

NSF Proposal #0025860: **Group Dynamics, Cultural Capital and Social Networks:
Internationally Collaborative Longitudinal Studies.**
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I. THEORETICAL AND CONCEPTUAL BACKGROUND

In spite of the richness of ethnographic field research, there is little cumulativeness in terms of systematic longitudinal data that allows restudies or subsequent researchers to study group dynamics, and a dearth of methods, concepts and theory for guiding longitudinal field studies (cf. Foster 1979), in spite of their importance to the field. The objectives of this grant are to achieve the synergies among senior colleagues, junior faculty, graduate researchers and post-docs engaged in multiple longitudinal field site studies needed to develop and test theories of group and institutional dynamics in richly studied ethnographic and ethno-historical contexts. The objectives of theoretical synthesis include network theories of group dynamics and social and cultural capital in the context of production and exchange.

As a methodological contribution to network analysis in longitudinal field sites, this grant provides: (1) training and research direction to students and researchers in centers for network analysis at UCI, Columbia and Cornell and at seven campuses abroad (EHESS, Lille, UNAM, Complutense, Barcelona, Cologne, Hamburg), through the medium of (2) open workshops in the U.S., Europe and Mexico led by the PI, and involving presentation of (3) past and continuing work on methodological improvements to network analytic techniques with consultant graph theoretician Harary, and (4) continued collaboration with Slovenian computer scientists Batagelj and Mrvar to provide software for large-network analysis of longitudinal field sites. The method of training is combined with substantive research objectives through multi-investigator collaborations on new or existing longitudinal field sites. While not funding the primary field research, this grant will serve as a basis for matching grants for other projects and will support major substantive contributions from 24 projects in which the PI is principally involved or in which collaborations have been established. These include some of the classical (cf. Foster 1979) long-term field studies in anthropology (Gwembe Tonga, Tzintzuntzan, Chuukese), two such sites researched by the PI and L. Brudner-White (Feistritz/Austria, Belen-Tlaxcala/Mexico) that will now be archived and opened to qualified researchers, six longitudinal studies of elites and economic or political institutions, seven longitudinal studies of social class formation, and seven longitudinal studies of network changes in social organization. Each project site builds on previous work of multiple investigators that have resulted in computerized longitudinal databases from field studies or historical archives.

The theoretical focus of the present study is on *Group Dynamics, Cultural Capital and Social Networks* in complex societies. The theoretical framework fuses social network theory within the broader set of fields originating under the study of group dynamics (reintegrating exchange theory within a broader production groups framework that emphasizes group processes in the development of cohesion and group solidarity, which are the basis of cooperative social activity), and relates to the new institutional economics framework (North 1990) for the study of institutional change. Nine specific hypotheses from the theoretical framework are discussed in this proposal, although others may be found in prior publications of the PI and other collaborators. Hypotheses will be tested using network, statistical, graph theoretic and case study methods developed or integrated by the PI and others for use in longitudinal network studies. Methodological issues will also be developed out of conference discussions of the group of researchers (see <http://eclectic.ss.uci.edu/~drwhite/nsf/collabor.html>), so as to include those used by particular research groups -- such as the EHESS emphasis on the study of local spaces in the frame of global networks -- or those unique to particular case studies.

Background and Illustrative Prior Research: Radial Cohesion and Cooperativity

This proposal evolves out of previous transatlantic cooperation awards (with matching grants from NSF and the Humboldt Foundation) that developed research dialogues among German, American and French anthropologists, evident in Schweizer and White (eds., hereafter S&W1998), involving field studies and restudies, formal representation and conceptualization, and rapprochement of game theory, exchange and alliance theories with substantive problems of group dynamics.

Coming out of our collaborative research were concepts of major importance – and hitherto largely unexamined – for the network study of complex societies, such as: Structural endogamy, which defines potentially cohesive social units, and the more general phenomenon of radial cohesion; both defined below. Since most studies define social cohesion by locally dense networks or Simmel's idea of crosscutting groups (Blau and Schwartz 1984), there has been little study of the types of cohesion created by self-bounding social units of intermediate or large scale – ones that possess multiple independent paths of connectivity between actors and high density (at some scale and conditional on egocentric constraints) within the self-bounded unit.

Concepts, Algorithms

White and Harary (1998a,b; White 1997 <http://eclectic.ss.uci.edu/knhe/str-endo.htm>; Harary and White 1998; Brudner and White 1997) have developed a series of graph theoretic formalizations of concepts of social cohesion, network density relative to formal constraints (e.g., limitations to two parents in kinship or to few adjacencies in neighborhood relations), conditional connectivities¹ and conditional blockmodels², that serve as methodological foundations for this study. To illustrate, a network is *k-cohesive* if it is not subject to disconnection by removal of *k* of its nodes (Stoer and Wagner 1994 give a min cut algorithm for edges with a run-time order of $O(|V|^*|E|+|V|^2 \log |V|)$; see Nagamochi et al 1997). A minimally (1-) cohesive graph, by Menger's theorem, has at least two independent paths between every pair of nodes: It follows that every pair of nodes in such a graph is connected by a cycle. A network is *z-radial* when its subgraphs of radius *z* from each distinct ego have very little cohesion. A network is both *z-radial* and cohesive, or *radially cohesive*, when there is extensive cohesion but only beyond the radius *z* from the perspective of ego networks (each node is contained in a larger cohesive subgraph with a radius greater than *z*). Within this family of concepts, each cohesion concept defines well bounded subgraphs of mutually exclusive sets of nodes or subsets of edges.

Structural Endogamy

Structural endogamy is a special case of our general concept of cohesion. White (1997, see <http://eclectic.ss.uci.edu/knhe/str-endo.htm> both for concepts and examples) defines structural endogamy in marriage systems as a maximal boundary condition on marriage and kinship ties where, in a network of couples, every pair of couples has multiple independent paths connecting them through parent-child ties. This definition leads to identification of large scale structurally endogamous aggregates (bicomponents) within human populations.³ Structurally endogamous aggregates are self bounding.⁴ In the kinship networks of complex societies they are often radially cohesive on a large scale because social or religious norms (or laws) prohibit close intermarriage between families, yet, as in most human communities, there is a high degree of endogamy at some level.

In an ethnographic case study presented, critiqued and amplified at our Barcelona meeting, White, Schnegg and Brudner (1998) were the first to use the structural concepts of White and

¹ A conditional definition is one that preserves some property *P*. Conditional- or *P-connectivity* of a connected graph *G*, $\kappa(G:P)$, is the smallest number of nodes of *G* whose removal disconnects *G* into components each having property *P* (Harary 1983). The *P-density* of *G*, $d(G:P)$, is the ratio of edges of *G* relative to the maximum number of edges in a graph with property *P* having the same number of nodes as *G*. As a partial measure of cohesion, a subgraph *G* of a network has a *maximal connectivity* $\kappa(G)$ of *k*, $\kappa(G)=k$, if each pair of nodes has *k* independent paths between them, but some pair of nodes has fewer than *k*+1 independent paths between them. *Cohesion* is measured by a pair of numbers, $\langle \kappa(G), d(G) \rangle$, where $d(G)$ is the density of *G*. This conception of cohesion facilitates our definition of radial cohesion below.

² A blockmodel of a graph corresponds to a partition (coloring) of nodes that preserves a certain property *P* (White and Reitz 1983). A *conditional coloring* (Harary 1984) partitions the nodes (or edges) of a graph *G* with respect to property *P* such that each subgraph induced by the partition has property *P*. We are studying the use of such graph theoretic concepts for structural analysis along with further concepts of *conditional blockmodels* that will not be defined here.

³ Network analysis packages, such as Pajek (Batagelj and Mrvar) and UCInet, contain algorithms for finding bicomponents that have run times close to order $O(|E|)$, proportional to the number of edges.

⁴ The technical trick (White and Jorion 1992,1996; White 1997) for finding endogamous bicomponents is to construct the marriage network so as to separate marriage cycles from ordinary egocentric transitivity of extended kinship relations. For a structurally endogamous group to be *cohesive* (see footnote 1), it must also have a significant density of edges relative to a network with a maximum number of edges and the same number of nodes.

Harary (1998a) to define a new set of concepts of social cohesion that allow a wide variety of ethnographic cases to be analyzed in a new light. Both papers defined a minimal criteria for the cohesiveness (Lewin - forces that keep the individual in the group) of a group not simply in terms of a set of members who are connected (and potentially *disconnectable* by removal of an intermediate link) but in terms of multiple lines of connectedness (as in an attractive force field). In graph theoretic terms, a cohesive group must meet the minimal criteria of a *bicomponent*, where every pair of nodes are linked by more than one independent path. This allowed us to distinguish proximal cohesion (as in a balanced or clustered network, with locally cohesive subgroups) from *radial cohesion*, in which local cohesion is missing (ties are asymmetrically contracted, intransitive, and do not form local cycles of short diameter) but there is a definite boundary formed by multiple long-diameter cycles of social relations. Such structures are necessarily connected, free of cutnodes whose removal would lead to disconnection, and to be cohesive must be relatively dense as measured by the ratio of edges to nodes.

One of the key problems in working at the scale of large or radially cohesive groups, however, is the theoretical interpretation of whether and how the existence of such groups makes a difference in terms of manifest cooperative behavior. Members of our project – Lindenberg (1997, 1998) and Leenders in Holland, Bell (1995, 1998a,b) at UCI, Bearman (1997, 1998, & Kim 1997) at Columbia, Breiger (1991,1998) at Cornell, our set of Cologne anthropologists (see S&W1998) – Schweizer, Bollig, Görlich, and some of their students, such as Schnegg --, and others (see Doreian and Fararo 1998) are helping to rethink some of the fundamental concepts concerning groups, group dynamics and the dynamics of exchange, sharing, solidarity and cooperation. Lindenberg (1997), for example, begins with a critique of why the group-dynamics research traditions, that seemed to promise in the 1960s a synthesis between ethnographic findings (Homans 1950) and experimental studies, soon fell apart into specialized – functional, cognitive and structural – strands, each with significant but limited success. He argues that for these strands to be reintegrated, it is necessary to change from exchange theory to a theory of production, where exchanges are governed by exigencies of production: Such a theory must include a theory of goals and a theory of framing (limited or cognitively framed rationality) that connects goals and functional interdependence with social cognition. Further, as groups are always connected in a production process with other groups, they must be studied as networked entities. Members of our anthropological group are incorporating some of Lindenberg's suggestions in a Barcelona conference volume – presenting a new round of our field and comparative studies – edited by our junior faculty at Cologne (Bollig and Görlich, with senior colleague Helbling at Zurich), and aimed at theorizing the dynamics of institutional change.

Networks and Production Groups: Concepts of Sharing and Exchange

Lindenberg's (1998) work on solidarity addresses one of the key problems that we face in the study of radial cohesion and structural endogamy in complex society. He takes the approach of *networked production groups* to develop an ethnographically sensitive theory of observed solidarity behavior in groups, one that links functional interdependency in the context of common production and shared goals not just to cooperative behavior in common good situations but to four other necessary components of solidarity that include *sharing*, *responses to need*, *avoidance of damage* to others, and explanations or *repairs for failure to comply* with solidarity norms. Strong solidarity is theorized to result from such a buildup of overlap of sharing groups that risk comes to be cognized as shared, and, in the way that interaction between group members is cognitively framed, individual gain does not alternate with solidarity. Further, with strong solidarity, Lindenberg predicts that group boundaries will be strictly delimited, and that equality rather than equity (fairness but not necessarily equality) will be a governing norm of interaction.

The framework of group dynamics is one that views people as coexisting in groups because of three types of interdependencies: functional (cf. Homans 1950), cognitive (cf. Sherif 1936), and structural (cf. Cartwright and Harary 1956), and these need to be reintegrated. Groups are a collection of people organized around resources used to produce some recognized good; shares in the product(s) of a group are central to group membership (Bell 1998b). While Lindenberg (1998) tries to analyze shared resources within production groups as a basis for conceptualizing social exchange, Bell (1998a,b) shows why exchange theory must give way in understanding within-group allocation to an

independent analysis of sharing as a *mode of allocation* that is a function of rights or rightful claims on the resources of a group. Shared allocations are made not on the basis of exchange but on variable principles of equity – and here of course, issues included in the present research such as succession and inheritance in a framework that includes marriage and kinship are ones of central importance to which our network analyses have much to contribute (see hypothesis 6). Bell's (1998a,b) work helps to define how we need not only bounded theories of rationality – re:cognitive framing – but of the applicability of exchange concepts themselves. At the center of this growing clarity of theoretical consensus and dispute, the attempts to implement and test competing or complementary paradigms will be central to the present series of research projects and the dialogues that these researches enable among researchers-theoreticians-analysts (roles which variously intersect). In the ongoing Tlaxcala project, for example, it has been very productive to examine production groups and sharing, how such groups articulate, behavioral indicators of solidarity at different levels, and the different cognitive orientations of actors in different contexts.

Theoretical Relevance to the Study of Complex Societies

However it is modified in the course of this research, the relevance of networked production group theory to contemporary economics and the state, as seen in Lindenberg's argument, is that strong solidarity, but not weak solidarity, is inimical to the growth of profitable economic relationships based on market exchange. In all societies, however, there are goods that require joint production, hence sharing groups. The framework of networked production groups – and concomitant issues of sharing and exchange – has great import for anthropological theory and theories of institutional change. The behavioral study of solidarity leading to theories about the emergence and effects of solidarity outcomes (strong, weak, absent/individualistic) as concrete phenomena is crucial because of its centrality in the emergence of norms, institutions and informal social regulation – or conversely, conflict and factionalism. These constitute the transaction costs of any socioeconomic system (cf. North 1990), which are indisputably the major component of any economic system. As Lindenberg (1998) notes, even the modicum of solidarity essential within face-to-face groups for any economy to operate is highly precarious and susceptible to myopic short-run rationality or signals of opportunism in the balancing of power relations that will shift cognitive framing by actors over to individual gain at the expense of others. On the cultural side of Lindenberg's theory, the manner in which sociocultural frames are constructed is crucial to stability or change in solidarity behavior.

Recapping the Concept of Structural Cohesion: Proximal and Radial

The theoretical synthesis that we aim at is strengthened by the PI's work on concepts for embedding structural and network analysis within the context of functional and cognitive (including cultural schemata – see Böck in S&W1998) frameworks. In the PI's work, and in joining forces with graph theorist Harary (whom Lindenberg credits with pioneering the structural strand of group dynamics research), a key element has been to provide an alternative to defining structural cohesion in a group, not just by "local" structures such as balance or clustering, but in terms of the boundary condition for that type of connectedness which operates either locally or at longer reaches through multiple independent paths of connectivity (see *bicomponents* above).

Local Spaces in the Frame of Global Networks

If the techniques of structural analysis can help to identify aspects of global structure in the analysis of social networks in complex societies, a second major avenue for study is to examine the shape and the possible constraints that weigh on local spaces given a total set of links. Collaborations in the present project include those at the Ecole des Hautes Etudes en Sciences Sociales in which the respective program directors of their new Ph.D. program in Social History and Demography, Maurizio Gribaudi (see http://www.ehess.fr/centres/ldh/DEA/la_filiere.htm), and of UCI's Ph.D. Program in Social Networks, the PI, D. White, are conjointly working to develop interactive social networks research tools for graduate students and researchers to use in studying ways in which particular subsets of individuals are embedded in, affected by, and impacting upon, a larger structure of social relations and institutions.

II. HYPOTHESES

In the variety of ethnographic and historical datasets that we will be studying, there is much to be learned from heuristic hypotheses concerning interdependencies, such as those numbered 1-9 below.

By interdependence I mean that network function, cognition or structure has emergent properties which themselves come to frame subsequent functions, cognitions or structurally constrained actions. This often leads to the kinds of path dependent dynamics of institutional development noted by North (1990): The crescence or slow congealing of micro-level interaction into institutions that may lock each other into local optima.

Cohesion and Structural Endogamy

A first set of hypotheses for our study of complex societies concerns radial cohesion.

1) self-bounded radially cohesive groups are common in complex societies and their graph-theoretic boundaries are often functionally interdependent with caste, class, and ethnicity (an hypothesis, like most of those below, tested by standard cross-tabs and correlation). Prime examples of radially cohesive groups in complex societies are structurally endogamous groups formed by cycles of marriages linking consanguineally extended families. Such groups may be radially rather than proximally cohesive if close intermarriage among blood relatives is prohibited or avoided, and their detection in terms of network patterns is a problem of some subtlety (relational functions and attributional cognitions are also interdependent in terms of how such groups operate). The importance of radial cohesion in complex societies, however, is by no means limited to recognition of the importance of kinship and marriage networks. It is one thing to recognize that such networks may be diffuse but radially cohesiveness in ways that, in channeling pathways for succession to office for the transmission of ownership, are fundamental to the political, economic and social structure of large-scale social systems. Equally if not more important, however, are other networked relationships that operate in occupations and institutional structures, cross-cutting kinship and marriage ties, that may also have hitherto unrecognized structures and functions that operate through radial cohesion.

2) such groups are often associated with the shared production of some goods.

3) the associated production groups will be strongly or weakly solidarity, depending on the overlapping of shared productions, relations with other groups, and the cognitive framing of interaction.

Networked Production Group Theory in Framing the Content of Ties

A second set of hypotheses builds on a production theory approach to the cognitive framing of interaction that has been rigorously developed theoretically but awaits broader application. Bell (S&W1998a) begins from recognition of actors as members of production groups; where rights of such groups over persons are distinguished from rights of persons over wealth held by such groups. Three types of wealth transfers or payments are distinguished: those involving *exchange*, between parties with different interests (such as members of different groups), those involving *alliance*, between parties in different groups seeking to align their interests, and those involving *transfers* between parties in the same group, involving a presumed commonality of interests. Bell's concept of wealth-holding groups (1998a,b) and Lindenberg's of production groups are closely aligned. My translation of Bell's central hypothesis (1998a) is that:

4) differences necessarily arise in cognitive framing between payments in the context of solidarity – dowry as gifts for *alliance* – versus payments such as bridewealth that arise in the context of *exchange*. Different types of payments, arising out of production groups, set a context for interpreting structural interdependencies (with predictions that differ depending on whether models of exchange or of alliance are mobilized).

5) The cognitive framing of dowry for alliance, for example, sets a basis for structural interdependence among maritally cohesive families (structurally endogamous aggregates) which is weakly solidarity across different groups, even in the presence of a high degree of stratification and division of labor. In contrast, bridewealth as exchange (unless additional alliance elements are present) sets up a competitive gain-maximizing orientation between different groups, and a basis for structural interdependencies through solidarity within groups, expansion of group size, and problems of group segmentation (Bell and Song 1995).

Augustins (1998), expert in European inheritance and succession allocations, argues that

6) the dominance of different grouping principles of kindreds, domestic groups, and lineages is associated with different equity framings – egalitarian (division of property/titles), privileged/unique

(unity of estate, titles), sex selective – which lead to different characteristic coalitions (formalized within a game theoretic for sharing) and to different network structures.

Social and Cultural Capital

Two of the principal applications of social theory based on social network concepts are in the areas of social and cultural capital. Different types of cultural and social capital that individuals acquire in the course of their lifetime – differential knowledge, skills, and connections due to the social background or origin of individuals, and the acquisition of occupational, professional, elite or avocational ties, or of wider, cross-cutting, ramifying, bridging, or ‘weak ties’ (Granovetter 1973, 1982, 1985), including the exploitation of structural holes by entrepreneurial strategies (Burt 1992) – are constituted via social networks. Less well known and less well studied as a problem in network theory are the positive and negative aspects of interdependencies between cohesiveness/solidarity and social/cultural capital:

7) What role do different types of cohesiveness, or lack of cohesiveness, play in the formation and dissolution of social groups and institutions? How do they affect the acquisition and retention of different types of social and cultural capital?

8) How are variations in types, overlaps, and levels of solidarity, as under points 3) 5) and 9), structurally interdependent with characteristic forms of conflict or factionalism?

Networked Production Group Theory in Framing Outcome Evaluations

A fourth set of hypotheses come out of the comparative work by Paige and Paige (1981), one of our best theories, tested cross-culturally, of consequences of different types of production groups in pre-state societies. We will be looking for extensions of similar theories that have broader applications, but their hypotheses may apply to some of our ethnographic cases in complex societies, e.g.:

9) Low resource production produces high evaluation of reproduction, leading to female-centered groups; high but unstable resources (like animal husbandry) produce high evaluation of potentially shifting alliances, leading to ritualized segmentation; and high resource production produces high evaluation of in-group social capital, leading to strong fraternal interest groups, emphasis on reproductive surveillance, and bridewealth exchange.

III. EXAMPLES

Published Examples: Partial Paradigms

Brudner and White (1997) demonstrate an ethnographic case where it is precisely the boundary condition of structural endogamy (radial cohesion, in this case) that is consonant with social class differentiation. They posit and test a series of hypotheses about the co-occurrence of the formation of social class and the formation of the cultural and social capital of that class as part of the same process of marital relinking and the reconsolidation of landholdings among a network of farmstead heirs. Marriage payments involve dowry, alliances between farmsteads, and with a minority status in the region and resistance to sale of farmsteads to outsiders, the structurally endogamous aggregate of the valley is one of strong intra-class inter-farmstead solidarity framed as high equality in spite of wealth and ranking differences. All of these patterns fit the hypotheses.

Houseman and White's (W&S1998a) restudy of Leach's Pul Eliya, with a dowry- alliance or solidarity-based dual organization rather than one based on exchange, also fits the hypotheses: as a Dravidian society subjugated by Hindus, strong minority/majority boundary and high overlap of shared production predicts the observed egalitarianism. The normative expectation that a matrimonial ally will give back land claims transferred with marriage to the agnatic group whence they came is consistent with Lindenbergs behavioral indicators of solidarity. Factionalism follows a logic of withdrawal of further marriage alliances when the norm of solidarity is not satisfied in reciprocation of land claims.

White and Schweizer's (S&W1998) Javanese study, with dowry proportional to stratified wealth differences, and overlapping memberships rather than sharp external boundaries or overlapping of shared production, is framed as solidarity that weakens almost to nil for the poorest families, but becomes more proximally cohesive but still weak among the elites, consonant with a high degree of overall societal integration (overall marital cohesiveness is largely radial with pockets of proximal cohesion among elites). Consonant with a single dominant type of weak solidarity, one that incorporates patron-client relations through kinship connections linking different strata, there is a single

Javanese set of kinship norms that adapts itself differentially to different structural positions in the social system.

Houseman and White (1998b) study a series of very different nomadic societies in the Amazon, where the resource base is low and reproduction is valued: here weak solidarity is created through reciprocal *gifting* of personnel (alliance, not exchange: none of the enforcement mechanisms for exchange are present) cognitively and structurally framed in terms of dual matrimonial organization; a social structure that supports and frames cooperative activities in multiple production groups through balance principles of structural equivalence between opposing congeries related by affinity. The adaptive advantage of this form of structural interdependence, in the absence both of the state and of rigid in-group/outgroup boundaries, is that it does not force the emergence of strongly solidarity groups (in the form of lineages or descent groups) that would lead to segmentary conflicts.

In the Amazonian vs. Pul Eliya cases, Bell's (1998a) distinction of gift as opposed to exchange gives substance to the concept of alliance (as opposed to affinity, which can be either exchange or alliance or neither one) and leads to differing implications for weak and strong solidarity in the twin contexts of marriage networks and production groups. This rejection of Lévi-Strauss's concept of the *exchange of women* makes it clear that the cognitive framing of Dravidian-type kin systems (egocentric dual organization), found in both low and high resource systems, share a similar type of gift-for-alliance structure *either* involving members of one's group or involving material goods.

Studies in Process: Further Paradigmatic Examples

Another example of radially cohesive relationships that may form solidarity groups concerns the compadrazgo relationships found in many areas of Mexico, as White, Schnegg and Brudner (1998) demonstrate in their ethnographic network study of compadrazgo for the region of Tlaxcala. In Tlaxcala we find both marriage networks and compadrazgo networks to be radially cohesive, and to cross-cut one another in a regional system of social integration. The boundaries of the radial cohesion are coordinate with a distinct identity held by Tlaxcalans in Indian villages where land ownership has been retained but there is also significant involvement in a wage economy in which the owners of the industries providing wages are viewed as outsiders operating in terms of potentially exploitative labor contracts. Here the conditions predicting strong solidarity at an extensive territorial level – that of the heartlands of a subjugated former state system – is born out by the existence of strong social norms prescribing customary ritual behaviors that pervade social life, and strong sanctions for prohibitions against alienation of free lands to outsiders by any member identified with the larger regional community.

White and Johansen (1998, in a book that will be an introduction to the analysis of situated genealogical networks) apply a series of hypotheses using our cohesion concepts, in the case of the formation of a Turkish nomadic clan, to accurately predict interdependence between stayers versus leavers (who go back to village life) and differences in cohesive positions with respect to the subgraph of kinship and marriage ties. In this case, the cohesion is proximal, and informal leadership/followership coalitions in this stateless society within a larger state are interdependent with closeness and redundancy of marriage alliances, including blood marriages within the bilateral descent lines of lineage ancestors. This case follows a general model common to a number of Arab and middle eastern societies with exchange relationships (bridewealth) having alliance components (blood marriages and proximal cohesion; also dowries, gifts and reciprocities) between lineages, but within lineages, strong solidarity relations. This structure is consonant with unstable resources, shifting alliances and high observed factionalism.

IV. RESEARCH PLANS AND COMPONENTS

Programs and Implementation of Algorithms

White, Mrvar and Batagelj (1998) are the designers and implementers of a joint project to provide the appropriate algorithms and programs for the constructions, visualization and graph theoretic analysis of large scale social networks. This aspect of the project is 95% completed but important additions remain (e.g., min cut and other algorithms proposed below). White finished his P-graph software package for genealogical and ethnographic network analysis in 1997 (White and Skyhorse 1997). In that same year Batagelj and Mrvar (1997) implemented a vastly improved software package for large network analysis

using extremely fast sparse-network algorithms. The three of us then began to collaborate to develop and fine tune the specific algorithms and options needed for this project. More work, operationalizing new formal concepts for further analysis of large scale networks, however, will be done by Harary and White as part of this proposal. First, we will complete a fundamental conceptual model (P-systems) for the representation and structural analysis of kinship networks (Harary and White 1998). Second, we want to finish work begun on conditional connectivities; and third, on conditional densities (White and Harary 1998b), which will allow us to implement algorithms to measure how close to maximum density are the various kinds of graphs that we utilize for the study of social structure: graphs which are invariably limited in various ways in the maximum possible in-degrees and out-degrees of nodes. Fourth, we will undertake new work on conditional colorings, which have been previously explored by Harary (1984), and on conditional blockmodels, in ways that will provide an additional set of tools for structural analysis of the social networks of interest to the present study. Fifth, we will work with Breiger (1991, Breiger and Han 1998, Breiger and Roberts 1998 – see completed projects, Table 1) whose recent refinements to network theory and statistical blockmodeling will lend an additional layer of structural modeling to the present set of projects, and with Bearman (1998) whose idea on structural casing of historical events is related to the structural exploration of cohesion concepts central to the present proposal. Sixth, we are working with one of Bearman's students (Moody 1998) on algorithms for detecting k-cohesion in large networks.

Data and Case Studies (Table 1)

The scope of collaborative studies in which various students, post-docs and faculty researchers will participate involves the 24 longitudinal fieldsites or historical cases studies listed in Table 1. Nearly all of these databases have already been computerized, although there is some funding for additional coding. In addition, eight completed projects will be documented for use in research training and as possible future sites for longitudinal studies.

Table 1: the 24 Research Sites	PIs (see key for country)	<i>UCIStudent /Post-Doc</i>	Topic	Collaborator (see key)	Data Source	Data Status
American Presidents	Stephan-Norris	<i>R.Grannis</i>	Elites	White	Books	Computerized
Mexican Presidents	Jorge Gil(M)	<i>Alcántara</i>	Elites	White	Mixed	Computerized
Spanish Elites	N.Pizarro(S)	consult:drw	Elites	Breiger*7 <i>Reyes H.</i>	Archives	Published,Co.
French Public Health	Gribaudi(F)		Elites	White	Archives	Computerized
Old Testament Lines	<i>R.Grannis</i>	<i>B.Jester</i>	Elites	White	Texts	Computerized
European Royalties	White	<i>B.Jester</i>	Elites	White	Texts	Computerized
Geneva Scientists	<i>Widmer</i>	<i>Fitzgerald</i>	Elites	White	Archives	Computerized
Nord-Pas-de-Calais(F)	White	<i>R.Johnson</i>	Class	J.M. Dupriez(F)	Book	Pilot done
Norfolk(E)	Bearman*1	<i>Fitzgerald</i>	Class	White	Books	To be coded
Bevis Marks(E)	Berkowitz*2	<i>Fitzgerald</i>	Class	White	Books	Computerized
Guatemala		<i>Casasola</i>	Class	D.Bell	Archives	Computerized
Drame, Slovenia	White		Class	Batagelj/ <i>Mrvar</i> (SI)	Field	Computerized
Sawahana Indonesia	Schweizer		Class	White	Field	Computerized
Tzintzuntzan(M)	Kemper*3*	<i>Widmer</i>	Village& Migrants	White	Field	Cross-indexing
Tlaxcala(M)	White	<i>Fitzgerald</i>	Villages& Factory	<i>Schnegg</i> (G)	Field	Computerized
Omaha(N)	White	<i>Skyhorse</i>	Omaha-S	Houseman(F)	Field	Computerized
Chuukese(P)	Goodenough	<i>Skyhorse</i>	Crow-S	White	Field	Computerized
Gwembe 2-4(A)	Colson*6	<i>Fitzgerald</i>	Crow-S	White	Field	Computerized
Rapanui(P)	McCall(A)	<i>J.Hess</i>	Marriage	<i>M.Colima</i> (S)	Field	Computerized
Ndembu(A-Z)	V.Turner ⁺	<i>Anthro.stu.</i>	Marriage	White	Field	Computerized
Beti, Cameroons(A-C)	Houseman		Marriage	White	Field	In Process
Biafada(A-G)	Gaillard(F)		Marriage	White	Field	Computerized
Wampar, New Guinea	Fischer(G)	<i>Anthro.stu.</i>	Iroquois	White	Field	Computerized

Pere Manus	Mead ⁺	<i>Anthro.stu.</i>	C-I-H	White	Field	Computerized
Completed projects (some to be archived) as sites for possible future longitudinal research						
Qing Imperial Lineage	James Lee*5	<i>J.Stern</i>	Elites	D.Ruan	Archives	Computerized
Feistritz (Au)	Brudner		Class	White	Field	Computerized
Supreme Court(U.S.)	Breiger&Han	*7	Solidarity	John Roberts Jr.	Archives	Computerized
Pul Eliya, Sri Lanka	Leach ⁺		Dravid'n	White/Houseman	Field	Computerized
Amazonian societies	Various		Dravid'n	Houseman/White	Field	Computerized
Gwembe 1(A-Z)	Scudder*5	<i>Fitzgerald</i>	Iroquoi-S	<i>Sam Clark</i> *8	Field	Computerized
Groote Eylandt(Aus)	Bearman*1	Source:Rose	Gen.Exch	White	Field	Computerized
Turkish Nomads	Johansen(G)		Clan	White	Field	Computerized
Keys : (A-C,G,Z) Cameroons; Guinea- Bassau, Zambia; (Au)Austria; (Aus)Australia; (E) England; (F) France; Guatemala; Mexico; (N)No.Am.Indian; (P) Polynesia; Slovenia; Spain; Turkey; U.S.	(A)Australia (F) France (G) Germany (M) Mexico (S) Spain *1 Columbia *2 Vermont *3 SMU *4 Penn *5 Cal Tech *6 Berkeley	<i>Graduate students or Post-docs marked in italics throughout the tables</i>		All UCI except (F) France (G) Germany (SI)Slovenia (S) Spain *7 Cornell *8 Penn State		

In the case studies discussed and those planned for the period of proposed research, we begin by radically disaggregating the materials of societal, biographic, institutional and organizational histories by considering their constituent empirical relationships in the detailed ethnography of kinship, processes of labor, work or professional life, and larger work or administrative organizations. Looking at the networks constituted by these relationships as graphs whose configurations change through time, we are interested in developing both theories and questions as to how cohesive structures both emerge and disappear, and how and what these structures contribute to the ongoing processes of formation, retention and dissolution of different types of solidarity and of social and cultural capital involved in societal, institutional, and organizational structures and their historical lifetimes, as well as the social capital of those individual biographies that intersect these structures at various points and types of participation.

Data Safeguards, Access, and Human Subjects Review

Many of the databases in Table 1 are under the separate auspices of a professional researcher (listed as PI; White is PI of subprojects in five cases); others are in the public domain; still others are thesis or research datasets of Ph.D. candidates or post-docs. In each case, issues of confidentiality are carefully considered (see White 1990) under purview human subjects reviews at each PI's home institution, and such arrangements as exist for sharing data are subject to agreement by the respective PIs. Datasets in the public domain or using published sources will be made available on the Linkages Project web site <http://eclectic.ss.uci.edu>. Human subjects for PI White's 5 projects are either in the public domain (European Royalty; Drame, Slovenia), published (Nord-Pas-de-Calais; this status also pertains to data from Bearman, Rose, Leach, Mead and Turner), archived and exempted from human subjects review (the historical Omaha), or primary fieldwork of the PI previously subject to review (Tlaxcala).

Feasibility

What makes the size of the comparative project and the magnitude (100-10,000 families per case) of each database manageable is that White and Jorion (1992) (1) identified an extremely simple coding system to allow not only complete genealogical and ethnographic data entry for large populations, and (2) provided a computational language for analyzing such networks. Batagelj and Mrvar (1997) then (3) provided their package for graphic visualization, network scaling and analysis of large datasets and (4) implemented new algorithms and options needed for the present study. Finally, (5) I modified my package to provide conversion programs to a standard GEDCOM format used in Batagelj and Mrvar's Pajek software as well as in standard commercial or shareware programs for genealogical analysis (see <http://eclectic.ss.uci.edu/~drwhite/doug.html>). Their package, however, is not limited simply to

genealogical data but accepts the full range of data types both for network and standard rectangular file data analysis. Data from either their programs or mine can also be exported for import into UCInet or other standard network analysis packages as well as standard statistical packages. Graphic data output in the form of structural configurations of large graphs are also easily prepared for printing or for presentation in dynamic web pages, such as 3-D VRML images that can be rotated, manipulated and examined in detail. Guides to all these types of analysis are available through the PI's home page. The analytic techniques are thus well documented, easy to use, readily comprehensible to students and researchers, and rapidly accomplished in terms of speed of data analysis or new data entry. These techniques have been taught by the PI to researchers at four of the collaborative institutions involved in the project: the Universities of Cologne and Hamburg (Ethnologie), Lille (Institut de Sociologie), the Ecole des Hautes Etudes en Sciences Sociales (Social History and Demography). The Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas (Depto. de Modelación Matemática de Sistemas Sociales) at UNAM in México has asked for such training, and the Universidad Complutense de Madrid will incorporate such training in their planned Social Networks MA program.

Three Illustrative Projects

An illustrative collaborative project (Irvine/Cologne) of the proposed research involves the application of networked production group theory and analytic techniques to compadrazgo networks in Tlaxcala, Mexico. Cologne Ph.D. candidate Michael Schnegg will be funded from Germany for fieldwork to renew data collection first undertaken in 1975 (White, Nutini, and Brudner 1975; Nutini and White 1997) with the next generation of families in one of the villages previously studied. New network findings from the original data (White, Schnegg and Brudner 1998) include not only a high extension of radiality to cohesive kinship networks (no marital relinkings within the first to third egocentric network zones), but high radiality ($z=2$ -radial) in the endogamous cohesiveness of the compadrazgo network for all of the members of the community except those involved in the Ayuntamiento Religioso. The latter are the only members of the community who form a series of completely connected compadrazgo triads. These, furthermore, overlap along their edges to form a series of proximally cohesive blocks that act as « governing unities » among roughly contemporary sets of community leaders. Schnegg's research will investigate whether such unities are still in effect, whether proximal cohesion has spread (as we would predict) to connections amongst the new commercial elite, and whether class divisions have begun to occur along new lines of coalition based on economic differences that were formerly absent in the community. If so, we would predict a decline in the frequency of compadrazgo ties that are placed so as to create and reinforce large scale radial cohesion within and between neighboring communities – a form of distributed solidarity integrally connected to the egalitarian ethos and heterogamous marriage and compadrazgo networks of the previous historical period. Many aspects of Lindenberg's networked production group theory fit this case, but we also envisage a new kind of theorizing of the dynamics of integration versus fission in solidarity social class formation via the concept of radial cohesion.

Another illustrative project involves the study of political networks in Mexico, where a team of researchers at UNAM/IIMAS has been working on the analysis of the PRI (the ruling party for 70 years). This analysis aims at finding the mechanisms through which kinship groups function as quasi-corporate aggregates in the sense that they provide an informal network through which social, symbolic and economic capital flow through marriage relinking. The researcher, Narda Alcántara, is an UNAM/IIMAS anthropology student sent on a UNAM science fellowship to complete a Ph.D. training in Social Network Analysis at UCI. She will begin fieldwork, with IIMAS and UCI funding, working with Mexican PIs Jorge Gil and Samuel Schmidt (et al., 1997), interviewing members of the PRI network on marital networks in the period 1929-1970.

A third project in collaboration with Maurizio Gribaudo (EHESS – see above) illustrates our broader perspective on the intersection between institutions, professional biographies, occupations, and interpersonal social networks (including kinship and marriage links). This is a network study in which the data have been fully assembled and computerized from historical archives concerning the careers, networks, and institutions connected with the establishment of the public health organizations and ministries in 19th century France. White provided expertise to this project on converting the computerized data into a form suited to network analysis, both on the level of global structure and of

“local spaces in the frame of global networks,” which is the orientation of the researchers at EHESS involved in the project. This pilot project will help show and train students and researchers on how to incorporate overlapping strategies for the examination of local embeddings in large-scale historical networks and social spaces. It is intended to lead to shared databases, scholarly exchanges on research issues, and computer resources for international research collaborations closely related to topics of the present proposal. The present proposal would also provide travel and research funding for UCI faculty and student participation in the larger EHESS program and projects (one UCI anthropology student, Tamara Teghlio, is seeking funding for participation in the Paris seminars in the academic year 1999-2000).

Auxiliary Analyses

The principal theoretical questions addressed in this proposal have not given a full indication of the range of analyses that are possible with the methodology or large-scale longitudinal field or historical site network analysis that the PI has been instrumental in developing in the last eight years. White and Jorion (1992, 1996), White (1997), White and Johansen (1998) and other publications address some of these additional possibilities, which include detailed statistical analysis of changes in the frequencies of different types of marriage, baseline models for assessing marriage frequencies (controlling for demographic variation in the numbers of different types of relatives available for marriage in a population), and simulation of random baselines (with control for variable demographic patterns) to assess these patterns. We have methods available for scaling and comparing the overall morphological structure of kinship and marriage as well as other types of networks. Given our longitudinal data on kinship and marriage networks, we have a whole host of methods, evidenced in recent publications, for examining succession to office, transmission of property (material and symbolic), recruitment to organizations, the structure of ascribed and achieved status, and a host of other detailed phenomena of interest to the study of class and elite formation, the transmission of social and cultural capital, and institutional dynamics.

Plan of Research, Timing and Budget

The basic plan is simple: we have 24 datasets for case studies undergoing or ready to undergo analysis (with new fieldwork funded or pending in some cases), and 10 Ph.D. candidates-in-training or post-docs at UCI, plus a number of students, post-docs and faculty researchers at other institutions, each involved in one or more specific projects using common methodology and theoretical concepts. Many of the central training functions and collaborative advising on these projects are done by the PI, who is Graduate Director of the UCI Social Networks Program, chair of four of the students on this project (Casasola, Fitzgerald, Jester, Skyhorse) and committee member for 4 others. Most of the specific projects are directed by other PIs affiliated with the general project. Each is assumed to have independent initiative and adequate funding, including travel. In five cases PI White is also the PI of a specific project (Tlaxcala, Omaha Indians, Industrial Bourgeoisie of the Nord-Pas-de-Calais region, European Royalties, Drame village/Slovenia). Students will thus either be: collaborating with White (e.g., Schnegg from Cologne; Casasola, Jester, Johnson and Skyhorse from UCI) and/or Bell (Casasola) at UCI; PIs on their own thesis project for which White is advisor or committee member, or collaborating with some other faculty member in the U.S. or elsewhere on a project for which White is an advisor or consultant. Alcántara from UCI for example is working with UNAM professor Jorge Gil (and S. Schmidt) on a project on Mexican elites for which White is a consultant, and her Ph.D. advisor. In some cases data are from a researcher who is deceased such as Mead, Leach, Dorsey or Turner but whose data are available for analysis. In other cases a living ethnographer such as Colson, Goodenough, Scudder, or Fischer (Hamburg) has made field data available for secondary analysis.

Each UCI student will receive a \$1,000 stipend (or in cases of multiple projects, a double stipend) on completion of their part of the main project: analysis of data from their case study using the common methodology and testing the pool of common hypotheses. Other students are assumed to have or be obtaining their own research funding.

International travel funds for UCI participants, faculty (including Stephan-Norris, White, Brudner, Bell), students (Grannis, Alcántara, Stern, Jester, Johnson, Fitzgerald, Casasola, Skyhorse, Hess; with three slots open for other anthropology students) and post-docs (Widmer) are sought from NSF

International programs for scientific exchanges with France, Germany, Mexico, Guatemala, Slovenia or Austria and Spain. These funds will allow collaboration with an overseas counterpart at another university, travel to the appropriate research site, and travel to workshops or conferences, as detailed in the budget. Faculty (Bearman, Berkowitz, Breiger, Colson, Goodenough, Han, Kemper, Lee, Scudder, H. White in the U.S.; Batagelj, Dupriez, Fischer, Gaillard, Gil, Gribaudo, Houseman, Johansen, Leenders, Lindenberg, McCall, Pizarro, Schweizer overseas) and researchers outside the U.S. (Colima, Mrvar, Schnegg) or at other U.S. Universities (Clark) are responsible for their own travel expenses through other funding agencies, often through matching awards. Such expenses as are required for further fieldwork are available elsewhere (e.g., Schnegg restudy in Tlaxcala, Alcántara - Mexico, Widmer follow-up fieldwork in Tzintzuntzan).

Project Topics and Structure of the Research Collaborations

The focus of these studies is on complex societies in Eurasia, Africa and the Americas. They nearly all include, but are not limited to, networks of kinship and marriage as well as various types of production groups or organizations, and utilize a common methodology for network analysis. The common questions asked by the researchers in the collaborative work on different cases, as well as comparisons between them, are informed in the present case by the theoretical framework developed in this proposal and amplified in other publications. In a number of cases (see Table 1) there is a specific focus on different types of elites and on distributive networks that may provide access to power and succession to office. In another broad set of cases there is a specific focus on questions about the network construction of social class. The remainder involve more specialized questions about the social and institutional change in marriage structures, including special cases of Crow-Omaha type societies, considered by Lévi-Strauss to have a particularly interesting network structure which he terms semi-complex. Some of the residual cases are of interest because they have various mixed elements, in Lévi-Straussian terms, of semi-complex and complex marriage systems.

Detailed Research Schedule of White and Harary, and Workshops (Table 2)

The PI's teaching schedule repeats a cycle in 1999 and 2000 of moderate teaching Winter quarter, no teaching in residence Spring, free summers for this project, and heavy teaching in Fall. Other than fall quarters, when there is no time for research work, the PI's research time will be devoted to this series of closely related projects, which includes supervision of his Ph.D. students and collaborative work with post-doc Eric Widmer as well as assistance to other international projects. Table 2 details an approximate work schedule, which for the PI is little different than the schedule pursued during the last two years supported by European funding, with the exception that it will be much easier to carry out this schedule with NSF and student funding. All of the PI's previous research and travel expenses have been paid for the last five years by grants to his international collaborators as listed for projects below (especially Schweizer, but with support from Lille and EHESS/Paris MSH and in the past from CNRS programs as well). Workshops during this 2-year period will be 2 days long, the first an introduction to formal concepts and methods by White and Harary, together with discussion of specific research problems; the second a computer lab instructional session on project specific data analysis.

Table 2: PI Timetables	Winter 99	Spring 99	Summer 99	Fall	Winter2000	Spring 2000	Summr2000	Fall 2000
PI sites								
Tlaxcala (2 publications completed)	Supervise start of <i>Schnegg</i> restudy fieldwork	Check data collection	Help data code and computerize		Assist in analysis	→	Assist with thesis	(begin new joint Pubs.)
Nord-Pas-de-Calais	Supervise 30 hours of coding	Run analyses	Visit Lille Workshop		Collaborate with Lille colleagues...	Regarding additional ...	data and writeup	→
Omaha	Review computer file data quality	Run analyses	Assess theory re: writeup		Begin writeup	Writeup	Finish writeup	Submit
European Royalties	Run preliminary analyses	Run analyses	Assess theory re: writeup		Begin writeup	Writeup	Finish writeup	Submit
Drame	Run preliminary analyses	Run analyses	Assess theory re: writeup		Begin writeup	Writeup	Visit Slovenia	Submit

Methods collaboration							
Harary (3 articles in process)	finish publication on cohesion, density, implement algorithms	Work on conditional blockmodels & connectivities		Finish publication of articles	Begin work on book	Work on book	→
Batagelj and Mrvar	(joint article should appear)	Propose algorithms	Implement algorithms	Expand computer capabilities	Make system easy for anth	Visit Slovenia	(new articles)
Workshops: D White and F. Harary			Paris, Lille, Madrid			Cologne, Hamburg	
Co-PI sites							
Feistritz (cf. Brudner and White 1997)	Reanalyze case with respect to farm sizes	Prepare new graphics	Begin new article with Brudner	Continue publication	Submit article	Visit Carinthia: future work	Plan future work
Student sites							
Nord-Pas-de-Calais	Work with <i>Johnson</i>	Run analyses	Visit Lille	Work on joint article	→	Visit Lille	Completn
Mexican Presidents	Work with <i>Alcántara</i>	(her fieldwork)	(her fieldwork)	(her thesis)	(her thesis)	(her thesis)	Completn
Norfolk	Work with <i>Fitz</i>	(data)	(his thesis)	(his thesis)	(his thesis)	(his thesis)	Completn
Bevis Marks	Work with <i>Fitz</i>	Writeup	(article)	(article)	Completion		
Guatemala	Work w <i>Casasola</i>	(her thesis)	(her thesis)	(her thesis)	Completion		
Chuukese	Assist <i>Skyhorse</i>	→	(her thesis)	→	Completion		
Ndembu	find <i>anth.student</i>	Analysis	→	(co-author)	→	→	Complete
Wampar	find <i>anth.student</i>	Analysis	→	(co-author)	→	→	Complete
Pere Manus	find <i>anth.student</i>	Analysis	→	(co-author)	→	→	Complete
Old Testament	Assist <i>Grannis, Jester</i>	→	→	→	(their article)		
Collaboration							
Biafada	Assist Gaillard with data	→	Visit Lille (Workshop)	Assist Gaillard with analysis	→	Visit Lille	(assist his publicatn)
Tzintuntzan	Assist <i>Widmer</i>	→					
French Public Health	Assist Gribauidi	→	Visit Paris Workshop	Writeup and analysis with Gribauidi	→	→
Beti	Assist Houseman	→					
American Presidents	Assist <i>Granis&S-Norris</i> : Analysis	Analysis Writeup	→	→	→	Joint publication	
Geneva Scientists	Assist <i>Widmer and Fitzgerald</i>	→	(their article)	End			
Turkish Nomads	See book ms to final publication		Make data available	End			
Consulting							
Spanish Elite	Assist Pizarro, <i>Reyes-Herrero</i>	→	Visit Madrid Workshop		To be determined		
Qing	Assist Lee to...	archive for	future study	End			
Sawahan	Assist Schweizer	→	VisitCologne			VisitCologne Workshop	
Rapanui	Assist <i>Colima</i>	→	→		(her thesis)	→	→
Gwembe	Assist <i>Clark, Scudder, Colson</i>	→	To be determined		→	→	→

Travel Funding and Timetables for Students and Post-doc (Tables 3 and 4)

Some funding is requested from the Anthropology program for U.S. travel for students and post-docs

Table 3: Student/Post-doc U.S. Travel Timetables	1999-year 1	2000-year 2
<i>Fitzgerald-Norfolk, Bevis Marks</i>	To/From consulting with Berkowitz, Bearman	To/From consulting with Berkowitz, Bearman

<i>Skyhorse</i> -Chuukese	To/From consulting with Goodenough	To/From consulting with Goodenough
<i>Skyhorse</i> -Omaha		To/From Omaha tribal area
<i>Grannis</i> -Amer. Presidents	Visit to Archives	

Travel funding for Harary will provide the means for collaboration with the PI at UCI or at intersecting sites where both will present training workshops (regionally advertised and open to all researchers) or presentation of results and theoretical ideas to other researchers. The funding sought for student and post-doc travel (Table 4) through NSF international programs (France, Germany, Mexico, Guatemala, Slovenia or Austria and Spain) is for airfare and 10 days maximum expenses per visit, not for extended fieldwork expenses, for which funding is obtained separately.

Table 4: Student/Post-doc Int'l Travel Timetables	1999-year 1	2000-year 2
<i>Johnson</i> -France	To/From France (consultation/fieldwork)	To/From France (consultation/fieldwork)
<i>Alcántara</i> -Mexico	To/From Mexico (fieldwork)	To/From Mexico: Thesis Consultation/Field
<i>Fitzgerald</i> -Norfolk, Bevis Marks, Tlaxcala	To/From Germany for conference presentation/consulting re: Norfolk, Bevis	To/From Tlaxcala Mexico for fieldwork training; or to Geneva for securing new archival collection
<i>Casasola</i> -Guatemala	To/From archival/ interview fieldwork	To/From archival/ interview fieldwork
<i>Anthro student</i> -Ndemdu	None-anthro department could provide	
<i>Anthro student</i> -Wampar	None-anthro department could provide	
<i>Anthro student</i> -Pere Manus	None-anthro department could provide	
<i>Jester</i> -European Royalty	To/From Germany for conference presentation/consulting	
<i>Jester</i> -Old Testament	None	
<i>Brudner</i> -Feistritz, Drame	To/From Cologne for consultation	To/From Carinthia/Slovenia to renew fieldwork
<i>Widmer</i> - Tzintzuntzan, Mexico	To/From Tzintzuntzan and To/From consultations involving v.Kemper at SMU	To/From Tzintzuntzan and To/From consultations involving v.Kemper at SMU

V. RESULTS AND SIGNIFICANCE

Significance

Work to date reviewed in this proposal represents a major achievement of modern mathematical anthropology and computer science, one that will be made more readily available to every anthropological fieldworker and researcher as part of this project (see note 5): the ability to ground a study of social organization in situated genealogical networks, to add the rich complexity of ethnographic data on social relations, groups, and attributes as well as connections to resource bases and productive units. We have evolved a theoretical language and hypotheses that make it possible to examine some of the key connections between observed social networks, production groups and exchange, and to describe the functional, cognitive and structural interdependencies of group dynamics. The ability to relate the study of these interdependencies to structural and outcome variables of cohesion and social solidarity marks an important theoretical advance, given that social solidarity supporting norms and institutions is critical to economic and political structures and the healthy functioning and productivity of human societies. Yet we believe that we are only at the beginning of a growing series of achievements, especially since our theoretical vocabulary – following the lead of consultants to this project who are some of the best of the formal theoreticians in the social sciences – begins to be closely integrated or contending with that used in the new institutional economics, economic sociology, and other central social science subdisciplines. What we have achieved as well is an unprecedented ability to marshal social network representations and analyses of entire situated social organizations with no loss of individual detail – giving access to the level where individuals have agency -- nor loss of generality at the level of abstracting the principles and dynamics of social groups and institutions.

The Value of Longitudinal Studies to Population Futures and to Future Researchers

Longitudinal datasets such as the Gwembe Tonga, as part of the present comparative project, have had massive impact on World Bank, IMF, and UN development policies, such as those on resettlement (Scudder 1997,1998). They allow social change to be understood through detailed analysis at successive time periods. Of major importance to longitudinal research assessments of human

populations is the addition – to the battery of techniques for the study of social and institutional change, group dynamics, and the social and cultural capital of groups and individuals – of network analysis and cross-case comparisons using common theoretical frameworks. Projects such as this one (and the previously NSF funded Gwembe Tonga projects in which the present PI was involved), are vital to the establishment and continuity of longitudinal and ethnosociological-historical research in anthropology and sociology. They also provide a new model and opportunity for future cohorts of anthropological researchers to have access to existing longitudinal datasets and results, and to build new research, more deeply informed in terms of data on social processes, allowing new or different kinds of questions to be asked, on these foundations.

Expected Results

Publications resulting from this project will be largely of three types: development and tests of theories against detailed case studies, limited comparisons of case studies illustrating fundamental theoretical concepts and types of explanations, and formal development of new concepts in mathematical anthropology and graph theory. Publications of the various PIs of the subprojects may also benefit from the sharing of theory and methodology and the training of students and researchers in the methods of large-scale longitudinal social network analysis developed, taught and used in the larger project.

Training workshops in Cologne, Hamburg, Paris, Lille, Madrid and Mexico City are intended not only for project researchers but, recruiting interested researcher in each locale, will help to diffuse the new computer-based methodology⁵ for longitudinal field studies. As with our earlier projects, we are likely to organize one or two sessions coming out of this project at social network meetings (like the problem of the evolution of institutions at the Barcelona meeting), out of which some additional joint or edited publications may emerge.

Collateral support is provided for 5 UC Irvine Ph.D. dissertations, and training and thesis consultation for other students both at UCI and at Cologne (Schneegg), Ljubljana-Slovenia (Mrvar), Madrid Complutense (Reyes Herrero), Barcelona (Colima), Ecole des Hautes Etudes en Sciences Sociales (through workshops for their Ph.D. students in social history), UNAM/Mexico (where Alcántara is a permanent researcher), and possibly Lille and Nanterre in France, SMU in Texas and San Carlos in Guatemala, where there are colleagues or student researcher associated with the project. For letters from some of the collaborators, see <http://eclectic.ss.uci.edu/~drwhite/nsf/collabor.html>.

Collaborative development of theory, methods, and applications will involve U.S. faculty from Irvine, Cornell (Breiger, Han) and Columbia (Bearman, H. White; Lazarsfeld Center) and network researchers in Groningen (Lindenberg, Leenders) and elsewhere overseas. The Cologne, Paris-EHESS, UNAM, and Madrid-Complutense programs affiliated with the project have or are planning formal academic and research liaisons with UCI involving the type of collaboration envisioned in the present project. New software and professionally shared databases for continued longitudinal research will be made available through the collaborative research network and our workshops, which are open to social scientists both in the U.S. and internationally.

⁵ The principal computer programs that have been developed and will be further developed in this project are made available through the web sites for Pajek (large network analysis: <http://vlado.mat.uni-lj.si/pub/networks/pajek/default.htm>) and White's P-graph (software for marriage and kinship networks: <http://eclectic.ss.uci.edu/~drwhite/pgraph/p-graphs.html>).

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