Conceptual Ethnography: Integrating Disciplinary Practice

Douglas R. White

Abstract. Conceptual ethnography begins from the recognition that the compartments and conceptions of anthropology and ethnography are interlinked. Here I examine cognition and social networks in relation to the concept of culture, exemplified in the study of kinship. Concepts used in network analysis of the context and behaviors involved in kinship lead to new understandings of patterns of cohesion. Within cohesive groups, people in various communities are shown to use the network itself to compute categories of kinship in unexpected ways that do not require the kinds of assumptions anthropologists often make about the connection between kinship terminology and behavior. It is shown that this lends support to the view that cognition cannot be considered a strictly internal mental process but involves the social environment itself as part of the cognition in the wild, as Ed Hutchins has aptly put the case in referring to cognition in naturally occurring culturally constituted human activity.

The goal here is to show how basic topics such as kinship have not been understood properly by anthropologists because its cultural content – both mental models and social rules -- has been improperly interstook in terms of *categories* such as features and components. The case studies (powerpoint slides) will show how a relational approach to kinship that can operate independently of named categorical rules (like categorical descent groups) if we look at how people use other to 'count' and identify relevant relational features of kinship in a network context.

For this reason it is not useful to consider culture in terms of purely internalized cultureal models and without dealing with the various layers of interconnections between behavior, networks, cognition, and socially cohesive units such as community or organizations in which people interact. Meaning does not always come packaged with intrinsic attributes (e.g., componential features) but often relies to relational calculation, counting on other people or the environment to supply conditional and criteria of meaning. Culture is not then simply distributed in the sense that individuals carry different components of chunks to which they have differential access internally, but that much of cognition is constructed on-the-fly, relationally 'on-line', i.e., the individual's cognition extends significantly to those extrinsic relations.

1. **Introduction**

Rather than isolating various conceptions of the compartments of anthropology that are cut off from one another, *conceptual ethnography* begins from the recognition that these compartments and conceptions are interlinked (Leaf 1979: 334). "Conceptual" here is not a label for a theory but a common practice in anthropology, which is to regard ethnography as a series of experiments that explore the relationships between the concepts used in the ethnography and the interrelated aspects of what is being studied. As Leaf (1979:336) notes (see also Schweizer 1998), further:

> "The view of science as a system of knowledge which follows from this conception of scientific procedure is that of a network of linked experiments, demonstrating the nature of and relations among key phenomena. The linkages extend not only across major areas of anthropology, but also into other fields: ritual to paleoanthropology to physical anthropology to primate studies to experimental psychology to language study to speech pathology, and so on."

This approach places certain limitations on theory and practice. Trying to define culture as a shared mental schemata, for example, implies several levels of misplaced concreteness. First, it implies that culture is a collection of things, or abstracted properties of those things (the schemata), and second that culture is reduced to one of its components rather than viewed as a complex interrelationship among components.

In order to study interlinkage, part of what must be conceptualized in ethnography is net-works of processes' and relationships. Malinowski, for example, was an outstanding process ethnographer, although his conceptual ethnography rarely made his concepts explicit. Instead, he embedded his ethnographic concepts in a process description, and kept expanding and interlinking his process descriptions of interrelated phenomena in successive chapters, books, and articles. Conceptual ethnography and process description, however, make no pretense of completeness or "holism" even though the focus is on connections (see Leach, 1968), so that subsequent research such as that of Weiner (1976) for the Trobriands, contributes to the cumulativity of conceptual ethnographic experiments.

A process description is not an ordinary classificatory description, but rather contains conceptual "handles" that allow one process description of dynamic relations among elements to be superimposed on and compared with others. It remained for Goodenough (1965) to extract, for example, Malinowski's concepts about institutional change and process, and to apply his conceptual experiments to another ethnographic context, that of the Onotoa Gilbertese.

For Goodenough, however, as in the title of his book *Description and Comparison in Cultural Anthropology* (1970), these two aspects remained distinct, and reflected his opposition of the concepts emic and etic. For him, emic was an objective referent (denotative meaning) of

the way words are used within a culture (or mental schema), contrasted with connotative meaning on the one hand, and objective etic associations evident to an observer and to the ethnographer. The denotata of kin terms in his and other analyses of componential meaning were their concrete referents in terms of kin types. What this obscured were the relationships between logics of calculating types of relatives relationally (father of father=grandfather, for example, as a relative-product definition), the social context of usage and connotation, and the social network in which observations are made and symbols are used, and of course the longer-term social practices observed in this and related contexts.[1] In cognitive anthropology today, it is still extremely difficult for ethnographers to get a handle on these complex relationships, as does Hutchins' (1995) *Cognition in the Wild*, in which cognition is conceptualized not as an internal process but one in which sociocognitive contexts and environments are an integral part.

Goodenough's categorical and denotational orientation, however, opened up his ethnography to further weaknesses that provoked examination of foundational issues, as in the Fischer-Goodenough residence debates and the questioning of the notion of cultures, on the analogy with linguistic grammar, as constituted by sets of rules. The latest resolution of this problem by Skyhorse (2003) shows that it is a network variable, the closer of two distances of two spouses in their respective links in the genealogical network to a senior relative with rights to grant the use of land, that all-but-determines residential choice.

2. Integrating Levels

In conceptualizing complex interrelationships, networks are very often referred to by anthropologists of all persuasions, but typically as a metaphor for complex embeddings that are not fully conceptualized or explicated. Hutchins' conceptual ethnography - "the best way to find out how people make meaning is to go among them and carefully examine what they actually do" (http://hci.ucsd.edu/dew/html) – takes this metaphor to ground level to dispel the idea that cognition and context are independent entities.

[1] According to Lehman (personal communication) “The whole emic/etic distinction taken that way was based on taxonomic, pre-generative phonology with terminology by K. Pike. And it is now understood that this is incoherent and empirically wrong-headed. We now say (remember that I am a linguist) that ‘phonetics’ refers to the detailed acoustic ~ articulatory description of an utterance or segment, whilst ‘phonology’ refers to derivational rules (or, say their Optimality Theoretic equivalent) that ‘map’ selected distinctive phonetic features onto their surface realizations. We do not recognize a specific taxonomic or classificatory level of ‘phonemic’ description because it runs counter to generativity or derivational process. In particular, we reject on strong grounds the notion that ‘emic’ means unrestrictedly arbitrary reconfigurationg of the objective features of accoustics or articulation. The equivalent is my rejection, in ethnography, of the arbitary (and circularityr ridden) ‘feature’ or ‘Direct’ in the Romney-D’Andrade paper arguing against the Wallace-Atkins [relative-product] treatment of English language kin terminology.

2.1 The Failure to Understand Cognition, Kinship or Culture Categorically

Understanding cognition as a categorical system has not been successful as a means of integrating anthropological knowledge or providing a productive theory of culture. Mary Black-Rogers's (1967) attempt at a 'componential' ethnography of the Round Lake Ojibwa illustrated the problem of disconnected domains. Some domains are indeed differentiated by componential features, but many are better understood relationally, Hutchin's (1995) approach to cognition operates with a relation component as to how people cognize with reference to signs in their environment, many of which are socially or technologically constructed and operate as well as extensions of memory.

Anthropologists have largely failed to understand kinship because of its relational context. The dominant concepts of analytical kinship, guiding description, were categorical: descent, as an assignment of group membership, is a categorical concept, for example. (Here, the examples will be given in powerpoint)

…

2.2 The Contribution of Network Analysis

Social network analysis as a discipline, in contrast, has focused over the last fifty years in the development of relational concepts, that is, ways of defining *transferable concepts* that contribute "handles" - like those alluded to above - that allow one process description of dynamic relations among elements to be superimposed on and compared with others.

To illustrate Hutchins' point about cognition and context with an example from network theory: Many ethnographers of Dravidian South Asia have been mystified by kinship terminologies that seem to imply a dual division of "my" relatives (those I don't marry) and "my" affines, a classificatory category opposed to the first and including all those I can marry. Dravidian-speaking societies with such kinship classifications do not possess matrimonial moieties in which membership is hereditary. Most anglophone ethnographers have denied any connection between unnamed membership categories operating at the social level and the dual schemata operating at the linguistic level.

There are, however, two ways of "counting" kin relationships: one within the terminology (an affine of an affine is "my" relative in a Dravidian system) and the other through "counting" on actual people in a genealogical network. As one traces a path of actual kin in a Dravidian system the principle that operates is that one gender (e.g., female) is distinguished for counting sidedness. Every time a kin-path in a genealogical network uses a link of that gender to parents (+1) or switches to spouse (+1), one changes sides. If I were female (side 0) and I trace the path through myself (+1) to my sister (1+1=0 in binary logic) I am still on my side, but from her to

her husband (1+1+1=1), like the case of my husband (+1), is a switch in sides. So if one married by this binary logic of counting relatives, one would have the same result as a hereditary matrimonial moiety. If the "counting gender" is female it corresponds to a patrilineal moiety and if it is male the correspondence is to a matrilineal moiety. As one of the ethnographers of Dravidian kinship reports in direct response to this paragraph:

> I take this as fundamentally right for Dravidian systems, or at least, for all S. Indian and Sri Lankan ones. The reason is that one commonly encounters in the ethnography, if it is detailed enough (usually it is not!) debates amongst informants as to whether or not some person, p, is marriageable. These debates invariably turn on how far up, ascendingly, one tries to reckon, i.e., up to what generational of ascent [which implies a common ancestor, as Houseman and I have shown for Pul Eliya] … The process is complexly networked across a community of conflicting opinions, conflicting degrees of reliable memory and so on…. Note in particular the arbitrariness and, therefore, indefinite variability that comes from choosing how far back in time to begin the downward iterative switch-reckoning (Lehman, personal communication).

As Read (2004:2) states, “for expressing what constitutes a kinship terminology (system) [KTS]… we hav two parallel conceptual systems: a system of genealogical tracing (for which the genealogical grid is an idealized form [of an actual genealogical network]) and a system of kin terms generated in [the form of relative products]. Differently put (Read and Chit Hliang 2005:2) “while genealogy is not the generative sources of KTS, it is the universal ‘model’ that motivates KTS.” It is the fact that genealogies are not strictly trees but networks with multiple paths connecting certain pairs of individuals that *requires* the context of instantiated cognition and discussion about alternative renderings of relationships into kin terms.

Now, it is a simple matter to represent a genealogy as a graph and to compute on that graph, as do speakers of Dravidian languages, the "sidedness" of relatives according to a counting system for (potential disputable) genealogical tracing. If one knows which of the two counting -systems is used, depending on how off-generation marriages are reckoned, (e.g., a sister's daughter marriage can only correspond to females as the counting number, as if patrilineal moieties were operative), it is easy to check consistency with Dravidian sidedness logic at the level of the network. Further, we know as a proven mathematical theorem that if there are no inconsistent marriages at the egocentric level (including all prior generations, although there is typically a finite limit to the depth to which they are consider), examining cycles in the network that double back to ego because ego married someone already linked to them genealogically, then the network is divisible into two sets such that marriages are always between the two.

My own initial forays into a conceptual ethnography involving network concepts had a strikingly negative effect on my audiences and reviewers. Reviewing a book manuscript on dual organization in *kinship networks,* with actual networks the focus of study, the principal reviewer objected to "French" "idealist models." The data here, however, were actual behaviors in real

networks, with genealogies constructed to include all known ancestral relatives, not idealized models of kinship. Because we are lacking concepts to link kinship categories to actual networks, that is, the reviewer could not even imagine that studies of kinship structures in actual networks could be anything but idealist.

The resistance here among American sociologists is to the idea that "other people" might have relational logics rather than Aristotelian categorical ones. The problem, however, goes much deeper. In another paper, on cohesion in kinship networks, I told my sociological audiences that I was presenting my findings using a graph of the actual networks, in which they could see and verify the structural features that I was discussing. The idea that was appalling to some of them, some of my best colleagues really, was that I was not using matrix analysis and mathematics to "reduce" my network to verifiable network properties, properties known to matrix theory. Shouts came from the audience, "You've become a postmodernist!", meaning (oddly enough, when queried) that I had become a particularist and no longer interested in verifiable generalizations. Lehman (personal communication) commented on my experience thusly: “Far worse, …your audience, it seems, your audience demanded, it seems, a Saussurean, taxonomic, static, non-derivational matrix (e.g., a matrix without non-trivial transforms!) as alone defining ‘structure, which has infected both Radcliffe-Brownean theory and Lévi-Straussean structuralism.”

What I had to explain was that there was no matrix operation that could be used to "discover" structural cohesion, which corresponds to embedded subnetworks of maximal size in which every pair of nodes had at least k paths between them that were independent (Le., that ran through none of the same intermediaries) and that this was mathematically equivalent to maximal subgroups of people who could not be disconnected without removing at least k of the intermediaries who connected them in the network. I had to explain, further, that because of this proven equivalence, this property of structural cohesion was easily evident intuitively to members of such groups provided they were not too large, and that whether such structurally cohesive groups were small or large, the consequences of this type of cohesion were enormous because such groups were (1) resistant by definition to disconnection by removal of members, (2) internally coherent and cohesive because of the multiplicity of paths connecting their members (which is where structural consistencies or inconsistencies may come in), and (3) precisely and well defined in terms of boundaries and embeddings because (1) and (2) were logically equivalent in terms of boundary definition, even though this equivalence was so nonobvious that no social scientist had ever measured and tested the predictiveness of this network variable. (Lehman again: “The matter of boundaries here is interesting, since, as said above, a boundary is set by the choice of the point in the ascending generation(s) from which the switch-reckoning proceeds downward.”

Structural cohesion is also a measurable network concept that is applicable to semantics, cognition, and other relationships, Le., to networks that are not defined by social but other types of relations. Thus, we might look, if we were looking for linkages, at the relationships among levels as we move from cognitive to social networks, for example.

As a more prosaic example, one might want to choose, for example, among multiple measures of centrality in order to formulate how differences in centrality of actors or the degree of centralization in a network operate to shape observable dynamics. Freeman, Romney and Freeman (1987) found that people who were more central in their network had a more "normative" assessment of who attended meetings while average reports of those who attended sporadic meetings (not reflecting normative biases) tended to be more accurate. Boster (1985), in a different kind of network (plants-humans), found that people with more expertise and experience in relation to food species judged tended to score higher in consensus with others as to plant identifications.

2.3 The Convergence of the "New" Cognitive Anthropology and Relational Conceptual Ethnography

Tjon Sie Fat (1990), Gould (2000), and Read (2000, 2001), among others, have arrived at an approach to the conceptual ethnography of kinship in which it is the relational or relative-product component that provides the most general and accurate model of cognition applied to classificatory kinship systems, and that the same type of models apply equally well as componential analysis of denotata for descriptive kinship systems. Read argues that algebraic, relative-product, or other [i.e., algebraic] relational logics are a general model for human thought. If this represents a "New" Cognitive Anthropology, it is much more in line with network approaches, if they are seen as applying both to social behavior and to cognition.

2.4 The Contribution of Dynamics

Thus, looking at linkages across the levels represented by behavior, cognition, cognition, and socially cohesive units such as community or organizations in which people interact, for example, gives us a key to how to view culture as embedded in networks of interaction, networks that are, of course, dynamic. The dynamics implicit in this approach but waiting to be discovered also gives us a goal of understanding process, relations, change and transformations but also how multiple levels of meaning may be involved even in the simplest process of making definitions.

When Ulla Johansen and I began our investigation of Turkish nomad kinship networks, she immediately expressed the idea that a network analysis would show the shifting referents of terms like *kabile* while different ethnographers in the same region working in the same groups

variously translated as "tribe," "clan," "maximal lineage," "lineage" or "family," depending on context. This example shows not only that the same set of persons may often be ‘structured’ conceptually by *different* knowledge systems but even within *the same* knowledge sysetm when it allows relational definitions that have shifting referents. In correspondence with our concept of structural cohesion, words shifted reference in relation to (1) boundaries of cohesive groups defined by cohesive intermarriage and (2) boundaries of cleavage in differential contexts of segmentary conflict. These proved to be twin aspects of the same segmentary embedding relationships. Analysis of the frequencies of intermarriage showed a fractal or self-organizing pattern in which intermarriage along a kinship distance scale had a long tail (power-law distribution of frequencies) that creates an unstable equilibrium balanced among near and distant alliances. The same kind of distribution appeared for frequencies of blood marriages, balancing close against distance. Finally, the pattern of reciprocal marriages among lineage segments, wherein reciprocity generates strong ties of trust, was shown to generate a navigable network (White and Houseman 2002) that integrated the lineages, the clan, the clan with surrounding nomad tribes, the tribes with and the surrounding villages as well as with membership in the national political institutions (White and Johansen 2004). Processually, in the nomad study, it appeared that the processes involved in clan ethnogenesis were those of structural cohesion, and that dissolution at this level back into identifiable clan cleavages (according to cohesive boundaries) posed the problems of contemporary integration split between larger nationhood and modernization on the one hand - with new patterns of leadership - and traditional clan identities and leadership patterns on the other.

When anthropologists take a longitudinal view of social process, as in the various conceptual ethnographies in Kemper and Royce's (2002) *Chronicling Cultures*, even over periods of field work separated by two or three years, we see rapid reconfigurations of social networks, activities, institutional configurations, and the "stuff' of cultures. In the longer term we need both observations and theories about social and cultural dynamics. An interactional view of how changes occur seems appropriate. (Lehman: “This parallels nicely the argument in generative linguistics that grammar change results in iterative *reanalysis* applied to the hear utterances that are input to the Language Acquisition Device.”)

2.5 A Two-Sided Convergence

To complete the argument of this paper, two directions need to be developed in order to meet. One is to give a more relational account of cognition. For kinship cognition and terminology, that has been the project of Read (2000, 2001, 2004). His larger project posits a two-sided practice, one a relative-product internal cognitive calculus, and the other a network-based, out-in-the-world (in this case, genealogicy) process of tracing in the context of instantiation. Both are

relationsal, and we can study the links between them. After I give the ethnographic example of Pul Eliya (and other cases in the powerpoint slides), I will then explore the convergent direction: how to examine behavioral practices that are implicated in network structure, and how to begin to infer such unobservables as preferential patterns of behavior in behavior itself. For this purpose, in this essay, I use the development of ring cohesion theory to develop that direction. And finally, since ring cohesion deals with the kind of dense interaction that is involved in the generation of culture and cultural rules or preferential systems, we can tie in the further development of the concept of culture with the development of our own conceptual practices in ethnography and ethnographic analysis.

3. An Ethnographic Example: Cognition and Cultural Practice in Pul Eliya

Pul Eliya was the monograph by E. R. Leach (1961) that destroyed the assumptions of classical British Social Anthropology about the permanency of corporate kinship structures. He showed kinship to be a flexible idiom deployed in the service of land and water claims in which genealogies and group memberships were manipulated to strategic ends. Cooperative labor was facilitated by affinal ties between brothers-in-law of opposite "sides" in the kinship terminology, while competition between co-resident brothers over inherited resources was rife, and sisters could inherit "male" property utilizing an alternate "binna" marriage pattern (uxorilocal) provided she married a man from so far outside the village that his kin ties would not count in the affinal sidedness system (nullifying the choice point for how far back to start the switch-reckoning). He noted, however, the "puzzle" of how the affinal alliances were organized and how they fit with kinship terminology and cognition. Houseman and White (1998a) present an understanding of how this worked based on a network analysis.

Their key finding was that with respect to blood kin, marriages were perfectly sided in terms of network behavior, if the network were considered to be a bipartite structure a woman of one side always married a man of the other. The exceptional marriages of women as if they were male heirs in the absence of brothers, using "binna" residence and a husband selected from remote village, however, were the exception where the woman retained her children retained the sidedness normally given to her brothers' children. The" counting" of sidedness cognitively, then, was done on the genealogical network itself, but only that portion of the network where links were consanguineal ones rather than affinal, and within the core village, excluding pairs of relatives from remote villages, for whom sidedness was not at issue in inheritance. Like Hutchins' finding in *Cognition in the Wild*, a part of "cognition" is offloaded onto the external social environment. In contrast and in evidence of this point, if "sidedness" is computed on the genealogical network but through affinal ties, the two-sided exchange system found by the

proper cognitive formulation of the sidedness rule becomes incoherent. Sidedness, properly constituted, forms a coherent bipartite network consistent with a low rate of errors, and the errors are consistent with informant statements about "wrong" marriages.

Figure 1: Three independent paths between nodes 1 and 5.

4. New Results: Ring Cohesion and Simulation

Because so many of my own studies, using a conceptual ethnography approach to tie networks and dynamics into other aspects of culture, involved the concepts of structural cohesion, two further approaches were tried. One, ring cohesion, is to study the empirical distribution of the cycles that constitute the structurally cohesive units in a network. This is a generalization of work being done on cycles in chemical networks (Vismara 1997; Gleiss 2001; Gleiss et al. 2000, 2001). The other, simulation of feedback circuits, assesses various theoretical probability models of how such structures are formed.

4.1. Ring Cohesion Methods

Ring cohesion is a developing theory of how structural cohesion in networks is constituted both in terms of structure and dynamics. Recalling one of the two equivalent definitions of structural cohesion, that every pair of nodes in a structurally cohesive subnetwork have at least k independent paths between them, and when k > 1 there are also k-1 independent cycles that run through them. In this context, a set of cycles is defined as independent if each contains an edge that is not contained in any of the others. Figure 1 shows an example where there are three independent paths between nodes 1 and 5, the whole network is 3-cohesive, and it contains only 4 independent cycles.

A *ring* is a cycle within a set of independent cycles, so the maximal number of rings in this example is four. The triad cycles 1-2-3-1, 1-3-4-1, 2-3-5-2 and 3-4-5-3, for example, are one way to define the set of rings in this network. Another set of rings, however, is 1-3-2-5-4-1, 1-2-3-1, 1-3-4-1 and 2-3-4-2. The first set, overall, are shorter cycles, but the concatenation of all four of these cycles is required before the longer cycle in the second set, 1-3-2-5-4-1, appears.

In general, if there are k edges (8 in this case) and n nodes (here, 5), there are k - n + 1 independent cycles in a connected network (here: 8 - 5 + 1 = 4). There may be many other cycles which, once a set of rings is determined, are nonindependent: they appear once the rings are

added together.

The theory of ring cohesion, then, begins with the idea that structural cohesion is generated by some set of rings that in combination, create all the cycles in a structurally cohesive subnetwork. If we can determine what process created the original set of rings, we have "accounted" for sum total of the structural cohesion.

In a longitudinal data set, we may even know the exact order in which edges were formed, and hence determine the original set of rings. Say that this order was 1-2-3-1, 3-4-1, and 3-5-2 and 4-5. Then we know that our four triad cycles are the original set of rings. But if the order was 1-3-2-5-4-1, 1-2-3, 3-4 and 4-2, then our second set of rings was the original, even though the end result was the same. Our processual account of this outcome, however, will be different depending on the temporal order.

4.2. From the Ring Concept to Dynamics via Probability Models

Knowing the order of events provides the basis for longitudinal analysis, but this is not the same thing as understanding dynamics - what is the generating process? Once we have the concept of rings as the generating sets of cycles for structural cohesion, we can easily develop probability models that give us some ideas about possible dynamics. If we wanted to know, for an example like Figure 1, what was the likely temporal order in the formation of rings that might have generated that graph, it is easy to develop a statistical distribution that orders the probabilities of different types of ring sets. Simply using intuition and paper-and-pencil diagrams, we can see that there are many ways in which the order of appearance of edges in that graph would generate our four triadic cycles. It is impossible for this graph to have been formed by four tetradic or pentadic cycles, however. That gives us an intuitive clue that compact or short-length ring cycles are more likely than longer ones. Consider random paths that might generate the first ring. The probability that this ring is triadic is 1/3rd.[2] The probability that it is a 5-cycle is 2/27th, and from there all successive rings will be triadic. The probabilities of different ring sets can be computed precisely to give a statistical distribution of their likelihoods. In the present case, the probability of a ring set with a 5-cycle is $p = 2/27 < .075$. This is a measure of statistical significance of deviation from randomness. The probability of two 4-rings is 2/9, with one 4-ring is 2/9, and the probability of four 3-rings is about 13/27, the most likely structure. So if longitudinal observations showed four triadic cycles the significance test would say this might easily be produced by a general statistical tendency to produce short rings, and it would be the existence of these cycles as against the background of the network from which they were extracted that would be significant. If, however, the temporal order of ring formation showed that the 5-cycle

[2] The probabilistic computations here are for paths starting at a random nodes and moving to adjacent nodes with no backtracking. As edges are added, and a new edge forms two or more cycles, we consider shortest cycle to be the one formed, the others being nonindependent.

occurred first, rejection of the null hypothesis would imply that we might need a model of the dynamics of ring formation in which three is an initial preference for formation of longer cycles.

4.3. A Marriage Network Example

In a marriage network structural cohesion exists when two people who are previously kin or marriage-related are married. Blood marriages, such as with MoBrDa, can be described as cycles, but so can marriages with affines, such as sister exchange, or a cycles of eight marriages among different families. We would like to find the rings that generated all of the cycles in a marriage network. Such an inventory will tell us not only what types of marriage (MoBrDa, FaSiDa, FaBrDa, etcetera) are most common, but which of these marriages generated other marriage cycles indirectly or as a consequence. With proper software (White 2005), it is now possible to easily construct a marriage network from genealogical data and to do a relinking census of previously related couples. The number of independent relinkings in a connected network is computed from the formula m(G) = k - n + 1 (the cyclomatic number m(G) of a marriage graph G). The ring sets of smallest diameter typically will be the most likely longitudinal generators of these rings. The marriage types of such a set of shortest rings will typically constitute the relinking census, unless a longitudinal census shows that longer initial cycles are preferentially favored. Hamberger, Houseman, Daillant, White and Barry (2005) provide a full treatment of matrimonial ring structures: how to compute them and how to determine from a full census of relinking cycle some of the salient structural properties of the network. What I am adding here, having instigated the development of these graph theoretic procedures for the study of marriage networks, is a statistical method for testing hypotheses about the lit dynamics that produced the network.

4.4 Ring Structures as Indicative of Network Dynamics

Ring cohesion methods and theory can be applied to networks of any type. They become more interesting when the links in the network are of different types, so that we can study how cycles of heterogeneous links of differing frequencies generate the structural cohesion in a network. In kinship networks, for example, there are two fundamental kinds of links, male and female. A relinking census will then correspond in this case to a census of the frequencies of different types of blood marriages and different types of relinking among 2, 3 or more families. And if time-codes are attached to the edges - time of formation - then it is possible to do statistical hypothesis testing as to inferences about network dynamics. In the case of the Turkish nomads (White and Johansen 2004), for example, we were able to determine that the wide variety of blood marriages was sufficient to constitute a ring set that accounted for affinal relinkings as nonindependent cycles, but that the converse did not hold. In other societies studied, the reverse is true. Further, we found that the ring sets with smallest diameters were consistent with network dynamics. Note

that once the correct ring set is identified, then there is a variety of procedures to identify the processes that generate the ring dynamics. What if for a given network, we rejected the hypothesis that ring structures were generated by the most probable, smallest diameter cycles, and we found that there were probabilistic biases in cycle formation that favored the formation of longer cycles? That is what we find, for example, in some marriage networks where blood marriages are disallowed or discouraged, and especially in societies with (a) classificatory kinship terminology and (b) preferences towards sidedness in the formation of marriage networks (Houseman and White 1998a, b). For processes that generate deviation of ring diameters from a random-diameter model, or for rings clustered in a way that deviates from the most likely (randomly related) model, and irrespective of how the rings are made up, we will need a biased probability model for ring diameters and ring clusters. For that, we turn to simulation.

4.5. Simulation

Working with Santa Fe Institute researchers and a computer scientist (White, Tsallis, Farmer and White 2005), we jointly developed a ring cohesion simulation that investigates the relationship between various biases on random processes of ring formation in order to observe the effect on ring diameter and clustering as well as other properties: Given several probabilistic parameters, are the resulting networks scale-free? Small world? Navigable? How do the topologies of the networks generated by the biases vary, and how do they alter the constraints on local behavior in the network? This simulation is to our knowledge the first to investigate what we call" feedback" behavior in networks: local behavior aimed at creating cycles, and the links between the probabilistic biases on these local behaviors and the outcomes in terms of network topology, including ring diameters and clustering. I will be reporting further on the results of this simulation when this paper is finished.

5. Conclusions

Interaction and feedback should be central processes in the evolution of learning and diffusion of elements in culture, and cohesion, with its effect on sharing but also on segmentation, ought to be a central structural feature with strong effects on cultural formations. The conceptual ethnography that I have been engaged in has alerted me as to processes of segmentation and dynamic, shifting forms of integration and shifting levels in systems of representing meanings. Hopefully, attempts to define culture will resist the tendency to overconcretize "culture" as an entity, system, or structure, and will look to dynamic, interrelated processes. In short, however culture is defined in terms of its relative coherence as a relational system, it cannot be defined in terms of shared cognition that is intrinsic to mental processes and it cannot be considered as a strictly mental phenomena, since part of cognition itself lies in social interaction, and cognitive

processes themselves operate on and within the networks constituted by interaction. The relationship between cognition and social networks, then, is dynamic and itself interactive, allowing and accounting for continual processes of change, and this dynamic ought to be considered as intrinsic rather than extrinsic to our conception of culture.

Acknowledgements

This paper was written under the auspices of project ISCOM, "Information Society as a Complex System," a European Union grant to PIs David Lane, Geoff West and Sander van den Leeuw in which the author is one of four project directors.

References

Boster, J. S. (1985) Requiem for the Omniscient Informant: There's Life in the Old Girl Yet. In *Directions in Cognitive Anthropology.* Janet Dougherty (ed.). University of Illinois Press. pp. 177-197.

Fischer, J.

Freeman, L. C., A. K. Romney, and S. Freeman. (1987). Cognitive structure and informant accuracy. *American Anthropologist* 89: 310-325.

Gleiss, P. M. (2001) Circuit Bases of Strongly Connected Digraphs Abstract: The cycle space of a strongly connected graph has a basis consisting of directed circuits. The concept of relevant circuits is introduced as a generalization of the relevant cycles in undirected graphs. A polynomial time algorithm for the computation of a minimum weight directed circuit basis is outlined.

Gleiss, P. M., P. F. Stadler, A. Wagner, D. A. Fell (2000) Small Cycles in Small Worlds

Gleiss, P. M., P. F. Stadler, A. Wagner, D. A. Fell. (2001) Relevant Cycles in Chemical Reaction Networks. *Advances in Complex Systems* 1:1-000.

Goodenough

Goodenough

Gould, S. H. (2000). *A New System for the Formal Analysis of Kinship.* Edited by David Kronenfeld. Lanham, MD: University Press of America.

Hamberger, K., M. Houseman, 1. Daillant, D. R. White and L. Barry. (2005) Matrimonial ring structures. *Mathematiques et sciences humaines* 168:83-121. Journal of the Ecole des Hautes Etudes en Science Sociales, Paris. Social Networks special issue edited by Alain Degenne.

Houseman, M. and D. R. White 1998a,b

Hutchins, E. (1995) *Cognition in the Wild*. Cambridge, Mass.: MIT Press/Bradford Books.

Kemper, R. van, and A. Royce, eels. (2002) *Chronicling Cultures: Long-Term Field Re search in Anthropology.* AltaMira Press.

Kumbasar, E., A. K. Romney, and W. H. Batchelder, (1994) Systematic biases in social perception. *American Journal of Sociology* 100: 477-505.

Leach, E. R. (1961) *Pul Eliya.* Cambridge: Cambridge University Press.

Leach, E. R, (1968) *A Runaway World.* British Broadcasting Corporation.

Leaf, M. (1979) *Man, Mind and Science.* New York: Columbia University Press.

Lehman, Kris (F. K. L. Chit Hlaing), personal communication, November 2004.

Read, D. W. (2000) Formal Analysis of Kinship Terminologies and Its Relationship to What Constitutes Kinship. *Mathematical Anthropology and Cultural Theory* 1 (46 pages). http://www.sbbay.com

Read, D. W. (2001) Formal Analysis of Kinship Terminologies and its Relationship to What Constitutes Kinship. Special Issue of *Anthropological Theory,* D. Kronenfeld, ed.

Read, D. W. (2004) New Results: The Logic of Older/Younger Sibling Terms in Classificatory Terminologies. Letters to MACT, November, pp. 1-4. Mathematical Anthropology and Cultural Theory. http://www.mathematicalanthropology.org/

Read, D. W. and F. K. L. Chit Hlaing. 2005, The Read-Lehman Letters on Kinship Mathematics. UC eScholarship Repository, http://repositories.cdlib.org/hcs/MACT/0105DWR-FKL Reprinted from MACT. Mathematical Anthropology and Cultural Theory.
http://www.mathematicalanthropology.org/

Schweizer, T. (1998)

Skyhorse, P. (2003). Residence on Romanum Revisited. Ph.D. Dissertation, Program in Social Networks, University of California, Irvine.
--- (1998). Adoption as a Strategy on a Chuukese Atoll. *The History of the Family* 3(4), Special Issue: Adoption and Family Recomposition: Inventing Family Continuity. Edited by Antonette Fauve-Chamoux.

Tjon Sie Fat, F. E. (1990) *Representing Kinship, Simple Models of Elementary Structures.* Leiden: Faculty of Social Sciences, University of Leiden.

Vismara, P. (1997) Union of all the Minimum Cycle Bases of a Graph. *Electronic Journal of Combinatorics 4:R9.* Abstract: The perception of cyclic structures is a crucial step in the analysis of graphs. To describe the cycle vector space of a graph, a minimum cycle basis can be computed in polynomial time using an algorithm of Horton (1987). But the set of cycles corresponding to a minimum basis is not always relevant for analyzing the cyclic structure of a graph. This restriction is due to the fact that a minimum cycle basis is generally not unique for a given graph. Therefore, the smallest canonical set of cycles which describes the cyclic structure of a graph is the *union of all the minimum cycle bases*. This set of cycles is called the *set of relevant cycles* and denoted by CR in ___. A relevant cycle can also be defined as a cycle which is not the sum of shorter cycles. A polynomial algorithm is presented that computes a compact representation of the potentially exponential-sized set CR in O(m) (where denotes the cyclomatic number). This compact representation consists of a polynomial number of relevant cycles without listing all of them. (improvement on K. Paton. An Algorithm for Finding a Fundamental Set of Cycles of a Graph. Comm. ACM, 12:514-518, 1969.)

Weiner, A. (1976) *Women of Value, Men of Renown.*

White, D. R. (2005) Ring Cohesion in Marriage and Social Networks. *Mathematiques et sciences humaines 168*:5-28 Journal of the Ecole des Hautes Etudes en Science Sociales, Paris. Social Networks special issue edited by Alain Degenne.

White, D. R. and U. C. Johansen (2004) *Network Analysis and Ethnographic Problems: Process Models of a Turkish Nomad Clan*. Boston: Lexington Press.