# Culture and Cognition

## Cultural anthropologists are now investigating the logical structure of culturally organized behavior.

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Cultural anthropology has as its central interest the description and analysis of a certain kind of regularities in human social behavior. The regularities in question are the customs—or, to use the technical term, the culture—of the group. The work of describing such regularities within the boundaries of a particular society during a brief cross section of time is called ethnography. All of the comparative and theoretical work of cultural anthropology depends upon thorough and precise ethnographic description.

Systematic ethnography began about a century ago. The early ethnographic works were exercises in natural history and were of theoretical interest chiefly insofar as they provided materials for crude calendars of cultural evolution. The naturalistic phase was succeeded in the early 20th century by a Linnaean period during which interest in cultural evolution flagged and intense effort was directed toward the exact and detailed description, or at least classification, of thousands of languages, of various aspects of culture, and of hundreds of whole cultures on the basis of more or less objective morphological criteria. The heyday of "pure" ethnography was succeeded by the development of more sophisticated theories of cultural change, of cultural structure and function, and of the relation of cultural processes to processes in other analytical domains, such as personality structure and development, psychopathology, hominid physical evolution, and so forth. But ethnography remains the minimum essential task of cultural anthropology and continues to be the subject of intensive methodological study and experimentation.

One of the products of modern studies in ethnographic method has been an increasing awareness that the research operations of the ethnographer produce primarily not naturalistic or statistical descriptions of regularities in overt behavior but descriptions of the rules which the actors are presumably employing, or attempting to employ, in the execution and mutual organization of this behavior. A second product of these methodological studies is the recognition that a set of such related rules forms a calculus which describes cognitive process.

The work of the ethnographer, in describing the cognitive processes which have been culturally standardized in society, may perhaps best be made clear by an analogy. Let us suppose that a nonmathematician is given the task of describing a new mathematical calculus which is in active use by a group of people who have not bothered to formulate their system of calculation in a text or monograph. It has, in other words, been developing informally over the years, is currently being used in developed form, and is being taught to new users by example and by oral instruction. The investigator is allowed to interview and observe—that is, he may ask questions during coffee breaks, watch people computing, save scraps of paper from wastebaskets, take photographs of the machines employed, talk a few times with a project director, listen to people teaching one another the right way of doing things, and make other such minimally interfering kinds of observation and inquiry. He may even be permitted—and he will certainly be well advised—to join the group as a novice and learn to use the calculus himself.

Now, as he analyzes the data collected in these various ways, he does not merely tabulate the frequencies and intercorrelations of various classes of observed behavior in order to arrive at the calculus; if he did this, he would be giving equal weight to misunderstood jokes, learners' mistakes, slips of the pen, plain sloppy work, gibberish produced by broken computers, leg-pulling, and competent professional operations. What he does, instead, is to infer the system of rules which these people are attempting to apply. The assurance that he is on the way to an adequate understanding of these rules will be given him by the logical completeness of the system he infers and by his ability, when using it, to produce behavior which an expert will reward by saying, in effect, "That's right; that's good; now you've got it." Sometimes, of course, a sociologist or a psychologist will say to him, "But it is the behavior that is real, not this abstract system which no one actually applies perfectly and completely and which is merely the asymptote of the real curve of behaviors." To this the investigator simply replies that culture—conceived in this sense as a collection of formal calculi—is just as real as algebra, Euclidean geometry, and set theory, which are also "merely" the asymptotes of the "real" behavior of fallible students, professional mathematicians, and machines. Indeed, he will point out, these other calculi *are* aspects of a culture, and their apparently greater tangibility is attributable to the incidental circumstance that they have been the object of more intensive study, in order to make their elements and operations explicit, than the undescribed calculus which he has just been investigating.

Let us now look at the ways in which anthropologists are actually attempting to formulate the calculi of culture. We shall consider first the method of componential analysis as applied to kinship systems.

### Componential Analysis of Kinship Terminologies

The study of kinship is an anthropological specialty on which considerable labor and ingenuity have been lavished for many years. In particular, the terms by which the individual refers to his kinfolk have attracted attention, both because of the variety of observed arrangements from culture to culture and

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because of the rigor and elegance with which these relatively restricted taxonomies can be described. The problem of description is not simply to translate an exotic nomenclature into English or some other, scientific language. In fact, exact translations can rarely be made. The problem is to define the taxonomic system itself—that is, to explicate the rules by which the users of the terms group various social and genealogical characteristics into concepts. It is a problem in cultural semantics, then, not in practical or structural linguistics, and as a semantic problem it is of cognitive and logical interest.

The meaning of kinship terms has been traditionally rendered, among English-speaking ethnologists, by a straightforward procedure: each term is matched with a primitive English term (for example, *mother*), with a relative product of two or more primitives (for example, *mother's brother*), or (in most cases) with a group of single terms or of relative-product terms, or of both. Each primitive term and each relative product denotes a "kintype." There are eight basic primitive kintypes, and they are conventionally represented by the first two letters of the corresponding English term (*Fa, Mo, Br, Si, So, Da, Hu, Wi*); there are an indefinitely large number of relative products in which each antecedent primitive is read as possessing the subsequent primitive (for example, *MoBr* is read as "mother's brother") (*1*). The English term *uncle* thus may be defined in kintype notation by the expression:

Uncle = *FaBr, MoBr, FaFaBr, MoFaBr, FaMoBr, MoMoBr, etc.*

The definition of English *uncle* is, however, not semantically satisfactory because it does not identify the principles by which the kintypes (and the corresponding kinfolk) have been grouped into the set of denotata, and because the set of kintypes which it denotes has no finite boundary. Since kintype definitions in all languages are in general semantically ambiguous and often unbounded, anthropologists have been dissatisfied with them.

Componential analysis, as developed in the original papers of Goodenough (*2*) and Lounsbury (*3*), is a method of determining the semantic components of the concept for which a given term is a rubric. The componential analysis of a kinship lexicon commonly consists of five steps: (i) the recording of a complete set of the terms of reference; (ii) the definition of these terms in the traditional kintype notation (*Fa, FaBr*, and so on); (iii) the identification, in the principles of grouping of kintypes by terms, of two or more conceptual dimensions each of whose values ("components") is signified by one or more of the terms; (iv) the definition of each term, in a symbolic notation, as a specific combination, or set of combinations, of the components; and (v) a statement of the semantic relationships among the terms and of the structural principles of the taxonomy. To give a simple example of the method, let us take, in their formal and referential sense, a familiar group of American-English terms denoting degrees of consanguinity and perform a componential analysis of their meaning.

*Stage 1*: We select *grandfather, grandmother, father, mother, brother, sister, son, daughter, grandson, granddaughter, uncle, aunt, nephew, niece,* and *cousin* as a group of terms in American English used to refer to consanguineal relatives.

*Stage 2*. We define these terms, employing the primitive kintypes *Fa, Mo, Br, Si, So,* and *Da:*

Grandfather = *FaFa, MoFa*
Grandmother = *FaMo, MoMo*
Father = *Fa*
Mother = *Mo*
Brother = *Br*
Sister = *Si*
Son = *So*
Daughter = *Da*
Grandson = *SoSo, DaSo*
Grandaughter = *SoDa, DaDa*
Uncle = *FaBr, MoBr, FaFaBr, MoFaBr,* etc.
Aunt = *FaSi, MoSi, FaFaSi, MoFaSi,* etc.
Nephew = *BrSo, SiSo, BrSoSo, SiSoSo,* etc.
Niece = *BrDa, SiDa, BrDaDa, SiDaDa,* etc.
Cousin = *FaBrSo, FaBrDa, MoBrSo, MoBrDa, FaSiSo, FaSiDa, MoSiSo, MoSiDa, FaFaBrSo, FaMoBrSo, MoFaSiDa,* etc.

*Stage 3*. We observe that all but one of these terms (*cousin*) specifies sex of relative; all but one makes some discrimination with respect to generation; all specify whether the relative is lineally or nonlineally related to ego; and nonlineal terms specify whether or not all the ancestors of the relative are ancestors of ego, or whether all the ancestors of ego are ancestors of the relative, or whether neither is the case. From these observations we hypothesize that three dimensions ($A$, $B$, and $C$) will be sufficient to define all the terms. Sex of relative ($A$): male ($a_1$), female ($a_2$). Generation ($B$): two generations above ego ($b_1$), one generation above ego ($b_2$), ego's own generation ($b_3$), one generation below ego ($b_4$), two generations below ego ($b_5$). Lineality ($C$): lineal ($c_1$), colineal ($c_2$), ablineal ($c_3$). We use Goodenough's definition of the values on this dimension of lineality: lineals are persons who are ancestors or descendants of ego; colineals are nonlineals all of whose ancestors include, or are included in, all the ancestors of ego; ablineals are consanguineal relatives who are neither lineals nor colineals (*4*).

*Stage 4*. We define the terms now by components, adopting the convention that where a term does not discriminate on a dimension, the letter for that dimension is given without subscript.

Grandfather, $a_1b_1c_1$
Grandmother, $a_2b_1c_1$
Father, $a_1b_2c_1$
Mother, $a_2b_2c_1$
Brother, $a_1b_3c_2$
Sister, $a_2b_3c_2$
Son, $a_1b_4c_1$
Daughter, $a_2b_4c_1$
Grandson, $a_1b_5c_1$
Granddaughter, $a_2b_5c_1$
Uncle, $a_1b_1c_2$ and $a_1b_2c_2$
Aunt, $a_2b_1c_2$ and $a_2b_2c_2$
Nephew, $a_1b_4c_2$ and $a_1b_5c_2$
Niece, $a_2b_4c_2$ and $a_2b_5c_2$
Cousin, $abc_3$

The definitions are represented paradigmatically in Fig. 1.

As is evident, each term has been so defined, with respect to the components selected, that no term overlaps or includes another; every component is discriminated by at least one term; and all terms can be displayed on the same paradigm. We do not argue that this is the only or even the best representation —only that it is adequate to define the set of terms chosen (*5, 6*).

## Study of Folk Taxonomies

The principles of componential analysis, and the label "componential analysis" itself, have been used in linguistics in the construction of grammatic and phonemic paradigms (*7*). Componential analysis has also been used for the exposition of the meaning of color terms, of concepts of disease, and of the nomenclature of folk botanical taxonomies (*8*). It is evident that the general method of componential analysis is applicable not merely to kinship taxonomies but to taxonomies of any kind, whether the taxonomy is associated with a nomenclature or with other kinds of differential behavior, and indeed, whether the taxonomics are folk taxonomies or more explicit and self-conscious scientific taxonomics such as the schemata of biological taxonomy and the periodic table of the elements.

Now from the standpoint of interest in cognitive process, the value of componential analysis as a method lies not merely in its utility in clarifying what a certain group of speakers "mean" when they use a set of terms but in its ability to reveal the structure of the logical calculus which is employed in the given taxonomy associated with the terms. Implicit in the procedures of componential analysis is the statement of the semantic structure in a symbolic code. At first, no doubt, the semantic structure was stated in code for the sake of convenience, in order to avoid the cumbersome task of scribbling elaborate verbal definitions after each term in the nomenclature. But then it was realized that liberating the analysis from its concern with the original nomenclature and with its particular semantic freight makes it much easier to consider the cognitive structure (just as it is easier to consider the structure of language if one ignores the particular semantic content of the utterances).

The semantic paradigm which is the product of a componential analysis is merely a mapping of a particular set of behaviors (such as a set of words) on a logical space. The logical spaces actually employed in folk (and scientific) taxonomies seem to differ considerably in detail (though not in principle) from the kinds of logical spaces that are conventionally recommended for mathematical and other systematic practical thinking by Western logicians (although the principles by which they are constructed are no doubt well enough recognized). A logical space may be generally characterized as a group of values (logical predicates) related by certain rules. Each of these values refers to a subset of a set of empirical phenomena (such as the set of all living and remembered members of a community).

Many logical spaces are class-product spaces. In class-product spaces, any values which refer to mutually exclusive subsets of the universe, and are

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<tr><th></th><th colspan="2">$c_1$</th><th colspan="2">$c_2$</th><th colspan="2">$c_3$</th></tr>
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<tr><td>$b_1$</td><td>Grand-father</td><td>Grand-mother</td><td rowspan="2">Uncle</td><td rowspan="2">Aunt</td><td colspan="2" rowspan="5">Cousin</td></tr>
<tr><td>$b_2$</td><td>Father</td><td>Mother</td></tr>
<tr><td>$b_3$</td><td colspan="2">[Ego]</td><td>Brother</td><td>Sister</td></tr>
<tr><td>$b_4$</td><td>Son</td><td>Daughter</td><td rowspan="2">Nephew</td><td rowspan="2">Niece</td></tr>
<tr><td>$b_5$</td><td>Grand-son</td><td>Grand-daughter</td></tr>
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Fig. 1. A componential paradigm of American-English terms denoting degrees of consanguinity. [After Wallace and Atkins (*6*)]

therefore mutual contraries of one another, are said to belong to a single dimension. In fact, the group of values represented in a space will usually divide into two or more dimensions. At least one of these dimensions will be logically independent of at least one other (that is, no value or group of values on that dimension implies, or rules out, a value or group of values on the other). Logical spaces may, however, in principle also be constructed of values whose product relations are relative products rather than class products, and furthermore, dimensions can be constructed of values which do not follow the two-valued rule of mutual exclusiveness of referential subsets. Even when class-product spaces are considered alone (and this is the usual preference in componential analysis), considerable variation is possible: dimensions may be nonordered or ordered (and of course they can be ordered in various ways, such as continuous-variable, discrete-variable, or partial ordering); dimensions can be finite or infinite; and the "shape" of the space may be of at least three types. The simplest shape (and probably the rarest in folk taxonomies) is the orthogonal space, which is constructed from independent dimensions, and which may be defined as the set of class products formed by all unique combinations of values from the several dimensions, each product including one value from each dimension and each product being non-self-contradictory. Nonorthogonal spaces are constructed from a group of dimensions of which at least one pair is nonindependent. There are at least two types of nonorthogonal spaces: in the first type, all the dimensions span the same set of referents, but at least two values from different dimensions are mutual contraries; in the second type, at least one value on one dimension and each of the values on another dimension are mutual contraries. The three types of class-product spaces may be represented, for purposes of discussion here, by three simple diagrams, constructed in each case from two dimensions (Fig. 2).

An orthogonal space may be neatly mapped as a "solid" rectangular matrix; a rectangular matrix displaying a nonorthogonal space will have "holes" representing the impossible class-products.

Evidently, then, the range of logical models available for choice by a particular culture in the construction of a folk taxonomy is considerable. Ethnologists should not, and in fact do not any longer, expect the shape and other characteristics of the logical space on which a folk taxonomy is mapped to be necessarily the simple and convenient orthogonal class-product space so familiar in textbook expositions of social science methodology. And that human folk taxonomies in general cannot be said to be confined to that logical structure known as the orthogonal class-product space is in itself something of a discovery.

Class-product spaces have the additional convenience, for the scientist, of being readily measurable. It is possible to count the number of dimensions, of values on each dimension, and of cells in the space, and to compute a measure of semantic information. The unit of semantic information, by analogy with the unit of statistical information, is the binary choice, and it can be easily shown that the value for the logarithm of $L$ to the base 2, where $L$ is the number of terms in a taxonomic lexicon, is the minimum number of binary dimensions necessary to define each term on an orthogonal space.

Even rough measurements of the quantity of semantic information contained in such folk taxonomies as kinship lexicons and the phonemes of language suggest strongly that human folk taxonomies rarely require more than the equivalent of six binary dimensions on any given level of abstraction. This number is not far from the "magical number seven" which apparently limits the complexity of binary conceptual discriminations possible for experimental subjects in the psychological laboratory (*9*). The possible existence of a $2^n$ rule, limiting the complexity of taxonomic systems practicable for cultural standardization, has interesting implications for human physical and cultural evolution and for mental health (*10*).

## Other Kinds of Logical Calculi in Cultural Systems

Taxonomy is just one of the cognitive structures necessary to organized "meaningful" behavior (including cultural behavior, where taxonomies are shared or at least complementary among the members of large groups). Three other kinds of calculi may be mentioned as having already received some, and as deserving more, attention from the cognitive standpoint from anthropologists: the hierarchical ordering of states in terms of differential desirability; calculi of transformations of state; and systems of deductive and inductive logic employed in folk science and technology.

The anthropological study of "values" (that is, of customary formulations, on a highly abstract level, of what are the desirable and undesirable human experiences) has included some partial and incomplete formal taxonomic efforts which are in the technical tradition of componential analysis (*11*). The development of a scientific taxonomy of values for cross-cultural use, and the mapping of the major values of a particular society on the cross-cultural taxonomic matrix, is not of much use in culture and cognition research, however. The relevant problem has been more clearly defined in psychoanalytic theory and in role theory. To introduce this problem, let us argue that each society should (optimally) be so designed that the fewest possible number of value dilemmas exist for its members. Thus, if a set of values is given $(a, b, c, \ldots, n)$, they should be mapped onto an absolute order of levels of desirability in such a way that the fewest number of pairs will occupy the same levels. Perhaps the simplest of the solutions is the partial ordering exemplified (in truncated form) in such formulas as:

This above all; to thine own self be true,
Thou canst not then be false to any man

which has the form:

$$[a \rightarrow \sim (\sim b)] \rightarrow [a \rightarrow b]$$

But while religious and political systems of ethics strive to establish partial orderings of values in the form:

$$a \rightarrow b \rightarrow c \rightarrow \ldots \rightarrow n$$

in which one can start with a supreme value and derive all other values from it lineally, various circumstances of personal history and social and situational complexity generally work to unravel such utopian formulations. The logical net of values actually observed thus usually branches, often asymmetrically. Branching, on the one hand, leads to the possibility of value conflicts (in the effort to resolve which there may even be created independent value domains, as when one system of ethics applies to the ingroup, another to the outgroup) and, on the other hand, merges values, sometimes with unhappy consequences (as in the case of the involuntary establishment of equivalences in the transference neurosis). The value dilemmas imposed by discontinuities in cultural conditioning, and by innovation and

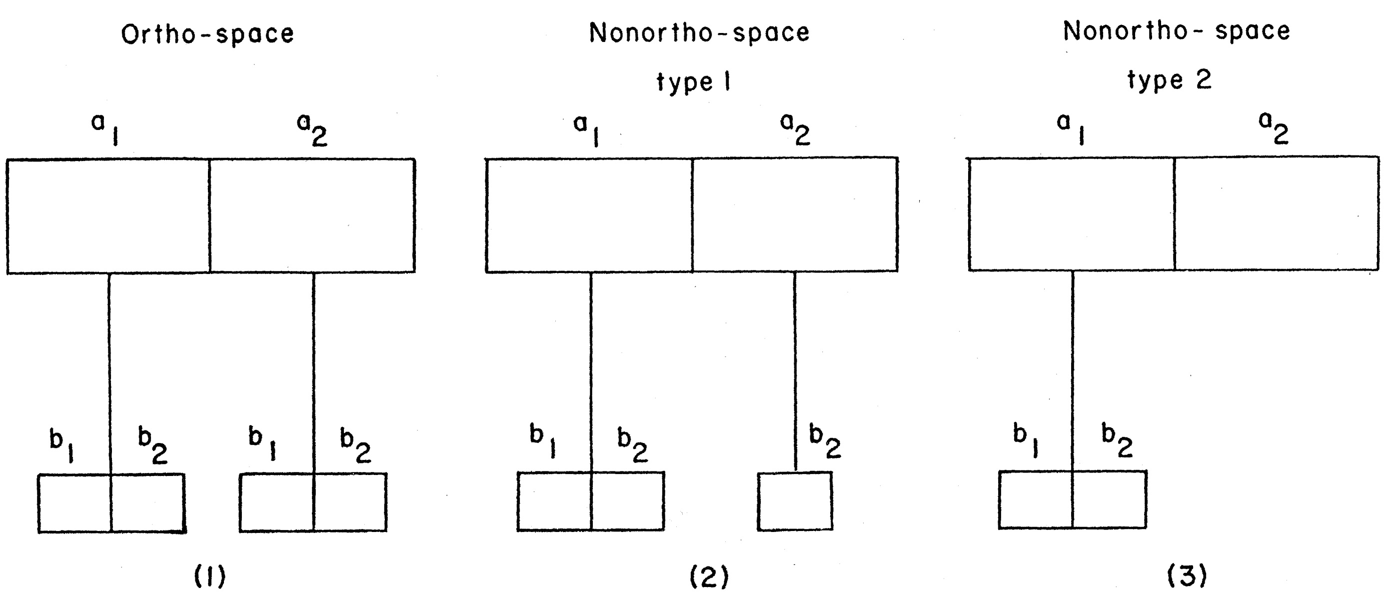


Fig. 2. Types of class-product spaces formed of two binary dimensions. [After Wallace and Atkins (*6*)]

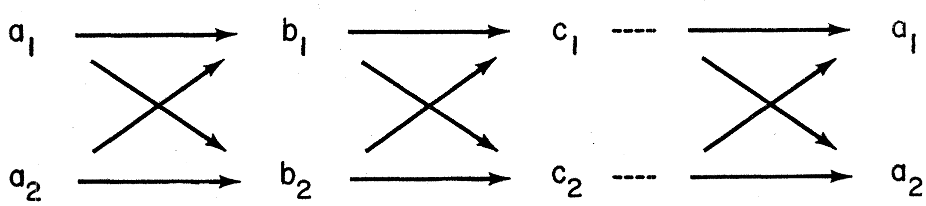


Fig. 3. The standard formula for a sociocultural system.

acculturation, and the consequent effort by social reformers to create internally consistent calculi of values, have been of particular interest to anthropologists concerned with national character and with culture change.

The cultural calculi which describe transformations of state are embodied in processual descriptions of how things happen and in rules, techniques, recipes, or programs for getting things done. Given a set of entities defined on appropriate taxonomic spaces, and given a goal specified in a value hierarchy, the process equation integrates a sequence of events in what some psychological theorists call a Plan (*12*). Much of culture, then, can be regarded as an archive of Plans. The formal nature of these Plans has been approached by anthropologists in four principal ways: (i) by attempting to contrast the logical structure of primitive and civilized, or magical and rational, thinking; (ii) by summarizing the cognitive representation of a behavioral system as a stochastic, and particularly a Markov, statistical process, which can in principle be evaluated in terms of the quantity of organization of the system; (iii) by treating Plans as problem solutions in decision theory and applying to them such mathematical models as the theory of games; and (iv) by treating sets of related transformations as Galois groups.

The assumption that primitive peoples think according to radically different rules of logic, and that these "primitive" logical calculi are needful to account for such irrational beliefs about process in the natural world as mana and taboo, magic, witchcraft, and so forth, is an old one. It has been unfortunately coupled with a psychiatric theory that the psychotic regresses not merely in the direction of his own infancy but in the direction of the infancy of the species, and that—to complete the circle—thought processes of psychotics in modern mental hospitals can be studied as a means of understanding primitive thought. There is, however, no real evidence that any primitive people characteristically and conventionally employs what Western logicians would define as a logical fallacy. And to suppose that the primitive is *unable* to think rationally, for instance, would lead to the expectation that the primitive hunter would perform the following feat of cerebration, with suicidal consequences:

> A rabbit has four legs.
> That animal has four legs.
> Therefore that animal is a rabbit.

This fallacious piece of reasoning follows the so-called law of Von Domarus (subjects are identical if they have a common predicate). Such reasoning has been attributed to primitives and schizophrenics alike (*13*), and, had it been in fact widely applied during the Paleolithic period, it would long ago have been the death of our ancestors. A more profitable approach is to explain the scientifically demonstrable nonvalidity of certain pieces of native theory (as, for instance, notions of taboo and of magic) as arising from a lack of empirical knowledge rather than from a peculiarity of the logical forms. The theories of natural process implicit in beliefs about taboo, magic, and witchcraft are not illogical; they are simply wrong.

The analysis of the cognitive representation of complex processes and relationships as stochastic process has been suggested, but there would be major difficulties in securing appropriate bodies of data. The periodic Markov process in particular (in distinction to the aperiodic process emphasized by Shannon in his work on information theory) seems, in principle, appropriate for the representation of cognitive models of sociocultural systems, which are largely composed of alternative events probabilistically related in repeated fixed-order sequences. The standard formula for such a system would be that given in Fig. 3, with each conditional probability (designated by an arrow) somewhat less than 1. One advantage of this model is that it collapses, as the set of probabilities approaches unity, into simple logical structures, and that at all levels of probability the total system can be measured with respect to the quantity of statistical information, or (complementarily) the quantity of statistical organization, it "contains." The measure of organization is potentially of great interest in considering the processes of cultural and personality change, since one may inquire whether certain types of pattern changes in systems are associated with increases or decreases in their quantity of organization (*14*).

The use of mathematical decision theory models—such as game theory—has also been proposed for analysis of certain ethnographic materials. Moore, for instance, has suggested that scapulimancy—divining from the pattern of cracks in the scapula of a roasted animal—may be interpreted as a method for maximizing the probability of success in hunting, when empirical knowledge of game movements is lacking, by randomizing decisions as to hunting grounds, time of hunt, and so on (*15*).

The abstract mathematical model of related transformations provided by Galois group theory is potentially of considerable significance. For instance, native theories of historical cycles (as in the Near Eastern cycles of reincarnation and of world degeneration and renewal), and Hindu concepts of ritual pollution and cleansing, may be usefully analyzed by means of group theory. Group theory has in other branches of science proved to be convenient for clarifying the logical structure of transformations, and it will probably turn out to be equally useful in the domain of culture and cognition.

The study of ethnoscience has an interesting role in the study of culture and cognition. Nowhere in our own culture are the logical structures of cognitive processes more explicitly formulated than in science. Hence, comparison of "primitive" science and technology, from the standpoint of logic and cognitive process, with contemporary science is apt to be profitable. Already some interesting bodies of material are becoming available: Hallowell's observations on measurement of space and time among the Ojibwa (*16*); the work of Goodenough on native astronomy in Micronesia (*17*); Barnett's work on the logical structure of technological innovation (*18*); my own investigation of the Iroquois theory of dreams (which anticipated essential features of Freud's dream theory by at least 300 years) (*19*); the study of calendrics and arithmetic of the Maya [who independently invented a positional notation and the zero (*20*)]; and so on.

Despite the anthropologist's tendency to question the universal applicability of psychological principles, the most useful methodological assumption with which to approach the study of the logical calculi in folk sciences is that these calculi are already contained in logical structures familiar to, or at least implicit in, Western symbolic logic. Cultural relativism, with respect to logic, applies more forcefully to the content of propositions than to this form of their relationships. Perhaps this can be made clear by citing the example of Handsome Lake, a Seneca Indian prophet of the late 18th century, who (successfully) preached temperance to his people. Handsome Lake did not speak or read English and received no training in Western logic or scientific method. Yet he said (*21*):

> . . . Good food is turned into evil drink. Now some have said that there is no harm in partaking of fermented liquids.
>
> Then let this plan be followed: let men gather in two parties, one having a feast of food, apples and corn, and the other cider and whiskey. Let the parties be equally divided and matched and let them commence their feasting at the same time. When the feast is finished you will see those who drank the fermented juices murder one of their own party but not so with those who ate food only.

His was hardly a prelogical mentality. Handsome Lake's experimental design follows precisely Mill's Second Canon of Inductive Logic (the Method of Differences), which states, "If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance in common save one, that one occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or the cause, or an indispensable part of the cause, of the phenomenon" (*22*).

## Methodological Problems and Theoretical Implications

The use which is made of symbolic logic, algebraic notation, set theory, and other formalisms in studies of culture and cognition should not permit a confusion of these enterprises with other logicomathematical analyses of social and cultural phenomena which aim simply at precise and accurate description of overtly observable phenomena.

The commitment to describe the psychological reality of culture requires that not just any model which predicts some overt class of action be accepted, but only that model which is used as a system of reckoning by the actor. Not infrequently it can be demonstrated that two systems of reckoning will yield the same result in overt behavior. For example, there are several different ways to compute the square root of a number; the task in culture and cognition would be, not simply to find *a* way, but to find *the* way being actively employed by a person or a group. The technical problem of determining which of two equally predictive models corresponds best to the model actually being used by the subject requires the introduction of problems of choice which were not a part of the originally predicted behavior and which precede it in the chain of reckoning.

Now, just as the ethnographer may invent a taxonomic model which will predict satisfactorily how a speaker will refer to his kinsmen but which does not describe how the speaker reckons kinfolk, so it is possible that two members of the same society may produce similar or complementary behaviors without sharing the same cognitive model. Indeed, if one makes the conservative assumption that no set of people all share the same cognitive model requisite to a type of behavior, one may ask the larger question: How are diverse cognitive models (of values, plans, taxonomies, and so on) articulated in a functioning cultural system? This question leads to a consideration of the properties of a metacalculus whose components are the diverse calculi of particular individuals or subgroups cooperating to maintain stable systems of relationships (or, for that matter, failing to do so). It has been demonstrated that a family of such metacalculi exists (we shall call it the family of equivalence structures), each of whose members is the sum of the plans of two or more individuals. Each component plan minimally consists of an instrumental action by the planner, followed by a facilitating action by his partner and a consummatory action by the planner. The intriguing feature is that neither partner's plan need include an awareness of the other's in order for the two plans to sum to a stable and mutually rewarding interaction system (see Fig. 4 for an analysis of the simplest equivalence structure). In fact, except where plans are shared, the metacalculus is always a more complex system than is included in the plan of either partner. This suggests several interesting functional properties of sociocultural systems, among them the dual properties (i) that an effective and viable sociocultural system can evolve which is categorically beyond the capacity of any of its members to incorporate in a single Plan, and (ii) that the maximum size of a sociocultural system is associated with a minimal level of cognitive sharing.

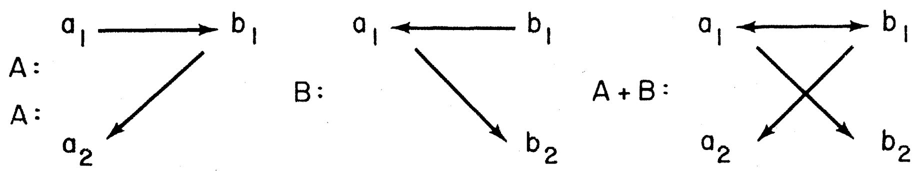


Fig. 4. The summation of nonshared plans ($A,B$) in an equivalence structure ($A+B$). [After Wallace (*23*)]

## Conclusion

Anthropologists are turning their attention to the cognitive structures which are basic to customary behavior in society (*24*). In general, these studies work to expose the abstract calculus underlying the specific content of behavior by the use of a symbolic notation and the application of available logical-mathematical models as hypotheses. Particular attention has been paid to the semantic analysis of folk taxonomies, such as kinship terminologies, but formal analysis of other aspects of culture, such as values, the program of behavior released in particular situations, and folk science, is also a promising area of work. The principles of the metacalculi to which the diverse cognitive structures of individuals sum in stable social systems are, then, to be regarded as principles of sociocultural organization itself.

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3. F. G. Lounsbury, *ibid.* **32**, 158 (1956).
4. W. H. Goodenough, private communication (1959).
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# News and Comment

## Higher Education Bill: It Has Bipartisan Support, But There May Be a Lively Battle Anyway

This week the House passed and the Senate began debating what will probably be the major education bill of the session.

The bill provides $300 million a year for academic facilities and, in the Senate version, also for beginning a program of federal scholarships which will grow in a few years to 50,000, 4-year scholarships annually. The Senate version, as brought to the floor, allows no money for outright grants to universities, on the grounds that this might be unconstitutional, since some of the money will go to church-connected universities. The House version divides the $300 million annually 60-40, with the larger share going for grants, the rest for long-term, low-interest loans.

The kind of bill that will finally pass, then, depends heavily on the outcome of a Senate-House conference that will be held to resolve differences between the two bills. There will be an effort in conference to get the Senate to accept the House's grant provisions and the House to accept the Senate's scholarship provisions.

Some sort of higher education bill would have passed last year if the wrangle over church and state had not developed. The House bill, which then contained a modest scholarship program as well as grants and loans, was killed in the Rules Committee along with the rest of the Administration's program for education. But it had come out of the Education and Labor Committee with the support of a majority of the Republicans as well as the unanimous support of the Democrats, and it was generally assumed that it would pass the House by a comfortable margin.

There was a good deal of recrimination about the Rules Committee fiasco. Edith Green, of Oregon, who chaired the subcommittee which wrote the bill, along with a number of others, had argued all along for giving the higher education bill priority last year, in order that this most widely supported of the Administration's education bills could get through the House promptly, before it could be tied up in a controversy over general aid to education. The Administration, though, insisted on giving priority to the general aid bill. It took the view that the higher education bill could be pushed through any time, but that the general education bill, needing all the help it could get, would have a harder time getting through if it were brought up after the House had already passed another major education bill.

As it turned out, of course, Mrs. Green was right. The Administration strategy resulted in the failure to pass the higher education bill without helping to save the general education bill, although at the time the decisions on priority were made it was hard to foresee how really intense the church-state controversy was to become. Aid-to-education bills had, after all, been before the House for years, and the church-state controversy had never before been a major factor.

### This Year's Strategy

Against this background, the decision this year, understandably, was to get a higher education bill through the House as promptly as possible. In order to get the bill through the Rules Committee it was technically necessary to report it out of the Education and Labor Committee again as a new bill. This was done at the tail end of last session, and in order to give the bill its best possible chance, the more controversial scholarship section was left out. The bill still could not get through, for by that time the controversy had become so bitter that there was no majority for any kind of bill.

By the opening of the new session, things had calmed down. Everyone had had several months to cool his temper, and the evident intention of