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KINSHIP THEORY: A PARADIGM SHIFT

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The received view regarding the centrality of kinship terminologies in kinship systems assumes that terminologies are genealogically constrained. This assumption ignores the generative logic of kinship terminologies, hence the need for a new paradigm. It is argued that kinship systems are based on two conceptual systems: the logic of genealogical tracing and the logic of kin term products. Structural implications of the generative logic of terminological structures are discussed, including the logical basis for the difference between descriptive and classificatory terminologies and transformations that may be made between different kinship terminologies through simple changes in structural equations. Connection between ethnographic observations and structural properties are identified. (Cultural anthropology, kinship, formal models, genealogy)

INTRODUCTION

"… in inventing kinship, anthropology invented itself…" (Trautmann 1992: 393)

"Kinship used to be described as what anthropologists do. Today, many might well say that it is what anthropologists do not do." (Sousa 2004: 265)

Kinship studies, though characterizing anthropology from its inception (Kuper 1988, Eriksen and Nielsen 2001), have currently lost centrality in American cultural anthropological research, as reflected in the second of the above quotes. The focus of kinship studies has shifted away from "kinship as a terminological system and as a symbolic system 'in its own terms'" towards "kinship in terms of social relations among variably situated actors engaged in the practice of social reproduction" (Peletz 1995: 366), with goal tracing "connections and conceptual crossovers … at vastly different scales" (Franklin and McKinnon 2000: 279). The change in research focus, though, does not derive from resolution of older, fundamental questions such as the relationship between a terminological system and social organization (Keesing 1975). Instead, the questions that drove kinship research in the 19th and most of the 20th century have simply been abandoned and not resolved -- what Chris Knight (2008:79) refers to as "intellectual bankruptcy," thereby putting anthropologists in the precarious position of proclaiming as irrelevant research aimed at understanding the causal basis for the systems of kin relations that are of primary concern to people in most, if not all, societies. The properties of kinship terminological systems that help frame the kin world within which societal members interact need to be explicated, not hidden from view

Rather than abandoning the challenge of hard questions, we need to address them head-on. Lack of progress in answering those questions stems, I argue, from assuming

that kinship begins with genealogy -- as is asserted by statements such as: "kinship systems are terminologies, terminologies are [genealogical] classifications…" (Kroeber 1917: 395); "Where the distributional criteria are genealogical and egocentric, we speak of relations of kinship" (Scheffler and Lounsbury 1971: 38); or in even more extreme form: "kinship relations are biological relations" (Makarius 1977: 710, emphasis in the original) -- despite extensive ethnographic evidence to the contrary. Proponents of the genealogical position have assumed kinship distinctions relate to properties of a genealogical space -- lineality/colineality, ancestor/descendant, male/female, etc., even though ethnographic evidence shows otherwise. As McKinley has noted for the Malay: "The term abang is better understood by its relations to other terms in the system of status levels than it is by its relation to the corresponding genealogical notion of 'older brother'" (1981: 360, emphasis added). Schneider notes for the Yapese kin concepts of citamangen and fak that "… the relationship between citamangen and fak may not properly be translated as 'father' and 'child,' and is indeed not even a kinship relationship according to certain [genealogical] definitions of that term…" (1984:78).

That genealogy alone does not provide the conceptual basis upon which kinship relations are formed is shown in the way kin relations are established through feeding and nourishment among the Wari' in Amazonia (Vilaça 2002), through residence among the Korofeigu of New Guinea (Langness 1964), via nursing in the Arabian area (Altorki 1980), in Iran (Khatib-Chahidi 1992), among the Hindu Kush in Pakistan (Biddulph 1880) and in the Balkans (Hammel 1968) (see discussion by Parkes (2001, 2004)); through godparenthood (e.g., Paul 1942 for Middle America, Fine 1994, Héritier-Augé and Copet-Rougier 1995 for Catholic Europe); through fosterage (e.g., Smith 1903 [1885] for Arab societies, among others); through a name giver-name receiver relation (e.g., Bamberger 1974 for the Kayapó, Marshall 1976 for the !Kung san, Lave, Stepick, and Sailer 1977 for the Krĩkatí) and through blood kinship (e.g., Vernier 2006 and references therein for Turkey). For the Trio in Amazonia, "Co-residence can be as closely binding as the ties of genealogical connexion, and in [Trio] thought they are not truly distinguished" (Rivière 1969: 65). For the !Kung san among whom I did field work in the early 1970's, kin relations outside one's family are established through name-giving, not through genealogy (Marshall 1976). These, and numerous other examples, lend support to Schneider's conclusion that "the way in which kinship has been studied does not make good sense" (1984:201) since "[i]t exists in the minds of anthropologists but not in the cultures they study" (1972:51).

The genealogical assumption leads to assertions such as a kin term "is the 'name' of a genealogically established category" (Scheffler and Lounsbury 1971:13, emphasis added) that are contradicted by abundant ethnographic examples to the contrary, e.g., Lorna Marshall's comment regarding the !Kung san: "a person would not always know why [in a genealogical sense] he applied a certain term to someone, but he would know that the term he used was proper…" (1976:204, emphasis in the original). The genealogical position must assume categories labeled by kin terms whose origin lies outside the genealogical space. The formal methods heretofore advocated for the analysis of kin terms (such as componential analysis and rewrite rules) provide descriptive, not causal,

accounts of the relationship between kin terms and their associated categories of genealogical relations (Read 2000) and consequently "questions about why kinship structures took the forms they did were ignored" (D'Andrade 2004: 311). As a result, the genealogical argument does not identify the underlying logic of a kinship terminology viewed as a cultural construct: "un système de parenté ne consiste pas dans les liens objectifs de filiation ou de consanguinité donnés entre les individus; il n'existe que dans la conscience des hommes, il est un système arbitraire de représentations, non le développement spontané d'une situation de fait" ("kinship does not consist of objective ties of filiation or of blood connection between individuals; it exists only in the minds of men as an arbitrary, not an emergent, system of symbols" (Lévi-Strauss 1958: 61, translation mine).[1] The ontological relationship between a genealogical space determined through genealogical tracing of links connecting individuals and kin relations as they are identified through the use of kin terms remains hidden (see Read 2001b), despite the importance of the latter for the way we work out the kin relations we have with others. As Hayden has observed in a current context: "Kinship terms … become one medium through which gay and lesbian coparenting families declare equal claims, for both parents, to a legitimate relationship with their children" (Hayden 1995: 50).

At issue, then, is whether a kinship connection between one person and another hinges on kinship being based, on the one hand, on a property shared by the individuals in question, such as a physical property arising from a genealogical connection between individuals engendered through reproduction or an attribute of individuals such as resemblance arising from genetic connection (Hirschfeld 1986, Jones 2000), or, on the other hand, whether what constitutes a kinship connection between one person and another is a cultural construct (Schneider 1984, Delaney 1986, Schneider 1992, Weston 1992, Weismantel 1995, among others) expressed through a kinship terminology constituted as an interconnected system of symbols (in the linguistic sense), with persons identified as kin to one another realized in many different modalities as the above examples demonstrate.

If kinship is not reducible to genealogy, we need a new paradigm for what constitutes kinship, one that enables us to recast unresolved questions in a new light. What is amiss is not whether kinship as it is expressed through a kinship terminology is part of human societies ("the notion of a kinship terminology [is not] seriously problematic" (Allen 1998: 314)), but the presumption that kinship begins with genealogical relations and so analytically we consider kinship through the lens of genealogy: "the genealogically defined grid is the only analytic device that has been applied to most of the systems which anthropologists have studied. There has been almost no systematic attempt to study the question without employing this device. To put it simply, it is about time that we tested some other hypotheses." (Schneider 1972:49). What constitutes another hypotheses is the theme of this paper: a new paradigm for what we mean by kinship.

THE BASIS FOR A NEW PARADIGM: KINSHIP THROUGH A CULTURALLY CONSTRUCTED SYSTEM OF KIN TERMS

The proposed new paradigm for a system of kinship relations is the antithesis of the genealogical paradigm. The genealogical paradigm can be summarized as follows, begin-

ning with reproduction as the means for engendering a genealogical relation formally represented as a kin type. Other genealogical relations are then constructed through taking the product of kin types and are collectively organized together in the form of a genealogical space, or grid. Structuring processes external to the genealogical grid are assumed to provide the causal basis for partitioning the genealogical grid into categories of kin types. The kin terms are interpreted as linguistic labels for the kin type categories. In this framework, any structure among the kin terms is the consequence of external processes, such as constraints on behavior arising for both social and ecological reasons, that determine a partition of the genealogical space into categories of kin types. Hence causality would be from behavior to the distinctions made in the kinship terminology.

The new paradigm reverses this sequence by beginning with kin terms viewed as cultural constructs, including culturally determined computations for linking kin terms to one another subject to structural constraints and thereby forming a structured system of kin terms. Kin terms can then be linked to categories of kin types through the kin term structure, thereby producing a structured system of kin type categories that provide genealogical definitions for kin terms. I call the process through which the kin terms are linked to categories of kin types cultural instantiation (see Read 2002). The ethnographic examples discussed above show that cultural instantiation is not limited to categorization based on a genealogical space. Other categorizations are possible, depending upon the cultural context, thus the paradigm can accommodate the ethnographically documented different ways in which individuals are considered to be kin to one another. In this paradigm, both the genealogical space of kin type products and the kin term space of kin term computations are part of the system of kinship relations expressed through a kinship terminology. The space of kin terms is mapped to the space of genealogical relations and not the reverse as is assumed in the genealogical paradigm.

The terminological space along with the genealogical space linked via cultural instantiation together form the conceptual system we, as culture-bearers, use for identifying and constructing kin relations. Because a collection of kin terms has structure directly as a system of linguistic symbols, rather than indirectly through the labeling of genealogical categories, we can determine whether structural properties for the system of kin terms are embedded causally in the form of social organization that structures interactions among societal members. By considering differences in constraints across different the terminological spaces for different terminologies, we can also delineate the structural basis for differences among kinship terminological systems.

In the remainder of this paper I will first define a kin term product, based on ethnographic evidence, through which kin relations are calculated. The kin term product may be used to graph visually the structure of the terminological space for a kinship terminology. Next I demonstrate, using the American kinship terminology, how the structure displayed in the kin term map may be generated from a set of primary kin terms and structural equations motivated by properties of kinship terminologies such as reciprocity of kin terms. When the primary kin terms are instantiated as genealogical categories, they, in conjunction with the generative logic of the kinship terminology structure, predict the instantiation of all other kin terms as categories of kin types. The predicted categories are

found to be in 100% agreement with informant derived genealogical definitions of the kin terms. These results are then used to illustrate structural consequences for kinship terminology structures arising from differences such as whether a sibling term is a primary term or not; more specifically, I demonstrate that the kin term equations used to define classificatory terminologies are the logical consequence of a terminological system in which a sibling term is a primary kin term. This demonstration identifies the special role of the sibling terms in classificatory terminologies and I relate the structural results to ethnographic observations on the importance of siblings in Polynesian and other Pacific Island groups. Finally, I consider three terminologies that are dissimilar at the surface level of kin terms as they are used in the societies in question, yet differ structurally only by the value of a parameter in a structural equation common to these three terminologies. This result illustrates the potential of the new paradigm for developing a typology of kinship terminologies based on differences in the structural equations and generating terms from which a terminology may be generated. From these results I conclude that the generative approach to terminologies provides a new paradigm that will lead to new insights into longstanding questions we have had about the place of kinship terminologies in social and cultural systems.

KINSHIP TERMINOLOGY COMPUTATIONAL LOGIC

(1) Definition of a Kin Term Product

Formal approaches such as componential analysis and rewrite rules have assumed a genealogical space and idealized genealogical relations – kin types – as the primitive concepts. The underlying problem with the genealogical constraint approach is straightforward. That approach assumes an already existing classification of a genealogical space and only considers the cultural information and logic underlying the classification in an indirect and incomplete manner. Formal analyses that start with the genealogical space as a primitive property are inevitably examining the consequences of the logic of a terminology structure as it is expressed through mapping the terms onto the genealogical space, rather than the structure and logic of kin terms as a conceptual system (Read 2000, 2001a, b). In brief, a kinship terminology needs to be considered in its own right as a structured system of (linguistic) symbols with logic and structural properties arising out of the way it is determined as a cultural construct (Schneider 1984).

The logic that gives rise to the kinship terminology in the form of a system of symbols underlies the way kin relations are determined through kin term calculations and not by reference to genealogy. There are a plethora of ethnographic examples documenting how kin relations are determined through calculations with kin terms. Parkin (1996) observes that "[t]he ethnographic literature is full of discussions of how, when two people meet for the first time, they set about determining their relationship to one another" (p. 94) by using calculations with kin terms and not genealogy and cites Vatuk's (1969: 96) report on Hindi kinship and Good's (1981: 113) report on the kinship system of the Kondaiyankottai Maravar of South India as examples. Similarly, the Toba Batak establish the

proper use of kin terms through "reference to how the individuals use other kinship terms . . . not how those individuals are genealogically related" (Hirschfeld 1986: 221). For the Shipibo, Behrens (1984) notes that "Kin terms are elicited from informants without their recourse to genealogical relationships; rather, terms of reference are assigned to individuals by tracing only through the terms themselves…. Two women used the kin terms they applied to a third individual in order to determine the kin relation between their offspring and that person" (p. 146). Sahlins (1962) makes explicit the calculations involved in his discussion of Moala kinship:

> [K]in terms permit comparative strangers to fix kinship rapidly without the necessity of elaborate genealogical reckoning – reckoning that typically would be impossible. With mutual relationship terms all that is required is the discovery of one common relative. Thus, if A is related to B as child to mother, veitanani, while C is related to B as veitacini, sibling of the same sex, then it follows that A is related to C as child to mother although they never before met or knew it. Kin terms are predicable. If two people are each related to a third, then they are related to each other (Sahlins 1962: 155).

In the same vein, Levinson (2002) observes for Rossel Island:

> Kinship reckoning on Rossel does not rely on knowledge of kin-type strings…. 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).

(See also Kelly (1977: 69) for the Etoro, Sigarimbun (1975: 147) on the Karo Batak (both cited in Hirschfeld 1986), Overing Kaplan (1975: 181) for the Piaroa, Marshall (1976) for the !Kung san, Feinberg (1981: 106) for the Anuta, Gow (1991: 193-194) for the Piro, and Vilaça (2002: 352) for the Wari', among numerous other ethnographic examples documenting the use of a kin term calculus rather than genealogical tracing to determine kin relationships.)

Underlying these examples is the way a kinship terminology makes it possible for relations between terms (and then between the persons included in the instantiation of these kin terms) to be established without recourse to genealogy. As Good expressed it in his discussion of kinship among the Kondaiyankottai Maravar: "If ego knows what term to use for alter A, and also knows what term A uses for alter B, he can easily work out what term he himself should use for B" (1981: 113). This kind of calculation is the basis for what I call a kin term product (Read 1984):

> *Definition*: Let *K* and *L* be kin terms in a given kinship terminology, **T**. Let ego, alter$_1$ and alter$_2$ refer to three arbitrary persons each of whose cultural repertoire includes the kinship terminology, **T.** The kin term product of *K* and *L*, denoted *K o L*, is a kin term, *M*, if any, that ego may (properly) use to refer to alter$_2$ when ego (properly) uses the kin term *L* to refer to alter$_1$ and alter$_2$ (properly) uses the kin term *K* to refer to alter$_2$.

For example, in the American/English Kinship Terminology (AKT), if L is the kin term

Aunt and K is the kin term Son, then if ego refers to alter1 as Aunt and $alter_1$ refers to $alter_2$ as Son, ego (properly) refers to $alter_2$ as Cousin, hence Son o Aunt = Cousin (read "Son of Aunt is Cousin") in the AKT. Note that this is not a statement about genealogical relations as Aunt, Son and Cousin are kin terms and no statement is being made about the genealogical relationships among ego, $alter_1$ and $alter_2$. It might be the case, for example, that $alter_2$ is an adopted son and $alter_1$ is related by marriage to ego. The equation simply asserts that ego would (properly) refer to $alter_2$ as Cousin in the situation where ego (properly) refers to $alter_1$ as Aunt and $alter_1$ (properly) refers to $alter_2$ as Son, which is consistent with the AKT even when applied to adopted children. The kin term product expresses the (proper) informant response, or what Bourdieu calls the "official representation" (1990: 167), to questions such as: "If you (properly) refer to someone by the kin term K, and that person (properly) refers to someone by the kin term L, what kin term would you use to (properly) refer to this last person?" The criteria by which the informant arrives at an answer (genealogical calculation, personal experience, etc.) are not of primary concern, only the term(s) that is deemed by the informant to be the consequence of this kind of kin term calculation.

(2) Kin Term Map

From this information about kin term products, we can construct a kin term map (Leaf 1971, 2008, Read 1984) so as to visually display the linkages among kin terms determined by taking kin term products with the primary kin terms. Each kin term is listed once in the kin term map and a distinctive arrow type is associated with each primary kin term. For all of the primary kin terms, the corresponding arrow type is drawn from each kin term (call it the initial kin term) in the kin term map to the kin term that results from taking a product of the primary kin term associated with the arrow and the initial kin term. In the case of the American kinship terminology (AKT), we might use the kin terms Mother, Father, Son, Daughter, Husband and Wife as the primary terms, or alternatively we might use the kin terms Parent, Child, and Spouse as the primary terms (see Figure 1, based on Parent, Child and Spouse as the primary kin terms). (Capital letters are used to distinguish between, say, mother in the English language used in its kin term rather than its genealogical sense; e.g., the sentence "Mary is my mother" can either mean that Mary is the woman who begat ego (genealogical mother) or Mary is the woman who has the kin relationship, mother, with ego even if Mary is not ego's 'birth mother' and instead, say, ego was adopted by Mary.) Different terminologies have different kin term maps (see Figure 2 for the Shipibo kin term map).

Like the results of componential analysis or rewrite rule analysis, a kin term map uses description to make evident structural properties of the terminology. For the AKT, some of these structural properties include the substructures repeated in different parts of the terminology, such as the pattern of arrows going upward from Self, the pattern of arrows going downward from Self,[2] and the pattern of arrows going down from terms such as Aunt or Uncle (see Figure 1). Unlike the analytic results of componential analysis and

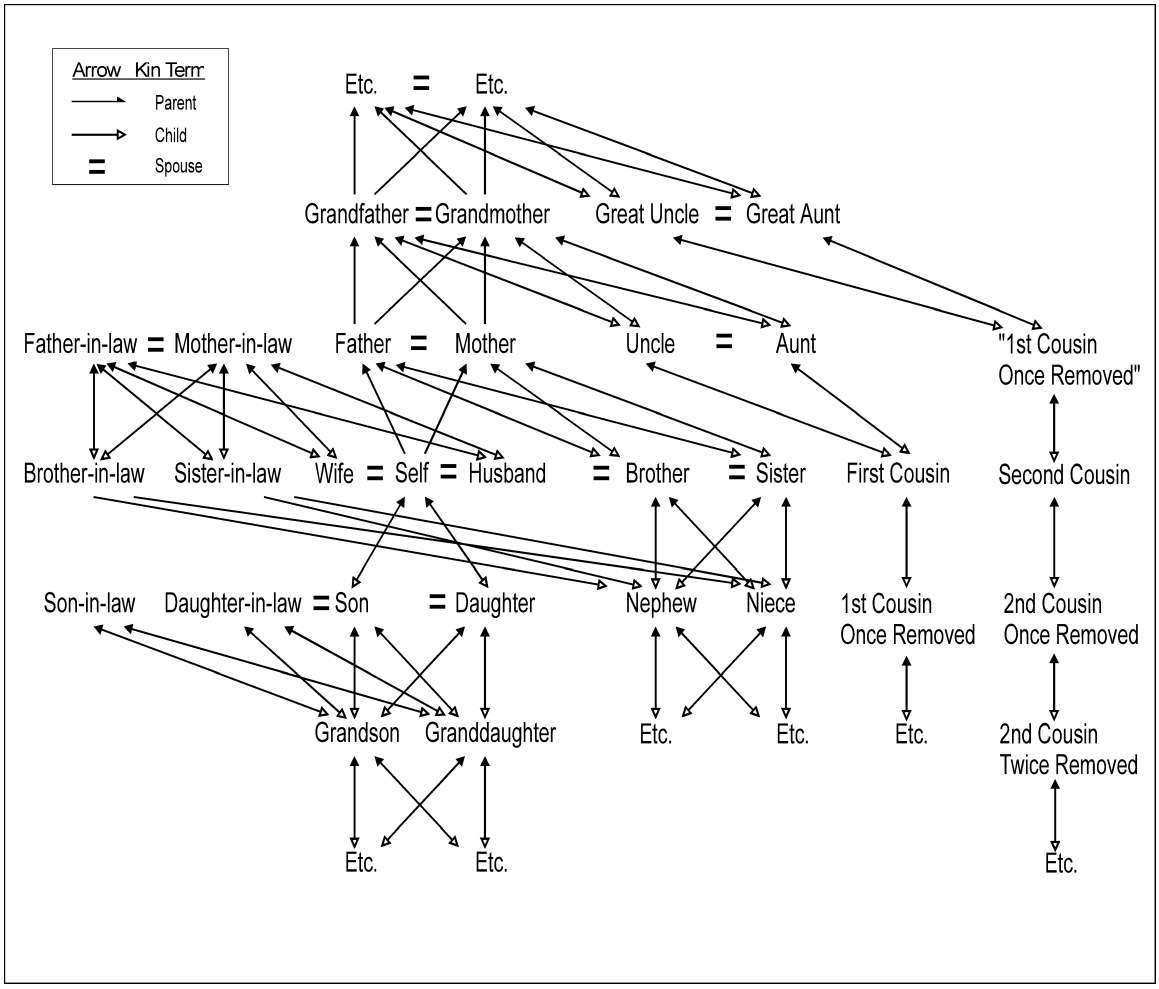

Figure 1: Kin term map for the American Kinship Terminology. Solid headed, upward arrows represent the result of taking kin term products with the kin term, Parent. Open headed, downward arrows represent the result of taking kin term products with the kin term, Child. The "=" sign represents the result of taking kin term products with the kin term, Spouse. The nodes labeled with Etc. indicate that the map continues using the same pattern as displayed in the immediately preceding nodes.The term Cousin Once Removed is shown twice—once with quotation marks and once without—for clarity in drawing the kin term map. In the map, a kin term always corresponds to a single node; thus, there is a single node labeled 1st Cousin Once Removed.

rewrite rules, however, the kin term map displays structural linkages among kin terms wi thout using an imposed intervening device such as a genealogical grid. The kin term map, in this sense, is independent of genealogical connections and kin term computations can be carried out, as illustrated above with ethnographic examples, using the kin term map directly and without first knowing the mapping of kin terms to a genealogical grid. The latter would be necessary if kinship were initially determined by genealogical connections. The kin term map can be linked to genealogical connections when the kin terms are given cultural instantiation as categories via genealogical connections – or it can be linked to categories based on adoptive relations, name relationships, milk relations, etc.

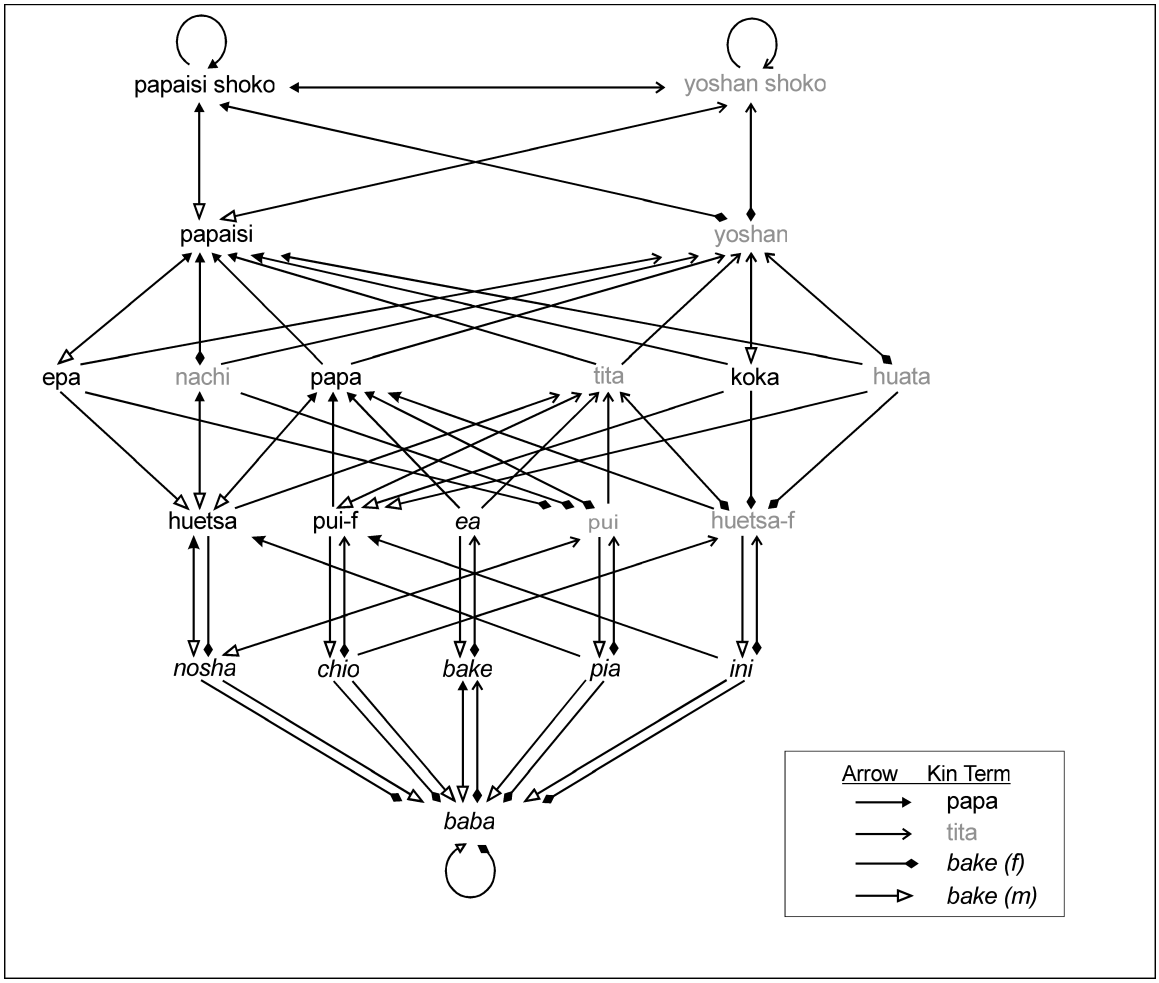

Figure 2: Kin term map for the Shipibo, a horticultural group in Peru. Primary kin terms are sex marked. Note the striking structural differences between the kin term map for the Shipibo and for the AKT.

Cultural instantiation of the symbols in the kin term map is necessary since the map, by itself, only displays the linkages among kin terms viewed as a system of (abstract) symbols and does not inform us about content when a kin term is interpreted as a category.

(3) Predicted Genealogical Kin Term Definitions

We can link the kin term map to genealogical relations by instantiating the primary kin terms as categories with genealogical content and then using the kin term map structure to determine the genealogical content for all other kin terms in the kin term map instantiated as categories. For example, after constructing the kin term map for the AKT shown in Figure 1, we can map the primary kin terms (in accordance with cultural knowledge elicited from, in this case, American culture-bearers) to categories of elementary, ego oriented kin types used for genealogical tracing via: Self → {ego}, Parent → {ego's genealogical mother, ego's genealogical father}, Child → {ego's genealogical son, ego's genealogical daughter}, Spouse → {ego's wife, ego's husband}. (For notational

simplicity, we will henceforth leave ego and the genealogical qualifier implicit when referring to a genealogical kin type.) We can now assign genealogical content to all other kin terms in the kin term map by mapping the representation of a kin term as a product of primary kin terms -- with the product determined by the sequence of arrows going from Self to the kin term in question in the kin term map -- to a product of sets of kin types based on the primary kin terms. For example, [Brother, Sister] = Child o Parent as a product of primary kin terms for the AKT since we go from Self to Parent via a "Parent Arrow" and then to [Brother, Sister] via a "Child Arrow." Next we map Child o Parent to {son, daughter} × {mother, father} = {mother's son, mother's daughter, father's son, father's daughter}, where we define the product of two sets of kin types to be the set of kin types formed by taking a kin type product of each kin type in the second set with all of the kin types in the first set. More formally, if we let *m*, *f*, *s* and *d* be symbols for the kin types mother, father, son and daughter, then Child o Parent → {*s*, *d*} × {*m*, *f*} = {*ms*, *fs*, *md*, *fd*}.[3] When we carry out this procedure for each of the kin terms in the kin term map, we obtain a predicted mapping of kin terms onto an ego-oriented, genealogical grid (see Figure 3). The predicted mapping of kin terms onto a genealogical grid agrees precisely with the genealogical definition of kin terms in the AKT.

The fact that we can predict the genealogical content for each of the non-primary kin terms has two important implications. First, specification of kin terms using genealogical criteria cannot be irreducible information about kin terms since that information can be recovered through specification of the kin term map and a mapping of the primary kin terms to the genealogical space. If genealogical definitions of kin terms were primary data as is assumed in the genealogical accounts of kinship terminologies, we would not be able to recover those definitions using less information than is contained in them. Second, if the kin term map can be generated from the primary kin terms and a few, emically salient, structural equations that indicate when a more complex kin term product can be replaced by a simpler kin term product, then we have constructed a formal way to generate both the kin terms for the kinship terminology and their genealogical content. This result shifts the basis for comparison of terminologies to the primary kin terms and structural equations from which the terminologies can be generated, as will be discussed below.

(4) The Generative Logic of a Kin Term Map

The key argument to be made here is that the kin term map has a structure that can be generated from the primary kin terms. There is no a priori reason to assume the kin term map can be generated in this manner. Unlike rewrite rule analysis that is unconstrained and hence will always succeed, regardless of how the genealogical space is partitioned (Read 2000), the same is not true for any kin term map and must be established on a case-by-case basis. The discovery that kin term maps do have a generative, algebra-like structures (see Read 1984) has such far reaching and thorough-going implications for our understanding of kinship systems as to amount to a paradigm shift in Kuhn's sense. The

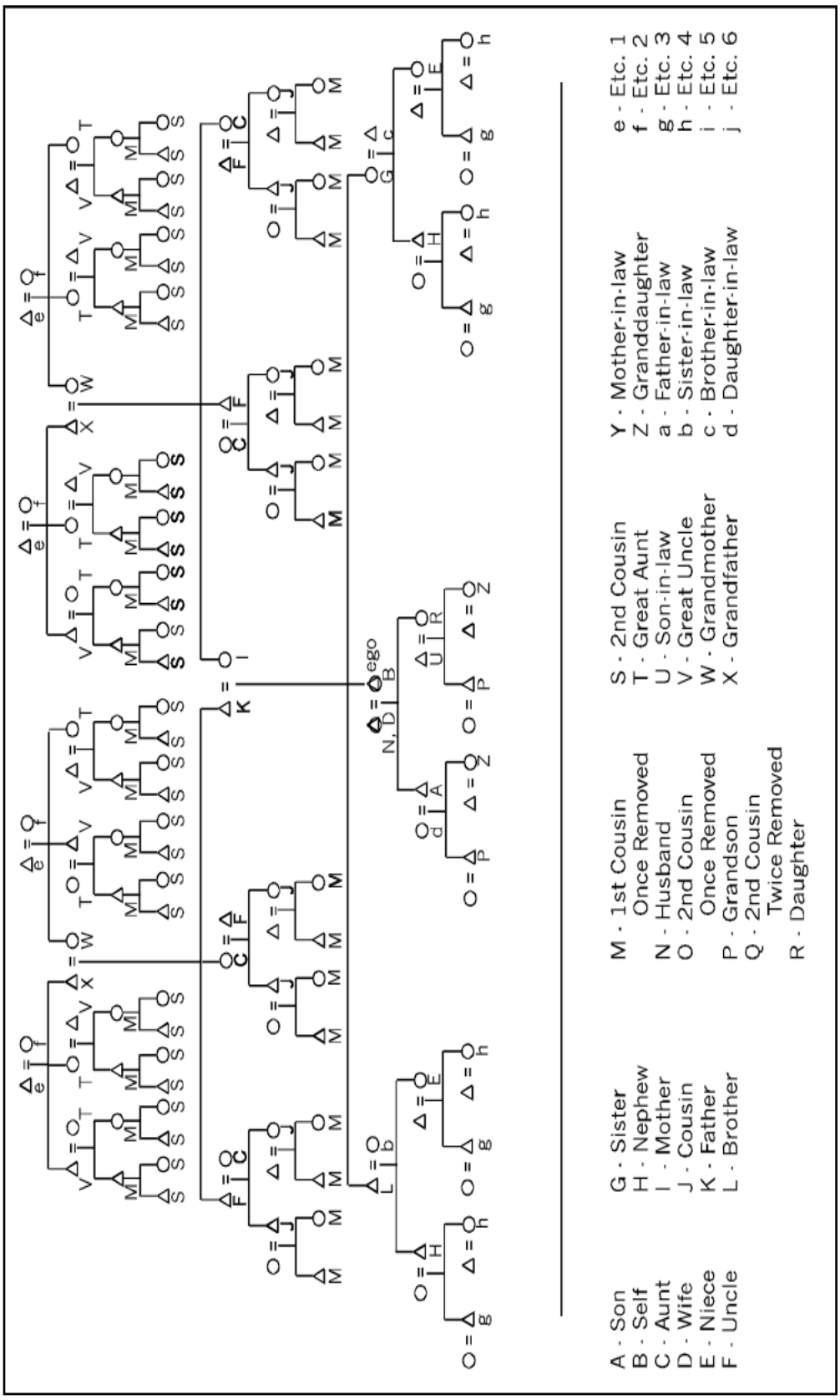

Figure 3: Genealogical diagram for the AKT as predicted from the algebraic structure shown in Figure 4 and the mapping from abstract kin terms to kin types defined by Self → {ego}, Parent → {m, f}, Child → {d, s} and Spouse → {w, h}. Note that 2nd Cousin Once Removed and 2nd Cousin Twice Removed are outside hte genealogical range of this diagram.

received view operates from the position that the features of a kinship terminology arise from constraints and/or conditions external to a kinship terminology. The terminology, it has been assumed, reflects whatever structuring processes are in play that underlie the organization of individuals into social groupings, along with the range and kinds of behaviors associated with interaction among group members. The features of the terminology may suggest, in this framework, what components of social organization might be involved in these structuring processes as Leach (1958) argued for the Trobriand clans, but these features are assumed to be the consequence of processes external to the terminology and not to a logic internal to the terminology. If, however, a terminology has a generative structure then we must first consider the logic of that generative structure and what terminological features are present in the terminology simply as a consequence of that generative logic.

In this way, explanation shifts from appeal to unspecified external conditions to identification of internal logic. If, for example, what appears to be inconsistent usage of the "-in-law" suffix by users of the AKT – inconsistent since the spouse of a parent's sibling is an Aunt or Uncle (depending on sex) and not an Aunt-in-law or Uncle-in-law -- is in fact simply the consequence of the generative logic of the AKT, then attempts (e.g., Schneider 1980: 107, n. 7) to find an explanation for this seeming anomaly in the morphological form of kin terms through factors extrinsic to the terminology are vacuous. Or more generally, if the structural differences between descriptive and classificatory terminologies arise from whether a sibling term is a primary term or not (see below), speculation on what might be the conditions leading to the seeming anomaly of terminologies that do not distinguish genealogical mother and genealogical father from other kinds of genealogical relations (Morgan 1871, Wake 1879, Rivers 1914, Likhtenberg 1949, Radcliffe-Brown 1952, Dole 1965, Makarius 1977, Jones 2000, among others) have addressed a non-issue. The seeming anomaly is only such from our perspective of a terminology without a sibling term as a generating term. And in the other direction, the generative logic for a kinship terminology enables us to distinguish between properties that arise through the generative logic of the terminology versus properties that have "cultural work" behind them (Bennardo and Read 2007); that is, kinship properties that have been introduced, for cultural reasons, into what otherwise would be the generated terminological structure. At this point the formal analysis ceases to just be grounded in ethnographic observation and becomes a predictor of where future ethnographic investigation should be focused.

One effective way to validate the claim that a kin term map has a generative structure is to actually generate a kin term map from primary kin terms. We will outline the steps for so doing with the AKT as an example. The full argument for the AKT can be found in Read and Behrens (1990), along with a partial generative analysis for the consanguineal terms of the Shipibo kinship terminology (see Figure 2) and the male marked kin terms for the Trobriand terminology. Analysis of both the male marked and female marked kin terms for the Tongan terminology (which has a core structure identical to that of the Trobriand terminology) has been published in Bennardo and Read (2005, 2007). These analyses, along with an analysis of the complete Trobriand terminology and the

consanguineal terms of the Punjabi terminology can be carried out using the Kinship Algebra Expert System program (Read 2006).

The terminologies mentioned above are a diverse group that, at the surface level of terms and mappings onto a genealogical space, appear to have little in common. However, the theoretical goal is not just to demonstrate that it is possible to generate the structure of a kin term map (and thereby generate the mapping of a kinship terminology to the idealized genealogical space). A second goal is to determine what constitutes commonality in the generation of kinship terminology structures despite the obvious surface level differences in the kin term maps. A third goal relates to the relationship between a terminology and social organization. By knowing the generative basis for the structure expressed in a kin term map, we can consider the extent to which structural properties provide the conceptual basis for social categorizations and for culturally marked aspects of those categorizations, as will be discussed below with the concept of siblingship in Oceanic societies.

Our first step in this argument is to show, in a precise way, the manner in which a kin term map, e.g., the AKT kin term map, can be generated from its primary kin terms. We will outline the argument framed using conclusions that have been derived regarding commonality in the generation of kinship terminology structures. Thus the outline presented here for generating the AKT kin term map also addresses the second goal by presenting a construction sequence that seems to be common to all kinship terminologies.

(1) Determine a starting term for building the structure. The starting term for building the structure will be based on the concept of self. By "concept of self" is meant the conscious awareness of one's own existence, in contrast to the existence of others, as a sentient being (see Mead 1967[1934]: 135-226). The concept of self represents the awareness of one's conceptual distinctiveness as contrasted with the "others" with whom one interacts. The concept of self, which we will represent by the expression, Self, is fundamental to kinship even if the lexeme, self, is not (emically) considered to be a kin term. The instantiation of Self will be oneself (or, genealogically speaking, a category whose only member is ego). Thus Self may be used referentially to refer to oneself as the reference object.

Self is an identity element for the kin term product; that is, if K is a kin term then Self o K = K o Self = K. To see this, note that by Self o K is meant the kin term that ego would use for alter 2 when ego refers to alter 1 by the kin term K and alter1 refers to alter 2 as Self. The latter statement means that alter 2 = alter1. But alter 1 = alter 2 implies that ego refers to alter 2 by the kin term K, thus Self o K = K. A similar argument shows that K o Self = K and Self o Self = Self. Hence Self satisfies the conditions necessary for Self to be an identity element with respect to the kin term product. We can say that Self is the identity element since there can be at most a single identity element for the kin term product.[4]

The identify element need not be sex marked. For the AKT, Self is not sex marked, whereas for classificatory terminologies such as the Trobriand and the Tongan terminologies, we begin either with a Male Self or a Female Self.[5]

(2) Generate a core, ascendant structure. We next find in the kin term map a kin

term in a primary ascendant position that is not the product of other kin terms (i.e., a "parent" kin term). This ascendant term, may or may not be sex marked, depending on the terminology. Taking repeated kin term products of this ascendant term with itself forms the core ascendant structure. For the AKT, the primary ascendant kin term is the non-sex marked term Parent.[6] The core ascendant structure is then given by the sequence Self, Parent, Grandparent (= Parent of Parent), Great-grandparent (= Parent of Grandparent = Parent of Parent of Parent), and so on. This core structure (though not the kin term labeling) can be generated from the set of symbols, S = {I, P}, with the concatenation operation taken as a binary product over the set S (where I is the identity element for the concatenation operation) by constructing all possible products using the elements in S and the fact that I is an identity element to simplify binary products involving the I term. Thus, from S = {I, P}, we generate the set of products {I, P, PP, PPP, …}. This structure is isomorphic to the core ascendant structure under the correspondence: I ↔ Self, P ↔ Parent, PP ↔ Grandparent, PPP ↔ Great-grandparent, and so on. The construction also shows that the core ascendant structure has the form of an algebraic structure known as a semigroup with an identity element.[7]

(3) Construct the descendant structure. A structure for descendant kin terms is derived from the ascendant core structure by making an isomorphic copy of the ascendant structure. We stipulate that the isomorphic copy uses the same symbol for the identity element in both the ascendant and the descendant structure. The isomorphic copy will differ from the ascendant structure by using, say, the symbol, C, in place of the symbol P. The descendant structure, {I, C, CC, CCC, …}, is isomorphic to the descendant structure of kin terms in the AKT consisting of the terms Self, Child, Grandchild, Great Grandchild, etc.

A structural equation is introduced that makes each primary ascendant kin term the reciprocal of its isomorphic image in the descendant structure (that is, we want C to be the reciprocal of P, C o C the reciprocal of P o P, and so on). The structural equation is of the form (ascendant symbol) o (descendant symbol) = Identity Element. The motivation for this equation is as follows. For the AKT, this structural equation (expressed using kin terms) would be Parent o Child = Self (read "Parent of Child = Self"). That this is the equation implied by Parent and Child being reciprocal kin terms follows from the fact that (1) when ego, alter1 and alter2 are consanguineally related (since at this point in the production of the kin term structure affinal kin terms has not yet been introduced), (2) ego refers to alter1 as Child, and (3) alter1 refers to alter2 as Parent, it follows that alter2 is ego (that is, a person consanguineally related to ego who is properly referred to as Parent by the person ego properly refers to as Child must be ego). But if ego = alter2, it follows that Parent o Child = Self since ego refers to him(her)self by Self. In the algebraic structure the corresponding equation is P o C = I. In general, in the algebraic structure we introduce the equation X o Y = I to structurally define the symbols X and Y as reciprocal symbols, where X is an ascendant symbol and Y is the isomorphic copy of Y.

(4) Introduce sex marking of kin terms. Sex marking of kin terms is introduced, in general, in one of two ways.

(a) When the primary kin term is not sex marked, introduce two "sex marker" ele-

ments, M and F, into the algebraic structure generated in Steps (2) and (3), along with structural equations the sex marker elements must satisfy; e.g., MF = M = MM, FM = F = FF, and equations for products of algebraic elements with the sex marker elements that must be satisfied; e.g., XM = X = XF, for any algebraic element X. (This equation implies, for example, that Parent of Male is Parent. A product such as MP would correspond to the kin term Father in the AKT).

Structural equations are introduced as needed (both here and later with the introduction of affinal terms) for products between terms with opposite sex marking so that products of sex marked kin terms are logically consistent; e.g., Wife o Mother = 0 in the AKT even though Spouse o Parent = Parent.[8]

(b) For terminologies where the primary kin term(s) is (are) already sex marked, make an isomorphic copy of the algebraic structure for ascendant and descendant kin terms.

There are two possibilities for the identity element, I, when forming an isomorphic structure for sex marked elements. Either I is also the identity element in the isomorphic structure (as occurred when constructing the descendant structure from the ascendant structure), or the isomorphic structure will have a different symbol for its identity element. The distinction is between whether the structure of male terms and the structure of female terms share Self as a common, neutrally marked term for both kin term structures, or whether the identity term for the male terms is sex marked (e.g., Male Self) and the identity term for the female terms is also sex marked (e.g., Female Self) and so there is no common identity term shared by the male structure and by the female structure (see Bennardo and Read (2005, 2007) for an example of the latter with the Tongan terminology). This seemingly small difference in whether the identity term is sex marked or not has profound implications for the structure of kinship terminologies and how that structure becomes instantiated and becomes integrated into the social organization of a society (see below).

(5) Generate an affinal structure. An affinal structure is generated in one of two ways.

(a) A spouse element symbol is introduced along with structural equations that express the structural properties of a spouse kin term; e.g., equations such as Spouse of Spouse = Self, Spouse of Parent = Parent, and so on, are included for the AKT.

(b) The affinal structure is generated through logically necessary "marriage rules" expressed as a structural equation (see Read 2007 for an example based on the Kariera terminology from Australia).

Additional structural equations may be introduced that limit the extent of the affinal structure; e.g., equations such as Parent o Parent o Spouse = 0 (read "Parent of Parent of Spouse is not a kin term") and Parent o Spouse o Child = 0 (read "Parent of Spouse of Child is not a kin term") in the AKT.

(6) Introduce local structural properties. Rules are introduced that have the effect of modifying a portion of the structure generated in Steps (1) – (4). Rules of this kind for the AKT restrict which of the initial sex marked kin terms are kept as sex marked kin terms in the kinship terminology[9] and define kinds of Cousin, such as Ith Cousin J-times

Removed. The skewing rule for the Trobriand (and other) terminology is another example.

(7) Introduce term specific properties. An individual kin term may be modified or an individual kin term may be added to the terminology for reasons external to the generative logic of the kinship terminology. For example, in the Tongan terminology the logic implies that there should be a single term for 'Brother of Mother,' but in fact there are two terms: fa'etangata 'older MB' and tu'asina 'younger MB' because: "It is really important to know who is the heir to the property if a male wants to take the best advantage of his privileged position as fahu towards one's mother's brothers. Hence, the [Tongan Terminology] distinguishes between older and younger [Brother of Mother] as a cultural modification of the basic kinship structure" (Bennardo and Read 2005).

While the details for carrying out these 7 steps is involved, the steps are built around distinctions that arise in any kinship terminology: (1) ascendant versus descendant kin terms, (2) sex marking of kin terms, (3) consanguineal versus affinal kin terms and (4) context-based structural modification of a kinship terminology. The Table displays all of the pieces that are used in the generation of the AKT. Observe in the Table that equations (1) – (4) define structural properties of kin terms and are thus necessary equations. Equations (6) – (8) restrict the "size" of the affinal kin term structure and are thus culture specific as they could be modified without violating the logic of the terminology.

The rule for restricting the terms that are sex marked (see Table) is not logically necessary and does not appear, for example, in the French kinship terminology, which otherwise has a structure similar to that of the AKT. The rule for the cousin nomenclature (see Table) is both historically relatively recent and has now either been "lost" for most American users of the AKT or "ad hoc" rules have been constructed for the 1st Cousin, 2nd Cousin, etc. portion of the Cousin kin terms.

Cultural Implications of the Structural Logic of a Kin Term Map

One of the striking features of the AKT that has been clarified through generating the kin term structure is the logic underlying the seemingly inconsistent usage of the "-in-law" suffix to mark relatives through marriage except for the Aunt and Uncle kin terms. The structure generated from the generators and equations in the Table (see Figure 4) demonstrates that the equations, Husband of Aunt = Uncle and Wife of Uncle = Aunt, are a consequence of the logic of the terminology. More precisely, this pair of equations for Spouse of Aunt/Uncle can be shown to be logical consequence of the "Sibling-in-law" equation (see Equation (5) in the Table). The logic linking the "Sibling-in-law" equation to the Spouse of Aunt/Uncle = Uncle/Aunt equations is not overtly known to users of the AKT, yet users of the AKT are consistent in maintaining that Spouse of Aunt/Uncle = Uncle/Aunt provides the proper kin terms for the Spouse of Aunt or Uncle even though the latter is not consistent with the more evident pattern whereby relations through marriage are marked with an "-in-law" suffix. This structural discovery raises complex, and as yet unanswered, questions about the cognitive processes involved in relating the "deep

Table : Elements, Equations, And Rules Used To Generate The AKT

Generators for ascendant structure		*Isomorphic Generators for descendant structure*
Self, Parent		Self, Child
	Structural Equation for Reciprocity	
	(1) Parent o Child = Self	
	Sex Marking	
Parent → {FParent = Mother, MParent = Father}	M, F	Child → {FChild = Daughter, MChild = Son}
	Affinal Generator	
	Spouse	
	Affinal Structural Equation	
	(2) Spouse o Spouse = Self	
	Spouse Structural Equations	
(3) Spouse o Parent = Parent	(5) Spouse of Child of Parent = Child of Parent of Spouse	(4) Child of Spouse = Child
	Affinal Restriction	
(6) Parent o Parent o Spouse = 0	(8) Parent o Spouse o Child = 0	(7) Spouse o Child o Child = 0

Rules

Sex Marking: If (1) K is a non-sex marked kin term with corresponding sex marked terms FK and MK and (2) Spouse o K is a kin term or Spouse o K^r is a kin term, where K^r is the reciprocal term for K, then K will be a covering term for the two corresponding sex marked kin terms, FK and MK and the two sex marked terms will be kept in the terminology. Otherwise, the sex marked forms are deleted from the terminology. Example: Spouse of Parent is Parent, so Parent and its reciprocal, Child, are covering terms for {Mother, Father} and {Daughter, Son}, respectively. However, Spouse o Cousin is not a kin term so only the non-sex marked term, Cousin, is kept in the terminology.

Cousin Terms: The Cousin terms are labeled in such a manner that all Cousin terms are self-reciprocal and all possible Cousin terms, consistent with self-reciprocity, are given distinct labels (namely, Ith Cousin J times removed)

Note: Kin terms, rather than (arbitrary) symbols, are used for clarity and readability

level" at which the underlying logic of the terminology is "understood" to the more sur-

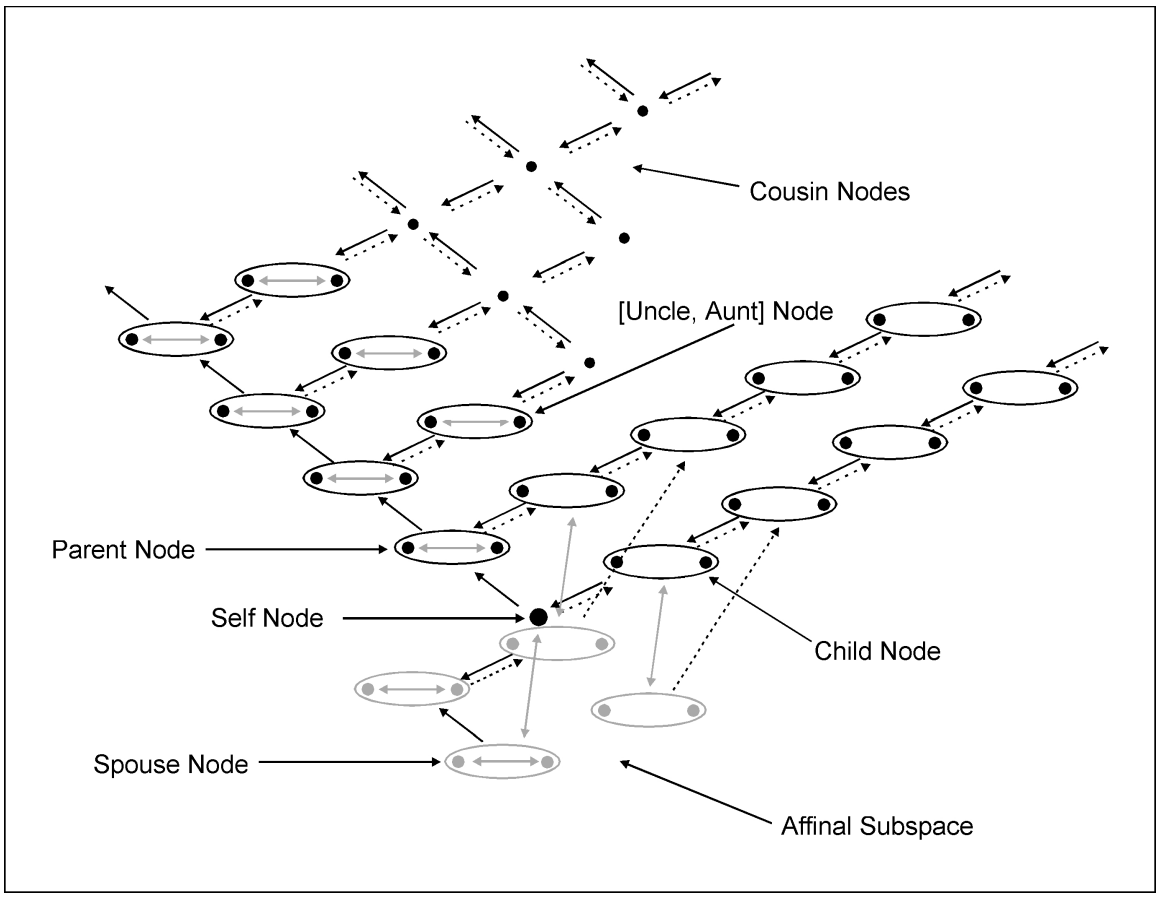

Figure 4: Algebraic structure generated from the information in Table 1. Solid arrows show the result of taking products with the primary ascending generating term. Dashed arrows show the result of taking products with the primary descending generating term. Double-headed gray arrows show the result of taking products with the primary spouse generating term. This structure and the structure in Figure 1 are isomorphic. Note that the arrow for the spouse generating term links the node in the Aunt and Uncle positions, hence Spouse o Aunt/Uncle = Uncle/Aunt by the logic of how the terminology is generated. The "-in-law" suffixes identify the "affinal" space that is graphed in long a third dimension separate from the two dimensions for the consanguineal space. Thus the labeling of the kin terms is consistent with the geometry of the terminological space.

face level of kin term usage, a distinction similar to langue versus parole in linguistics. More precisely, how do we "know" that modification of the aunt and uncle terms to aunt-in-law and uncle-in-law is inconsistent with a logic we cannot articulate, unless at a non-conscious level the brain/mind has inferred that logic during enculturation into American culture, including the American kinship terminology? The same inferential learning process for a terminology would occur, of course, during enculturation into any culture.

TWO CONCEPTUAL SYSTEMS: GENEALOGICAL STRUCTURE AND TERMINOLOGICAL STRUCTURE

Recursive Logic of Genealogical Tracing

The logic of genealogical tracing through computing genealogical products is understood by anyone who has constructed a family tree and does not need elaboration here. Genealogical computations are based on recursive logic in which the output of the computation algorithm can be the input for the next application of the algorithm. Thus, if the algorithm is something like "Construct a link from the target individual to a genealogical parent of the target individual," then if the algorithm is applied to person X and Y is identified as the output of the algorithm (that is, Y is a genealogical parent of X), then the algorithm can be applied to Y to arrive at individual Z who is a genealogical parent of Y and so Z is a genealogical parent of a genealogical parent of X, and so on. Similar comments apply to genealogical child. The recursive logic thus identifies a large network of persons connected via parent-child and child-parent links.

Algebraic Logic of Kin Term Computations

In contrast to the recursive logic of genealogical tracing, the logic of kin term computations is comparable to using the addition or multiplication tables for doing number computations. The kin term computations are not algorithmic but are based instead on a binary product over a set of symbols, just as the addition table defines a binary product over the set of number symbols.

Relationship Between the Two Conceptual Systems: Cultural Instantiation

Thus we have two conceptual systems, one based on the logic of genealogical tracing and the other on the logic of kin term products. The logic of genealogical tracing provides a computation system that forms networks of person-to-person relationships. The basis for these links is culturally identified and may only be putatively biological. The logic of kin term products provides a computation system that forms a structure composed of kin term to kin term links as shown in a kin term map. Since we have two conceptual systems, we want to know the formal relationship between them. We will not carry out a complete argument here (see Read 2001b), but will briefly consider the role of cultural instantiation in linking the two conceptual structures.

Unlike the genealogical product defined over symbols with already specified semantic content, the symbols used to generate the kinship terminology are given semantic content initially through the structure in which they are embedded and then through cultural instantiation through (but not limited to) mapping the generating elements to the genealogical space as discussed above (see Table). The genealogical content of the other kin terms is then determined by products of the generating elements that determine the kin term in question, along with the genealogical instantiation of the generating elements.

We can imagine assigning genealogical content to the products of generating elements in a different manner (which possibility has been assumed by the "received view" through its appeal to external conditions as a way to account for the genealogical references of a kin term), but if so the rewrite rule analysis would not reduce to a few rewrite rules as discovered by Lounsbury and Scheffler (e.g., Lounsbury 1965, Scheffler and Lounsbury 1971). The rewrite rules "work" only because the kin terms are assigned genealogical content in a manner consistent with the procedure for so doing discussed here.[10]

STRUCTURAL IMPLICATIONS 1: CLASSIFICATORY VERSUS DESCRIPTIVE TERMINOLOGIES AND CULTURAL IMPLICATIONS

Morgan's distinction between descriptive and classificatory terminologies was extremely insightful though non-intuitive as indicated by his abortive attempt to account for classificatory terminologies through group marriage. Morgan's distinction has been problematic from its inception, with some early researchers denying that the distinction had any import (e.g., Kroeber 1909) or others claiming that the classificatory principle of grouping parent's siblings with parent as part of the content of parent kin terms is a root property from which other terminology properties evolved (Allen 1989), hence it is the absence and not the presence of the classificatory principle in a terminology that needs to be explained, Neither position is correct as both fail to recognize that a structural property such as the classificatory principle arises from the logic for the generation of kinship terminologies.

Primary Sibling Term: The Basis for Classificatory Terminologies

The sequence of steps for generating a terminology structure introduces the classificatory principle as a logical consequence when generating a terminology that includes a sibling term as a primary term. A sibling term can be introduced as a primary term in the second step when selecting the primary terms from which the other terms are to be generated. In general, there are two kinds of terms that can be generators: ascendant ("parent") kin terms or horizontal ("sibling") kin terms. All terminologies necessarily include a parental term as a generator, though initially it may or may not, be sex marked. Sibling terms, however can either be generated from primary ascending and descending terms as is the case for the AKT where Sibling = [Brother, Sister] = Child o Parent (and is then bifurcated into sex marked Brother and sex marked Sister), or a sibling term may be a primary term and not the product of primary terms. Thus some terminologies are generated using only an ascendant primary term, whereas other terminologies are generated using both ascendant and horizontal primary terms. This distinction corresponds to descriptive versus classificatory terminologies, respectively (Read and Behrens 1990, Read 2001b).

Core Property of Classificatory Terminologies Space only permits outlining the logic whereby the core property of classificatory terminologies is embedded in a terminology (see Bennardo and Read 2005, Bennardo and Read 2007 for more details). The core

property, expressed genealogically, is the "collapsing" of collateral genealogical relations onto lineal genealogical relations; e.g., the kin term for ego's father is also the kin term for ego's father's brother, ego's father's father's brother's son's, etc (and similarly for ego's mother, ego's mother's sister, etc.) and so on. From a kin term perspective, the core structural equations are "Brother" of "Father" = "Father" and "Sister" of "Mother = "Mother", where "Brother", "Sister", "Father", and "Mother" are transliterations of the kin terms in question. Note that whereas a genealogical statement of the classificatory property requires that we list all possible genealogical positions for which ego would use the kin term "Father", we can express the classificatory property with kin terms by the two structural equations: "Brother" of "Father" = "Father" and "Sister" of "Mother" = "Mother".

We only need these two equation since we can deduce, for example, the equation "Son" of "Brother" of "Father" of "Father" = "Father" from the first of these two equations via: "Son" of "Brother" of "Father" of "Father" = "Son" of ("Brother" of "Father") of "Father" = "Son" of "Father" of "Father = "Brother" of "Father" = "Father." Thus we only need to outline the logic leading to the equations "Brother" of "Father" = "Father" and "Sister" of "Mother" = "Mother."

Generating Set To do this, we begin by constructing an algebraic structure with a generating set that includes both an ascendant element and a (horizontal) sibling element. Let S be given by S = {I, F, B} and let o be a binary product defined over S, where I, B and F are sex marked (male, for convenience) elements and I is an identity element. Our choice of symbols is motivated by our anticipation that the generating element, B, will be given the kin term interpretation "Brother" and the generating element F will be given the kin term interpretation "Father." For notational convenience, we will write products of generating elements without including the binary product symbol.

Ascending Structure The element, F, is an ascendant element; hence we can form the sequence of products F, FF, FFF, …. For many classificatory terminologies we have the structural equation, FFF = FF, (or possibly FFF = 0), which limits the extent of the ascending structure. We will include the equation FFF = FF. The symbol, B, will structurally become a sibling element via the transitivity equation, BB = B. We also include the equation FB = F ("Father" of "Brother" is "Father"). As with the AKT, the ascending structure is constructed by taking all possible products of the symbols in S and reducing each product to a simpler form wherever possible with the structural equations.

Descending Structure We construct the descending structure by making an isomorphic copy of the ascending structure. For the descending structure we form the generating set {I, S, B} so that both I and B will be elements common to the ascending and the descending structure. The descending structure will have the isomorphic equations SSS = SS and SB = S corresponding to the equations FFF = FF and FB = F, respectively. We also introduce the equation SF = B ("Son" of "Father" = "Brother").

Reciprocal Elements As discussed above, for algebraic elements X and Y to be reciprocal elements, either XY = I or YX = I, I the identity element. When X is an ascendant element we use the equation XY = I. Thus we include the equation FS = I in order for the elements F and S to be interpretable as reciprocal kin terms. For the element B, although the equation BB = I would make B a self-reciprocal element, we cannot use this equation along with the equation BB = B since the two equations together would imply B = I. Instead, we bifurcate B into a pair of elements, B+ and B-, with equations B+B+ = B+, B-B- = B- (corresponding to BB = B) and B+B- = B-B+ = I (which makes B+ and B- into reciprocal elements). The elements B+ and B- will have interpretation as "Older Brother" and "Younger Brother" respectively. Hence an "Older"/"Younger" distinction is necessary for the reciprocity of B when we have the structural equation BB = B. We can easily show that FB- = FB+ = F, with isomorphic equations SB- = SB+ = S for the descendant structure. Note that the algebraic construction identifies the logic from whence the "Older Brother"/"Younger Brother" distinction arises, namely the equation BB = B. (Absent the equation BB = B, the reciprocity of B could be introduced with the equation BB = I and in this situation we would have a terminology without the "Older Brother"/"Younger Brother" distinctions.)

Classificatory Property For all kinship terminology algebras, if XY = Z is a structural equation for the algebra, then the reciprocal equation YrXr = Zr is also a structural equation, where Xr, Yr, and Zr are the reciprocal elements for X, Y and Z, respectively. Thus, corresponding to the equation FB = F, we must introduce the reciprocal equation BS = S as part of the algebraic structure. Similarly, for the equations SB = SB+ = SB- = S we must introduce the reciprocal equations BF = B-F = B+F = F. Hence the fundamental equations for a classificatory terminology, namely "Brother" of "Father" = "Father, "Older Brother" of "Father" = "Father" and "Younger Brother" of "Father" = "Father", are a consequence of using a sibling generator in the general process for constructing a kinship terminology algebra (see structure on the left side of Figure 5). A similar argument applies to the kin terms "Sister" and "Mother" for the structure of female terms (see the right side of Figure 5).

Linkage between the Male Structure and the Female Structure

The two structures must be conceptually linked, else one would literally have two terminologies: one for males only and the other for females only. There are different ways by which these two structures can be linked conceptually. A common one is through linking the Male Self and the Female Self nodes a male sibling/female sibling link; that is, the instantiation of Male Self as a male ego and Female Self as a female ego is constrained by the requirement that male ego and female ego be genealogically linked as genealogical brother and genealogical sister. This implies that a male ego will have a "Sister" (the female who is the cultural instantiation of the Female Self node but not an "Older Sister" or a "Younger Sister", and similarly for a female ego (see Figure 5). Consequently, as shown by the logic for introducing a reciprocal element for the generator, B,

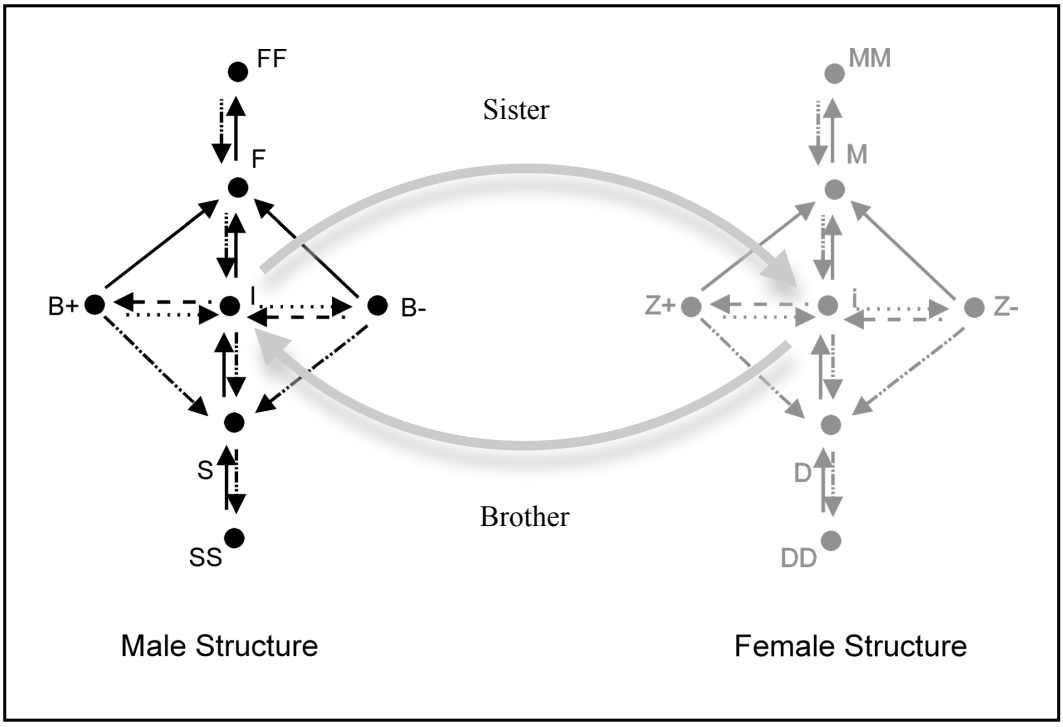

Figure 5: (1) Sex marking of elements is introduced by making an isomorphic copy (right side, dark gray structure) of a structure with male marked symbols (left side, black structure). (The gray arrows in the middle of Figure 5 are not part of these two structures.) The identity element, *I*, in the left structure is male sex marked and its isomorphic copy, *i*, in the right diagram is female sex marked, hence these are distinct elements and so the two structures are not connected via the identity element.

(2) The structures become connected by defining *i* to be a Sister term with respect to *I* and defining *I* to be a Brother term with respect to *i* (gray, curved arrows in middle). This implies that in the genealogical instantiation of the generating elements, $i \rightarrow$ {male ego's genealogical sister} and $I \rightarrow$ {female ego's genealogical brother}. Solid arrows: products with the F element; dashed dot arrows: products with the S element; dashed arrows: products with the B+ element; dotted arrows: products with the B- element. Arrows showing an element product that is mapped reflexively back onto itself (such as B+F = F = B-F, B+FF = FF = B_FF, and so on) are not shown. See Bennardo and Read (2005, 2007) for a complete description on the way the Male (Female) structure is generated from the generating set S = {I, F, B}.

including a sibling term as a generating term accounts not only for the classificatory principle but for properties such as an "Older Sibling"/"Younger Sibling" distinction made for siblings of the same sex but not for those of the opposite sex.

Cultural Implications: Cross Sex Siblings in Oceania

The structural, linking property for the male structure and the female structure via instantiation of Male Self as Brother (to a female ego) and instantiation of Female Self as Sister (to a male ego) is reflected directly in the way brother and sister are conceptualized

in societies with a classificatory terminology constructed in this manner. The Kuma of New Guinea, for example, comment that "Cross-sex siblings together constitute … a complete human being" (Reay 1975-76: 80, as quoted in Marshall 1981a), which parallels the structural property that the constructed link between Male Self and Female Self makes a whole kinship terminology structure. Even more explicitly, Lambert (1981) describes the brother-sister relationship in the Gilbert Islands in a manner almost identical to the constructed linkage between Male Self and Female Self instantiated as male ego and female ego who are (genealogical) brother and (genealogical) sister to each other: "brothers and sisters are alter egos" (p. 190, emphasis added). In addition, the structural link between Male Self and Female Self with instantiation brother and sister is observed in behavior such as a complementary relationship between brother and sister and the pairing off by parents of a brother with a sister, thereby leading to their close interaction with each other, such as sponsorship by brothers of "life crisis feasts" (p. 189) for sisters. Lambert points out that "These special responsibilities of a brother [to his sister] … were not inherent in his genealogical status" (p. 189, emphasis added). Thus it was not descent, but the structural linkage constructed through the terminology, that constituted their status as alter egos, a viewpoint also expressed by the Kaluli of New Guinea: "Kaluli ties of sibling relationship are in contradiction to those traced by descent (by genealogical reckoning) and … the sibling relationship takes precedence over descent whenever the principles are in conflict" (Lindenbaum 1964: 56, emphasis in the original, as quoted in Marshall 1981a: 9). A similar observation has been made by Burridge (1959) for the Tangu: "in Tangu today a person's descent is of small significance to him, but that relationships with siblings are of vital importance … marriage rules probably took their departure from siblingship rather than descent … [and] the relationship between brother and sister could be said to be the pivot of Tangu social life and culture" (pp. 128, 130, as quoted in (Marshall 1981a: 7).

The extreme emphasis placed on the relationship of a brother to a sister (but not equally of a brother to a brother or a sister to a sister) is widespread in the Oceanic area (see above for observations about the Gilbert Islands and New Guinea, Mabuchi (1960) for Western Polynesia and Melanesia, Hecht (1981) for the Pukapuka, Huntsman (1981) for the Tokelau, Smith (1981) for the Palau, Goodale (1981) for the Kaulong and Kelly (1977) for the Etoro, among others). The emphasis on siblings in general, and on the brother-sister relation in particular, has its underpinnings, I hypothesize, in a sibling term being a primary kin term and the conceptual link constructed between Male Self and Female Self via their cultural instantiation as genealogical brother and genealogical sister, respectively.[11] This hypothesis would help account for the importance placed on sibling relations in Oceania: "Oceanic materials have encouraged an analytic formulation of siblingship relatedness in terms of equivalent, parallel, or essentially complementary rights, obligations, and experiences, with respect to a specific territorial domain, political office, or other mediating element (Marshall 1981a). This formulation has significance both within Oceania (Marshall 1981b, Smith 1983) and beyond – in lowland South America (Kensinger 1985) and Southeast Asia (McKinley 1981, Luong 1984, Kipp 1986, Peletz 1988)" (Peletz 1995: 350).

STRUCTURAL IMPLICATIONS 2: TRANSFORMATION OF TERMINOLOGY STRUCTURES

Once the generating elements and structural equations that underlie a terminology structure have been worked out as illustrated above for the AKT, structures can be compared with regard to structural transformations that would change one kinship terminology structure into that of another kinship terminology, or if not the whole terminology, the core structure of ascending and descending kin terms. The structure for the consanguineal part of the AKT with non-sex marked terms (shown partially in C in Figure 5), for example, can be transformed into the core structure of ascending and descending kin terms of the Shipibo terminology by adding two structural equations to the AKT: (a) C o C o P o P = C o P ("Child of Child of Parent of Parent" is Child of Parent", or using AKT terms, Cousin = Sibling) and (b) C o P o P o P = P o P ("Child of Parent of Parent of Parent is Parent of Parent,", or using AKT terms, Child of Great-grandparent = [Great Uncle, Great Aunt] is Grandparent"). In this transformation, the non-sex marked symbols for the AKT are also transformed into sex marked symbols with same sex marking.

The same kind of transformation, but using one more product with the parent term in Equation (b), may be used to transform the core ascending and descending structure for the AKT into the core ascending and descending structure for the Punjabi terminology. If one less parent term is used in Equation (b) then we obtain a transformation of the core ascending and descending structure of the AKT into the core ascending and descending structure of the Machiguenga terminology.[12] Thus three possibilities for varying Equation (b): (1) C o P o P = P, (2) C o P o P o P = P o P and (3) C o P o P o P o P = P o P o P are central to transforming the core ascending and descending structure for the AKT into the corresponding core structure for the Machiguenga (a horticulture group in Peru) terminology, the Shipibo terminology and the Punjabi terminology, respectively.

In contrast, there is no transformation based on adding (or deleting) structural equations that will transform a descriptive terminology into a classificatory terminology or vice versa (contra Allen 1989). For this reason, descriptive and classificatory terminologies are both logically and structurally distinct. Any historical/evolutionary account of kinship terminologies will require at least two root terminologies and not a single, root terminology as the root terminology from which all other terminologies are derived. Since the study of the structure of kinship terminologies is still not complete, we may yet find other structural forms that are logically distinct from either the descriptive or the classificatory terminologies. [13]

DISCUSSION

The research discussed here opens new avenues for both the analysis of kinship terminology structure and consideration of how that structure may relate to the culturally constructed kinship context in which the terminology is embedded and through which social relations among individuals who recognize each other as kin are formulated. By directly considering a kinship terminology to be a cultural construct in its own right generated from primary elements, structural equations, and rules that introduce culturally

relevant modifications of the basic structure, it is possible to address structural relationships among terminologies at the deeper, structural level of their defining properties rather than the more surface level of the consequences of those defining properties.

Analysis and classification of kinship terminologies has often proceeded either by assuming a partial structure and then asking how the full structure can be obtained from the assumed structure (e.g., rewrite rules) or by focusing on some aspect of a terminology and then comparing that aspect across different terminologies. Murdock's classification of terminologies is an example of the latter. Another example is the use of a crossness/parallelness distinction among kin terms "abstracted from empirical terminologies" (Godelier, Trautmann, and Tjon Sie Fat 1998: 24) as a way to distinguish the Dravidian terminologies from the Iroquois terminologies and to classify variants on these two basic types. A more recent example is Allen's argument for a terminology with a tetradic equation as the genetic ancestor for all kinship terminologies.

All approaches that focus on the consequences of a structure or just a portion of a structure rather than how structure is generated run the risk of seeing as similar features that may have very different causes and seeing as dissimilar features that may have similar causes. For example, Murdock's classification of terminologies does not encompass a terminology such as that of the Shipibo Indians of Peru (Behrens 1984) (among many others) and the array of kin terms for the Shipibo terminology, for example, gives no suggestion that it shares any similarity with the AKT, the Punjabi and the Machiguenga terminologies. Yet as discussed above, these terminologies share the same structural equation form, thus any one of these terminologies can be obtained through a simple transformation of the basic structure underlying one of the other terminologies.

Though these terminologies can be transformed from one into the other, there is no reason for assuming a historical, genetic relationship among them since they are geographically isolated.[14] Hence the structural similarities are most likely analogous and not homologous, raising a question about the relationship between the structural form of a terminology and the consequences that structural form has on the social organization for the group in question. Is the causal direction from the adaptive implications of social organization to a terminology consistent with that form of social organization or is the terminology historically contingent and the social organization a complex framed by the structural implications of the terminology for kin groupings and how they are structurally interconnected? The latter opens the possibility that the relationship between social organization and, say, adaptive behavior (in the sense of how groups get access to and distribute resources, among other necessities, among societal members) cannot be fully understood without first working out the implications of a terminology structure for social organization and the tensions this may introduce for behaviors that are effective from an adaptive viewpoint (or from the viewpoint of the interests of different social groupings) but are not necessarily consistent with the kinship terminology structure.

The abstraction underlying the generation of terminological structures implies that semantic content for the symbols of the structure need to be introduced separately from the logic of how the structure is generated. I have used the notion of cultural instantiation as a way to identify the process by which semantic content is mapped onto (abstract)

symbols. Cultural instantiation of the symbols in the generated kinship terminology introduces a dynamic aspect to the kinship terminology structure in a cultural context. Instantiation is a way to capture both culturally encoded rules for usage of a terminology; e.g., who can be referred to by the kin term Mother? By the kin term Father?, and individual usage of a kinship terminology formulated in accordance with individual goals and interests (cf. Bloch 1971). Though the terminology structure is not dynamic (yet can be changed), cultural instantiation introduces a dynamical aspect through the way instantiation can vary through time. Analysis of kin term structure makes evident that instantiation is the aspect of a kinship framework more amenable to modification and change at the level of practice (Bourdieu 1990). Importantly, change at the level of practice can proceed without necessary change in the underlying conceptual structure of the kinship terminology. For example, many of the current issues about kinship in American/Western culture relate to questions such as: Who is a parent? (i.e., an instantiation issue) and not: Should a different primary kin term be used as the basis of the terminology? (i.e., a structural definition issue). Modification of the cultural rules for instantiation are at the heart of current changes in how we perceive of kinship in American/Western culture arising from new reproductive terminologies (see Strathern 1995) and to internal challenges to our traditional, cultural views of what constitutes, for example, a family and what constitutes marriage (see Ginsburg 1989, Ragoné 1994, Hayden 1995, among others).

CONCLUSIONS

The justification for a new paradigm is overwhelming. Neither the kinship = genealogy paradigm nor the kin term = denotation of social category paradigm (nor its more recent, gender construction variant) can account for the empirically, demonstrable properties of kinship terminologies. The fact that the genealogical definitions upon which the kinship = genealogy paradigm is predicated can be predicted implies that this paradigm lacks a foundation. The demonstrable logic of kinship terminologies cannot be accounted for with the kin term = denotation of social category paradigm. Perhaps even more critical is the contradiction between ethnographic evidence on how we use our kinship terminology in a computational manner to determine kin relations and these paradigms. Neither of them can account for the logic underlying the manner in which kin relations are computed using kin term products. Thus a new paradigm is needed, grounded in ethnographic facts and consistent with the empirical properties of kinship terminologies.

The new paradigm recognizes that we are dealing with two conceptual structures, one based on genealogical tracing and the other based on products of kin terms, each with its own logic, yet linked when the primary kin terms are culturally instantiated using the concepts upon which genealogical tracing is based. But cultural instantiation is not limited to just this mode of instantiation and can accommodate other, culturally prescribed modes of instantiation such as name giving, nursing, co-residence and the like when these behavioral practices are culturally identified as ways through which kin relations are formed. By determining the generative foundation and ensuing structural features of a kinship terminology, we are also opening a window – along with new questions -- into a richer and deeper understanding of the cultural and social systems that are at the core of

the anthropological endeavor. The new paradigm being proposed here is not just one of developing a formalism that is faithful to the structuring processes that are made evident through ethnographic observation, but has the potential of taking anthropological research from "thick description" to understanding the production of the patterning revealed through that thick description. Lambert's ethnographic conclusion that cross-sex siblings are "alter egos" is not just thick description, but a "mirroring" of the deep structure for how a female and a male structure are conceptually linked through male and female siblings. The formal analysis makes evident the structural basis for the cultural construction of the relationship between cross-sex siblings. The potential of the paradigm for advancing our understanding of human societies lies in it being based on a formal analytical approach grounded in ethnographic observation, thereby enabling a meaningful connection between formal result and ethnographic description.

BIBLIOGRAPHY

Allen, N. J. 1989. The evolution of kinship terminologies. *Lingua* 77:173-185.

—. 1998. "The prehistory of Dravidian-type terminologies," in *Transformation of kinship*. Edited by M. Godelier, T. R. Trautmann, and F. E. Tjon Sie Fat. Washington D. C.: Smithsonian Institution Press.

Altorki, S. 1980. Milk kinship in Arab society: An unexplored problem in the ethnography of marriage. *Ethnology* 19:233-244.

Bamberger, J. 1974. Naming and the transmission of status in a central Brazilian society. *Ethnology* 13:363-378.

Behrens, C. 1984. Shipibo ecology and economy, UCLA.

Bennardo, G., and D. Read. 2007. Cognition, algebra, and culture in the Tongan kinship terminology. *Journal of Cognition and Culture* 7:49-88.

Bennardo, G., and D. W. Read. 2005. The Tongan kinship terminology: Insights from an algebraic analysis. *Mathematical Anthropology and Culture Theory*. 2, http://www.mathematicalanthropology.org/?PG=TOC

Biddulph, J. 1880. *Tribes of the Hindoo Koosh*. Calcutta: Office of the Superintendent of Government Printing.

Bloch, M. 1971. The moral and tactical meaning of kinship terms. *Man, New Series* 6:79-87.

Bourdieu, P. 1990. *The logic of practice*. Palo Alto: Stanford University Press.

Burridge, K. O. L. 1959. Siblings in Tangu. *Oceania* 30:128-154.

D'Andrade, R. 2004. Why not cheer? *Journal of Cognition and Culture* 3:310-314.

Delaney, C. 1986. The meaning of paternity and the virgin birth debate. *Man, New Series* 21:494-513.

Dole, G. E. 1965. The lineage pattern of kinship nomenclature: Its significance and development. *Southwestern Journal of Anthropology* 21:36-62.

Eriksen, T. H., and F. S. Nielsen. 2001. *A history of anthropology*. London: Pluto Press.

Feinberg, R. 1981. "The meaning of 'sibling' on Anuta," in *Siblingship in Oceania*. Edited by M. Marshall, pp. 105-148. Ann Arbor: University of Michigan Press.

Fine, A. 1994. *Parrains, marraines: La parenté spirituelle en Europe*. Paris: Fayard.

Franklin, S., and McKinnon. 2000. New directions in kinship study: A core concept revisited. *Current Anthropology* 41:275-279.

Ginsburg, F. D. 1989. *Contested lives: The abortion debate in an American community*. Berkeley: University of California Press.

Godelier, M., T. R. Trautmann, and F. E. Tjon Sie Fat. 1998. "Introduction," in *Transformations of kinship*. Edited by M. Godelier, T. R. Trautmann, and F. E. Tjon Sie Fat. Washington D.C.: Smithsonian Institution Press.

Good, A. 1981. Prescription, preference and practice: Marriage patterns among the Kondaiyan-kottai Maravar of South India. *Man, New Series* 16:108-129.

Goodale, J. C. 1981. "Siblings as spouses: The reproduction and replacement of Kaulong society," in *Siblingship in Oceania*. Edited by M. Marshall, pp. 275-305. Ann Arbor: The University of Michigan Press.

Gow, P. 1991. *Of mixed blood: Kinship and history in Peruvian Amazonia*. Oxford: Clarendon Press.

Hammel, E. A. 1968. *Alternative social structures and ritual relations in the Balkans*. Englewood Cliffs: Prentice-Hall.

Hayden, C. P. 1995. Gender, genetics, and generation: Reformulating biology in lesbian kinship. *Cultural Anthropology* 10.

Hecht, J. A. 1981. "The cultural contexts of siblingship in Pukapuka," in *Siblingship in Oceania*. Edited by M. Marshall, pp. 53-77. Ann Arbor: The University of Michigan Press.

Héritier-Augé, F., and E. Copet-Rougier. Editors. 1995. *La parenté spirituelle*. Paris: Editions des Archives Contemporaines.

Hirschfeld, L. 1986. Kinship and cognition: Genealogy and the meaning of kinship terms. *Current Anthropology* 27:217-242.

Huntsman, J. 1981. "Complementary and similar kinsmen in Tokelau," in *Siblingship in Oceania*. Edited by M. Marshall, pp. 79-103. Ann Arbor: The University of Michigan Press.

Jones, D. 2000. Group nepotism and human kinship. *Current Anthropology* 41:779-809.

Kelly, R. C. 1977. *Etoro social structure: A study in structural contradiction*. Ann Arbor: The University of Michigan Press.

Kensinger, K. Editor. 1985. *The sibling relationship in lowland South America*. *Working Paper South American Indians, No. 7*. Bennington: Bennington College.

Khatib-Chahidi, J. 1992. "Milk kinship in Shi'ite Islamic Iran," in *The anthropology of breast feeding*. Edited by V. Maher, pp. 109-132. Oxford: Berg.

Kipp, R. 1986. Terms of endearment: Karo Batak lovers as siblings. *American Ethnologist* 13:632-645.

Kroeber, A. L. 1909. Classificatory systems of relationship. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland* 39:77-84.

—. 1917. *California Kinship Systems*. Berkeley: University of California.

Kuper, A. 1988. *The invention of primitive society: Transformations of an illusion*. London: Rutledge.

Lambert, B. 1981. "Equivalence, authority and complementarity in Butaritari-Makin sibling relationships (northern Gilbert Islands)," in *Siblingship in Oceania*. Edited by M. Marshall, pp. 149-200. Ann Arbor: University of Michigan.

Langness, L. L. 1964. Some problems in the conceptualization of highlands social structure. *American Anthropologist* 66:162-182.

Lave, J., A. Stepick, and L. Sailer. 1977. Extending the scope of formal analysis: A technique for integrating analysis of kinship relations with other dyadic relations. *American Ethnologist* 4:321-337.

Leach, E. R. 1958. "Concerning Trobriand clans and the kinship category '*Tabu*'," in *The developmental cycle in domestic groups*. Edited by J. Goody, pp. 59-72. Cambridge: Cambridge University Press.

Leaf, M. 1971. The Punjabi kinship terminology as a semantic system. *American Anthropologist* 73:545-554.

—. 2008 “Experimental Analysis of Kinship Terminologies.” Ethnology. 47: (forthcoming).

Lévi-Strauss, C. 1958. *Anthropologie structurale*. Paris: Plon.

Levinson, S. C. 2002. "Matrilineal clans and kin terms on Rossel Island," pp. 46: Max Planck Institute for Psycholinguistics.

Likhtenberg, Y. M. 1949. Sistema rodstva ostrova Raga i vopros o gerontokratii v Melanesii. *Sbornik Muzeya antropologii i etnografi* 12:254-276.
Lindenbaum, S. 1964. *Kuru sorcery: Disease and danger in the New Guinea Highlands*. Palo Alto: Mayfield Publishing Co.
Lounsbury, F. G. 1965. Another view of the Trobriand kinship categories. *American Anthropologist* 62:142-185.
Luong, H. V. 1984. "Brother" and "uncle": An analysis of rules, structural contradictions, and meaning in Vietnamese kinship. *American Anthropologist* 86:290-315.
Mabuchi, T. 1960. "The two types of kinship rituals among Malayo-Polynesian peoples," in *Procedings of the IXth International Congress for the history of religions, 1958, Tokyo and Kyoto*, pp. 51-62. Tokyo: Maruzen.
Makarius, R. 1977. Ancient society and Morgan's kinship theory 100 years after. *Current Anthropology* 18:709-729.
Marshall, L. 1976. *The !Kung of Nyae Nyae*. Cambridge: Harvard University Press.
Marshall, M. 1981a. "Introduction," in *Siblingship in Oceania: Studies in the meaning of kin relations*. Edited by M. Marshall, pp. 1-15. Ann Arbor: University of Michigan Press.
—. Editor. 1981b. *Siblingship in Oceania: Studies in the meaning of kin relations*. Ann Arbor: University of Michigan Press.
McKinley, R. 1981. "Cain and Abel on the Malay peninsula," in *Siblingship in Oceania: Studies in the meaning of kin relations*. Edited by M. Marshall, pp. 335-387. Ann Arbor: University of Michigan Press.
Morgan, H. L. 1871. *Systems of consanguinity and affinity of the human family*. Washington D. C.: Smithsonian Institution.
Overing Kaplan, J. 1975. *The Piaroa: A people of the Orinow Basin. A study of kinship and marriage*. Oxford: Clarendon Press.
Parkes, P. 2001. Alternative social structures and foster relations in the Hindu Kush: Milk kinship allegiance in former mountain kingdoms of northern Pakistan. *Comparative Studies in Society and History* 43:4-36.
—. 2004. Fosterage, kinship, and legend: When milk was thicker than blood? *Comparative Studies in Society and History* 46:587-615.
Parkin, R. 1996. Genealogy and category: An operational view. *L'Homme* 139:87-108.
Paul, B. D. 1942. *Ritual kinship: With special reference to godparenthood in Middle America*. Chicago: University of Chicago Press.
Peletz, M. G. 1988. *A share of the harvest: Kinship, property, and social history among the Malays of Rembau*. Berkeley: University of California Press.
—. 1995. Kinship studies in late twentieth-century anthropology. *Annual Review of Anthropology* 24:343-372.
Radcliffe-Brown, A. R. 1952. *Structure and function in primitive society: Essays and addresses*. Glencoe: Free Press.
Ragoné, H. 1994. *Surrogate motherhood: Conception in the heart*. Boulder: Westview Press.
Read, D. W. 1984. An algebraic account of the American kinship terminology. *Current Anthropology* 25:417-440.
—. 2000. Formal analysis of kinship terminologies and its relationship to what constitutes kinship (complete text). *Mathematical Anthropology and Cultural Theory* 1.
—. 2001a. Formal analysis of kinship terminologies and its relationship to what constitutes kinship. *Anthropological Theory (Special Issue)* 1:239-267.
—. 2001b. "What is kinship?," in *The cultural analysis of kinship: The legacy of David M. Schneider and its implications for cultural relativism*. Edited by R. Feinberg and M. Ottenheimer, pp. 78-117. Urbana: University of Illinois Press.
—. 2002. Cultural construct + instantiation = constructed reality. http://repositories.cdlib.org/hcs/DWR2002
—. 2006. Kinship Algebra Expert System (KAES): A software implementation of a cultural theory. *Social Science Computer Review* 24:43-67.

—. 2007. "Culture: the challenge for computational modeling," Paper presented in the session *Computational Models in Anthropology: What Are They Good For? Why Should You Care?* at the 106th Annual Meetings of the American Anthropological Association, Washington, DC (Nov. 28 – Dec. 2).

Read, D. W., and C. Behrens. 1990. An expert system for the algebraic analysis of kinship terminologies. *Journal of Quantitative Anthropology* 2:353-393.

Reay, M. 1975-76. When a group of men takes a husband. *Anthropological Forum* 4:77-96.

Rivers, W. H. R. 1914. *Kinship and social organization*. London: Constable.

Rivière, P. 1969. *Marriage among the Trio: A principle of social organisation*. Oxford: Clarendon Press.

Sahlins, M. 1962. *Culture and nature on a Fijian island*. Ann Arbor: University of Michigan Press.

Scheffler, H. W., and F. G. Lounsbury. 1971. *A study in structural semantics: The Siriónó kinship system*. Englewood Cliffs: Prentice-Hall.

Schneider, D. 1980. *American kinship: A cultural account*. Ann Arbor: University of Michigan Press.

—. 1984. *A critique of the study of kinship*. Ann Arbor: University of Michigan Press.

—. 1992. Comment. *Current Anthropology* 33:308-310.

Sigarimbum, M. 1975. *Kinship, descent, and alliance among the Karo Batak*. Berkeley: University of California Press.

Smith, D. R. 1981. "Palauan siblingship: A study in structural complementarity," in *Siblingship in Oceania*. Edited by M. Marshall, pp. 225-273. Ann Arbor: The University of Michigan Press.

—. 1983. *Palauan social structure*. New Brunswick: Rutgers University Press.

Smith, W. R. 1903 [1885]. *Kinship and marriage in early Arabia*. London: Charles and Black.

Strathern, M. 1995. "Displacing knowledge: Technology and the consequences for kinship," in *Conceiving the New World Order: The global politics of reproduction*. Edited by F. D. Ginsburg and R. Rapp. Berkeley: University of California Press.

Trautmann, T. R. 1992. The revolution in ethnological time. *Man, n.s.* 27:379-397.

Vatuk, S. 1969. A structural analysis of the Hindi kinship terminology. *Contributions to Indian Sociology n.s.* 3:94-115.

Vernier, B. 2006. Du bon usage de la parenté construite avec des humeurs corporelles (sang et lait) et quelques autre moyens. *European Journal of Turkish Studies*. Thematic Issue No. 4, The social practices of kinship. A comparative perspective, http://www.ejts.org/document623.html

Vilaça, A. 2002. Making kin out of others in Amazonia. *Journal of the Royal Anthropological Institute (N.S.)* 8:347-365.

Wake, C. S. 1879. The origin of the classificatory system of relationships used among primitive peoples. *The Journal of the Anthropological Institute of Great Britain and Ireland* 8:144-180.

Weismantel, M. 1995. Making kin: Kinship theory and Zumbagua adoptions. *American Ethnologist* 22:685-704.

Weston, K. 1992. *Families we choose: Lesbians, gays, kinship*. New York: Columbia University Press.

[1] By 'arbitrary' is not meant haphazard, but in the mathematical sense of a system where the choice of the symbol form does not, in and of itself, have meaning within the system of symbols.

[2] The formal analysis does not depend on Self being a kin term since the concept of self, the referent of the semantic label Self, is necessary for any notion of kinship as a conceptual system. The analysis identifies the structural positions in the kinship terminology, not whether the label for a structural position is considered to be a kin term. For convenience in exposition, we will consider Self to be a kin term.

[3] Kin term products are written left to right as in Son o Mother = Brother to allow the kin term transliteration: 'Son of Mother is Brother,' whereas kin type products are conventionally written right to left as in ms = b, which allows the kin type transliteration: 'mother's son is brother.' Capital letters will be used to denote kin term and lower case letters to denote kin types.

[4] There can be at most one identity element, for if I and I* were both identity elements for the binary product, o, then I o I* = I* since I is an identity element and I o I* = I since I* is an identity element. Therefore I = I o I* = I*.

[5] A sex marked self such as Male Self will not be an identity element for the complete terminology but only for terms with the same sex marking as Self. This leads, initially, to two distinct terminological structures: one for male kin terms and the other for female kin terms (see Bennardo and Read 2005, 2007).

[6] That Parent is the primary ascendant term rather than Mother and Father arises from the properties of the kin term map for the AKT. Initially, it might appear that the kin terms Mother and Father should be taken as primary ascendant terms. If we do so, we then find that the kin terms Mother and Father (and other pairs of terms such as Grandfather and Grandmother and the reciprocal terms, Son/Daughter and Grandson/Granddaughter) are in structurally equivalent positions in the kin term map for the AKT. Logically, we may replace a pair of structurally equivalent terms by a single, covering term, namely the kin term Parent (and similarly Grandparent for Grandfather and Grandmother, etc.). See Read and Behrens (1990) for a detailed explanation.

[7] A *semigroup* is specified by:
(a) a set S of symbols refrred to as the elements of the semigroup (e.g., the kin terms in a kin term map),
(b) an associative, binary product defined over S (the kin term product for kin terms and
(c) a set of structural equations for the binary product (the structural equations will be terminology specific).
An *identity element* is an element in the semigroup, call it *i*, such that $i \circ x = x \circ i = x$ for all elements in S. For the AKT the identity element is the kin term, Self.

[8] Strictly speaking the construction is done at the algebraic level and then the algebraic structure is compared to the kin term structure as shown in the kin term map. Thus for the AKT we make an isomorphic copy of the algebraic structure determined by the two symbol sets, {I, P} and {I, C}, then we introduce sex marking by including two symbols, M and F, and appropriate structural equations so that the concatenation of symbols yields reduction of symbol strings consistent with the interpretation of M and F as sex markers for kin terms.

[9] The sex marking rule for the AKT is: A kin term K is sex marked if, and only if, Spouse o K is a kin term or Spouse o Kr is a kin term, where Kr is the reciprocal term for the kin term K. Thus Cousin is not sex marked since Spouse o Cousin is not a kin term and the reciprocal of Cousin is Cousin, hence Spouse o (reciprocal of Cousin) = Spouse o Cousin = 0.

[10] That is, the content of kin terms is consistent with the process described here. We do not know the actual historical/evolutionary process by which kin terms and the content of kin terms came about.

[11] The Oceanic area highlights the problem with trying to equate kinship studies with gender studies. What male gender and female gender "mean" in the Gilbert Islands cannot be understood without first taking into account the structural features of the terminology, especially the constructed link between Male Self and Female Self and genealogical brother and genealogical sister. The converse is not true.

[12] The Machiguenga terminology has the same "classificatory equation," namely Sibling of Parent = Sibling, where both the Parent term and the Sibling term have the same sex marking. However the classificatory equation appears in the Machiguenga terminology for logically different reasons than for terminologies that have a sibling term as a primitive term. Hence classifying terminologies by genealogically expressed structural features such as parent's sibling = parent can be highly misleading.

[13] Another root terminology structures is exemplified by the !Kung san terminology (see Read 2007).

[14] There could be a historical, genetic relation between the Shipibo and the Machiguenga terminologies since the two groups are in the same general area in Peru.