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The Cultural Grounding of Kinship

A Paradigm Shift

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FROM ITS INCEPTION, virtually all work in the field of kinship studies assumes that marriage and reproduction, represented through genealogical relations, are fundamental to the definition of kinship (see Keesing 1975 ; Kroeber 1917 ; Rivers 1924 ; Scheffler & Lounsbury 1971, among others). Yet despite the seeming unanimity of equating kinship with genealogy, ethnographic accounts of kinship have been less sanguine about the centrality of genealogy. The Murinbata, notion of a « firestick father » is distinct from that of a genetic father « by the fact that the “firestick father” is sometimes a woman [Malinowski 1963] » (Barnes 1964 : 296). Similarly, the Tiwi distinguish between producing a biological child and a social child, for they « recognize that either a husband or a lover can make a baby by having sexual intercourse with its mother [however] [...] a Tiwi must *be dreamed* by its father, the man to whom its mother is married » (Goodale 1971 : 138, emphasis in the original). Among the !Kung San in southern Africa, genealogy is not of importance for a child learning the usage of kin terms :

« [They] were apparently not always assiduous in teaching their children the exact biological position of their kinsmen [...] and a person would not always know *why* he applied a certain term to someone, but he would know that the term he used was proper, and he would know the proper joking status to observe ; that would have been well taught him by his parents » (Marshall 1976 : 204, emphasis in the original).

But even assuming genealogy is the basis for kinship relations, this leaves unanswered the particular choices of genealogical classes that are labelled with kin terms. As noted by Roy D'Andrade, « questions about why kinship structures [i.e., terminologies] took the forms they did were

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ignored » (2003 : 311). The formal methods of componential analysis, rewrite rules and the recent appeal to optimality theory from phonemics (Jones 2010) only provide us with descriptive accounts of kinship terminologies, not the reasons for differences among them (Read 2000, 2010a). Formal accounts of the distinction made by Lewis Henry Morgan between the classificatory terminologies (now known as bifurcate merging terminologies) and the descriptive terminologies – a distinction made by him on the basis of absence or presence of collateral kin terms – depend on a hypothesized extensionist claim that is « cumbersome and *ad hoc*, like a geocentric theory of planetary motion » (Allen 1989 : 182)¹. We still have, then, the quandary posed by Morgan's assertion that the classificatory and descriptive terminologies involve « two radically distinct forms of consanguinity [...] so diverse in their fundamental conceptions and so dissimilar in their structure,» that how they « came into existence [...] may be wholly impossible to explain » (1871 : 11-12, 13).

Missing in the ascription of kinship relations to genealogical relations is any way to account for the logic of kinship terminologies that makes it possible for culture-bearers to compute (and understand) kin relations directly from kin terms without appeal to genealogy. Marshall Sahlins (among numerous other ethnographers) makes the logic of the computations explicit :

« [Kin] 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*, whereas 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 predictable* » (1962 : 155, emphasis added).

That kin relationships may be computed in this manner without appeal to genealogy implies there is a structural logic to kin terms. The terminology-specific structural logic has been worked out for a wide variety of terminologies (Read 1984, 2010c ; Read & Behrens 1990 ; Bennardo & Read 2007 ; Leaf & Read 2012) and implemented through computer modeling (Fischer 1994 ; Read 1996).

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1. Nicholas Allen's (2008) tetradic theory avoids the shortcomings of the extensionist hypothesis only by positing a socio-centric, societal division that allegedly changed into a self-centric terminology system, contrary to the direction of change in the Australian section systems used by him as a model for the tetradic system.

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In this paper we relate the logicity of specific kinship terminology structures to a common conceptual basis for both a genealogical and a kin term space. These jointly form a space of kinship relations, and both derive from a structure of relations we call a *family space*. The classification of genealogical relations by kin terms is determined through a mapping of a space representing kin term relations into a space of genealogical relations. This accounts for the genealogical definitions of kin terms otherwise presumed to be primary data for understanding kinship relations.

The relationship of the family space to the genealogical and kin terms spaces also makes evident two different ways that the sibling relation has been conceptualized. These two ways, we will demonstrate, account for the distinction between descriptive and classificatory terminologies, thus bringing closure to Morgan's « unresolvable » question. More generally, we can now make headway not only with regard to this issue but with other, outstanding questions in the study of the more formal aspects of kinship systems once we make a paradigm shift to viewing kinship from the perspective of a kinship space constructed from the structural relationships among a family space and the derived genealogical and kin term spaces (Read 2007).

Family Space

As a cultural construction, the system of kin terms constituting a kinship terminology must begin with initial (that is, primitive, in a logical sense) conceptual relations whose definition lies outside the kinship terminology, otherwise we have circularity. In our framework these primitive conceptual relations are derived from the culturally identified positions that form a family space from relations « *as ancient as the family* » (Morgan 1871 : 10, emphasis in the original). From an evolutionary viewpoint, these primitive conceptual relations had their origin in the evolving mental/cognitive capacities of the precursors of modern *Homo sapiens* (Read 2009, 2010b, 2012).



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We can model schematically the positions making up a family space by four positions connected using a vertical and a horizontal division as shown in Figure 1² (on the next page). A male or a female person may be assigned to each position (represented by a box in Figure 1) as a parent, child or spouse by cultural criteria that need not be biologically based.

2. The family space encompasses the atom of kinship (Lévi-Strauss 1958 [1945]) and has a tetradic, but not a socio-centric, structure.

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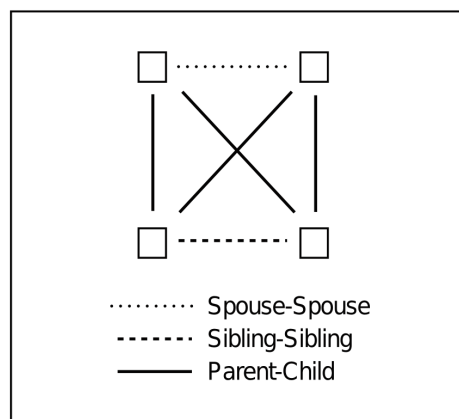


Figure 1 – Minimal graph of the positions, indicated by boxes, making up a family space

Four positions are necessary as there is both a vertical (parent-child) division and a horizontal (husband-wife and sibling-sibling) division. A person(s) may be assigned to each position by cultural criteria.

The structure formed in this manner satisfies the definition of a closed clique, a prototype of a maximally cohesive social network, hence forms a maximally cohesive structural unit. Assigning individuals to the positions in accordance with culturally valid criteria leads to a socially constituted behavioral unit we refer to as a family. The family, according to Émile Durkheim, « is a social institution, at the same time juridical and moral » (1898 : 329), where by a social institution is meant « patterns of social activity that give shape to collective and individual experience » (Bellah *et al.* 1991 : 40), which « have social positions and relations that are characterized by particular expectations, rules/norms, and procedures » (Martin 2004 : 1256).

The relations within a family are a parent-child relation, a spouse-spouse relation, and a sibling-sibling relation (Radcliffe-Brown 1950), sometimes differentiated by sex [Fig. 1]. The first two of these three relations subsume (but are not identical to) both a biological and a cultural dimension. The parent-child relation relates directly to reproduction, hence incorporates, in principle, a biological dimension. But it is the social relation between parent and child that is culturally marked, not the biological or physical relation. For a female, the parent-child social relation has to do with being a mother. Being a mother is not established merely by the act of giving birth, but signifies activation of the social status (and responsibilities) of mother according to culturally specified criteria that in addition to birthing, include adoption, suckling (El Guindi 2010), and co-residency, among other criteria across different societies.

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For males, the rights, responsibilities and duties of a father are established through marriage; that is, a social act that establishes the procreative, sexual or other rights of an individual (or individuals) socially recognized as an occupant of the spouse position³. The rights, responsibilities and duties associated with the position of father in the family space are variable both within and between societies in the way fatherhood is culturally conceptualized, ranging from extensive male parenting to its absence, and need not be based on a man's biological role in reproduction⁴. In some societies, such as the Tiwi as noted above, that role is not construed as being relevant to the formation of a child's status as a social person (Goodale 1971).

Marriage has no counterpart in the biological domain. Marriage is not a cultural expression of pair bonding (*contra* Chapais 2008). Instead, it is a culturally constructed social relationship that establishes when « a child [is] born to the woman under circumstances not prohibited by the rules of the relationship, it shall be accorded full birth-status rights in his [or her] society or social stratum » (Gough 1959 : 32)⁵.

Because of the interconnections among all the positions in the family space [Fig. 1], the birth-status rights accorded to a child born to a married woman must also be in accord with the rights, responsibilities and duties associated with the status of being a father. Jural rights a father has to the offspring of his wife identify, reciprocally, jural rights of those offspring concerning a father.

We can form another perspective on the family space by graphing it using a self position as a reference position for the family space positions [Fig. 2]. We will, for analytical purposes, refer to the person who instantiates the self position as Ego. The cultural assignment (or cultural instantiation) of a person to a position in the family space determines a relation between that person and Ego. We will refer to this relation by the position that is instantiated. When, say, a parent position is instantiated with woman A, then the mother relation holds between A and Ego.

3. We find occasional ethnographic references to so-called « group marriage » (e.g., Thomas 1906).

4. Among the Nayar of India in traditional times, a girl participated, before she reached puberty, in a marriage ceremony in which a man tied a *tali* around her neck but otherwise had no responsibilities towards her. His status as father is shown by the obligation of her children, regardless of the male identified as the putative father at the time of the birth of an offspring, to recognize him ritually as father upon his death.

5. Kathleen Gough's definition does not imply that full birth-status rights can only accrue to the offspring of a married woman. Rather, it asserts that only with marriage can it be presumed an offspring has such rights. Societies can establish other criteria by which the child of an unmarried woman may be accorded full birth-status rights. For example, in some societies it may be sufficient for a man to acknowledge paternity for a child to be considered fully legitimate.

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Culturally speaking, this relation may be expressed (in English) by phrases such as « Ego's mother is A » or, for Ego as speaker, « A is my mother. » Similar comments apply to the father relation. Any socially recognized person may be considered to be the occupant of the self position, which implies that genealogical tracing can begin with any person so recognized.

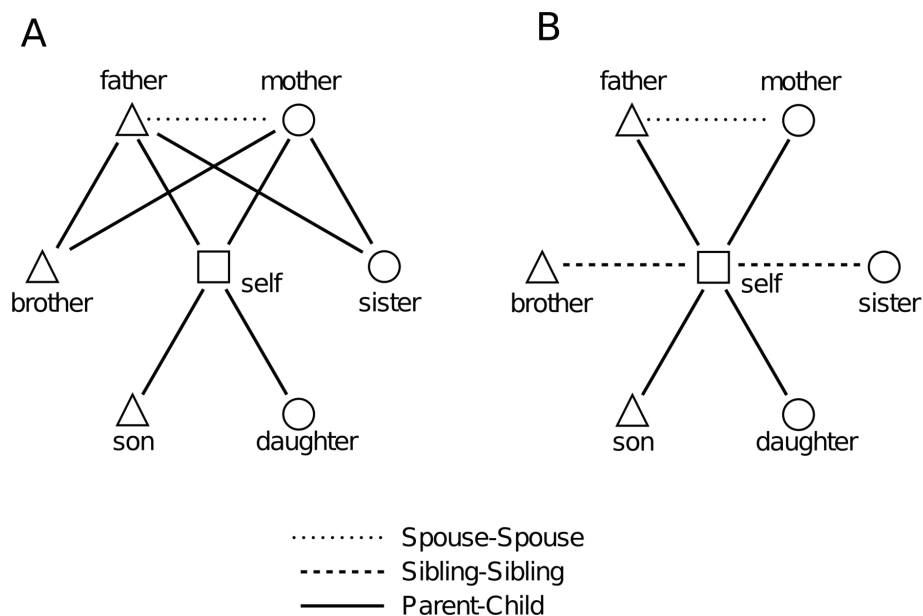


Figure 2 – Graph of the family space with a self position for reference

(A) The sibling positions are related to the parent positions via the parent/child relation.

(B) The sibling positions are related to the self position directly and to the parent position indirectly.

In both (A) and (B), the spouse relation identifies the person instantiated as spouse to be the “other (legitimate) parent”.

From the self position we have an ascending direction determined by the parent position in relationship to the self position and a descending direction determined by the child position in relationship to the self position. The self position has two structural possibilities for the orientation of the sibling positions. One is that the sibling positions are directly linked to the parent positions and indirectly to the self position through the parent position [Fig. 2A] and the other is that they are directly linked to the self position and indirectly linked to the parent positions [Fig. 2B]. The two possibilities arise from two interpretations that can be made of the fact that one's parent's child can either be oneself or one's sibling.

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The first possibility corresponds to imagining child of parent as being distinct from oneself, hence one's parent's child occupies a sibling position as indicated in Figure 2A. The second possibility corresponds to imagining that the child of parent is oneself, hence a sibling position is not linked directly to a parent position but to the self position as indicated in Figure 2B.

The Kaluli of New Guinea are a group with sibling relations conceptualized in this latter manner. When working out kin relations they « frequently invoke a sibling relationship as the link that explains the application of a term – “I call him brother because my father calls his father brother” [...]. [*The sibling relationship takes precedence over descent*] [parent-child links] whenever the principles are in conflict » (Schieffelin 1976 : 54-55, emphasis in the original). The Tangu of New Guinea are also reported to conceptualize that « siblingship is the determinant that descent [parent-child links] might have been expected to be [...] descent was probably always calculated from siblingship [...] and siblingship rather than descent always provided the definitive norms of social behavior » (Burridge 1959-1960 : 128, 130).

We will now see that these two ways sibling may be conceptualized account for the distinction Lewis Morgan made between descriptive and classificatory terminologies. To show this, we first need to identify how the family space relates to a genealogical space. Then we introduce the concept of a kin term space and the critical, conceptual relationship between the kin term space and the genealogical space. Jointly, these form a kinship space that provides the framework for the kinship relations we invoke as culture bearers in our dealings with other members of our society.

We identify and make explicit the logic underlying the form and structure of kinship terminologies within the kin term space where we can identify « the ideas and conceptions which [the terminology] embodies, of which the changes will be further and *logical developments* » (Morgan 1871 : 15, emphasis added). We make this logic evident through a natural representation of a kinship terminology as an algebraic structure implemented through software using the logic, concepts and ideas of object-oriented programming. The software implements the formal, algebraic analysis by first providing several ways to decompose the structural logic of the kinship concepts embedded in, and structurally organized through, a kinship terminology into their constituent elements. Next we determine whether it is possible to generate the terminology from those constituent elements using a general theory about the generative logic of kinship terminologies (Read 2007 ; Leaf & Read 2012).

Genealogical Space

8 By a *genealogical space* we mean the ensemble of genealogical pathways that express the way(s) one individual may be connected to another individual through possibly sex-marked parent-child links. A *genealogical pathway* is a sequence of parent and/or child positions (*genealogical positions*) beginning with self, such as self \rightarrow mother \rightarrow mother \rightarrow son. Genealogical pathways do not include all possible sequences of parent or child positions, but are typically restricted to either a sequence of parent positions, a sequence of child positions, or a sequence of parent positions followed by a sequence of child positions; i.e., they are restricted to pathways congruent with genealogical connection to a reference ancestor. The content of the genealogical positions is determined by assigning individuals to the corresponding parent and child positions in a family space in a manner consistent with cultural criteria. Individuals A and B are *genealogically connected* when there is a genealogical pathway for which individuals are assignable to all of the genealogical positions in the pathway and where A is the content of the initial, self position and B is the content of the terminal position in the genealogical pathway.

Genealogical pathways may be combined through concatenation to form a new genealogical pathway, subject to the constraint on admissible genealogical pathways. If P and Q are genealogical pathways, then we may concatenate P and Q by deleting the self position from Q and adding the parent and/or child positions (in the same order) from Q to the end of the sequence of positions in P. For example, if P is the pathway self \rightarrow father \rightarrow mother and Q is the pathway self \rightarrow son \rightarrow daughter, then we may concatenate P and Q to form the genealogical pathway self \rightarrow father \rightarrow mother \rightarrow son \rightarrow daughter.

The possible genealogical pathways that connect a person A identified as Ego to other persons may be generated recursively using the parent and child positions linked to the self position in the family space [Fig. 2]. We recursively compute ascending genealogical connections (paths) as follows. Let A (Ego) be the occupant of the self position. For each person that occupies a parent position (according to cultural criteria) linked to the self position when A is the occupant of the self position (see female B and male C in Figure 2), construct a path with each as self. That is, take B as Ego and repeat the process as with A, repeating again with each parent of B as Ego (and later with C), then repeating this operation for each set of parents. This results in a set of paths all beginning with A that collectively include all ascending genealogical relations of A.

We compute descending genealogical connections in a similar manner, using the self, son and daughter positions in the family space. The descending genealogical connections differ from the ascending genealogical connections in that the number of persons who are occupants of the child positions at any stage in the computation can be 0 or more, depending on reproductive histories and cultural criteria for assigning an occupant to a child position in the family space.

Ascending followed by descending genealogical connections may be constructed recursively in the same manner. Recursion, then, is the basis for the computation of genealogical connections and we may consider the genealogical space to be characterized by recursion of the parent-child relations in the family space (Lehman & Witz 1974).

The genealogical space contains an extremely large number of genealogical pathways due to the combinatorial explosion arising when there are two possible choices (mother or father for ascending pathways or son or daughter for descending pathways) at each step in the recursion. With n steps, the number of distinct genealogical pathways is 2^n . For genealogical relations no more distant than 2nd cousin (3 steps up and 3 steps down), there are 224 different genealogical pathways. A combinatorial explosion, then, makes the genealogical space extremely large and cognitively unwieldy beyond a few generations.

Kin Term Space

In an evolutionary sense, the initial use of genealogical pathways to express connections between persons would have run into a cognitive limitation with cohorts greater than a few tens of persons. All societies have systems for symbolically computing and expressing kin relations using an ensemble of around 15 to 25 kin terms. These terms form a kin term space in which symbolic computations circumvent the cognitive limitation. We call the ensemble of kin terms making up a kin term space a kinship terminology. Central to culturally transforming the large and complex genealogical space into a simpler, computational system using kin terms are two critical requirements: 1) a generative logic based on (symbolic) products of kin terms through which a computational system of kin terms can be constructed and 2) mappings between the kin term space and the genealogical space consistent with both the computation of genealogical pathways and the computational system of kin terms. Without consistency, the computational system would compete with genealogical pathways as a way to express kin relations among individuals.

The generative logic of the kin term space is based on constructing, in a culturally salient manner, new kinship relations starting with relations in the family space. Kinship relations include both the relations in the family space used to generate new relations and the new relations generated from these relations. The relations from the family space used to generate new kinship relations are the relations connected to self [Fig. 2A or 2B], where possibly (depending on the particular kinship terminology) a covering relation such as English parent will be used in place of the sex-distinguished relations in the family space. By kin terms will be meant the lexical labels for the kinship relation concepts generated in this manner.

A new relation may be generated from relations in the family space as shown in Figure 3 (solid arrows). Suppose two individuals, call them Ego and Alter₁, include in their cultural repertoire of kinship concepts the mother and father relations from the family space. Note that English speakers use the word mother (and father) both to refer to a position in the family space and as the label (i.e., kin term) for the kinship relation between speaker and the occupant of the mother position vis-à-vis speaker⁶.

More formally, let K stand for the kin term mother and L for the kin term father. Assume Alter₁ has the kinship relation K to Ego; that is, the person identified as Ego may properly refer to Alter₁ as « my K » (e.g., by « my mother » when K = mother). Suppose Alter₂ is a third person with the kinship relation L to Alter₁; that is Alter₁ may properly refer to Alter₂ as « my L » (e.g., by « my father » when L = father). Now construct a new kinship relation that will be the kin term product of L and K, denoted by $M = L \circ K$ (read « M is L of K »), where \circ is a symbol standing for the binary product determined by the word « of » (see Read 1984, 2007 for a formal definition).

The new kinship relation labelled by M will be the kinship relation of Ego to Alter₂; that is, Ego may properly refer to Alter₂ as « my M ». We also include, *not a kin term*, as a possible concept since not all kin term products identify another kin term; e.g., there is no kin term name corresponding to father of father-in-law in the American/English kinship terminology. Now, as culture-bearers, we need a name for this new kinship relation, father of mother, shown in Figure 3. Suppose we agree to use the word grandfather as its name, so $M = \text{grandfather}$ and Ego may properly refer to Alter₂ as « my grandfather ».

6. We can see this polysemy in an English expression such as « she is my mother ». Speaker may either be asserting that the female in question is one's biological mother, thereby identifying the *mother* position in the family space, or that speaker refers to her as mother for reasons such as adoption, hence *mother* is being used as the name of the relation between speaker and the woman in question.

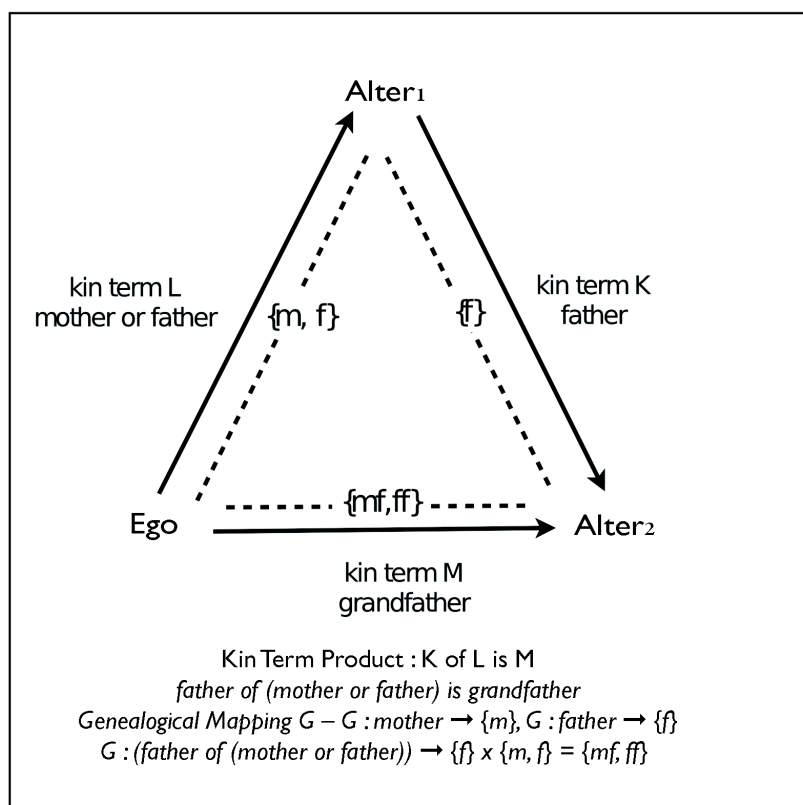


Figure 3 – The English kin term *grandfather* is determined from the product of the kin term *parent* = [mother, father] with the kin term *father* (see solid arrows). The genealogical definition of *grandfather* is derived from the kin term product by using the genealogical mapping of *mother* → {m} and the genealogical mapping of *father* → {f} via *grandfather* = *father* o *parent* → {f} x {m, f} = {mf, ff}, where *m* stands for the kin type genealogical mother, *f* for the kin type genealogical father and “x” is the genealogical concatenation operation for genealogical pathways (see dashed lines). Note: Kin term products are written right to left so that *father* o *parent* can be read “father of parent” as a product of kin terms. Genealogical concatenation is written left to right, so *mf* can be read “genealogical mother’s genealogical father”.

The meaning of the English kin relation concept named *grandfather* is determined by this construction process. Accordingly, *grandfather* is the kin term Ego uses to refer to Alter when Ego refers to a person by the kin term *mother* and that person refers to Alter by the kin term *father*. The construction has thus generated not only a kin relation but a kin relation concept.

We can construct the English kin relation concept, *father of father*, in a similar manner. *Father of father* could either have its own name or an already existing name. In the example we are constructing, the kin relation

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concepts are part of the English/American kinship terminology and the name, grandfather, is also used for the kinship relation concept given by father of father. (Using the same name for both father of mother and father of father in the American/English terminology derives from using the concept parent from the family space, rather than father or mother, to generate kinship relation concepts, as will be discussed below.) So the meaning of the English kinship relation concept, grandfather, is that it is the name for the kinship relation between Ego and Alter when Ego properly refers to a person either by the kinship relation mother or by the kinship relation father and that person, in turn, properly refers to Alter by the kinship relation father. Equally, it is the name for the kinship relation between Ego and Alter when Ego refers to a person by the kin term parent and that person refers to Alter by the kin term father.

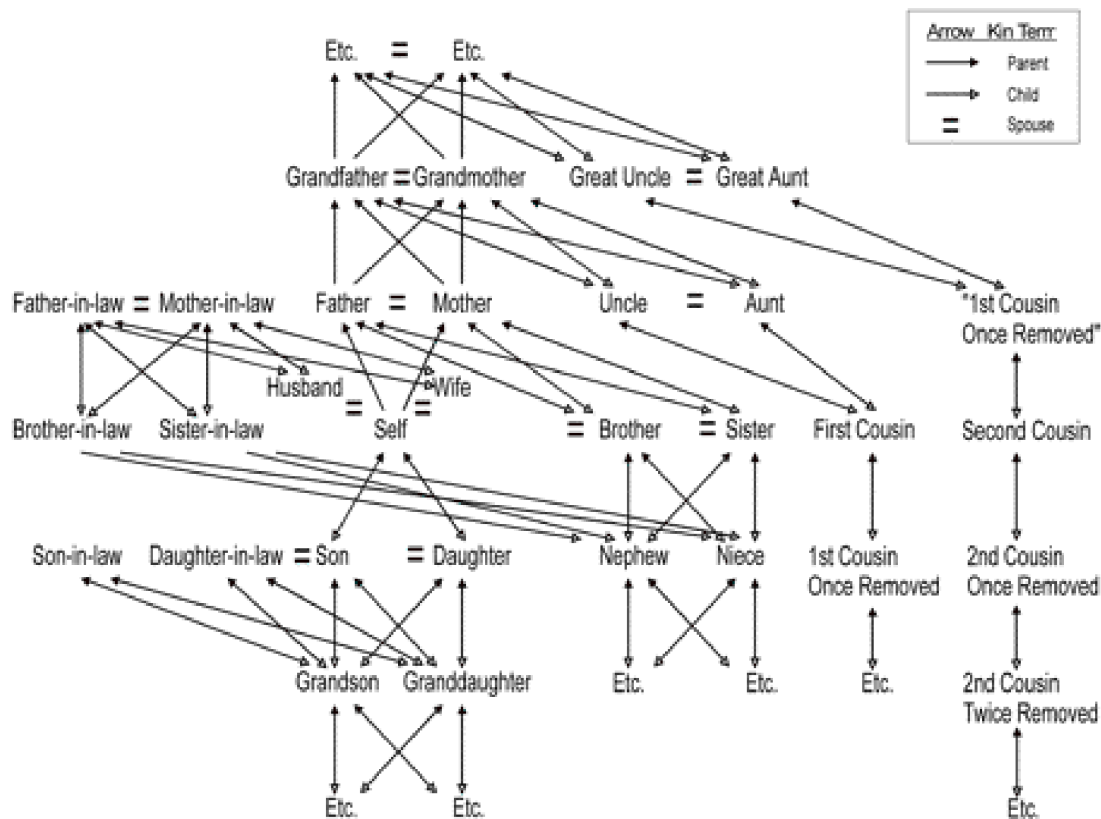


Figure 4 – Kin term map of the American kinship terminology based on the generating kin terms parent, child and spouse

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We continue this process of forming kin term products using the relations from the family space until, for any kin term product, either 1) we obtain an already determined kin term, 2) the kin term product is not included in the sense that there is no name for the product, or 3) we continue obtaining new kin term names but in a patterned manner (e.g., great great... great grandfather or grandchild). Because conditions 1)-3) exhaust all possibilities, the system of kin terms constructed culturally in this manner is a conceptually closed system, allowing for the possibility that there may be alternative names for the same kin term concept (such as pop, dad, « my old man » and so on as names for the father position in English) or the kin term name may be used metaphorically or otherwise in non-kinship contexts (such as the use of uncle or

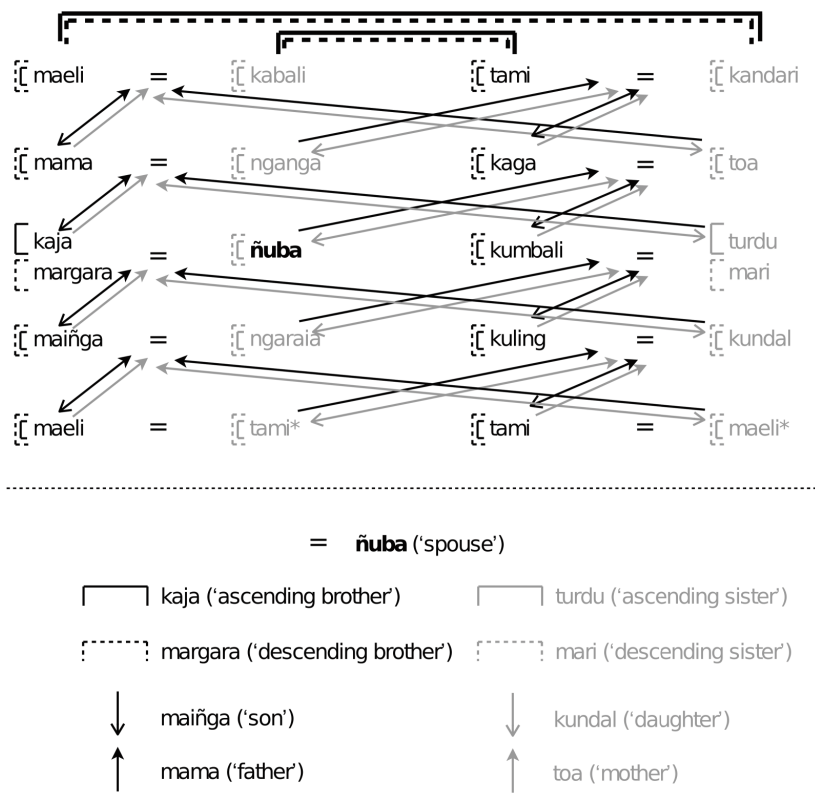


Figure 5 – Kariera kin term map from the perspective of a male speaker

The vertical arrows point to the “=” sign only for clarity of the diagram and should be understood as pointing to the kin term matching the sex marking of the arrow ; e.g., mama of mama is maeli. The vertical sibling symbols show that same-sex kin term products with sibling terms are reflexive ; e.g. kaja of mama = mama = margara of mama. The horizontal sibling symbols refer to a cross-sex kin term product with a sibling kin term ; e.g., turdu of maeli is kandari and kaja of kandari is maeli.

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aunt for the close friends of one's parents or the use of father in reference to a Catholic priest, where the usage is not closed under computation of relations – the son of an uncle who is one's parent's close friend is not a cousin and the sister of a Catholic priest is not an aunt).

We may display the kinship terminology graphically with a kin term map showing how kin terms are conceptually interrelated through kin term products using kin relation concepts from the family space. Figure 4 shows the kin term map for the American/English kinship terminology and Figure 5 the map for the terminology of the Kariera, traditionally a hunter-gatherer group in western Australia. In contrast to the descriptive American/English terminology, the Kariera have a classificatory terminology. Striking structural differences between these two terminologies are immediately evident from their respective kin term maps. Note in particular the presence of collateral terms in the AKT and their absence in the Kariera terminology, the distinction Morgan made between descriptive and classificatory terminologies.

Whereas the American/English terminology has a structure somewhat reminiscent of the idealized genealogical space presumed to represent the kin relations categorized by kin terms, the structure for the Kariera terminology, as noted by Morgan, bears little resemblance to the structure of the genealogical space.

Mapping of the Kin Term Space into the Genealogical Space

The construction of a new kinship relation concept from existing kinship relations also determines a genealogical definition for each new kin term in a manner consistent with concatenation of genealogical pathways as shown in Figure 3. Thus the genealogical definitions of kin terms are not primary data since those definitions are derived from the way kin terms are generated using kin term products⁷. This makes it possible to compute kinship relations symbolically using kin terms rather than more concretely with genealogical pathways. Hence we can map the genealogical pathways to the kin term space, then do the computations symbolically in the kin term space, and lastly map the resulting kin term(s) back to the genealogical space, though in practice users of a terminology typically express and compute kinship relations using kin terms without reverting to genealogical pathways, as indicated by the quote from Sahlins.

7. Murray Leaf and Dwight Read (2012) discuss mapping the kin term space into the genealogical space in more detail. Dwight Read (2001) demonstrates that the predicted mapping of kin terms for the American/English terminology agrees completely with the elicited genealogical definition of kin terms. Similar results have been obtained for all other terminologies for which the structural logic of the terminology has been worked out.

Theory for the Generation of Kinship Terminology Structures

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We now outline a theory for the formation of kinship terminology structures using kin term products (Read 2007 ; Leaf & Read 2012 ; see also Read & Lehman [Chit Hlaing] 2005). Briefly, kinship terminologies are generated using the following steps, beginning with kin terms derived from the structural positions making up the family space of positions around self [Fig. 2]. We will illustrate the theory using the English terms parent = [mother, father], child = [daughter, son] and spouse = [wife, husband] for the family positions.

The generation of a kinship terminology structure utilizes six steps, starting with an ascending structure, next forming a descending structure, then adding sex marking of kin terms, then including affinal terms, then introducing local properties of the terminology structure and finally incorporating terminology properties whose origin is extrinsic to the terminology structure.

The steps are as follows :

- Step 1 : Construct an ascending structure of kin terms using a term that identifies an ascending position in the family space.
- Step 2 : Construct an isomorphic, descending structure of kin terms using a term that identifies a descending position in the family space. Include a structural equation that defines the ascending term to be structurally reciprocal to the descending term (see below).
- Step 3 : Introduce sex marking of kin terms either by a) introducing a pair of sex marker elements, one for each sex or b) by forming two structures, each isomorphic to the combined ascending and descending structure, with one structure consisting of male-marked (including neutral) terms and the other structure consisting of female marked (including neutral) terms.
- Step 4 : Introduce a term for the affinal relation in the family space connecting the mother and father positions. This is done either through a) adding an element along with structural equations that define the added element to have the structural properties of an affinal term or b) through defining some of the terms generated in Step 3 to be affinal terms.
- Step 5 : Introduce terminology specific rules that locally modify the structure determined from Steps 1-4.
- Step 6 : Introduce any relevant culture-specific kin term distinctions that arise from usage of the terminology, such as the term with transliteration, « younger brother of mother », in the Tongan terminology due to inheritance rules (Bennardo & Read 2007).

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Generation of the American/English Kinship Terminology

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We now show that we can generate the American/English kinship terminology using the above theory for the structure of kinship terminologies. To do this, we first determine the generating kin terms by simplifying the kin term map down to a core structure of ascending kin terms. Next we construct a kinship structure using the steps discussed above. Lastly we determine whether the constructed terminology is isomorphic to the American/English kinship terminology.

Simplification of the Kin Term Map

We simplify the kin term map shown in Figure 4 by first removing all kin terms linked to self only through products with wife or husband terms. Then we « fold over » the two sides of the ladder-like structure of kin

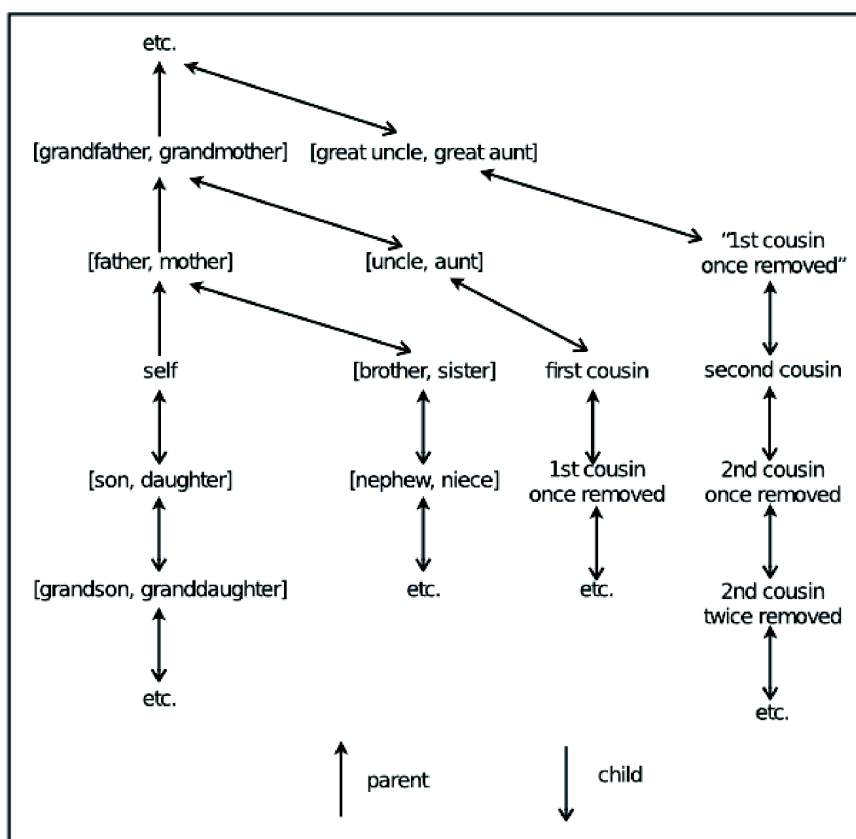


Figure 6 – Simplified kin term map for the English kinship terminology

Affinal terms have been removed and pairs of terms that differ only by sex marking have been combined together in square brackets.

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term products extending upward and downward from self and the parallel structure through the brother and sister terms by replacing a pair of sex marked terms K and L with a neutral covering term denoted by [K, L]; e.g, we replace the pair of terms father, mother by [father, mother], which corresponds to the neutral English kin term, parent. This gives us the reduced structure shown in Figure 6. Next we remove the descending part of the structure based on products with [son, daughter] (= child) and arrive at the core structure shown in Figure 7A.

Generate the Core, Ascending Structure

The form of the reduced structure implies that we use $A = \{self, parent\}$ as the set of generating terms. In the structure that we generate, all kin term products using the ascending term, *parent*, define new kin term concepts since the reduced structure continues indefinitely. This yields the sequence of kin term concepts *self*, *parent*, *parent o parent* = *grandparent*, *parent o grandparent* = *great grandparent*, and so on [Fig. 7B], which is clearly isomorphic to the core ascending structure in Figure 7A.

Each of *grandparent*, *great grandparent*,... are additional kin term concepts generated through kin term products since no structural equations have been introduced that would reduce any of these products to a simplified form.

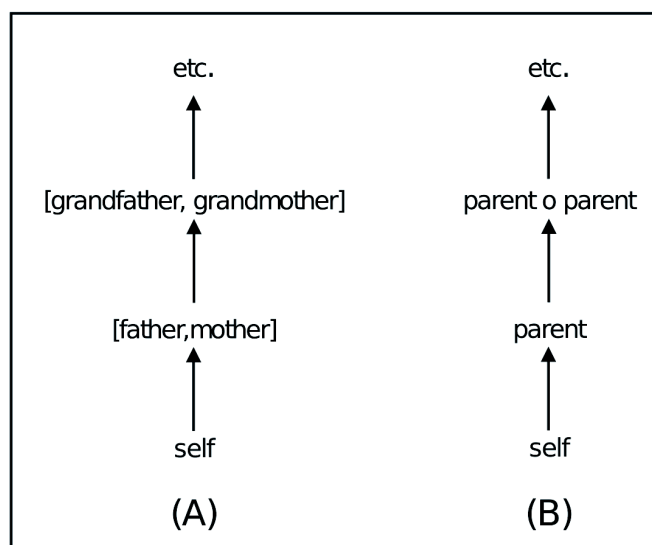


Figure 7 – (A) Core, ascending structure for the American/English kinship terminology.
(B) Structure generated from the generating set $A = \{self, parent\}$.

Generate the Descending Structure

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We generate the descending kin terms via a structure isomorphic to the ascending structure by using the generating set $D = \{self, child\}$ to generate the descending terms obtained from the set $A = \{self, parent\}$ and then replacing the ascending term *parent* with the descending term *child*. If there were any structural equation included as part of generating the ascending structure, we would include the isomorphic structural equation with *parent* replaced by *child*.

Reciprocity between the kin terms *parent* and *child* is introduced by the structural equation :

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

The equation states that when Ego refers to Alter₁ as *child*, and Alter₁ refers to Alter₂ as *parent*, then Ego refers to Alter₂ as (my)*self*. This is precisely what we mean by *parent* and *child* being reciprocal terms in the domain of consanguineal relations (affinal relations are not yet part of the generated structure), since Alter₂ must be Ego if Ego and Alter₂ are related consanguineally and Ego refers to him(her)self as *self*; hence Ego refers to Alter₂ as *self*. The structure generated by the generating set $\{self, parent, child\}$ and the structural equation $\text{parent} \circ \text{child} = \text{self}$ is shown in Figure 8 and is isomorphic to the kin term map in Figure 6.

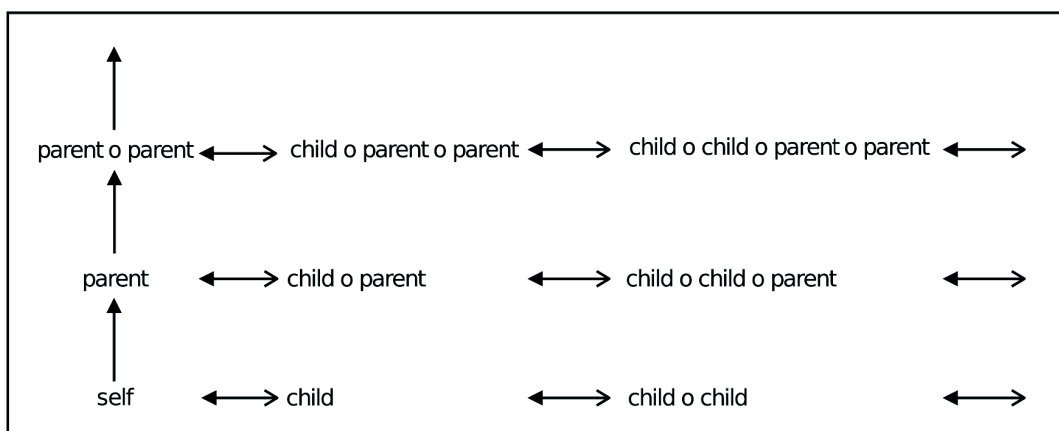


Figure 8 – Structure generated by the set of generating terms $G = \{self, parent, child\}$ and the equation $\text{parent} \circ \text{child} = \text{self}$ making *parent* and *child* into reciprocal terms.

Sex Marking of Kin Terms

We introduce sex marking of terms through adding sex marking elements that have the effect of bifurcating the generated kin terms into male and female marked terms. (Details can be found in Leaf & Read 2012.)

Affinal Kin Terms

Affinal relations are introduced (in this example) through adding a spouse element (also bifurcated into husband and wife) to the generating set G , so G now becomes $G = \{self, parent, child, spouse\}$. Structural equations are added that express the conceptual relations among these generating elements :

(2) $spouse \circ spouse = self$ (equation for structurally defining a spouse term)

(3) $spouse \circ parent = parent$ and, reciprocally, $child \circ spouse = child$ (universal equation for kinship terminologies)

(4) $spouse \circ (child \circ parent) = (child \circ parent) \circ spouse$ (i.e., *spouse of sibling = sibling of spouse*; this equation restricts the size of the structure for the affinal terms)

(5) $parent \circ (parent \circ spouse) = 0$ (i.e., *parent of parent-in-law is not a kin term ; a terminology specific equation*) and, reciprocally, $spouse \circ (child \circ child) = 0$ (i.e., *spouse of grandchild is not included as a kin term ; a terminology specific equation*)

(6) $parent \circ (spouse \circ child) = 0$ (i.e., *parent of child-in-law is not included as a kin term ; a terminology specific equation*)

Restriction of the Sex Marking of Kin Terms

Sex marking of kin terms for the English terminology is restricted by the rule that a kin term K remains sex marked only if $spouse \circ K$ or $spouse \circ$ (reciprocal term for K) is a kin term. This restriction implies that the self-reciprocal term *cousin* is not sex marked – as in fact is the case – since $spouse \circ cousin = spouse \circ (child \circ child \circ parent \circ parent) = spouse \circ (child \circ child) \circ parent \circ parent = 0 \circ parent \circ parent = 0$ from Equation (5). This derivation also agrees with the fact that there is no commonly recognized English kin term for *spouse of cousin*.

The structure we have generated is shown in Figure 9 and is isomorphic to the kin term map in Figure 4. Thus we have shown how the American/English terminology may be generated from concepts derived from the family space.

Accounting for “Anomalies” in the Terminology

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The generated structure also accounts for an apparent anomaly in the American/English kinship terminology. The suffix « in-law » appears to be a linguistic device for marking relatives by marriage, except that *spouse* of *aunt* (*uncle*) = *uncle* (*aunt*). There is no inconsistency because logically $spouse \circ aunt (uncle) = uncle (aunt)$ (see Figure 9, [uncle, aunt] node). What *in-law* marks, instead, are the terms making up a third dimension introduced by kin term products with the spouse term. The product of spouse does not map *aunt* and *uncle* into this third dimension and so by this criterion the *in-law* suffix is not relevant.

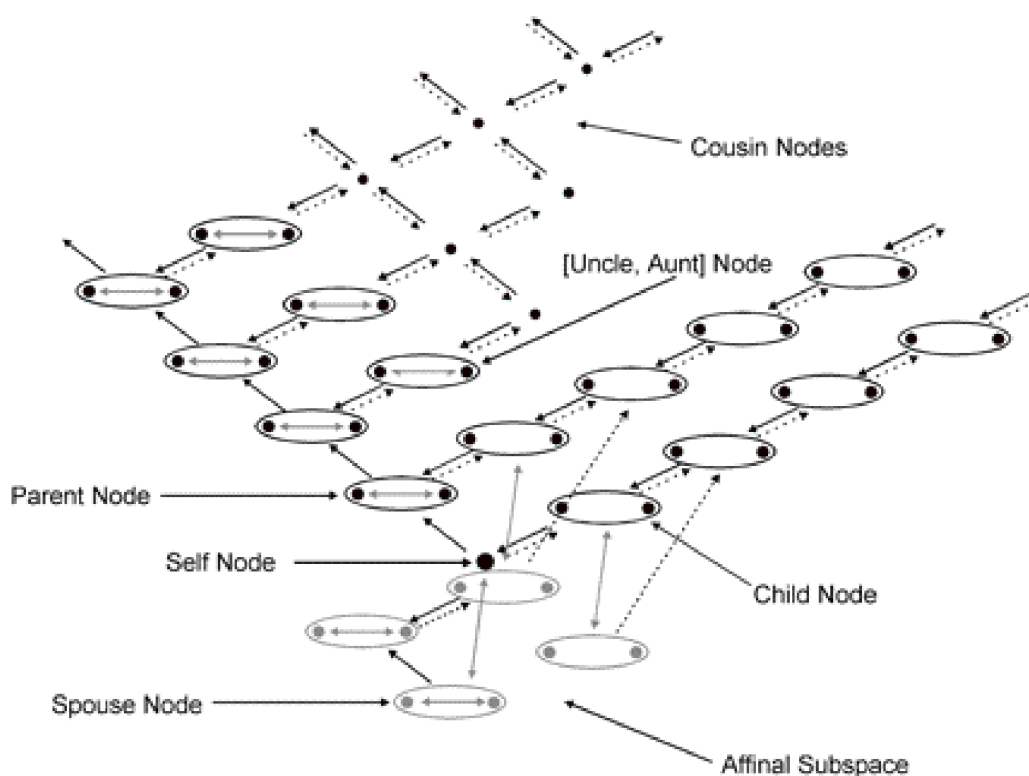


Figure 9 – Generated kinship terminology

The solid, single-headed arrows show the result of taking a product with the generating term, *parent*. The dashed, single-headed arrows show the result of taking a product with the reciprocal generating term, *child*. The gray, double-headed arrows show the result of taking a product with the affinal generating term, *spouse*. The oval around a pair of nodes indicates that the pair of nodes differ by sex marking. The gray nodes are the affinal nodes generated by the *spouse* generating term. The gray double-headed arrows indicate products with the *spouse* generating term.

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Accounting for the Fundamental Division Between Descriptive and Classificatory Terminologies

We now explore briefly a crucial difference in kinship terminology structures that arises when changes are made in the generating set for the kinship terminology. More precisely, we will identify the structural basis for the differences between descriptive and classificatory terminologies introduced by Morgan.

The division has endured despite problems with providing an adequate definition for what constitutes a descriptive versus a classificatory terminology. Morgan used presence or absence of collateral kin terms to make the distinction. For example, the American/English terminology has the lineal kin term sequence *son/daughter*, *self* and *father/mother* as well as the collateral terms *nephew/niece*, *brother/sister*, and *aunt/uncle* for the -1, 0 and +1 generations, respectively. In contrast, the classificatory Kariera terminology does not distinguish between, for example, genealogical parent and genealogical same-sex sibling of genealogical parent. Both genealogical father and genealogical father's brother (among other males) are referred to by the same kin term, *mama* (« father »). Any male referred to as *maiñga* (« son ») by a person referred to by Ego as her/his *kaja* (« ascending brother ») or *margara* (« descending brother ») will be someone Ego refers to as *maiñga*.

We will now show that a simple difference in the generative logic of terminologies accounts for the structural differences between descriptive and classificatory terminologies discussed by Morgan. This difference leads to a verified ethnographic prediction regarding the social meaning of the kinship concept of sibling.

Classificatory-Descriptive Terminology Distinction : Structural Implications of Sibling as a Generating Term

The argument presented here was developed algebraically (Read & Behrens 1990) using the paradigm introduced by Read (2007) for the analysis of kinship relations. Dwight Read and Clifford Behrens showed that classificatory terminologies differ from descriptive terminologies due to the latter using a generating set that includes an ascending generation sibling term. For the Kariera terminology, let $A = \{\textit{male self}, \textit{mama}$ (« father »), \textit{kaja} (« ascending brother ») be the generating set for the ascending kin term structure⁸. We include the following structural equation :

8. Note that had we used brother as a generating term in the generating set A, then *brother* would be the isomorphic term in the generating set D and we would have the equation, .../...

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(7) $mama \circ mama \circ mama = 0$ (typically, classificatory terminologies limit the extent of the ascending structure ; an alternative equation for some classificatory terminologies is $mama \circ mama \circ mama = mama \circ mama$)

(8) $kaja \circ kaja = kaja$ (structural equation for making *kaja* a sibling term)

(9) $mama \circ kaja = mama$ (structural relationship between *mama* (« father ») and *kaja* (« ascending brother »))

The descending structure will be generated using the set $D = \{male\ self, mai\i\~{n}ga\ \text{ (« son »), margara\ \text{ (« descending brother »)}\}$, along with the structural equations isomorphic to equations (7)-(9) :


(7*) $mai\i\~{n}ga \circ mai\i\~{n}ga \circ mai\i\~{n}ga = 0$

(8*) $margara \circ margara = margara$

(9*) $mai\i\~{n}ga \circ margara = mai\i\~{n}ga$

We introduce the structural equation :

(10) $mama \circ mai\i\~{n}ga = male\ self$

 **To** make *mama* and *mai\i\~{n}ga* into reciprocal kin terms and the equation :

(11) $kaja \circ margara = male\ self = margara \circ kaja$

To make *kaja* and *margara* into self-reciprocal kin terms.

Closure Under Reciprocity of Structural Equations

Next we use another universal property for kinship terminologies, namely closure under reciprocity of structural equations. If we have the structural equation $X \circ Y = Z$, then we will also have the reciprocal equation $Y^r \circ X^r = Z^r$, where X^r , Y^r and Z^r are the reciprocal terms for X , Y and Z , respectively. For example, Equation (11) is the reciprocal equation for Equation (7) and is included as a structural equation. The reciprocal equation property implies that for classificatory terminologies the reciprocal equation for Equation (7*), namely $kaja \circ mama = mama$ is part of the generated structure. It also follows that $margara \circ mama = mama$, hence genealogical brother of genealogical father will be referred to as *mama*, the defining equation used typically to identify classificatory terminologies.

[Rest of the footnote 8] brother \circ brother = male self, defining brother as a self-reciprocal term. This, along with the sibling equation brother \circ brother = brother, implies that brother = brother \circ brother = male self, thus erasing the sibling term brother from the structure by reducing it to the identity element male self. Hence having the different terms kaja and mai\i\~{n}ga for ascending and descending generators, respectively, is logically necessary, which accounts for the fact that classificatory terminologies typically make an older/younger sibling distinction among the same-sex sibling kin terms.

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Thus the difference between classificatory terminologies and descriptive terminologies is determined by whether sibling is a concept constructed from the kin terms *parent* and *child* (as is the case for the American/English terminology where we have $child \circ parent = [brother, sister]$), or whether sibling is an irreducible generating concept on a par with *parent* as an irreducible generating concept.

Implications of Sibling as a Generating Term

Including a sibling term as a generating term leads to the ethnographic prediction that *sibling* should be conceptualized differently in societies with descriptive terminologies versus societies with classificatory terminologies. This prediction is verified by ethnographic observations regarding the concept of sibling in societies with classificatory terminologies as a generating concept. As discussed above, the concept of sibling among the Kaluli and the Tangu of New Guinea corresponds to that of a generating concept. Similar notions of the primacy of sibling have been reported for the Polynesian area (Marshall 1986) with their classificatory terminologies. The structural differences in the concept of sibling between societies with descriptive versus classificatory terminologies in the context of a family space are shown in Figures 2A and 2B.



The idea of a paradigm shift (Read 2007) is justified by recognizing that the kinship space is not simply determined through genealogical relations as has been generally assumed, but incorporates, in an integral manner, a kin term space over which symbolic computations of kin terms may be made in accordance with a generative logic for a kinship terminology. Expressing the kinship space in this manner clarifies and identifies the fact that the genealogical definitions of kin terms do not reflect unstated and assumed criteria external to the concepts that make up the cultural understanding of kinship, but derive from those concepts in a straightforward manner through the way in which new kinship relation concepts are generated through the product of other kinship relations. The algebraic representation of the structure of a kinship terminology (and its companion implementation as a computer model) is not imposed in the manner of other formalisms such as rewrite rules, componential analysis or optimality theory, but derives from making explicit the concepts and ideas about kinship relations expressed in the kinship terminology and through usage of kin terms (Read 1984 ; Lehman 2000 ;

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Leaf & Read 2012). By so doing, we make evident how the properties of terminologies relate to the structural logic embedded in a kinship terminology and thereby clarify the relationship between kinship space expressed through kinship terminologies and systems of social organization.

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