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See table of contents

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Article abstract

Traditional anthropological models of kinship employ rule-based classical semantics to account for the meanings of kinship, clanship and the attribution of kin terms. This article uses cognitively-based, prototype semantics and distributed, sub-symbolic representations to explore the meanings of kinship relations among the Managalase of Papua New Guinea.

Cognition, Meaning and Kinship: Connectionist Models of Cultural Representation [1]

William H. McKellin *

En Anthropologie, les modèles traditionnels de la parenté utilisent les règles de la sémantique classique pour interpréter la signification des relations de parenté, des relations claniques et l'attribution des termes d'adresse et de référence.

Cet article utilise la sémantique des prototypes et les représentations sous-symboliques pour explorer le sens des relations de parenté chez les Mangalase de la Papouasie Nouvelle-Guinée.

Traditional anthropological models of kinship employ rule-based classical semantics to account for the meanings of kinship, clanship and the attribution of kin terms.

This article uses cognitively-based, prototype semantics and distributed, sub-symbolic representations to explore the meanings of kinship relations among the Managalase of Papua New Guinea.

Kinship, language, and cognition were dominant themes throughout Roger Keesing's impressive career. His descriptions and analyses of Kwaio kinship and his interests in cultural and cognitive models span the days of the "new ethnography" and the cognitive anthropology of the 1960s and 1970s to the more recent developments in cognitive science, cognitive linguistics and psychology. In his final public presentation at the Canadian Anthropology Society Meetings the day before his death, Roger Keesing lamented anthropologists' hesitation to cross disciplinary boundaries and their unfamiliarity with relevant research in related disciplines, such as cognitive science. At the time of his death his interdisciplinary focus brought together interests in anthropology, psychology, and linguistics. He drew upon the ground breaking work of Rosch on the psychology of categorization, and the works of G. Lakoff, Fauconnier and Langacker in cognitive linguistics and cognitive semantics. He blended these more traditional anthropological issues of symbolism and cross-cultural comparison. His cautious applications and critiques of the ethnosemantics of kinship were transformed into to a re-examination of cultural categories (Keesing, 1987) and ethnosemantics

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(Keesing, 1993a, 1993b). These resulted in a re-evaluation of kinship studies (Keesing, MS) in which he repudiated his previous structural semantic analysis of kinship in favour of a more cognitively based approach. The earlier semantic, rule-based approach and the more recent cognitive models offer distinct theories of analysing and representing cultural meanings and categories.

In this paper I will examine two lines of current research in cognitive science that open new approaches to an anthropological understanding of mental and social representations, classification, and memory. I will present two responses to traditional semantics. George Lakoff has developed a cognitive semantics based on Rosch's (1973, 1978) analysis of prototype semantics and an analysis of the role of metaphor or analogical reasoning. Keesing employed this approach in recent lectures on time (Keesing, 1993a) and the body (Keesing, 1993b), and in his writings on kinship (Keesing, mss). The second approach is based on recent research in psychology and cognitive science generally called Connectionist or Parallel Distributed Process. Connectionist models offer a different mode of representation than cognitive linguistics but share the same basic assumptions about the importance of cognitive processing (Lakoff, 1989). I will demonstrate the explanatory value of these models by relating these issues of cognition to an earlier debate concerning the use of descent as a distinctive feature for describing and defining kinship and the relationship between kin groups and kin categories. Roger Keesing contributed to this discussion in several articles (1967, 1970a, 1970b) including a comparison between Fortes's analysis of Tallensi kinship and clanship (Fortes 1945, 1949, 1953, 1959, 1969) and his own account of the cognatic kinship system of the Kwaio (1970b). After discussing the competing theories of semantic, cognitive and cultural categories and representation I will return to this issues of kinship. I will employ a cognitive model to analyse kinship data from the Managalase of Papua New Guinea whose system of social organization is similar in many regards to that of the Kwaio.

SYMBOLIC AND SUB-SYMBOLIC MODELS

Semantics and the structural analyses of kinship were central in the development of cognitive anthropology and anthropological theory during the 1960s and 1970s. The debates among Goodenough, Loundsbury, Leach, Lévi-Strauss, Scheffler, Schneider, Wallace, and Keesing explicitly employed linguistic models of descriptions and analyses. They treated mental and cultural representations as language-like symbols. Kin terms and other cultural representations were thought to exhibit the same properties as other systems of rule-governed semiotic codes:

1. Symbols are qualitatively distinct. A conventional, semiotic, language-like symbol has either a discrete, unitary meaning (denotation) or a primary semantic kernel, in addition to its extensions – its peripheral connotations. Symbols are defined by the accumulation of component features and the distinctive features that distinguish them from other similar representations.

2. The principles that govern semiotic symbols are based on logical rules (such as the law of the excluded middle) rather than cognitive processes.

3. Symbols and their meanings (the features and distinction) are shared (not approximated) by their users. Traditional semantic symbols do not represent the variability and social diversity between users' knowledge and understandings of the system.

4. Code based semantic systems are essentially context-free, with pragmatics and questions of relevance or context as peripheral rather than an essential contributors to their meaning.

These traditional assumptions were challenged by research on the psychology of categorization with the development of prototype semantics, and the implications of studies of memory. Prototype semantics emerged from work on the ethnosemantics of colour conducted by Rosch (a psychologist), and anthropological linguists, Berlin and Kay. Rosch, in her research on colour categories with Dani-speaking subjects in Irian Jaya (Heider [Rosch] 1972), and on colour and other kinds of categories in North America (Rosch 1973, 1978; Mervis and Rosch 1981), showed that lexical terms such as those for colours are not arbitrary divisions of the colour spectrum. Instead, the perceptual salience of different hues affected the distinctions among lexical categories.

Rosch also found that some examples referred to by a particular term are treated as better examples, or more salient than others (navy

blue rather than turquoise for "blue," for example). This led her to identify the prototype as a kind of category in which members that share some of the same features coalesce. Other constituents of prototype share decreasing degrees of similarity to the central member. This gives category membership a quantitative dimension. In contrast, to traditional categories defined by necessary, crucial features, which created rigid boundaries between categories, prototypical categories grade into one another as the number of features shared by peripheral members with the central member of one category decrease, and the number of features in common with a neighbouring category increase.

As anthropologists and linguists grew to realize the importance of the pragmatic dimensions of language, context and anthropological studies of cultural categorization slowly shifted their focus away from the discrete categories and the formalisms of ethnosemantics to more flexible representations that could better account for variability. The emergence of explanations using prototype semantics and metaphor emerged as an alternative to the more mechanical structuralist paradigm (Coleman and Kay, 1981; Quinn, 1982).

Current understandings of cognitive and cultural representations can be traced to studies of memory by Fredrick Bartlett in the 1920s and 1930s. Bartlett, a colleague of W. H. R. Rivers, studied individuals' recall of stories. He discovered that not only were his subjects able to recount information from the stories they were given, they also "remembered" information that was not actually presented in the original account. He also found that his subjects had difficulty recalling information in stories from other cultures. In these instances, the events and activities of characters were unfamiliar to the subjects. The subjects altered the material to make it coherent with their background knowledge. Bartlett (1932) concluded that remembering is not simply the retrieval of old information. Instead, it is a reconstruction of the past that uses the recall of some previous experiences as indexes, which are guided by the current context, structured by cultural rules of inference, and combined with individuals' background knowledge. The pattern of inferences that Bartlett (1932) called schemata, supplies missing information to create coherent memories.

This seminal insight of Bartlett's has resurfaced as psychologists and anthropologists have turned their attention to the role of narrative in memory and culture. The term is now applied to abstract, simplified representations of information (Holland and Quinn, 1987) in story grammars, cultural models, and cognitive schema. The cognitive principles denoted by the schema serve as an alternative model to structural, rule-based accounts of linguistic, mental, and cultural representations.

In contrast to the more conventional forms of generative linguistics and semantics, Lakoff (1987) contends that linguistic analyses must be based on an understanding of cognitive processes. Schemata and prototype effects are able to capture the variability and lack of discreteness characteristic of meanings that evade more mechanical, rule-based representations. Lakoff's position may be summed up by the following principles:

1. Mental and cultural representations are based on categories which reflect prototype effects in which one central member serves as the exemplar and other instances, considered poorer representations of the category, have only a portion of the properties of the exemplar. Categories are defined quantitatively as well as qualitatively.

2. The rules that govern the relations of prototypic symbols should be based on patterns of cognitive processing rather than rules of logic. The logical law of the excluded middle, essential for logical inclusion and exclusion of members in semiotics categories, is not consistent with the grading of prototypic categories.

3. Representations reflect natural variations. They are based on establishing approximate, analogical mappings between the representation and that which is represented rather than on a mechanical, one-to-one correspondence between the code and interpretation.

4. Representations and rules do not need to be shared for communication. Communication is based on approximation and analogical inference that generalize from known patterns to enable the participants to go beyond the information given.

5. Meanings are not abstractly fixed, but are instantiated associations of connections among a number of features in regular patterns in particular contexts.

Prototypes, like traditional symbols, are based on the sets of features shared by members of a category. But the prototype emerges when the quantitative distribution of features identifies the relative importance or centrality of some features over others. This quantitative dimension also enables prototypes to express the non-discreteness and variability encountered in the ways that symbols are used in communication. Unlike symbol systems that require discrete codings and decodings, prototypic representations do not require participants to share identical meanings of terms, they only need to approximate the others' representations.

Lakoff offers a clear example of the concepts of cognitive schema and prototype semantics in his analysis of "mother." He notes that, in classical semantic theory it should be possible to give a clear statement of the necessary and sufficient conditions to define "mother" such as *a woman who has given birth to a child*. This however does not cover all possible cases equally. Lakoff contends that "mother" is a complex cluster of individual cognitive models that compose what he calls a cluster model: mother. The particular constituent models that form the cluster are:

> The BIRTH MODEL: a person who gives birth is the mother.
>
> The GENETIC MODEL: the female who contributes the genetic material is a mother.
>
> The NURTURANCE MODEL: the female adult who nurtures and raises a child is the mother of the child.
>
> The MARITAL MODEL: the wife of the father is the mother.
>
> The GENEALOGICAL MODEL: the closest female ancestor is the mother.

While in our casual use of "mother" these various models may be undifferentiated, some situations (such as discussions of new reproductive technologies) force us to recognize these distinctions. In these more specialized usages one set of features of MOTHER is foregrounded while the other constituents of MOTHER remain in the background. When the situation requires more specificity, the constituent themes produce additional terms: stepmother, surrogate mother, birth mother, foster mother, biological mother, etc.

Lakoff's example demonstrates some of the complexity of abstract, prototype-based semantic definitions. Nevertheless, his approach does not address the dynamics involved in employing these models in social contexts. Connectionist models offer a different mode of representing schemata.

Connectionist Representations and Distributed Social Cognition

Schemata, such as those initially developed in psychology and used in structural semantics and story grammars retain an older, top-down, deductive form in which information is structured by preexisting categories. By contrast, the cognitively-based prototype effect is driven by purely inductive, bottom-up processes that do not recognize the role of prior knowledge in perception. Dissatisfied with the rigidness and mechanical nature of memory schema and story grammars and their inability to account for learning as well as memory, Rumelhart, McClelland and the Parallel Distributed Processing (PDP) Group devised new forms of schematic relationships described as Parallel Distributed Processing networks. The PDP or Connectionist schemata are designed to processes information simultaneously – in parallel – from the top-down and from the bottom-up. Knowledge is represented in networks of features similar to those of conventional, top-down, deductive schemata. However, the connections between features or nodes are not necessarily hierarchial. During information processing, the features used to represent knowledge are matched with the features of new information to increase the strength of the existing patterns. New information that does not fit the established configuration of features is not rejected, but used to modify the previously existing schema (Rumelhart, Smolensky, McClelland and Hinton, 1986). The patterns of these Connectionist schemata are not based simply on the presence of features, as in traditional schema. Quantitative scores or weights are used to represent the frequency of features and their patterns of interdependence. Comparable patterns of distinctiveness are also incorporated into the network as inhibitions that register the separation between features. Prototypes emerge from these complex patterns of connections and inhibitions.

If, for example, we return to Lakoff's discussion of the cluster model MOTHER and examined how the concept is used, we can see how meanings might be affected by the interdependence and the

frequency of constituent models. If asked what is most characteristic of a "mother," most English speakers would likely say that the BIRTH MODEL: *the person who gives birth* is the most important feature, followed by the GENETIC MODEL: *the female who contributes the genetic material for a child*. The extent to which these two share features makes them virtually indistinguishable in most situations, but it is necessary to differentiate between when discussing *in vitro* fertilization. With the recent increase in children born to single mothers, however, we might find that the NURTURANCE MODEL, *the female adult who nurtures and raises a child*, has increased its salience while the MARITAL MODEL: *wife of the father*, has probably declined. The GENEALOGICAL MODEL: *the closest female ancestor*, is probably irrelevant to most people and would likely evoke quizzical stares. Though the features or constituent members of the cluster model MOTHER may remain the same, the network representing their interdependence and salience or strength can trace changes and personal or contextual shifts in the meaning of the concept.

In Connectionist semantics, meanings are represented as the patterns and strengths of the connections among the features or nodes in the network. Meaning is not just the sum of the components themselves but the *configurations* of features – their *Gestalt*. In this way ***it differs from componential analysis***. Traditional semantics represents meaning by structurally discrete symbolic units. Smolensky (1988) has contrasted symbolic meanings from distributed networks which he describes as sub-symbolic representations. In a Connectionist network the same set of features are able to represent meanings that would be stored as single symbols in traditional semantics. By retaining the distinctive attributes or features and contextual associations of a concept, these subsymbolic, Connectionist networks are able to describe the whole, while retaining the distinctiveness of its parts. [2]

Connectionist networks are also designed to recognize patterns and generalize from partial information. Just as Bartlett's subjects "remembered" information that was consistent with the stories he presented, but did not actually mention, we infer information based on what is known. Thus, in North American society we have customarily used the biologically based features of MOTHER to make inferences about social relationships; we customarily assume marriage between the child's parents, and a nurturing relationship between parents and child. Conversely, when we see an adult woman caring for a child we infer that she is the birth, genetic, marital, and genealogical MOTHER. This holds as long as the most salient biological features of MOTHER are not violated by the age of the woman or apparent differences in ethnicity. The pattern matching of Connectionist networks model this inferencing process.

This ability to generalize can create problems if the patterns of features representing different concepts overlap to such an extent that the network does not maintain a separation between related prototypes. The overgeneralization may create confusion like the transposition of similar phone numbers, names or words. While this appears to be a weakness of Connectionist networks it has also proven a powerful tool to describe analogical reasoning and metaphor.

Connectionist networks are designed to represent complex processes of inference and learning, not simply store and retrieve information. They exhibit the ways that individuals alter their perceptions and memories to create coherent accounts. These networks are valuable aids in understanding the complex analogical process involved in social perceptions and the contextual variations of collective representations.

I. CONNECTIONS AND MANAGALASE SOCIAL COGNITION

The nature and explanatory value of Connectionist, subsymbolic representations can be seen in their ability to present some of the complexities of kinship. The debates about descent, kinship, and clanship that Keesing (1970a, 1970b) addressed are similar to the debate about the nature of semantic categories and forms of representation. In both instances, the controversy surrounds the ways that real and analytical categories are defined. Like structural semantics which looked for distinctive features to define categories, Fortes sought a single criterion (descent) to define kinship categories and distinguish members of kinship groups. Keesing (1970b) argued that the complex rules and theoretical categories of descent and filiation that Fortes constructed to account for Tallensi lineage and clan structure systematically obfuscate the cognatic dimensions of kinship in that society.[3] He contended, based on an analysis

of the rights and obligations of Tallensi and Kwaio kin to make offerings at ancestral shrines, that the lived experiences of the members of these two societies were much more similar than indicated by their ethnographers' descriptions of their systems of social organization. In the future, he predicted, analyses of kinship would examine the specific relationships, and rights and obligation of members of societies, rather than cloaking them in concepts like "patrilineal," "matrilineal," and "cognatic."

The remaining portion of this paper demonstrates the ability of Connectionist models to capture much of the complexity of individuals' relationships and group affiliations as well as portraying the synthetic, collective notions represented by kinship categories and clan identities. The data was gathered during research in Jinebuina, among the Managalase speakers of Oro Province, Papua New Guinea in 1976-1977 and during three months of fieldwork in 1984.

Approximately 5,000 Managalase inhabit the fertile ridges of the Managalase (Hydrographer) Plateau between the low coastal mountains and the foothills of the Owen Stanley Range. Like the Kwaio, Managalase trace kinship cognatically, but also appear to form groups, lineages, and clans and based on descent and filiation (Keesing, 1970b). The Managalase word *agan* can be thought of as a prototypical concept or cluster model composed of three dimensions or constituent models based on lineal, territorial, and exchange relations. In practice, the term encompasses individuals who share immediate genealogical links of one or two generations, who garden together, share food exchanged with affines, and use a common "clan" name. These names do not denote exclusive groups, but label abstract categories of potential affiliations. Genealogical ties, shared connections to various kinds of land, and common exchange relations are the basis for cooperation in everyday activities. *Agan* membership is extended to include ancestors and predecessors, descendants and successors who establish and maintain ties by sharing procreative substances and food offerings. Each individual's social identity is defined in relationship to the others with whom they share blood, land, and exchange partners. With each negotiation for a feast or exchange, individuals highlight one or more of their affiliations and identities (McKellin 1990, forthcoming). While all members of and *agan* may be referred to as *vue* (same sex siblings), brothers who share common procreative substance, territorial rights, and exchange partnerships are the prototype of *agan* affiliation.

Plant emblems, *aza*, are also used to represent contextually defined groups of individuals whose lineal, territorial and exchange interests are the basis for social, political, and economic cooperation. These groups are much like the Kwaio *tau* (Keesing, 1972). Although these plant emblems provide a convenient and flexible shorthand for representing common identities and interests, they are used infrequently. The most common way that individuals identify their common interests is by referring to themselves as *vue*.

The term *vue* has a range of meanings including same sex siblings having the same parents, patrilateral and matrilateral parallel cousins, people whose ancestors gardened, hunted and fished on the same land, people of the same clan, people whose matriline came from the same place (thus including cross cousins), fellow villagers, men who were tattooed together, and people who assist each other with feasts (including both males and females who have married sisters or brothers). The term's meaning in a particular circumstance is dependant on the pragmatic contextual constraints.

Individuals emphasize one or other of their array of *agan* identities and make appeals to different ranges of *vue*, depending on the political or ritual context, political alliances, or on the affiliations of their exchange partners or associates.[4] Thus Makai, the Village Councillor, and his two brothers, Arasa and Magua manipulated the scope of their kinship affiliations. At times they distinguished themselves as *vue anej* (siblings of the same source) who had the same parents, gardened and hunted the same land, and collaborated in exchanges. They also identified themselves by their Misaj clan membership which emphasized their claims to the site where humans first ascended from below ground. At many feasts, however, they activated their Bun'ora affiliations to garner more widespread support.

II. THE SUBSTANCE OF KINSHIP

All social relations are created by shared substance or *siru* (moisture): male and female procreative fluids and the juices of game and produce from either jointly owned hunting and gardening land, or from feasts given by affines and political

allies. Fluids transmit the *kaven* (soul, essence, or smell) and *ajide* (strength) of the person, his or her magic, and/or the food itself. More distant kin – both parallel and cross-cousins – share less procreative substance, garden produce and game, and receive fewer gifts together in exchanges. Conception and birth do not delimit an individual's total biological and "spiritual" substance; ties of substance change through the course of a person's life cycle, from conception through maturity to death, a change of substance that is common elsewhere in New Guinea.[5] Managalase kinship is much too complex to be consistently reduced to mere procreative relations. Genealogical connections are potentially *useful* for rhetorical appeals and group recruitment, but they are not *sufficient* for strong claims on kinship, to property, or *agan* affiliation.

III. TERRITORY

Gardens and the people with whom one gardens and shares food are the most visible expression of an individual's identity and social relationships. An individual's *tin* (estate) encompasses a variety of territory, consisting of gardening and hunting land, the fruit and nut trees planted by gardeners, pools and rivers, and the *marura* (spiritual sites) that give their names to the surrounding regions. Individuals who regularly garden together or have common hunting territory also share the same *siru* from this food. As children, siblings share food from the same sources. After they have married, brothers continue to eat daily meals and feasts together, while their sisters and their husbands exchange food with them. These commensal ties may extend into the next generation if married sisters make gardens with their brothers on their jointly owned natal land. Rights to both the land and its lore must be maintained not only with current owners but also with the spirits of their predecessors who continue to inhabit the land after death. Ritual feasts are shared among the children and adults who garden and hunt together and portions are offered to the spirits of the predecessors. Like the sacrifices of the Tallensi and Kwaio, these offerings are important constituents of kinship and social affiliations.

Exchange

Exchange relations shape social affiliations and identity in two ways. First, people affiliated with the same *agan* are obligated to cooperate as exchange associates in maturation rites, affinal exchanges, pig feasts, and marriages. They cosponsor or assist each other in giving feasts and share the food received in exchange. Exchange relations may also create distinctions among those who are joined by lineal and territorial ties. Participants are separated into givers and recipients – those with whom they will share or exchange food. A marriage between individuals who have common *agan* affiliation forces kinsmen and women to select which party they will support in this and succeeding affinal exchanges. Not only does it separate the participants, it also creates a division among the community of ancestors who receive offerings from the feasts. Each time that the scheduling and composition of a feast is negotiated, individuals make strategic decisions to participate that affect their social identities and *agan* affiliations.

Social Organization, Strategies, and Networks

Individuals' choices of gardening, hunt, marriage and exchange partners brings past patterns of practice together with the abstract cultural principles of lineality, territoriality, and exchange. A decision to enter into a new relationship must take into account cultural assumptions about social and biological reproduction, the pattern of previous land use and exchange, and a calculation of the probable impact of the decision on existing affiliations and exchange alliances. Individuals must weigh their options and assess the strengths of others' social and political connections. Congruent lineal ties and rights to territory, as well as exchange relations, create powerful, intersecting communities of interest.

Connectionist networks are useful ways of representing individuals' overlapping attributes of individual and *agan* identity and of demonstrating how the ties of ownership and interaction shape perceptions of social affiliations. A network using McClelland and Rumelhart's (1988) Interactive Activation and Competitive Learning (IAC) network was used to present particular information about individuals and the patterns of relationships that emerge from their claims to *agan* membership, lineal ties, ownership of different kinds of territory, and patterns of exchange ties.[6]

The information represented in the network represents relations of people to one Jinebuina clan, Bun'ora, and was constructed using data from interviews with each person regarding clan

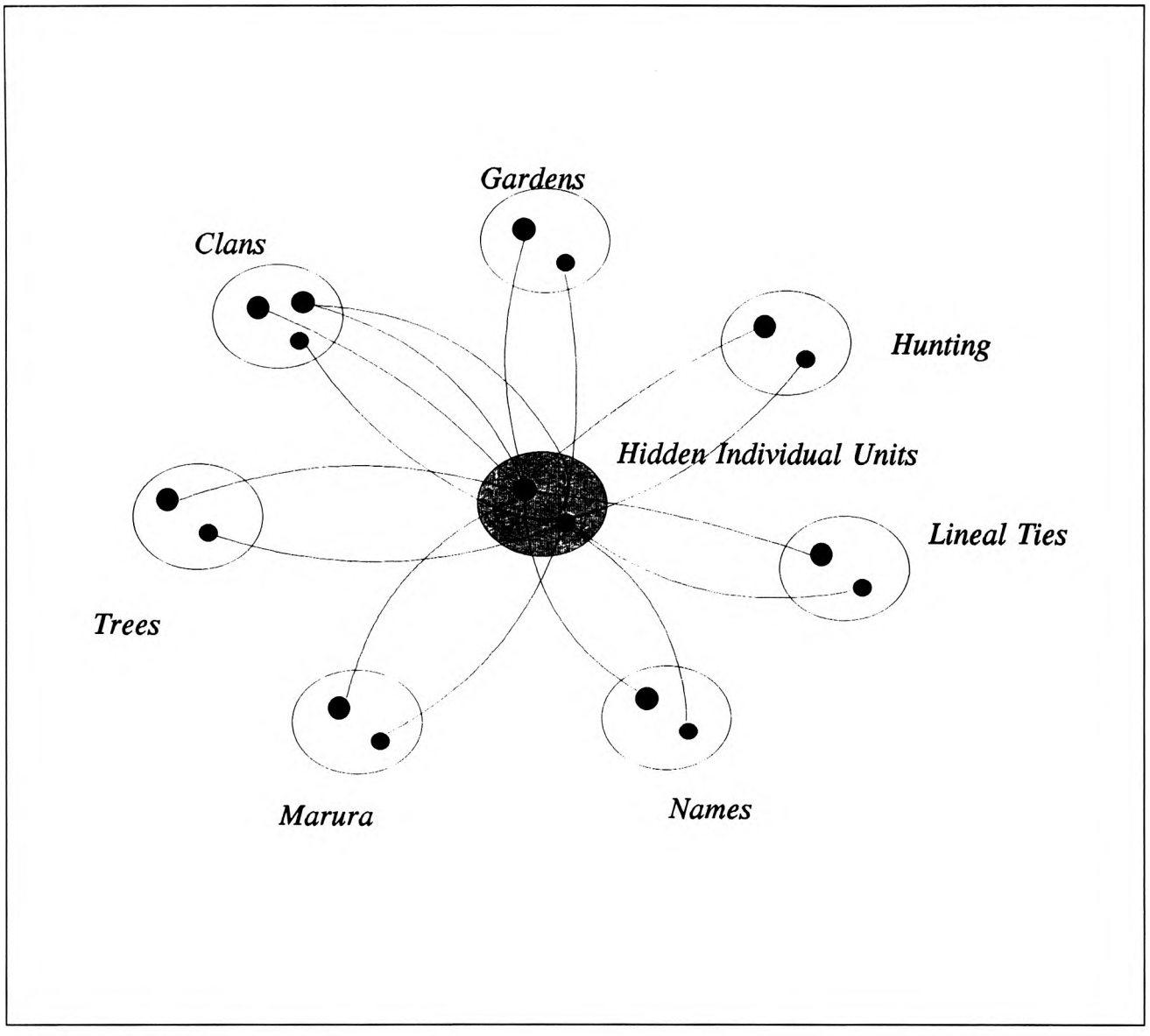

Figure 1. *IAC Network for Managalase Kinship*

identity, genealogical relations among individuals, ownership of various kinds of gardening, and hunting land, trees, and *marura*, and their exchange relations. The clusters of features (clan names, gardens, hunting territory, trees, *marura* sites, and individuals' names) in the network were the sets of attributes used by villagers to identify and explain their relationships to each during a census I conducted in Jinebuina.[7] Each person's constellation of attributes that form their social identity (lineal ties, rights to land, and exchange relations) is connected to the individual's name through the central Hidden Individual Unit. (Scores for the Hidden Units are not relevant and are indicated on Table 1 by brackets, [ ]). Similarly, the connections among all those who share the same attributes are linked through the Hidden Units, as are the connections that associate ownership of gardening and hunting territory with ownership of the trees, and *marura* at these locations.[8]

The information about the associations in the network are revealed by starting from a person's name or other attribute. The network begins to search for patterns of associations from that starting point. The network identifies shared patterns of attributes and seeks similarly connected features to complete the pattern. It does not necessarily retrieve the actual attributes of individuals but reflects the patterns of associated features. Unlike standard statistical prototypes, these Connec-

tionist networks simulate the same kinds of inferences or generalizations as individuals. They model inferences much like those that people make when they assume that, because a person has a tree in a certain place and has gardened at a site, they also have rights to the *marura* there. A network reflects the perspective of its starting point in much the same way that individuals make biased inferences about others (G. Sankoff 1971, 1972; Taylor, 1982).

The following tables show the patterns and salience of relations among the Bun'ora men of Jinebuina and the attributes that contribute to their identity.[9] Table 1 presents the interaction of the genealogical, territorial, and exchange attributes shared by people affiliated with Bun'ora (identified with **) and the strength of individuals' connections to these attributes of individuals who claim Bun'ora membership.[10] Positive scores indicate associations while negative numbers signify inhibitions, or increased distances among attributes that distinguish features from shared attributes of Bun'ora affiliation. The higher the score after each attribute, the more central it is as a constituent of the Bun'ora schema. The negative numbers for some individuals and their attributes indicates inhibiting connections that result from divisions produced by intermarriage and exchange relations among individual who still assert Bun'ora claims. The inhibitions generated by intermarriage and exchange between affines can reduce the strengths of other connections as new gardening and hunting practices generate new, distinctly non-Bun'ora patterns of association.

If a single attribute was characteristic of all Bun'ora individuals, it would have a score equal to that of the Bun'ora clan name (89). The figures for *marura* and other property demonstrates that this

Table 1

Bun'ora Affiliations Based on Lineality, Territory, and Exchange

Cycle 30

Clan	Garden	Hunting		Trees		Marura		Names		Hidden Individuals		
**Bun	89	H-bar	-10	T-arm	-15	T-tub	-15	**Ara**	**32**	[Ara	89]	**Arasa**
Eko	-17	H-eme	-17	T-arr	-14	T-uge	-14	**Aru**	**-11**	[Aru	-16]	**Arun**
Kuba	-16	H-gog	-14	T-bed	-14	T-uib	-11	**Bah**	**-1**	[Bah	38]	**Baho**
Mis	39	H-gui	63	T-bir	-15	T-uid	-15	**Bor**	**11**	[Bor	61]	**Boraku**
G-ahu	7	H-hig	63	T-dea	67	T-zoz	-12	**Daj**	**-11**	[Daj	-18]	**Dajahare**
G-aji	-14	H-isi	-11	T-gib	-11	M-a'a	56	**Gag**	**-11**	[Gag	-15]	**Gago**
G-bed	-9	H-kaj	-14	T-got	-14	M-aji	56	**Had**	**-11**	[Had	-16]	**Hadaje**
G-dem	-11	H-kid	-14	T-har	-4	M-ara	-12	**Kiv**	**20**	[Kiv	70]	**Kivide**
G-dor	-8	H-lai	-14	T-hua	-71	M-aru	56	**Koh**	**-11**	[Koh	-16]	**Korahare**
G-gib	9	H-man	-12	T-isi	-16	M-avo	-12	**Koj**	**-11**	[Koj	-16]	**Koreaje**
G-got	-4	H-mis	63	T-jin	75	M-bad	-10	**Mag**	**32**	[Mag	89]	**Magua**
G-har	-11	H-mua	-14	T-kan	-13	M-bis	-14	**Mai**	**4**	[Mai	51]	**Maive**
G-isi	47	H-nub	-10	T-kua	-13	M-biv	56	**Mak**	**33**	[Mak	90]	**Makai**
G-jin	7	H-sab	-14	T-kur	-16	M-eni	-14	**Mar**	**21**	[Mar	70]	**Marurahi**
G-man	-12	H-sam	23	T-sam	-14	M-jih	-12	**Mat**	**-11**	[Mat	-14]	**Matag**
G-mun	-14	H-sub	-9	T-sar	-14	M-joi	-15	**Mor**	**-11**	[Mor	-17]	**Morij**
G-osi	6	H-uib	-6	T-sir	59	M-kar	56	**Nag**	**0**	[Nag	41]	**Nagori**
G-sig	-8	H-zar	18	T-sub	-15	M-kua	-14	**Sav**	**-11**	[Sav	-18]	**Savasa**
G-tam	64	H-zir	-14	T-sug	-16	M-nub	-69	**Tan**	**-11**	[Tan	-17]	**Tanai**
G-uib	57	T-ahu	63	T-tam	73	M-siv	-10	**Tap**	**-11**	[Tap	-17]	**Tapui**

is not the case. The scores also show that the clans themselves are not exclusive.[11] Because brothers Makai, Magua, and Arasa claim membership in both Bun'ora and Misaj and share a high number of additional attributes with other members of Bun'ora, a query about Bun'ora also generates responses for Misaj. They appear to be the individuals most strongly associated with Bun'ora – its prototypic members, despite their more common public identification as Misaj. Able and powerful local politicians, they have worked hard to maintain and extend their Bun'ora affiliation, for without it they would lack any significant attachment to their fellow villagers. Makai's appearance as the best exemplar of Bun'ora despite his frequent absences on government business, gives some insight into how he managed his relationships to make him the village counsellor and the man with the strongest and most extensive web of political relations on the western plateau. The similarities among Makai, Arasa, and Magua also reflect both their conscious effort to act in unison and brotherly solidarity.

Table 2 demonstrates the diversity of Bun'ora identities by comparing the connections of two key figures, Arasa and Baho. Though each is affiliated with Bun'ora and is equally distinguished from Eko'ora, the strengths of their affiliations to Misaj and Kuba'ora clans are inverse. Arasa's closest kinsmen according Table 2 are those with whom he shares the highest number of attributes that form similar patterns. These scores are consistent with his own assessment of his affiliations to his brothers Makai and Magua (his *vue anej*, "siblings from the same source"), as well as Marurahi, a matrilateral parallel cousin who was fostered by Arasa's father, and Kivide, who was nursed by their mother. Baho's closest kinsmen are his brother (*vue anej*) Maive and Boraku, with whom he was raised after his father died. Koreaje, his elder brother's son and Nagori were fostered by Baho and Maive. The different strengths of the connections of other men to Arasa and Baho demonstrates the factional cleavages among them that led to a riot and division of the village following the death of Nagori's father (McKellin, 1990).

The network also approximates the groups of individuals who represent themselves collectively by their *aza* (plant emblems). Makai, Arasa and Magua use leaves from the same tree *misas*, while Baho, Maive and Koreaje employ *sisum* (taro) leaves because their name sounds similar to that of their father, Isumare.

Table 2

Affiliations and Relationships of Others to Arasa and Baho

Arasa

Clans		Names		
Bun	79	**Ara	80	Arasa
Mis	55	Mak	32	Makai
Kuba	16	Mag	31	Magua
Eko	17	Mar	20	Marurahi
		Kiv	14	Kivide
		Mai	-3	Maive
		Nag	-5	Nagori
		Gag	-9	Gago
		Bor	-11	Boraku
		Daj	-12	Dajahare
		Had	-12	Hadaje
		Koh	-12	Korahare
		Koj	-12	Koreaje
		Aru	-12	Arun
		Bah	-12	Baho
		Mat	-12	Matag
		Mor	-12	Morij
		Sav	-12	Savasa
		Tan	-12	Tanai
		Tap	-12	Tapui

Baho

Clans		Names		
Bun	75	**Bah	80	Baho
Kuba	44	Mai	28	Maive
Mis	-15	Bor	22	Boraku
Eko	-17	Koj	21	Koreaje
		Nag	21	Nagori
		Mak	2	Makai
		Ara	-3	Arasa
		Aru	-12	Arun
		Daj	-12	Dajahare
		Gag	-12	Gago
		Had	-12	Hadaje
		Kiv	-12	Kivide
		Koh	-12	Korahare
		Mag	-12	Magua
		Mar	-12	Marurahi
		Mat	-12	Matag
		Mor	-12	Morij
		Sav	-12	Savasa
		Tan	-12	Tanai
		Tap	-12	Tapui

V. DISTRIBUTED COGNITION AND CULTURE

In his analysis of Tallensi and Kwaio definitions of kinship and descent, and the role of ancestral shrines, Keesing (1970b) noted that the two societies did not seem so dissimilar if one examined the patterns of individuals' obligations to ancestors. The distinctions between Fortes's unilineal Tallensi and the cognatic Kwaio faded when he looked beyond descent and examined other activities and obligations that organized the lives of people in these societies. Keesing suggested that anthropologists' descriptions and analytical definitions hid an underlying similarity between the two. He proposed that in future studies of kinship and social organization, societies would not be categorized by single criteria such the rules of descent used to distinguish patrilineal, matrilineal, and cognatic "systems." Instead, group relations and memberships, patterns of inheritance, was well as a variety of other social obligations would be specified to capture the complexities of kinship relationships and social organization. He also argued that anthropologists's would need more subtle analytical categories and tools. The apparent simplicity and elegance of structural models of kinship enticed anthropologists to create simplistic, inappropriate formal models that belied the complexity of kinship (Keesing, 1972).

This presentation of Managalase clanship and kinship using a Connectionist network shows that complex ethnographic categories can be represented in ways that are consistant with many of the intricacies of the ethnographic data. The Bun'ora analysis reveals the prototypic qualities that make Aresa, Makai and Magua exemplary members of Bun'ora and also distinguishes them as "siblings from the same source." This network of Managalase kinship employs cognitive principles of inference based on the association of patterns and the actual distribution of the attributes used by Managalase when they apply kin terms, assess their ties to others, and negotiate new relationships. Connectionist models have developed through inter-disciplinary research in psychology, linguistics, and cognitive science offer anthropology an escape from the restrictions of logic-based, structural categories. They provide a means of recapturing the cognitive biases that shape the ways people actually create and employ prototypic cultural categories, remember information, and make inferences about others.

Notes

1. The research on which this paper is based was supported by grants from the Social Sciences and Humanities Research Council of Canada and the Spencer Foundation.

2. Recently, a number of researchers have attempted to combine the flexibility of subsymbolic representations with the efficiency of more traditional symbolic forms.

3. Despite the importance given to various genealogical ties and unilineal rules of recruitment and succession in lineage theory, Fortes (1969) admitted that members of some clans among the Ashanti of West Africa only share a common clan name.

4. Even after death, a spirit may manipulate his or her publicly recognized affiliation through a medium by moving to an *asis ara* (spirit village) in another hunting territory, or to another marura associated with a different clan in anticipation or response to new marriages or exchange alliances among his or her descendants.

5. See Salisbury (1964), A. Strathern (1973), R. Wagner (1974).

6. This is an admittedly modest simulator package, but adequate for this selection of data. Its limitations on the size of the reports restricted the network to those who actively participated in the public discussions about the fate of Jinebuina. The goal of many of the more sophisticated algorithms used for associative memory is to reduce generalization to retrieve single items. Since the goal here is to identify basic cooperating social units comprised by several of the most closely related individuals, these restrictions are not necessary.

7. Data on kinship and the use of kinship terms was originally elicited with a method developed by Frederick Rose (1960) and elaborated by D. Turner (1974) which does not assume genealogical referents for terms of social relationship. I asked village members for their relationship to each other person in the village and their rationale for applying the term. Their explanations revealed essentially three different but interrelated explanations for the terms used: lineal or genealogical ties, relations based on shared land, and common exchange relations. The results were followed by a more traditional genealogical method and interviews about genealogical relations, shared gardening, hunting land and water resources, totemic names, etc. and exchange partnerships.

8. Lineal affiliations to ancestors are not shown in the tables to follow because it would require more space to list all of the names of ancestors. It also seemed acceptable to treat these ancestral spirits as "invisible units."

9. The tables are not to be read as matrixes. The labels on the top and sides are simply to expand people's names and indicate the kinds of attributes listed.

10. ** Attribute queried

    G-(name) Gardens

    H-(name) Hunting Territory

    T-(name) Trees Inherited or Planted

    M-(name) Marura, "spiritual site"

    Positive numbers indicate the strength of the association between a given feature and the attribute queried, while negative numbers indicate the strength of the inhibitions between the attribute and the query. Savas does not claim Bun'ora affiliation but his wife is Bun'ora and his presence in the network helps to distinguish Bun'ora men by including their affinal ties as inhibiting connections.

11. Clan identities themselves are attributes which bring together associations inferred in one generation and assumed by successive ones.

References

BARTLETT, F. C.
1932 *Remembering*. Cambridge: Cambridge University Press.

COLEMAN, L. and P. KAY
1981 Prototype Semantics, *Language*, 57: 26-44.

FORTES, M.
1945 *The Dynamics of Clanship Among the Tallensi*, New York: Oxford University Press.

1949 *The Web of Kinship Among the Tallensi*, New York: Oxford University Press.

1953 The Structure of Unilineal Descent Groups, *American Anthropologist*, 55: 17-41.

1959 Descent, Filiation and Affinity: A Rejoinder to Dr. Leach, *Man*, 59: 193-97.

1969 *Kinship and the Social Order*, Chicago: Aldine.

HEIDER, E. (ROSCH)
1972 Universals in Color Naming and Memory, *Journal of Experimental Psychology*, 93:10-20.

HOLLAND, D. and N. QUINN (eds.)
1987 *Cultural Models in Language and Thought*, New York: Cambridge University Press.

KEESING, R.
1967 Statistical Models and Decision Models of Social Structure, *Ethnology*, 6: 1-16.

1970a Descent, Residence and Cultural Codes, *Anthropology in Oceania*, L. Haitt and C. Jayarwardena (eds.). Melbourne: Angus and Robertson, pp. 121-138.

1970b Shrines, ancestors, and Cognatic Descent: the Kwaio and Tallensi, *American Anthropologist*, 72: 755-775.

1972 Simple Models of Complexity: The Lure of Kinship, *Kinship Studies in the Morgan Centennial Year*, P. Reining (ed.), Washington, D.C.: Anthropological Society of Washington, pp. 17-31.

1987 Models, Folk and Cultural: Paradigms Regained? *Cultural Models in Language and Thought*, N. Quinn and D. Holland (eds.), Cambridge: Cambridge University Press.

1993a Time, Cosmology, and Experience. Lecture presented at the University of British Columbia, March 1993.

1993b The Body as Contested Site. The Negle Lecture, presented at the University of British Columbia, March 1993.

MS Kinship, Bonding, and Categorization.

LAKOFF, G.
1987 *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind*, Chicago: University of Chicago Press.

1989 A Suggestion for a Linguistics with Connectionist Foundations, *Proceedings of the 1988 Connectionist Models Summer School*, G. Hinton and Sejnowski (eds.), San Francisco: Morgan Kaufmann. pp. 301-314.

McCLELLAND, J. and D. RUMELHART
1986 *Explorations in Distributed Parallel Processing*, Cambridge, Mass.: MIT Press.

McKELLIN, W.
1990 Allegory and Inference: Intentional Ambiguity in Managalase Negotiations, *Disentangling: The Discourse of Conflict in Pacific Cultures*, G. White and K. Watson-Gegeo (eds.), Stanford: Stanford University Press, pp. 328-363.

Forthcoming *Hidden Paths in the Forest: Distributed Culture, Communication and Cognition Among the Managalase of Papua New Guinea*, Toronto: University of Toronto Press.

MERVIS, C. B. and E. ROSCH
1981 Categorization of Natural Objects, *Annual Review of Psychology*, 32: 89-115

QUINN, N.
1982 "Commitment" in American Marriage: A Cultural Analysis, *American Ethnologist*, 9(4): 775-798.

ROSCH, E.
1973 Natural Categories, *Cognitive Psychology*, 4: 328-50.

1978 Principles of Categorization, *Cognition and Categorization*, E. Rosch and B. Lloyd (eds.), Hillsdale: Lawrence Erlbaum Associates.

ROSE, F.
1960 *Classification of Kin, Age Structure and Marriage Amongst the Groot Eylandt Aborigines*, Berlin: Akademie Verlag.

RUMELHART, D. E., P. SMOLENSKY, J. L. McCLELLAND and G.E. HINTON
1986 Schemata and Sequential Thought Processes in PDP Models, *Parallel Distributed Processing: Explorations in the Microstructure of Cognition*, Cambridge, Mass.: MIT Press. Volume 2.

SALISBURY, R.
1964 New Guinea Highlands Models and Descent Theory, *Man* 64: 168-71.

SANKOFF, G.
1971 Quantitative Analysis of Sharing and Variability in a Cognitive Model, *Ethnology*, 10: 389-408.

1972 Cognitive Variability and New Guinea Social Organization: The Buang Dgwa, *American Anthropologist*, 74: 555-566.

SCHNEIDER, D.
1972 What is Kinship All About? *Kinship Studies in the Morgan Centennial Year*, P. Reining (ed.), Washington, D.C.: The Anthropological Society of Washington, pp. 32-63.

SMOLENSKY, P.
1988 On the Proper Treatment of Connectionism, *Behaviorial and Brain Sciences*, 11:1-74.

SPERBER, D.

1975 Anthropology and Psychology: Towards and Epidemiology of Representations, *Man*, 20: 73-89.

STRATHERN, A.
1973 Kinship, Descent and Locality: Some New Guinea Examples, *The Character of Kinship*, J. Goody (ed.), Cambridge: Cambridge University Press, pp. 21-33.

TAYLOR, S.
1982 The Availability Bias in Social Perception and Interaction, *Judgements Under Uncertainty*, D. Kahneman, P. Slovic and A. Tversky (eds.), Cambridge: Cambridge University Press.

TURNER, D.
1974 *Tradition and Transformation: A Study of the Groot Eylandt Aborigines of Northern Australia*, Canberra: Australian Institute for Aboriginal Studies.

WAGNER, R.
1974 Are There Social Groups in the New Guinea Highlands? *Frontiers in Anthropology*, Murray Leaf (ed.), New York: Van Nostrand, pp. 95-119.