

Modeling Cultural Idea Systems: The Relationship Between Theory Models And Data Models

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Abstract: Cultural idea systems are the conceptual means through which individual, subjective experience is transformed into objective reality for societal members. As a consequence, models relating to the cultural side of human social systems play a dual role of being both theory models and data models. The dual role stems from cultural idea systems providing theories for culture-bearers regarding the structural relationships among cultural concepts. These structural relationships can be modeled as a theory model for the cultural theory and then compared to a data model based on patterning in ethnographic observations about the social universe in which interacting culture-bearers are embedded and enculturated. An example of a cultural domain structured in this manner occurs with Arabic proverbs that provide the computational relationships between the concepts of friend and enemy. Computations with concepts are also used culturally to generate new concepts as shown by working out a culture theory for the structure of the English kinship terminology. Making explicit the cultural theories for kinship terminologies leads to identification, in a precise, and predictive, manner the conceptual distinction between descriptive and classificatory kinship terminologies -- a distinction that has played an important role in anthropological theorizing about the structure of human social systems. The prediction has been verified ethnographically, thereby underscoring the constructive role that modeling of cultural constructs can play in ethnographic research.

Language is ... a symbolic, intersubjective, self-referential system of signs we use to structure a meaningful existence among ourselves.
(Hustvedt 2009: 23)

In this paper we will explore some of the uses of models for representing and analyzing the structural properties of cultural idea systems through which individual, subjective experience is transformed into objective reality for societal members. By a cultural idea system is meant the concepts and ideas, transmitted through enculturation, that provide the conceptual basis upon which systems of social organization are predicated. These idea systems frame culturally meaningful behavior through cultural rules. As the anthropologist Claude Lévi-Strauss wrote, "Wherever there are rules we know for certain that the cultural stage has been reached" (1971: 8). Yet cultural rules may be "invisible" -- we act in accordance with them but as culture-bearers we need not be aware of them, for "cultural rules are often outside your cognizance, beyond your conscious attention" (Spradley and Mann 1975: 7). Our goal here is to make the rules

“visible” through formal modeling of cultural idea systems and then to see how the formal modeling enables us to formulate explanatory arguments for patterning we identify in cultural phenomena.

We will explore the formal modeling of cultural idea systems by beginning with a simple social behavior for which explanatory arguments can be developed without reference to cultural idea systems. Then we will introduce a cultural component that brings the ideational domain of cultural concepts into a data model. Next we explore the way in which cultural idea systems can be viewed as providing a theory stipulating the interrelationships among cultural concepts, with the implication that a theory model will prescribe the data structures we should observe.

Our simple social behavior is that of interaction between a pair of individuals varying along a continuum ranging from negative, hostile behavior, at one extreme, to positive, supportive interaction at the other extreme. In between are neutral behaviors that only evoke indifference on the part of the interacting individuals. Dyadic behaviors in a social group occurring along this continuum without a cultural component (e.g., in a non-human primate society) have patterning that can be expressed through, for example, a network-based data model showing who interacts with whom and with what behavior value on this continuum of behaviors.

We now include a culture transformation of this continuum of behaviors in the form of a culturally framed, discrete categorization of behaviors. Participants in a social context generally do not refer to the behavior of others by reference to this continuum of possible behaviors, but by categorizations such as whether the behavior is “friend-like” or “enemy-like,” with a culture specific category boundary. We then use these concepts to categorize those we interact with into categories such as friends and enemies. With this transformation, the network data model can now be re-expressed through interactions subjectively identified as friend-like or enemy-like by the participants.

The subjectivity limits the utility of the categorization for making the assessments Talcott Parsons identified as a necessary component of social interaction: “... in the case of interactions with social objects a further dimension is added. Part of ego's expectation ... consists in the *probable reaction of alter to ego's possible action*, a reaction which becomes anticipated in advance and thus to affect ego's own choices” (1964: 5, emphasis added). Person A encounters C and wants to know the likelihood that C will act towards A as a friend, absent evidence from prior interaction, when there is a third person, B, who is a mutual friend of A and C. Will C be motivated to act in a friend-like manner to A since B is a friend of C and B is a friend of A, or will C act on the basis of some other criterion? The concepts of friend and enemy, based just on dichotomization of a continuous scale, do not, by themselves, allow for the calculation of the “probable reaction” discussed by Parsons since there is no consistent, emergent, global pattern that arises when behavior is subjectively characterized as enemy-like or friendly-like.

Some cultures have circumvented this limitation by stipulating how the concepts of friend and enemy are conceptually interrelated. For example, the anthropologist Martín Gusinde commented, regarding those he worked with in Tierra del Fuego, “A person who has quarreled with someone from another group does not hold back his dislike ... he wears his innermost feelings clearly drawn on his face as soon as he meets his enemy *or the latter's friends*” (1931: 626, emphasis added). Thus the friend of an enemy is to be treated as an enemy by virtue of that

fact alone, thereby making the likelihood of friend-like or enemy-like behavior predictable when one knows who is a friend of whom.

This idea of using computations made with the concepts of friend and enemy to direct behavior is made explicit in Arabic proverbs: “Another proverb [from Morocco]... *r-’adhu nj-’adhu-inu dh-imdukkar-nu*, ‘the enemies of my enemies are my friends’” (Hart 1989: 767). The proverb makes it evident that *enemy* is not just the categorization of a continuum of behaviors, but is a concept in a system of computations involving the concepts friend and enemy. Altogether, the Arab proverbs give us a complete account of the possibilities:

- 1) A friend of a friend is a friend
 - 2) A friend of an enemy is an enemy,
 - 3) An enemy of a friend is an enemy,
- and
- 4) An enemy of an enemy is a friend.

The statements are cultural rules that have transformed the meaning of the concepts of friend and enemy, initially defined with reference to the phenomenal domain of behavior, into the meanings expressed in the computation rules.

The proverbs provide a theory for the concepts, friend and enemy, by defining the interrelationship between any two of these concepts in the same manner that gravitational theory expresses how the concepts force, mass and acceleration are interrelated. The validity of the theory given through these four equations does not lie in comparing it to a data structure based on behaviors, though, since it *defines* a universe, namely the society in question, structured according to the theory expressed in these four statements. This implies, as Clifford Geertz (1973) expressed it, that the theory must be a model *for* behavior, not a model *of* behavior. It follows that if behavior *is* structured according to this theory, then a data model will be isomorphic to a theory model and thus the cultural theory is explanatory of that behavior. Or, to put it another way, the culture theory constructs the reality in which social interaction takes place and without the theory that “reality” does not exist. The Arabic proverbs are constructing a “universe” in which “a friend of a friend is a friend, ...” and for this universe the proverbs are expressing the reality of what should be observed.

Accordingly, we need to consider friend and enemy as cultural concepts at two different levels of abstraction. The first is the partition of a continuum of behaviors, thereby enabling characterization of those with whom one interacts through the concepts of friend and enemy. The second is the abstract level of Friend and Enemy considered as linguistic symbols referring to concepts with meaning constructed through the relationships between the two concepts given in the four rules. As a theory, the four rules are not validated by agreement with friend and enemy behavior observations since they construct the social universe in which these behaviors take place but by ethnographic elicitation of cultural idea systems.

Now let us derive a theory model from the theory expressed in these four statements. Assume (as is likely to be the case for small-scale societies) that the friend network determined for all members of the society is connected; that is, there are no isolates in the network of friends for the society as a whole. From the subjective viewpoint of each person, p , the set G of persons making up the society will be divided into two subsets: the set G_1 of persons that p categorizes as Friend, and G_2 , the set of persons that p categorizes as Enemy (see Figure 1). Although G_1 and

G_2 are identified from the perspective of p , hence a subjective subdivision of the entire society, the theory implies that the categorizations are, in fact, socio- and not just ego-centric (see Figure 1 for details of the argument). Hence we have as a theory model that the society will be divided into two categories, with all members of a category either categorized as Friend or as Enemy by each person in the society.

In this culturally-constructed universe, all persons are coordinated globally in their

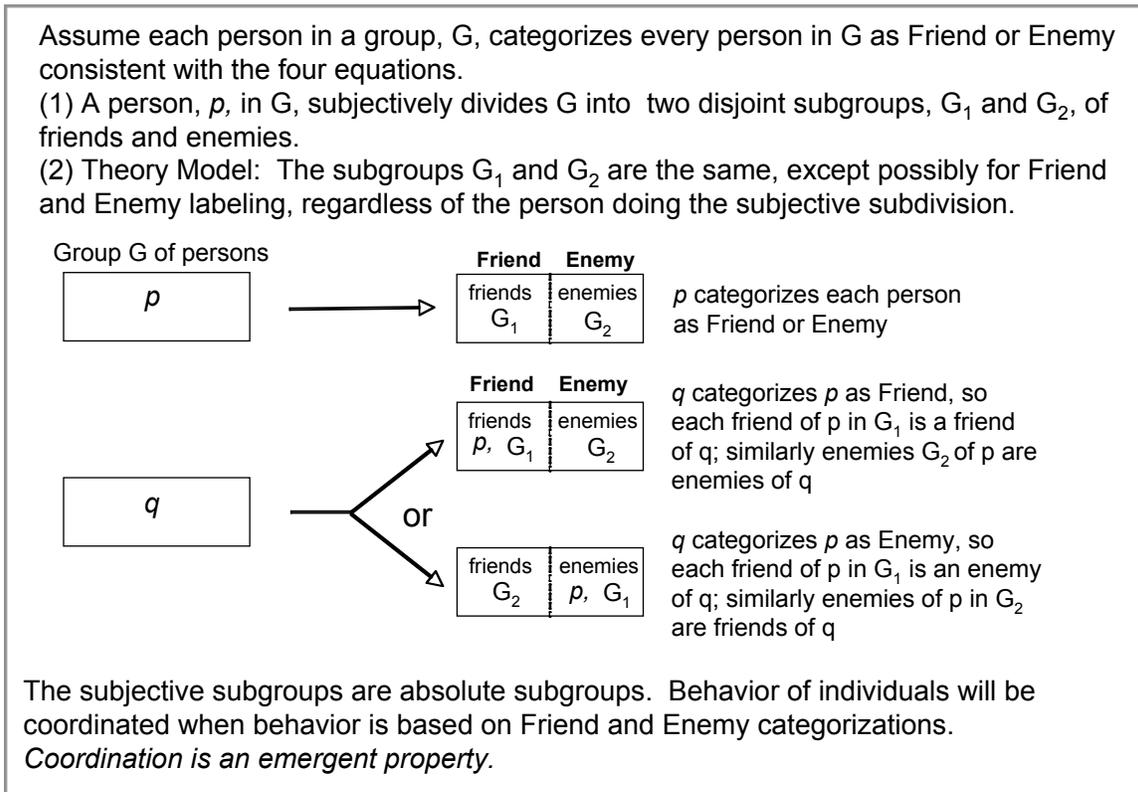


Figure 1: Theory model for Friend/Enemy rules. Subjective divisions into Friend and Enemy categories are consistent, leading to coordination among societal members as an emergent property.

perception that the society is divided into either those categorized as Friend or those categorized as Enemy, with differences between individuals only relating to which of the two groups is categorized as Friend and which is categorized as Enemy. Consequently, a data structure for this society should be one in which there is a (conceptual) division of the society into two “sides” in opposition. Empirically, this is precisely the case for factions in villages in India.

Factions are denied to exist (that is, there is no explicit criterion for what constitutes a faction or for membership in a faction) and yet clearly they are real (Leaf and Read n.d.). When Murray Leaf asked his informant about factions in the village where he was doing field work, his informant drew a diagram with a single vertical line as a data model for a faction. With further queries, it became apparent to Leaf that his informant was indicating that factions are the alignment that arises in a village in which the “sides” of the faction for some issue, indicated by the vertical line as a division between sides, arise in accordance with the calculations in the four equations; that is, those who are in agreement on the issue perceive themselves as friends to each

other and perceive those in disagreement with them as “enemies” and friends of “enemies.” As a consequence, the faction emerges as diagrammed by his informant and so the factions are real, yet without any explicit criterion for membership.

The four rules also appear in other contexts with different meanings. Consider the natural numbers, divided into even and odd numbers. With addition and odd and even numbers we have the four equations

$$(1) \text{ even} + \text{ even} = \text{ even},$$

$$(2) \text{ even} + \text{ odd} = \text{ odd},$$

$$(3) \text{ odd} + \text{ even} = \text{ odd}$$

and

$$(4) \text{ odd} + \text{ odd} = \text{ even}.$$

These are isomorphic to the four rules under the mapping Friend \rightarrow even, Enemy \rightarrow odd, “of a” \rightarrow “+” and “is a” \rightarrow “=”. Other examples include positive and negative numbers under multiplication, binary addition of 0 and 1, and the concepts of kin and affine in the Dravidian language kinship systems of India. For the even and odd numbers, the four equations express a data structure for the natural numbers validated by proving that the four equations are always true given the meaning of even or odd numbers, not by reference to observations in the physical world. Thus we have now shifted from a data structure about observable, external phenomena to a data structure for the constructed concept of numbers as symbols representing the cardinality of a set of objects.

We can express the structure common to these rules by stripping away content such as Friend/Enemy or even/odd and expressing the rules symbolically. To do this, let S be a set with two symbols, F and E : $S = \{F, E\}$. The symbol F and E can be instantiated as Friend or Enemy, as even or odd, or as any other pair of concepts. In each of the examples, the rules take as input two symbols and have as output a single symbol; that is, the rules can be used to define a *binary operation* over the set, S , of symbols. We will use the symbol “ \circ ” to denote the binary operation. Finally, we can express the four rules as equations using the symbols in S and the binary operation, \circ , as shown in Figure 2 (A). We can also express the four equations in the form of a product table (see Figure 2 (B)). Regardless of which representation is used for the binary operation, each of the idea systems is in the form of a symbol system with three components: (1) a set S of symbols, (2) a binary product defined for every pair of symbols in the set S , and (3) a structure determined by equations to be satisfied by the binary product.

We can graph the structure (see Figure 2 (C)) determined by the symbol system as follows. Let each element in S be a node in the graph. For each element, X , in S , indicate the product of that element with any element, Y , in S by drawing an arrow (whose form is specific to the element, X) from the node with the Y element to the node with the element $X \circ Y$. For example, in Figure 2 (C) a dashed arrow, the arrow form corresponding to E , is drawn from F to E since $E \circ F = E$.

What we have just described is an abstract algebra. An *abstract algebra* consists of a set S of elements, one or more n -ary operations, $n = 0, 1, \dots$, defined over S , and a set of structural equations satisfied by the n -ary operations. A 0-ary operation asserts that S has some property, a

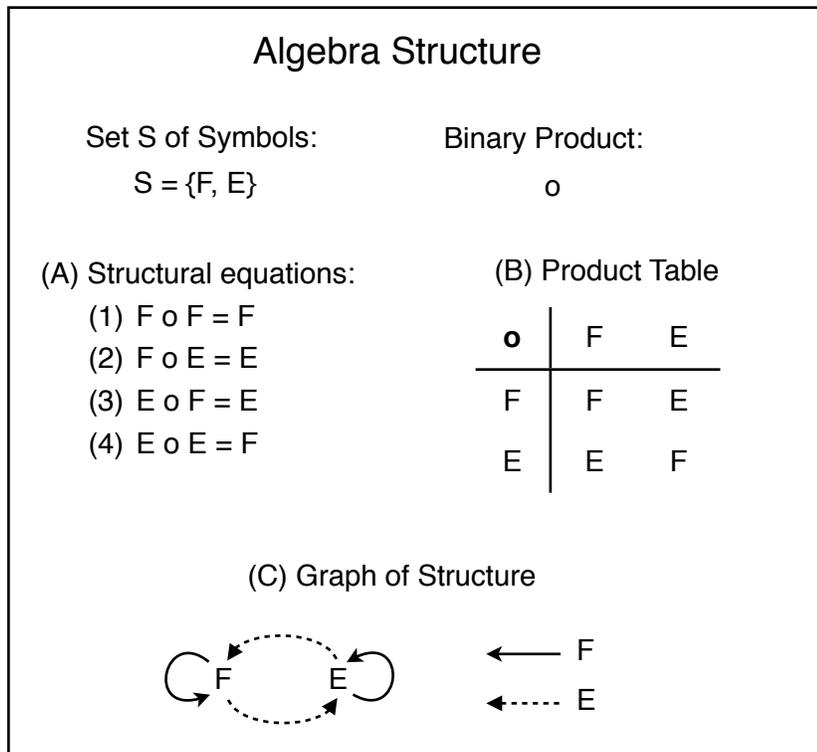


Figure 2: Concept algebra consists of a set of symbols, a binary product, and structure expressed in the form of (A) structural equations or (B) a product table for the binary operation. (C) The algebra can be graphed by making each symbol a node and drawing an arrow-type corresponding to each symbol, with the arrow pointing to the result of taking the product of the symbol at the base of the arrow with the symbol represented by the arrow.

1-ary operation acts on a single element, such as changing a positive number to a negative number, and a 2-ary operation is what we are calling a binary operation, and so on. The Friend/Enemy example is, then, a cultural construct in the form of an abstract algebra with a single (binary) operation. We have not imposed an algebraic structure on our four statements. Instead, the formalism clarifies the fact that the four proverbs are in the form of an algebra as they stand.

We can characterize algebraically the binary product defined by the equations as follows. First, the binary operation is *associative*; i.e., for any X, Y and Z in S (not necessarily different elements), $X \circ (Y \circ Z) = (X \circ Y) \circ Z$. This may be shown from the product table by confirming equality between the left and right sides of the above equation for all possible ways the two sides may be formed using the symbols from S. Second, the symbol F is an *identity element* for the binary product since $F \circ F = F$ and $E \circ F = F \circ E = E$. Third, every element, X, in S has an *inverse* in S since the only element other than the identity element is E and $E \circ E = F$, the identity element, hence E is its own inverse. Fourth, the binary operation is *commutative* since $E \circ F = F \circ E$. An algebra with a binary product that is associative, has an identity element, and every element has an inverse is known as a *group*, the most important class of algebras both within and outside of mathematics. The Friend/Enemy algebra is the smallest, non-trivial group and in addition it is an Abelian (commutative) group, the most important category of groups.

Though the product operation for the Friend/Enemy algebra has as its “output” an already established concept, new concepts can be generated through products of concepts and this

generative process provides the key to understanding the richness of cultural idea systems. Nowhere can this be seen better than with the cultural-idea systems we refer to as kinship terminologies, where a kinship terminology is a theory model expressing the culture-specific concepts that define and structure the social domain of kin relations. The concepts making up a kinship terminology are generated through a culture theory for products of the concepts of father and mother, the reciprocal concepts of son and daughter, the marriage concepts of wife and husband, and the concept of sibling.

We can elicit the cultural theory embedded in a kinship terminology by constructing a data model from the way culture-bearers compute kin relations directly using kin terms without first referring back to genealogical relations. Here is an ethnographic example of this kind of computation:

“Kinship reckoning on Rossel does not rely on knowledge of kin-type strings [genealogical pathways]. . . . What is essential in order to apply a kin term to an individual X, is to know how someone else, of a determinate kinship type to oneself, refers to X. From that knowledge alone, a correct appellation can be deduced. For example, suppose someone I call a tîdê “sister” calls X a tp:ee “my child,” then I can call X a chênê “my nephew,” without having the faintest idea of my genealogical connection to X.” (Levinson 2002:18)

Kin term calculations like this have been reported widely in the ethnographic literature (see Read 2001 for other examples) and are easily computed for one’s own kinship terminology. We can ask an English speaker, “If you refer to someone as uncle and that person refers to a woman as daughter, what kin term would you use to refer to that woman?” and quickly receive the reply “cousin.” This kind of computation determines a binary product over the set of kin terms that we will call a *kin term product* (Read 1984). We formally define a kin term product as follows:

Definition: Let K and L be kin terms in a kinship terminology, \mathbf{T} . Let ego, alter₁ and alter₂ refer to three arbitrary persons each of whose cultural repertoire includes the kinship terminology, \mathbf{T} . The *kin term product* of K and L , denoted $K \circ L$, is a kin term, M , if any, that ego may (properly) use to refer to alter₂ when ego (properly) uses the kin term L to refer to alter₁ and alter₁ (properly) uses the kin term K to refer to alter₂.

The cultural knowledge that enculturated individuals have of their kinship terminology can be elicited systematically (Leaf 2006, Leaf and Read n.d.), using kin term products based on the primary kin terms for the positions within a family. We can express the products graphically, in a manner similar to graphing the structure for the Friend/Enemy rules in Figure 2 (C). We will call the resulting graph a *kin term map*. Figure 3 shows the kin term map for the American/English terminology based on kin term products with the kin terms father and mother, the reciprocal terms son and daughter, and the affinal terms husband and wife. For comparison, Figure 4 shows the kin term map for the terminology used by the Shipibo, a horticultural group in the rainforests of eastern Peru. Structural differences are easily seen in the kin term maps.

We now determine whether there is a culture theory regarding kin term products that has a theory model isomorphic to the data structure for the English kinship terminology expressed as a kin term map. We do this by first simplifying the kin term map to its core structure of ascending kin terms, then we determine whether there is a theory of kin term products with a theory model

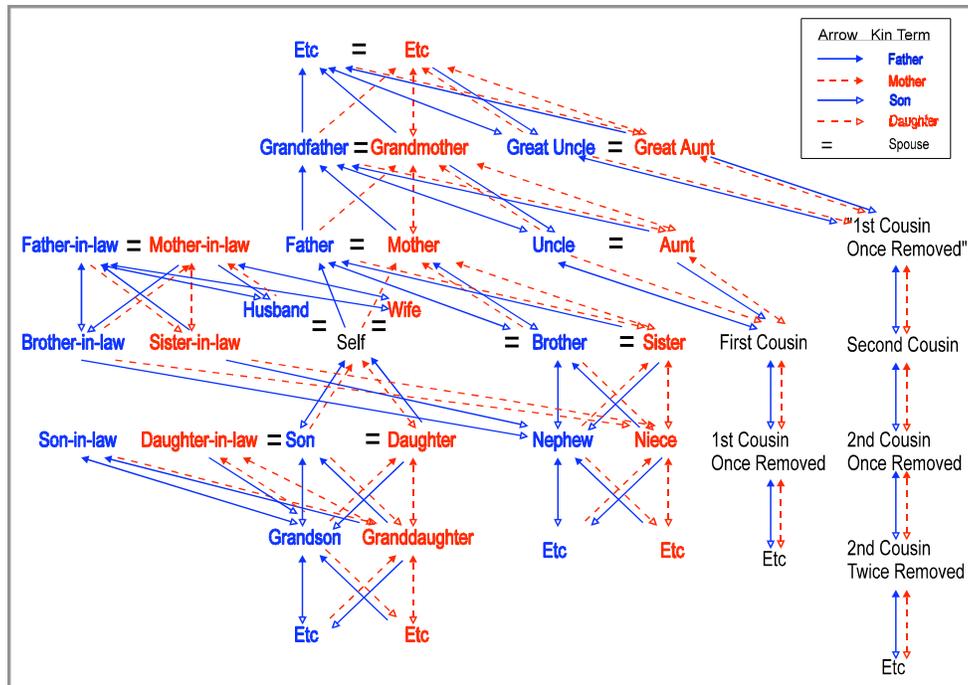


Figure 3: Kin term map of the American kinship terminology based on the generating kin terms parent, child and spouse.

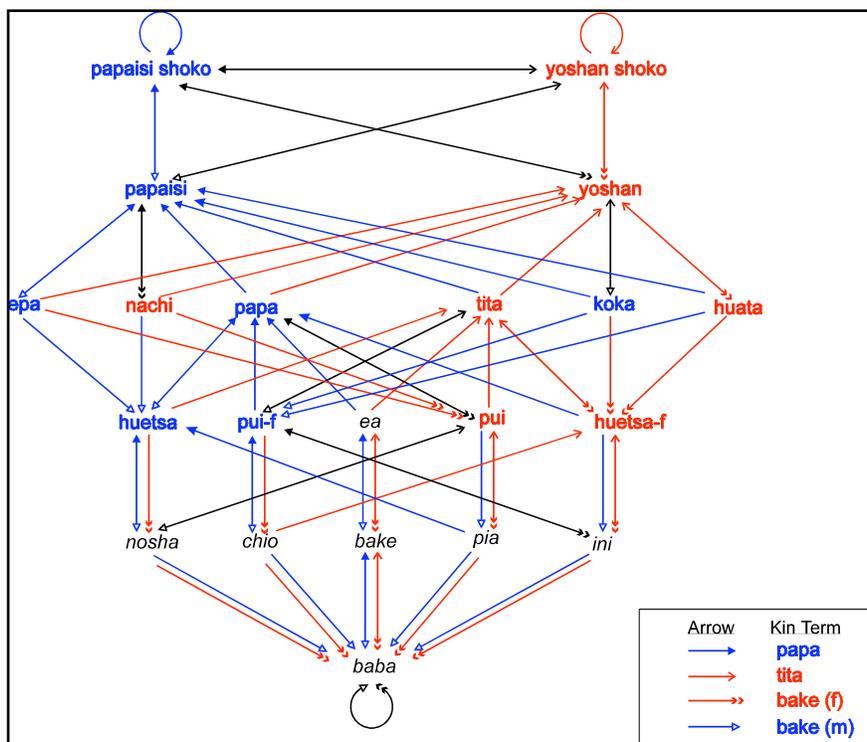


Figure 4: Kin term map for the kinship terminology of the Shipibo Indians, a horticultural group in eastern Peru.

isomorphic to the core structure, and if so, whether we can expand this theory to account for the complete kin term map of the English terminology.

We simplify the data structure by first removing all kin terms linked to self only through products with wife or husband. Then we “fold over” the two sides of the “ladder” of kin term products extending upward and downward from self and the parallel “ladder” through the brother and sister terms by replacing a pair of sex marked terms K and L with a neutral covering term denoted by $[K, L]$; e.g. we replace the pair of terms Father, Mother by $[\text{Father, Mother}]$, which, in this case, corresponds to the neutral English kin term, parent. This gives us the reduced structure shown in Figure 5. Next we remove the descending part of the structure based on products with $[\text{Son, Daughter}]$ (= Child) and arrive at the core structure shown in Figure 6(A).

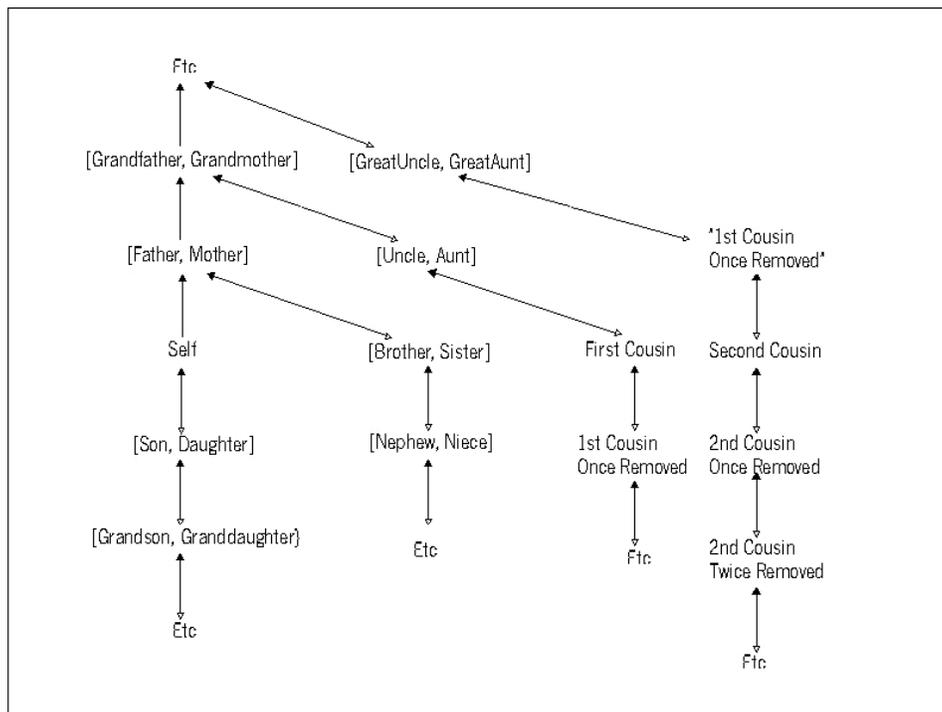


Figure 5: Simplified kin term map for the English kinship terminology. Affinal terms have been removed and pairs of terms that differ only by sex marking have been combined together in square brackets.

We can generate this core structure from a theory for the ascending kin terms. We begin by letting by $A = \{\text{self, parent}\}$ be the set of generating terms and stipulating that all kin term products using the terms in A define new kin term concepts; that is, there are no structural equations in the theory other than those needed for self to be an identity element for the kin term product. This theory generates the sequence of kin term concepts given by self, parent, parent o parent = grandparent, parent o grandparent = great grandparent, and so on (see Figure 6(B)), which is isomorphic to the core ascending structure.

According to this theory, each of grandparent, great grandparent, ... are new concepts generated through the kin term product. More generally, we can say that a new concept is generated whenever a kin term product cannot be reduced to an existing concept through a

structural equation that is part of the theory. The structural meaning for a kin term concept is derived from the way it is generated. For example, grandparent = parent o parent, hence grandparent is the kin term ego would use for alter₂ when ego uses the kin term parent for alter₁ and alter₁ uses the kin term parent for alter₂. Note that this implies, from a genealogical perspective, that grandparent is the term ego would use for ego's father's father, ego's father's mother, ego's mother's father or ego's mother's mother; that is, the categorization that the term grandparent makes of genealogical relations is the *consequence* of the grandparent concept generated

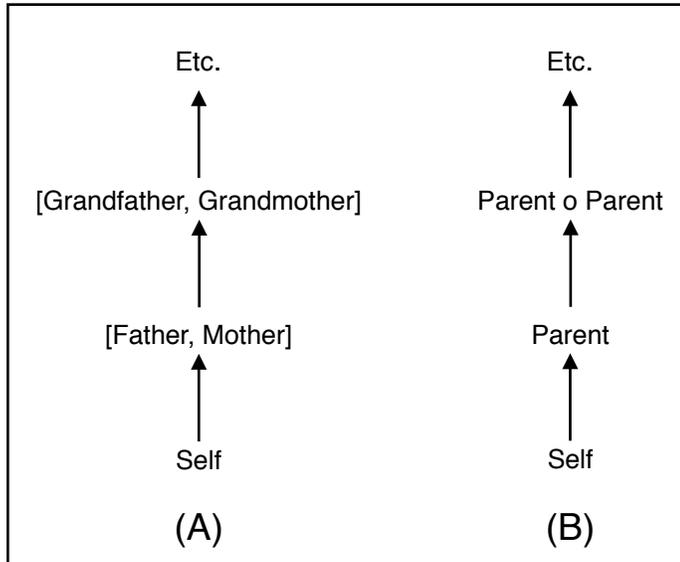


Figure 6: (A) Core, ascending structure for the English kinship terminology. (B) Structure generated from the generating set $A = \{\text{self, parent}\}$.

through kin term products and not the reverse. In other words, the kinship terminology *constructs* the categorization of genealogical relations and not the reverse (Read 2001, 2007), as has generally been assumed, thus making the kin term categorization of genealogical relations a constructed, not a natural, categorization.

We now expand the theory. First we generate the descending kin terms as a structure isomorphic to the ascending structure using the generating set $D = \{\text{self, child}\}$; that is, we replace parent in the set $A = \{\text{self, parent}\}$ with the descending term, child. Altogether, our set of generating terms will now be $G = \{\text{self, parent}\} \cup \{\text{self, child}\} = \{\text{self, parent, child}\}$, where \cup stands for set union. In addition, reciprocity between the kin terms parent and child, which must be part of the theory, is introduced through the structural equation:

$$(1) \text{parent o child} = \text{self}.$$

The equation states that when ego refers to alter₁ as child, and alter₁ refers to alter₂ as parent, then ego refers to alter₂ as self, which is precisely what we mean by parent and child being reciprocal terms in the domain of consanguineal relations (since affinal relations are not yet part of theory) due to both the fact that alter₂ must be ego if ego and alter₂ are related consanguineally and the fact that ego refers to him(her)self as “self.” The theory model derived from this theory is shown in Figure 7 and is isomorphic to the kin term map in Figure 5. Note that the theory model implies sibling = child o parent, hence we have the prediction that, for English speakers, sibling is conceptualized as a concept constructed from the concepts of parent and child. We will use this sibling property (below) when we compare descriptive to classificatory terminologies.

We continue expanding the theory by introducing sex marking of terms through bifurcation of generating terms into male and female marked terms; that is, we “undo” the folding used to simplify the kin term map. Affinal relations are introduced through adding a spouse element

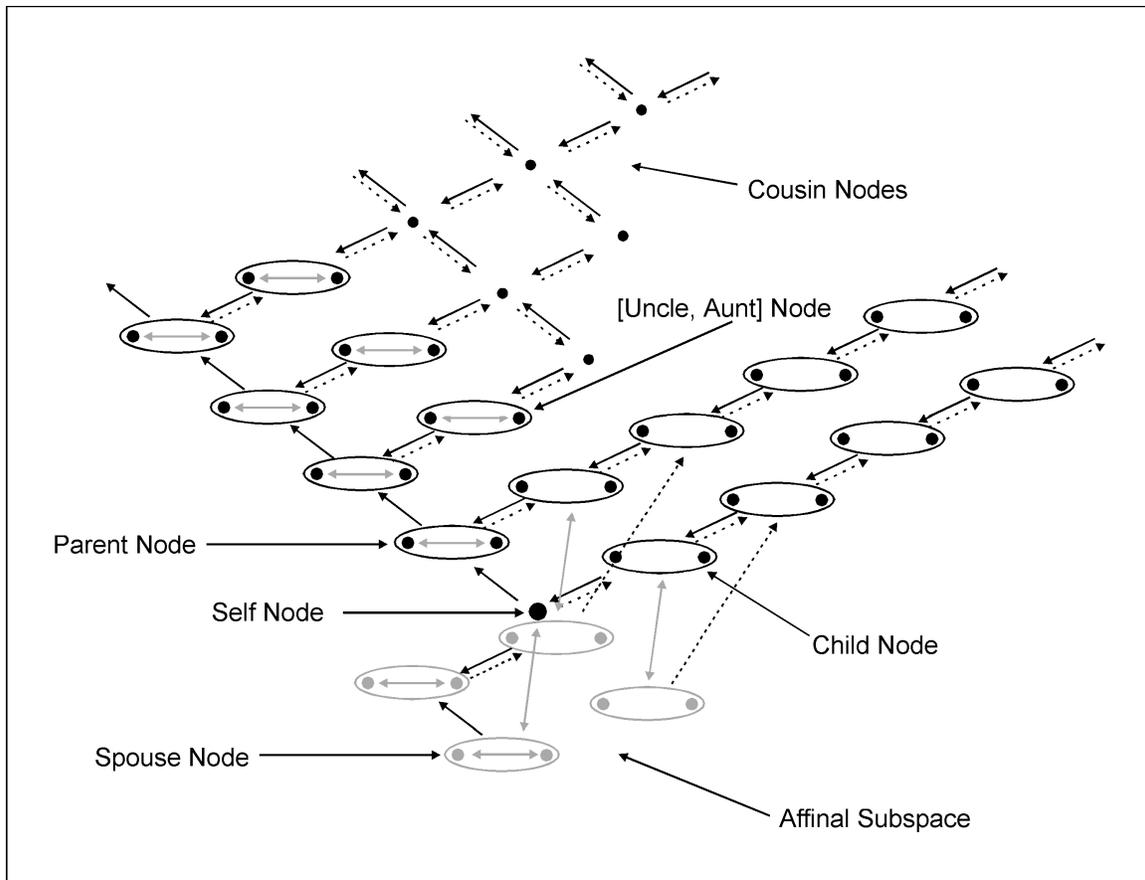


Figure 8: Theory model for the English kinship terminology. The solid, single-headed arrows show the result of taking a product with the generating term, *parent*. The dashed, single headed arrows show the result of taking a product with the reciprocal generating term, *child*. The gray, double-headed arrows show the result of taking a product with the affinal generating term, *spouse*. The oval around a pair of nodes indicates that the pair of nodes differ by sex marking. The gray nodes are the affinal nodes generated by the *spouse* generating term. The gray double-headed arrows indicate products with the *spouse* generating term. The structure is isomorphic to the kin term map shown in Figure 3.

We now explore briefly some of the implications that arise from making explicit a theory for a kinship terminology. We will show the implications this has for modeling differences in kinship terminologies between different societies. More precisely, we will identify the theory difference that gives rise to the terminology distinction between descriptive and classificatory terminologies introduced by Lewis Henry Morgan, a division that has played a central in theorizing about the relationship between kinship terminologies and systems of social organization.

The division has endured despite problems with providing an adequate definition for what constitutes a descriptive versus a classificatory terminology. Roughly, descriptive terminologies -- for which the English terminology is an exemplar -- always distinguish collateral from lineal relations in the -1, 0, and +1 generations. English has the lineal kin terms son/daughter, self and father/mother as well as the terms nephew/niece, brother/sister, and aunt/uncle for the -1, 0 and

+1 generations, respectively. In contrast, classificatory terminologies do not have kin terms that distinguish between genealogical parent and genealogical same-sex sibling of genealogical parent, hence both genealogical father and genealogical father's brother (among other males) are referred to by the same kin term, 'father' and any male referred to as 'son' by a person referred to by ego as 'father' will be someone ego refers to as 'brother', where 'kin term' is the closest transliteration of non-English kin terms into English.

Classificatory terminologies are common in Dravidian speaking parts of India, in the Pacific island area, in Australia, among some native American groups in North America, and in many societies in the amazonian parts of South America. They have been an enigma for theorizing about human societies as the terminologies do not reflect structurally a genealogical space as do the descriptive terminologies. We will develop here a simple difference in the generative logic of terminologies that provides an unambiguous, formal criterion for defining a descriptive versus classificatory terminology distinction. This difference leads to a verified ethnographic prediction regarding the social meaning of the kinship concept of sibling.

The argument presented here was developed algebraically (Read and Behrens 1990) using a general paradigm for the construction of kinship terminology structures (Read 2007). Read and Behrens showed that a theory for classificatory terminologies differs from a theory for descriptive terminologies in the first step of generating the core structure of ascending kin terms. Rather than a generating set such as $G = \{\text{self, parent}\}$, the classificatory terminologies use a generating set of male-marked (or equivalently, female-marked) terms that includes a sibling term distinguished by relative age. Accordingly, let $A = \{\text{male self, father, +brother}\}$ be the generating set for the ascending kin term structure, where male self is a sex-marked identity term for kin term products with male-marked terms and the "+" sign on brother indicates that this term has transliteration, 'older brother.' The structural equations are:

(1) $\text{father} \circ \text{father} \circ \text{father} = 0$ (or sometimes, $\text{father} \circ \text{father} \circ \text{father} = \text{father} \circ \text{father}$, depending on the terminology; classificatory terminologies vertically limit the construction of new kin term concepts)

(2) $+\text{brother} \circ +\text{brother} = +\text{brother}$ (structural equation for making +brother a sibling term)

and

(3) $\text{father} \circ +\text{brother} = \text{father}$ ('father' of 'older brother' is 'father').

The descending structure will be generated using the set $D = \{\text{male self, son, -brother}\}$, where -brother has transliteration 'younger brother', along with the isomorphic structural equations

(1*) $\text{son} \circ \text{son} \circ \text{son} = 0$

(2*) $-\text{brother} \circ -\text{brother} = -\text{brother}$

and

(3*) $\text{son} \circ -\text{brother} = \text{son}$.

We introduce the structural equation

(4) $\text{father} \circ \text{son} = \text{male self}$

to make father and son reciprocal terms and the equation

(5) $+\text{brother} \circ -\text{brother} = \text{male self} = -\text{brother} \circ +\text{brother}$

to make +brother and -brother reciprocal terms. Note that had we used brother as a generating term in the set A, then brother would also be the isomorphic term in the generating set D and we

would have the equation, brother o brother = male self, for defining brother to be a self-reciprocal term. Equation (2*) would now be brother o brother = brother. Together, these two equations imply that brother = brother o brother = male self, thus incorrectly erasing the sibling term, brother, from the algebra by reducing it to the identity element, male self. Hence having +brother as an ascending generator and -brother as a descending generator is logically necessary, which accounts for the fact that classificatory terminologies typically make an older/younger sibling distinction among the same-sex sibling kin terms.

Next we use another universal property for kinship terminologies, namely closure under reciprocity of structural equations. If we have the structural equation $X \circ Y = Z$, then we will also have the equation $Y^r \circ X^r = Z^r$, where X^r , Y^r and Z^r are the reciprocal terms for X , Y and Z , respectively. Examples of this property can be seen in Equations (3) and (5) with the reciprocal equations also included in the theory. This property implies that for classificatory terminologies, the reciprocal equation for Equation (3*), namely +brother o father = father is part of the theory. One can also show that -brother o father = father, hence brother of father = father, the defining condition for classificatory terminologies. Hence the difference between classificatory terminologies and descriptive terminologies is determined by whether sibling is a concept constructed from the concepts parent and child (as is the case for the English terminology since we showed that child o parent = sibling), or whether sibling is an irreducible generating concept on a par with parent as an irreducible generating concept.

Including a sibling terms as a generation term leads to the ethnographic prediction that sibling should be conceptualized differently in societies with descriptive terminologies versus societies with classificatory terminologies. This prediction is verified by ethnographic observations regarding the concept of sibling in societies with classificatory terminologies as a generating concept. Perhaps the clearest expression of sibling as a generating concept occurs with the Tangu of New Guinea. Among the Tangu “a person’s descent is of small significance to him but that relationships with sibling are of vital importance. Briefly, that *siblingship is the determinant that descent might have been expected to be*” (Burrige 1959: 128, as quoted in Bamford 2007: 58, emphasis added). The graphical differences in the concept of sibling between societies with descriptive versus classificatory terminologies in the context of a family space are shown in Figure 9 (A) and (B).

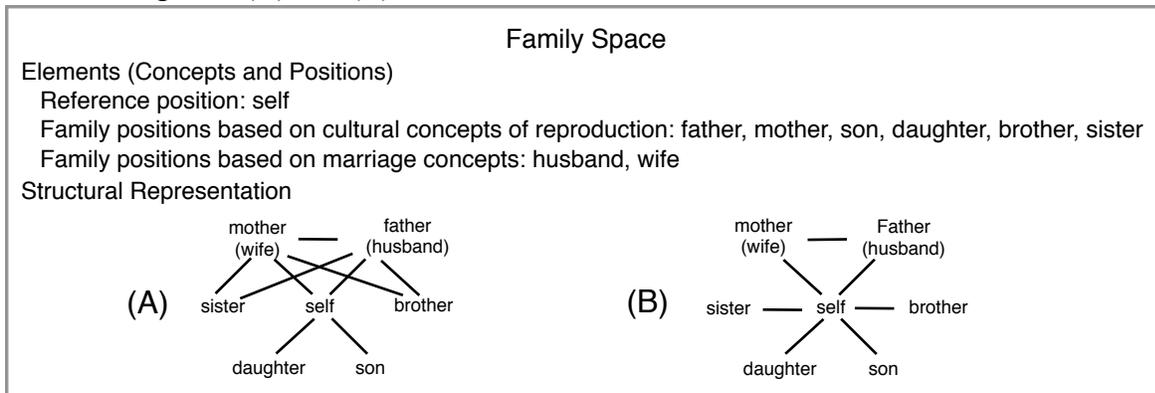


Figure 9: Comparison of two concepts of sibling. (A) Sibling conceptualized as child of parent and is the structure for descriptive terminologies. (B) Sibling conceptualized as a generating concept and is the structure for classificatory terminologies.

Concluding comments

This excursion into the modeling of cultural idea systems shows that cultural idea systems are a theory for constructing a social universe and a theory model in this context expresses properties of the social universe engendered by that cultural theory. Modeling that relates to cultural idea systems has several goals. One is to formally model a culture theory in a manner faithful to the concepts involved. With cultural constructs such as kinship terminologies, modeling must begin with concepts elicited from culture-bearers through ethnographic research and not with imposed concepts. The latter has characterized previous analyses of kinship systems and kinship terminologies (Leaf and Read n.d.) and, not surprisingly, has led to analytical cul-de-sacs in which analysis become little more than description (Read 2000). The use of a kin term product for the formal modeling of kinship terminologies is predicated on ethnographic data showing that this is the way that culture-bearers compute kinship relations and therefore provides a way to experimentally elicit the cultural knowledge embedded in a kinship terminology (Leaf 2006). With this approach, we can keep clear the difference between modeling aimed at making evident a culture theory embodied in a data structure based on ethnographic observations regarding cultural concepts versus more traditional modeling aimed at developing theory that accounts for patterning expressed in data structures based on observations about behavior. The two approaches are complementary, not in competition, but failure to recognize the difference in approaches has led to the mistaken assumption, for example, that evolutionary models framed at the level of behavior are also explanatory for changes at the level of cultural theories. With modeling focused at making evident a culture theory for cultural concepts, though, we necessarily have feedback to ethnographic observations since the model is expressed using cultural concepts. We should not be surprised, then, to find that the prediction regarding the centrality of a sibling concept in societies with classificatory terminologies is borne out unequivocally in ethnographic observations.

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