both to be false. This is what is meant by an inclusive disjunction.

In Kpelle, the third type of proposition is the exclusive disjunction, as in *ya lîi kpàa ífé lîi,* "Are you going or are you not going?" The object of the question is given two mutually exclusive options, one of which must be true and the other false.

The inclusive and exclusive disjunction are both indicated in Englsh by the ambiguous word "or," which can also be used to show an equivalence. So we can say, "I will bring a pen or a pencil"; "I will go to the movies or do my homework"; and "I used sodium chloride, or common table salt, in the experiment." The first statement is true if either or both of the alternatives is true; the second normally implies that only one is true; and the third shows the equivalence of the two terms. Therefore English is, in this point, far more ambiguous than Kpelle.

IMPLICATION

The fourth type of proposition in Kpelle is the following: *nà pà, ná pâi bá mîi,* "If I come, I will eat rice." The only way in which this statement can be false is if the antecedent is true and the consequent false, that is, if I come, but do not eat rice. Otherwise, even if the person has not yet come, we accept it as a true statement. This is a statement obviously different from the conjunction, where both antecedent and consequent had to be true, and different from either form of the disjunction, where either clause had to be true. We call statements of this fourth type implications. In Kpelle, as in English, they can be written in many different ways.

Kpelle arguments make frequent use of implications. The most common form is to use the phrase *à kè tí,* "if it should be so," to precede the final statement of the argument.

In English we can express the equivalence of two expressions by using a double implication, as in the statement, "You will pass the course, if and only if you pass the final examination." It is not possible to easily express in Kpelle such double implications or equivalences.

LOGICAL CONNECTIVES AND LEARNING

In order to determine the possible implications of these linguistic observations for learning situations which involve the use of logical connectives, we devised the following experimental situation.

Subjects are shown pairs of stimuli, two pairs per trial. One of the pairs was an exemplar of a logical rule, and the other was not. The subject's task was to tell the experimenter which stimulus pair embodied the rule and was thus correct on each trial. For instance, the stimulus pairs might be made up as in Figure 14. The stimuli were pieces of cloth colored red, green, yellow, or white. On each trial the experimenter chose the appropriate pairs of cloth stimuli and laid them out in front of the subject. (The stimuli for American subjects were paper squares pasted on

large cards.) In the example given in Figure 14, the pairs are red-green and red-yellow. Let us suppose that the rule in this case is conjunction; red *and* green is correct, but red or green combined with any other color is not correct. The subject makes his choice and is told if he is correct or not. Then a new set of stimuli is shown and he must choose again. He is allowed to choose until he has chosen correctly 10 times in a row, or has reached 40 trials. As in some of the other studies in this book, the measure we have used to evaluate the ease of learning is the number of the trial of last error before the subject makes 10 correct responses in a row (with a score of 40 assigned to anyone who failed to learn).

We hoped that the results of this experiment would provide answers to several questions that interested us. For instance, would the fact that the Kpelle have an unambiguous term for inclusive disjunction facilitate their learning in a situation
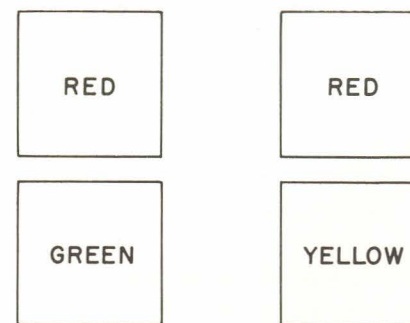

Fig. 14. Typical pair of stimuli used in the experiment testing the ability to learn logical rules.

which involves disjunction? We know from the work of Bruner and others that for the adult American, disjunctive concepts are relatively more difficult than conjunctive concepts, but we do not know if this is true in other cultures. Also, will the Kpelle have difficulty with a learning task involving the use of logical connectives? How will they perform in comparison with a group of Americans of roughly the same age?

In order to obtain data relevant to these questions, the following logical problems were presented to groups of 20 Kpelle adults, schoolchildren, and illiterate children: conjunction, disjunction, negation, implication, and equivalence. Comparison data for the first three rules were obtained from 40 American adults, most of whom had failed to finish high school, but who could read, and American schoolchildren ages seven to nine and ten to twelve.

The data in terms of the median number of the trial of last error are presented in Table 6 for the disjunctive, conjunctive, and negation problems used with all the groups of subjects.

Several points in the table warrant comment. First of all, the Kpelle do considerably better than the Americans on disjunction and negation, and approximately as well on conjunction. Secondly, although disjunction is obviously more difficult than conjunction for the Americans, disjunction is easier than conjunction for the Kpelle. Negation is the most difficult of the three rules for all groups of subjects.

TABLE 6
MEDIAN TRIAL OF LAST ERROR OF KPELLE AND AMERICAN SUBJECTS IN
LEARNING LOGICAL RULES

		Conjunction	Disjunction	Negation
KPELLE ILLITERATE CHILDREN	(20)	12.2	7.5	18.2
KPELLE SCHOOLCHILDREN	(20)	1.5	0.0	13.0
KPELLE ILLITERATE ADULTS	(20)	14.0	0.0	22.0
AMERICAN CHILDREN (7–9)	(10)	12.2	12.0	38.0
AMERICAN CHILDREN (10–12)	(25)	1.9	5.0	21.0
AMERICAN ADULTS	(40)	7.0	5.0	36.0

Although there are no comparative data and therefore no score tabulation, the Africans generally found implication harder, and equivalence almost impossible.

What can we conclude from these findings? The overall superiority of the African subjects is certainly impressive. Could it perhaps be accounted for by some peculiarity in the way the instructions were translated or the stimulus materials presented? This kind of explanation is unlikely. First of all, the same sorts of factors which operate in this experiment were presumably present in the geometric figure-learning discussed earlier. But in that experiment the Kpelle experienced serious difficulties. Secondly, it is difficult to see how any such factors could account for disjunction being more difficult for Americans than conjunction, but easier for the Kpelle. The most obvious hypothesis is that the precision of the Kpelle language with respect to disjunction aids them in this task. We will want, however, to verify this finding in other situations.

Before concluding this analysis of the formal structure of the Kpelle language, it is important to note that our breakdown of Kpelle into nouns, verbs adverbs, pernouns, connectives, and structures is not a system that a Kpelle person would devise. The Kpelle are not self-conscious about their language, no more than most Americans are self-conscious about English.

CONSTRUCTION OF ARGUMENTS

Propositions are not merely stated. They are used in discussion and argument. The typical Kpelle argument seeks to establish a conclusion on the basis of certain statements. To the best of our knowledge, this conclusion is almost never derived on a logical basis, but on the basis of tradition and experience. Consequently, a detailed discussion of types of argument does not belong in this chapter. The formal way to construct an argument in Kpelle is to make the statements which are supporting evidence, and then give the conclusion, preceded by either *à kè tí,* "if it be so," or *maamêni mà,* "for this reason." We have recorded only one case of something resembling a sustained logical argument: "In the way that all men will die, in the way that Sumo also is a man, in the same way Sumo will die." The Kpelle are capable of such an argument, cast in classical syllogistic form, but neither they nor Americans find much occasion to use such an argument.

To summarize, we have discussed Kpelle logical structures, but without making reference to their use of logical structure in learning and thinking. We have dealt with logic on a purely formal level. We have seen that the Kpelle have a language which can adequately describe the world of their experience. Terms are divided into several classes. Nouns name the contents of experience, and are either countable or noncountable, personal or impersonal, dependent, or free. Predicates may consist of an adjective, pronoun, verb, or possibly an adverb or noun phrase. Verbs all indicate actions of the subject, and are either transitive or intransitive.

Simple propositions can be made into compound ones by the use of certain logical connectives. These connectives parallel those used in formal logic, in all but one case. The Kpelle have in their language a negative, several conjunctive expressions, disjunctive expressions (both inclusive and exclusive), and several expressions for implication. They can only express equivalence in a complicated way. Their use of logical connectives is reflected in their ability to learn patterns which display those connectives. They find disjunction easiest; in order of increasing difficulty are conjunction, negation, and implication. Equivalence they find very difficult. This pattern contrasts significantly with American behavior, and many of the differences seem to reflect differences in linguistic structure between Kpelle and English.

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AMERICAN ADULTS	(40)	7.0	5.0	36.0

Although there are no comparative data and therefore no score tabulation, the Africans generally found implication harder, and equivalence almost impossible.

What can we conclude from these findings? The overall superiority of the African subjects is certainly impressive. Could it perhaps be accounted for by some peculiarity in the way the instructions were translated or the stimulus materials presented? This kind of explanation is unlikely. First of all, the same sorts of factors which operate in this experiment were presumably present in the geometric figure-learning discussed earlier. But in that experiment the Kpelle experienced serious difficulties. Secondly, it is difficult to see how any such factors could account for disjunction being more difficult for Americans than conjunction, but easier for the Kpelle. The most obvious hypothesis is that the precision of the Kpelle language with respect to disjunction aids them in this task. We will want, however, to verify this finding in other situations.

Before concluding this analysis of the formal structure of the Kpelle language, it is important to note that our breakdown of Kpelle into nouns, verbs adverbs, pernouns, connectives, and structures is not a system that a Kpelle person would devise. The Kpelle are not self-conscious about their language, no more than most Americans are self-conscious about English.

CONSTRUCTION OF ARGUMENTS

Propositions are not merely stated. They are used in discussion and argument. The typical Kpelle argument seeks to establish a conclusion on the basis of certain statements. To the best of our knowledge, this conclusion is almost never derived on a logical basis, but on the basis of tradition and experience. Consequently, a detailed discussion of types of argument does not belong in this chapter. The formal way to construct an argument in Kpelle is to make the statements which are supporting evidence, and then give the conclusion, preceded by either *à kè tí,* "if it be so," or *maa-mêni mà,* "for this reason." We have recorded only one case of something resembling a sustained logical argument: "In the way that all men will die, in the way that Sumo also is a man, in the same way Sumo will die." The Kpelle are capable of such an argument, cast in classical syllogistic form, but neither they nor Americans find much occasion to use such an argument.

To summarize, we have discussed Kpelle logical structures, but without making reference to their use of logical structure in learning and thinking. We have dealt with logic on a purely formal level. We have seen that the Kpelle have a language which can adequately describe the world of their experience. Terms are divided into several classes. Nouns name the contents of experience, and are either countable or noncountable, personal or impersonal, dependent, or free. Predicates may consist of an adjective, pronoun, verb, or possibly an adverb or noun phrase. Verbs all indicate actions of the subject, and are either transitive or intransitive.

Simple propositions can be made into compound ones by the use of certain logical connectives. These connectives parallel those used in formal logic, in all but one case. The Kpelle have in their language a negative, several conjunctive expressions, disjunctive expressions (both inclusive and exclusive), and several expressions for implication. They can only express equivalence in a complicated way. Their use of logical connectives is reflected in their ability to learn patterns which display those connectives. They find disjunction easiest; in order of increasing difficulty are conjunction, negation, and implication. Equivalence they find very difficult. This pattern contrasts significantly with American behavior, and many of the differences seem to reflect differences in linguistic structure between Kpelle and English.

11 / Verbalization and learning

LOGIC

ONE OF THE UBIQUITOUS FINDINGS in our experiments is that Kpelle subjects had great difficulty when asked to explain the reason for an answer or to state the general rule underlying the solution of a problem. For example, after learning to identify a rule (such as conjunction in the logic identification experiment) the subjects were routinely asked to describe what it was about the stimuli that determined their correctness. Rarely was a general answer given, such as, "The alternative which contains both red and green is always correct." In fact the request for a description of the concept was often disturbing to the Kpelle subjects. They were forced to use the particular stimulus in front of them to formulate a statement. Very often the response would be simply a description of the particular stimulus pair they had chosen. At other times, the response would be: "God told me," "I know it by my sense," "I can see it." Moreover, after giving such a description, the same Kpelle person who had identified the concept would often no longer make correct responses if further stimulus pairs were given to him. It seemed almost as though having invented an *ad hoc* verbalization, he would then feel forced to maintain it on subsequent trials.

GEOMETRY

This same inability to describe identified concepts appeared in the geometry tests. Descriptions were occasionally correct, but often wildly irrelevant. Commonly, persons would name an object out of their experience which resembled the correct figure on the last trial. Some said the triangle was like a house or like one of their musical instruments. The circle was described as being like the sun, or like an egg. Yet, there are Kpelle terms for both the circle and the triangle.

A detailed analysis of the responses given on the test distinguishing the triangle from the circle supports this conclusion. Twenty persons were tested, of whom all but one completed the test. Of the 19 who completed the task, 3 were unable to verbalize the concept at all. Four named the circle as round and 2 named the triangle, using the Kpelle term. The circle was described variously by others as like a wheel, a pot, a bell, and a pan. The triangle was described as branched, straight, having three senses, the butt of a gun, a checkerboard, and a musical instrument.

Others said they liked the figure, or that it was fine. And one drew the two figures with his fingers.

A sample of the more unusual answers from other tests is interesting, but it must be remembered the most of the answers were more prosaic. One informant said that the correct figure (in this case a triangle) was the path of a fair person, but that the wrong figure (a rectangle) was the path of an unfair person, because he had several paths to escape on. Another said that a right angle was made well and a non-right angle made badly. One said that a straight line was the path of a fair man, and the curved path that of an unfair man. Another said that the curved line was better drawn than the straight line.

COMPARISON

One exception to this inability to describe the correct concept was in the experiment concerned with identifying the greater or the smaller of two piles of stones, where about 50 percent of the subjects were able to state the concept. There were 160 cases altogether. At the end of this experiment, 53 statements were made correctly describing the larger pile, and 27 correctly describing the smaller pile (incidentally, this confirms the dominant role of "greater than" in the language). There were 18 responses giving the number of stones in the last correct pile. Four persons made statements equivalent to "I know it." The remaining 58 could not state why the pile chosen was correct. By contrast, in a typical set of 160 responses on logic tests, there were only 23 correct descriptions of the rule, 36 incorrect attempts, and 101 cases in which the subject was unable to offer any description.

THE VERBAL MEDIATION EXPERIMENTS

What is the relation between a subject's ability to verbalize, to construct a verbal rule, and his ability to learn the types of problems we have set for him and which he is sure to encounter in school? Certainly the relationship cannot be a simple one. Verbalization on the logical connectives learning problem is very poor, but the learning is relatively rapid. Conversely, learning on the geometry identification problems was poor, but the amount of verbalization was equal to or greater than that for logical connectives.

Because of the emphasis placed on verbal skills in school and the importance attributed to the role of verbal processes in the mediation of higher mental functions, we thought it important to obtain more evidence on this question.

One of the techniques we used can best be illustrated by considering the following problem: Suppose we show a person a tall-green block and a short-white block and ask him to tell us which block we "have in mind." After a very few trials, if that tall-green block is consistently called correct by the experimenter, he will consistently point to the tall-green block, regardless of its physical location. Now we complicate the problem slightly. On some trials the pair of blocks shown is tall-green and short-white. On the other trials the pair is tall-white and short-green. Let us suppose further that for the first pair tall-green is correct, while for the second pair

short-green is correct. Even though we mix the order in which we present the pairs and the position of each block in a pair, our subjects will rather quickly come to identify the correct block on each trial. The question is: By what process have they arrived at the solution to this problem?

American psychologists who have worked with this technique propose these two processes. The first, which is characteristic of small children, is to learn two separate responses, involving the absolute properties of the correct block in each pair. The second process, characteristic of older children and adults, is to learn a verbal label for the correct type of stimulus. This may be an implicit phrase such as, "Color is the important thing, and green is correct." In other words, the adult is said to use a verbal label which mediates his correct responses, while the child operates without this mediating process.

A second stage in the experiment is necessary to determine the validity of this hypothesis. After the subject has identified the correct block on 9 out of 10 trials, the task is changed in one of two ways. For some subjects the correct blocks are now tall-white and short-white, while for others the correct blocks are tall-green and tall-white. For the former subjects the previously relevant dimension, color, is still relevant, but now white is correct. For the latter a new dimension must be used, height.

If our hypothesis about the two types of learning processes is correct, we might make the following predictions. For those who learn which blocks are correct without applying verbal labels, the shift to a new dimension ought to be easier. After all, one of the old pairs is still correct, so there is just half as much to learn. If, however, the subject has labeled the correct dimension "color," he will have an easy time with the shift to another color since he is already paying attention to that aspect of the stimuli. In other words, the verbal label mediates his move from one stimulus to another. The prediction is that older children ought to learn faster when switched within a dimension, but younger children ought to learn faster when switched to a new dimension.

These predictions were confirmed in an interesting way by the Kendlers (1964) working with American children some years ago. These children, about five years old and in kindergarten, learned the two types of shifts with equal speed, requiring 12.2 and 15.2 trials to learn for the extradimensional and intradimensional shifts respectively. When the children were divided into groups of fast and slow learners, however, it was found that the fast learners showed the "mediated" pattern—they learned the intradimensional shift more rapidly. The slow learners mastered the extradimensional shift more rapidly. The Kendlers realized that they were working with subjects who were in a transition state between nonverbal and verbal thinking; by selecting fast and slow learners, they were sampling from those who had reached the higher developmental stage and those who had not.

Most interesting from our point of view is the fact that when this experiment was repeated with Kpelle children of a comparable age, *exactly the same pattern of results was obtained*. The only noticeable difference between the Kpelle and American groups was that the Kpelle children learned faster on all aspects of the problem. The two types of shifts are each learned in 7.8 trials. When we look at the

fast learners, the intradimensional shift is learned faster than the extradimensional shift, while the reverse is true of the slow learners. These results are summarized in Table 7.

TABLE 7
MEAN TRIAL OF LAST ERROR OF KPELLE AND AMERICAN YOUNG CHILDREN
IN SORTING COLORED BLOCKS

	Kpelle Illiterate Children (64)	
	Slow Learners (below median)	Fast Learners (above median)
REVERSAL	11.6	4.1
NONREVERSAL	7.8	7.9
	American Children (64)	
	Slow Learners (below median)	Fast Learners (above median)
REVERSAL	24.4	6.0
NONREVERSAL	9.0	15.5

This experiment seems to provide rather convincing evidence that simple forms of verbal mediation develop in the Kpelle child at about the same time that they appear in American children.

What about more complex problems of the same sort? Will the verbal mediation pattern of responding be maintained? To answer this question another experiment involving intradimensional and extradimensional shifts was run with Kpelle adults and older children. True to the trend obtained with the young children, the older Kpelle groups were superior when shifted within a dimension, indicating that they were using verbal labels to help mediate their learning. However, for these complex materials the Kpelle learned more slowly than their American counterparts. Moreover, the performance of the Kpelle adults was *worse* than that of Kpelle schoolchildren or illiterate children.

The pattern of these results, considered with evidence from other studies, suggests certain conclusions concerning the role of verbalization in learning among the Kpelle.

First of all, it appears to be a mistake to dichotomize learning (or thinking) into the categories concrete and abstract. Such a dichotomy is at least irrelevant, and perhaps wrong, in discussing the results of the studies reported here. There seems to be clear evidence that the Kpelle use generalizing verbal labels in their solution of simple problems. Although there is nothing very abstract about the problems, there is also nothing particularly concrete about the solutions. Concrete and abstract are two poles on an unspecified dimension. Rather than attempt to fit any bit of behavior into one category or the other, we must concentrate on specifying the level of abstractness present in any given situation and then determine what can be done to increase it.

One of the findings that caught our attention was the seeming lack of improvement in performance in various problem-solving tasks when the Kpelle adults are compared with the Kpelle schoolchildren. In the problem of shifting responses from one dimension to another, there is even some evidence that the adults may do worse than the children.

It would be a mistake to conclude from this that beyond the age of ten or so the Kpelle undergoes no intellectual development. Rather, it appears from several observations that the adult has learned to approach such problems in a manner that may actually hinder the solution. We have already mentioned the primacy of tradition in the determination of a man's prestige in the community. In an odd way, this factor seems to enter into the learning of new and (from the Kpelle viewpoint) bizarre problems. Instead of seeking to achieve a rapid and accurate solution to the problem, many adults seem to be seeking a clever hyperbole with which to describe the situation. After all, according to the Kpelle, the clever man is the one who constructs the unanswerable argument, not necessarily the man who is right!

Perhaps it may be a mistake to pose the problem (as we did earlier) simply in terms of the relation between verbalization and learning. What the Kpelle verbalizes and how he verbalizes it depends very much on the degree to which the topic or problem fits into his cultural framework. It seems that one of the ways in which our American and Kpelle subjects differ is that the Americans learn to label and categorize a plethora of things, imposing cultural relevance on seemingly unrelated things. This "cultural detachment" seems not to be part of the thinking of the Kpelle adult whose categories have been preformed by tradition.

It is important to note in this connection that the schoolchildren are clearly the best performers in all of the problem solving tasks we have used. Obviously, the first two years of schooling have more effect on the child than our survey of their mathematics learning would indicate. The children appear to be learning the ability to use generalizing verbal labels about a wide range of things.

This is highlighted by the results of the attribute sorting experiment mentioned earlier, where 8 cards could be sorted into triangles and squares, 2 or 5 figures, and red or green figures. Had we asked the adults to sort cotton goods into country cloth or store cloth, sewed into clothes or not, and dirty or clean, the response would probably have been much quicker. Why then the difficulty with circles and triangles? The answer we propose is that the application of a general label to objects such as those which are presented in an unfamiliar way was very difficult for the adults, but less so for the schoolchildren who had learned something about the arbitrariness of classification schemes.

12 / The Kpelle world view

KNOWLEDGE AND TRUTH

WE CAN ATTEMPT to formulate the Kpelle view of knowledge and truth from the foregoing. Knowledge is the ability to demonstrate one's mastery of the Kpelle way of life. Truth is the conformity of one's statements and actions to that way of life. These definitions are, of course, profoundly relativistic. They are without substance outside the boundaries of Kpelle land. And, indeed, the Kpelle man recognizes that each culture has the right to set its own standards, to recognize knowledge for itself, and to submit to its own truth.

Many facts about the Kpelle seem to fall into place if it is recognized that for them there are no ultimate standards, that the culture is its own reason for existence, that truths are self-validating. The absence of ultimate standards, a direct consequence of the Kpelle understanding of truth and knowledge, is evident in the Kpelle man's willingness to recognize another man's way of life in his own land. The Chinese can grow up to ten times as much rice as the Kpelle under comparable conditions—but that is the Chinese way, not the Kpelle way. The Vai do not eat monkeys and the Kpelle do. Americans boil their water, and the Kpelle do not. The Kpelle man seems to be unconcerned about the contradiction because to him there seems to be no contradiction. Each tribe has its own ways, and the fact that they differ is not at all surprising. This complaisant tolerance might be one of the principal reasons why the Kpelle do not feel challenged to accept the proposals for change made by outsiders. Those children who go to school and acquire a new set of values and ideas are simply regarded as tribal emigrants. They have joined a new tribe by their own choice. What they now do and think is, therefore, quite naturally different from what their parents do and think. They are no longer Kpelle, and they certainly have nothing to tell their parents.

That the Kpelle culture is its own reason for existence is a clear corollary of Kpelle concepts of truth and knowledge. There seem to be ultimately no reasons in education and problem-solving except that most fundamental of all reasons—authority. Moreover, authoritative truths are self-validating. Yesterday's statement of a given truth is the justification for today's statement of it and for tomorrow's action based on it. Thus all values are rooted in the past, and change in essential areas is consequently feared. Such change threatens to shatter the self-validating

system of authority. It is not so much "what is, is right," as "what has been, is right."

This explains why knowledge is primarily a possession of the elders. They have been in most intimate contact with the past. They *are* the past, living on in the present. It rends the fabric of Kpelle society for a man to challenge the authority of his elders. The new generation must listen and imitate, must be subservient, until one day they too will be the living embodiment of the tradition.

Secrecy is basic to Kpelle culture. A child cannot understand the past until he joins the secret society, which is the agency of preservation of the past. A child must mature, must be disciplined, must be prepared to enter into full possession of his culture. He must be shaped and molded so that he will have no desire to change what he has inherited. He must wait silently until his turn arrives to be the elder. Important men in the village became angry when asked how they knew certain mathematical facts. They would not answer. This was not information to be given out lightly, even if they knew the answer. For the old people, a fact is a fact. It cannot be called into doubt. It is self-validating, and needs no reason to support it. The child who asks "why?" is considered "frisky" and is beaten for his curiosity.

Knowledge for its own sake seems to have no place in Kpelle society. Education fashions the child in the mold of his ancestors. He learns to do what his parents and the village and the tribe and the history of his people force him to do. Knowledge as a preservative of the community, and as a support for the prestige of the elders, has great value. Education perpetuates a way of life, and so produces a reverence for what has been. It stifles individual creativity that the system might survive.

This helps to explain why "circular" reasoning seems so prevalent in Kpelle thought. Recall the cases we have mentioned. A person who confesses the crime of killing a baby through witchcraft will have two pieces of evidence for his crime: the baby died, and he had a dream about eating meat. The baby died because he ate him in his dream. And it was the baby he ate in his dream because the baby died. Or, women are convinced that they have children because the old woman living in the "spirit" tree on the edge of town has helped them. They know that the old woman helped them because they have children. In Kpelle society, facts are closed to an empirical test and to the influence of the outside world. Each facet of the tradition is justified by the whole of the tradition, and the whole of the tradition is justified by the parts.

A fact, perhaps a gem of wisdom supported by the elders, is not useful because it will lead to new activities, or because it will open up hitherto unknown pathways to knowledge. What is known is known by the elders, and will be known in due course by the new generation. And what is unknown is destined never to be known. So knowledge is largely unproductive, and there seems to be little need to transfer it to new situations. A fact is relevant in its own context but not in another. One tragic instance of this inability and unwillingness to transfer learning is the case of a worker in a local clinic. His job was to explain to his own Kpelle tribal people the importance of proper medical procedure, so that they would obey the doctor's orders. But when his own child was sick, he did not bring him to the clinic,

but allowed him to be treated with traditional medicine. The child died of a disease which could easily have been cured. For this man clinic knowledge had its place within the clinic, and not in his home village.

What then is the need of a careful, analytic, isolating use of language? Why should a Kpelle man pay close attention to the denotation of words and the implications of statements? Such behavior is not ordinarily essential to survival within the Kpelle system. The connotation of words is far more important. A person wins an argument by showing the support of Kpelle tradition for the actions which everyone knows are his. He need not indulge in logical deduction or quote evidence; he need only establish a convincing context for his words and deeds.

For scientists, information is productive, open to challenge and modification, and a source of suggestions for new ways of doing things. In Kpelle society, information is definitive, closed, and conservative. Most Kpelle cannot conceive of a culture not bound to authoritative structures and secrets, but dynamic and creative. In short, his way and the scientist's way are in complete opposition.

In addition to the observations and experimental work (already cited in this book) which support this analysis, there are two other lines of evidence which seem pertinent to a discussion of the Kpelle world view.

TERMINOLOGY

The first line of evidence comes from an analysis of Kpelle words for truth and knowledge. Contrary to any simplistic hypothesis about the relation between a culture's vocabulary for verbalizing about knowledge and their world view, the Kpelle have a well-developed system of knowledge words. They have terms which correspond roughly to our English words know, believe, true, opinion, trust, error, forget, understand, think, lie, clarify, overlook. The sentences in which these terms are used parallel very closely the corresponding sentences in English. The contrast with our Western scientific method is not at all apparent from this account of Kpelle terminology.

However, we think it would be a mistake to reject our findings on the basis of linguistic evidence. In fact, if we look a bit deeper, we find that we should expect the language to operate in this way. The Kpelle have an internally consistent system of life and thought, in which a person learns, thinks, knows, believes, trusts, forgets, lies, is clever or stupid, honest or dishonest. All of these actions or states are as appropriate within a tradition-oriented, radically relativistic society, as they are within a truth-oriented, scientifically inclined society. The important thing is the use of these words in a context wider than the simply linguistic one. We have found this usage among the Kpelle to be radically different from the usage we expect in the Western scientific community.

THE KPELLE OUTSIDE KPELLE LAND

The second line of evidence for our thesis that the Kpelle view of knowledge is relativistic and tradition-bound is supplied when a Kpelle leaves his community and enters another culture. If he chooses consciously to break with his home cul-

ture, he finds it relatively easy to accept the patterns of a new culture. He believes that the ways of other tribes are as worthy of respect in their own land as are his ways at home. Another man's truth may be different, but the Kpelle man is willing to live according to that truth when he enters a different society.

The Kpelle man is adaptable to other cultures, including the transition culture, which is rapidly dominating all Liberia, particularly where the motor road has penetrated. Interviews with village people clearly revealed that the road has brought the most change to Kpelle land. With it comes a new culture, a new way of life, new standards—or lack of standards. Many tribes mingle in new villages. One such community has a total of nine houses; living in them are persons from the Mende, Gbandi, Loma, Gola, Belle, Kpelle, Gio, Bassa, Mandingo, and Krio tribes—more tribes than houses. Naturally no one tribe can dominate, and thus a new set of standards must develop. There are certain traits and attitudes which are common to most of these tribes, as well as to the Americo-Liberian community, and from these a new *ius gentium,* a law of the nations, is arising.

The Kpelle man adapts to this new situation as well as the rest. He realizes that his background differs from that of his neighbors, and he adjusts to the community ways of life. Once outside his own milieu, defined by the power of the secret society and the chiefs, his own standards break down. He partially loses his own culture, although he can assume it again when he returns to his original home for a visit.

Thus the Kpelle man, because of his relativistic view of truth and his unreadiness to generalize, and because his own system does not extend beyond Kpelle borders, is more open to other cultures than someone from a more exclusive, absolutist culture. On the other hand, he is less open because neither his old standards, nor any new ones, are based on internal conviction.

In many ways, the new culture resembles that of his own home. The life in the Coastal cities, as well as in the new towns along the road, is similar in many ways: a deference to authority, a high valuation placed on clever use of strategy within customary patterns, and an atomic individualism. There is even a similar pattern in such commonplace matters as food, dress, and choice of friends and mates. The educated Kpelle man finds a pattern of life which may allow him to remain spiritually akin to his village brothers, even though alienated in other ways. The role of the Poro resembles that of the "civilized" secret societies, like the Masons, and continues to have great influence.

It is likely that the new pan-Liberian culture will simply allow the old patterns to persist, but without their responsibility to a living tradition. Unless the new tradition to which the Kpelle man comes can provide him with internal conviction and coherence, enabling him to rise above his complaisant relativism, he will probably continue to drift aimlessly. If this is not to be the case, a new attitude toward life and learning must somehow develop. One principal place where this development may be possible is the school. If our study has any real significance, we should be able to help the schools achieve this goal. It is to such recommendations for teachers that we now turn.

13 / Recommendations

DIFFICULTIES IN SCHOOL

WE BEGAN OUR STUDY with a twofold goal, namely, to understand the Kpelle child, and to recommend better methods of teaching him. In an attempt to understand the behavior of the Kpelle, we have found that the child has difficulty in using the language of his teachers, whether it is Liberian-English or standard English, preferring the loose, connotative style characteristic of his culture.

He is also unwilling, or finds it extremely difficult, to relinquish rote memory and imitation, stemming undoubtedly from the long-ingrained traditional Kpelle method of learning. We can see why, for similar reasons, he does not transfer knowledge from one area to another and why shrewd guesswork takes the place of discovery. We better understand, too, why he does not follow a train of reasoning to its conclusion, and why he is not upset by inconsistencies, passing innocently over logical pitfalls and errors.

It is obvious that the instruction he receives in school dismays and confuses him without enlightening him. Rote memory and imitation are, from the Western scientific point of view, totally wrong when employed to teach the Kpelle child, because these methods disregard the substance of his social and material daily life. Considering the many hours spent in trying to force him to accept an alien content through a methodology which cannot, by its very nature, make that alien content clearly understood, it is remarkable that the Kpelle schoolchild has learned anything at all.

AUTHORITY AND REASONING

What then is to be done? Our basic recommendation is for the teacher to reverse the present pattern of education. Instead of using the traditional Kpelle authoritarian method of rote memory and imitation as a means of introducing the Western content, the teacher should use the Western, scientific method for comprehending, clarifying and organizing content drawn *directly* from the child's familiar, daily experiences.

The Kpelle schoolchild does not in the present system of education organize his universe of school experience in a meaningful way. He does not look analytically at the structure or shape of visual stimuli. He does not pattern the words he hears,

nor does he think of mathematics in terms of laws and regularities. Instead, he accepts each item of knowledge as an isolated gem, connected in some mysterious way to the wisdom of accepted authority.

We see this lack of analysis, this unquestioning acceptance of authority, as the primary stumbling block to the Kpelle child's progress in school. For him the world remains a mystery to be accepted on authority, not a complex pattern of comprehensible regularities. The teacher must help him (and those children of other similar cultures) to overcome this difficulty by trying to break through this authority structure, always using materials and analogies from the child's daily life and setting them in a framework coherent and comprehensible to him.

To be most effective, the teacher should begin with materials of the indigenous culture, leading the child to use them in a creative way. To achieve this, the teacher must beware of the temptation to become a new authority figure, replacing the tribal elders. The child will seek authoritative answers as he has been accustomed to do. They should *not* be given. The teacher must show him the way to cross the bridge from the old culture to the new culture—which is impinging upon his life at an accelerating pace. The elders of his tribe pushed him frightened and ignorant through the fence into the Bush school—he has always been pushed blindfolded into the future by traditional authority, and his future has always remained much like his past. It is therefore essential that the child himself cross the bridge between cultures, with his eyes wide open. Instead of saying, as in the past, "So they say," he must learn to say, "I see."

To this end, the teacher must study the local culture and use its content so that the child may understand himself, and in understanding, break away from the traditional and authoritarian justification the tribe gives to that content.

SPECIFIC SUGGESTIONS

For the foreigner who comes to an African community to teach, a major problem is in getting close enough to the culture of his pupils in order to teach effectively. For the member of the tribe who will be teaching, the problem is in detaching himself sufficiently from his culture in order to gain perspective and objectivity enough to teach effectively. In the following, we will discuss some procedures both the foreign teacher and the Kpelle teacher can follow in applying what we have learned in the areas of logic, arithmetic, geometry, and measurement. The imaginative teacher should be able to create similar approaches to other topics in elementary mathematics instruction.

Logic In the area of logic, the most important thing to be learned from our study is that the children have the linguistic and psychological facility for both inductive and deductive reasoning. The teacher must draw on this facility in such a way that his entire classroom is a living example of the scientific method. He can arrange his data in patterns so that generalizations and answers are suggested to the student, and in so doing can help to develop inquiring intellects.

These characteristics are present in other cultures, as well as Kpelle, but they are often recessive and submerged. They can be made dominant in the child's life by this emphasis on free and inventive teaching and learning.

Arithmetic We have pointed out that arithmetic is built upon the idea of sets and their members. Instead of the usual methods of teaching first grade arithmetic, using an orderly system derived from Western examples, it would be far better if the teacher would use information such as that we have discovered concerning the Kpelle. For example, the teacher could have the children bring in collections of objects which they themselves would be asked to describe. They may then be asked to put these objects into various groups, according to their own method of classification. The teacher may then lead them to say what the groups have in common, and how they differ, leading them to state in their *own* terms that they have, for instance, a set of stones, a set of bottle caps, or a set of leaves. They may volunteer the words for such sets in their own language, and the teacher can use this information as a way of introducing English terminology. The details will vary from classroom to classroom; the important point is that the teacher let the children be *his* teachers as he gathers this information as the basis for *their own* organization of experience in an arithmetical framework.

Geometry In the area of geometry, the teacher might use the usual method of teaching, but since we have discovered that the Kpelle have very few nouns in the language for geometric shapes, there is a much better approach suggested by some of our experiments in identifying shapes. For instance, one particular experiment dealing with successive circles and triangles and correctly identifying eight in a row, as described in Chapter 8, is appropriate for a teaching situation.

Instead of presenting the stimuli to one subject, the teacher may use the entire class, divided into two teams, which guess alternately. He can use an object, such as a wood carving or a dunce cap, to be held by the team making the last error. The only way for one team to get rid of the object is for the other team to make an error. Thus, the team to make the last error will, at the end of the game, be found holding the object.

The stimuli can be presented in large blackboard drawings, and erased after the team has made its guess and been affirmed or corrected. After the class has identified the correct shape by guessing eight in a row correctly, the teacher should ask them to state the reason for choosing that shape. They should be encouraged to describe it as thoroughly as possible, and be given plenty of time to do so. If they can describe the correct concept but cannot name it, the teacher can help them make up a name of their own. Only after that has been done should he tell them the proper English name for the shape. He can then help the students find familiar objects in everyday life which are of the same shape, and name them.

Measurement In Kpelle culture, the local system of measures for dry rice is a perfect beginning for the discussion of the concept of measurement. These measures form an interrelated system, closely analogous to our English system. It is possible to introduce measurement without using this bridge from the traditional culture, but our experience is that the children will neither understand, nor properly use systems of measurement taught in that way. But if the Western units and procedures for measurement are taught parallel with the system the children know, leading the class to see the value of a coordinated, standardized system of measures, the Western concepts will then make sense.

CONCLUSION

Although the foregoing suggestions are specifically aimed at the teacher of mathematics in a Kpelle village, they have a wider significance. As we mentioned earlier, our emphasis on the need for effecting a rapid change from Kpelle to Western technological educations does not rest on any assertion of the innate superiority of the latter. The basic motivation is that the world's non-technological peoples, including the Kpelle, need a way of coping with the increasing exploitation and misery produced when Western cultures come in close contact with them without specific attempts at amelioration.

There are aspects of the Kpelle culture and of many cultures like it which should be altered, notably the blind acceptance of the authority of the past. However, Kpelle folktales, for example, indicate a delight in cleverness and dislike of authority, and where the authority of the culture does not stifle independence, such people are frequently open and pragmatic. The child must try, therefore, with the help of the teacher, to retain as much as possible of his cultural heritage. He must not become simply a poor imitation of an American or European child. He must *not* lose his identity.

The teacher shall in this way be helping the child to see the universality of mathematics and scientific method, a universality which allows him to apply his mind to any problem or question. The teacher can lead him to see that knowledge is productive and creative, lead him to a full understanding of his world and the power to improve it.

We conclude with the important conviction that children of the Kpelle or other cultures are capable of learning if they are taught correctly. Starting with a mind of rich potentiality and a subtle, flexible language, the Kpelle child can indeed improve the world he lives in. If this child understands his own heritage with the creative, open mind of the scientist, he himself will form his own future in continuity with the past.

We who are outsiders cannot predict what that future will be. Surely the Kpelle will form part of one larger unified culture, with features drawn from many societies. How they will achieve this goal is for the Kpelle and their fellow Africans to decide.

It is to those teachers who are willing to make this affirmative assumption with us, and who are willing to provide their students with the learning tools and attitude of mind necessary to shape their future, that we dedicate this book.

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